UNIVERSIDAD PARA LA COOPERACION INTERNACIONAL
(UCI)

PROJECT MANAGEMENT PLAN FOR PROJECT 24 HOURS SOLAR POWER FOR NIEUW AURORA

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FINAL GRADUATION PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE
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DEDICATION

I dedicate this Final Graduation Project to my parents Anita and Humphrey, my brother Edwin, to my wife and kids for always believing in me and providing support in everything that I do.

ACKNOWLEDGMENTS

Furthermore, I wish to express my gratitude to the EBS Chief Technical Officer (CTO) Mr. Eijndhoven who gave me the opportunity to do the Final Graduation project at EBS and to the former EBS Chief Executive Officer (CEO) Mr. Vaseur and former HATCH alliance manager Mr. Bonapart who have supported me in my career to become a professional engineer and project manager.

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ABBREVIATIONS AND ACRONYMS

- Chief Executive Officer (CEO)
- Chief Technical Officer (CTO)
- Chief Financial Officer (CFO)
- EnergieBedrijven Suriname (EBS)
- European Union (EU)
- Final Graduation Project (FGP)
- Government of Suriname (GoS)
- Inter-American Development Bank (IDB)
- International Competitive Bidding (ICB)
- Meeting Minutes (MoM)
- Memoranda of Agreements (MOAs)
- National Competitive Bidding (NCB)
- Operations and Maintenance (O&M)
- Photovoltaic solar system (PV system)
- Project Management Institute (PMI)
- Renewable Energy Technologies (RET)
- Request For Proposal (RFP)
- Risk Breakdown Structure (RBS)
- Service Level Agreements (SLAs)
- United Nations Development Programme (UNDP)
- Unit of Measurement (UoM)

EXECUTIVE SUMMARY (ABSTRACT)

NV EnergieBedrijven Suriname (EBS) is Suriname's power production, transmission and distribution company that also distributes propane gas through its subsidiary OGANE. The engineering department has been delivering engineering and project management services for capital projects over the past 8 years. The most significant projects executed during this time are projects to build institutional capacity, projects regarding the installation of thermal power plants, expansion of the electricity network, and upgrade of critical electrical infrastructure.

In 2019, the company started an initiative to build and develop internal project management capacity. One of the components of this initiative was to develop a Project Management Plan for a solar power plant project that was in execution by EBS. This was done because projects were being delivered too late, over budget and sometimes with unapproved scope changes. Top management then decided to train the companies' staff in the use of Project Management standards and practices. The project "24 hours Solar Power for Nieuw Aurora" was the first project for which a Project Management Plan was developed. The purpose of this Final Graduation Project (FGP) was to develop a Project Management Plan for the project "24 hours Solar Power for Nieuw Aurora. The Project Management Plan provided the engineering staff with a useful tool to manage the project and deliver it within the project constraints.

The general objective of this project was to create a Project Management Plan framed within the standards of the Project Management Institute in order to manage the project "24 hours Solar Power for Nieuw Aurora". The specific objectives of the project were; to develop a Project Charter in order to formally authorize the project and provide the project manager with the authority to apply organizational resources to the project; to develop a Scope Management Plan to ensure that the project includes all the work required, and only the work required to successfully complete the project; to create a Schedule Management Plan to manage the timely completion of the project; to create a Cost Management Plan to define the processes for planning, estimating, budgeting, financing, funding, managing and controlling costs so that the project is completed within the approved budget; to develop a Quality Management Plan to incorporate the organization's quality policy in order to meet stakeholders' objectives; to create a Resource Management Plan to identify, acquire, and manage the resources needed for the successful completion of the project; to develop a Communications Management Plan to ensure that the information needs of the project and its stakeholders are met; to create a Risk Management Plan in order to optimize the chances of project success; to create a Procurement Management Plan to purchase products services or results needed from outside the project team; to create a Stakeholder Engagement Plan to develop strategies to engage stakeholders in the work of the project.

As a first step in the methodology followed for the completion of the Final Graduation Project (FGP), information was gathered. This information was obtained from primary and secondary information sources, such as the Master in Project Management (MPM) course, the PMBOK Guide 6th edition, and documentation obtained from digital documents and internet research. Thereafter, qualitative, quantitative and analytical research methods were employed, which was the second step in the methodology. The tools used to produce the results of the FGP were templates and software programs. The assumptions and constraints applicable to the project objectives were visited thereafter, and as the final step, the FGP deliverables were developed.

The main conclusions are that the project is still in the planning phase and the emphasis of the Project Management Plan is on the initiation and the planning phases of the project. The development of the Project Management Plan provided the author of the FGP with a better understanding of the several project management knowledge areas. The start date of the project is June 5th, 2019 and the end date is May 11th, 2022. The project budget amounts USD 1,472,900 and the main quality objectives regard the delivery of a 180 kW peak solar system that is according to standard and customers' expectation, and capable of delivering 24 hours electricity service to the Nieuw Aurora community. Contracts will be signed for removal of vegetation from the project site and the turnkey delivery of the solar plant. Especially the development of the quantitative risk analysis presented significant challenges because of the subjectivity of the probability factors and uncertainties in estimating the cost impacts and monetized schedule- and quality impact of the potential risks.

The main recommendations derived from the FGP development are that the project team should use this Project Management Plan to execute the project and by doing so, significantly increase the chances of success of the project. Another recommendation is that the Project Management Plan is a living document that must be reviewed on a regular basis and updated as required in order to adapt to possible changes that could impact the project. A mandatory requirement is that all changes must be processed through the "Perform Integrated Change Control" process and approved changes must be communicated to the project team and relevant stakeholders. Changes to the Project Charter should be carefully considered once the document has been approved because a change could significantly impact all the other subsidiary plans. The project team should be aware and avoid occurrences of scope creep and gold plating. It is therefore recommended that the project manager includes quality as a separate topic to the agenda of the project team meetings. The project manager must take an active and leading role in communicating with all the project stakeholders.

1. INTRODUCTION

1.1. Background

NV EnergieBedrijven Suriname (EBS) is an energy production, transmission and distribution company that also distributes propane gas through its subsidiary OGANE. The Project Engineering department from Suriname's National Electricity Company (EnergieBedrijven Suriname (EBS) was established in 2011 as a result of one of the strategic objectives from the former CEO. The engineering department has been delivering engineering and project management services for capital projects over the past 8 years.

The most significant projects that were executed during this time are; the installation of thermal power plants, expansion of the electricity network, upgrade of critical electrical infrastructure and the installation of a solar power plant.

Up to date EBS engineering department has been using an internal document called "operations manual" to manage their projects. The operations manual contains some basic project information such as the project background, organizational structure, the project timeline, the scope of work and related schedule. The company is aware of the urgent need to manage projects in a more professional manner for example by the use of international project management standards and practices. In order to make a difference and to take project management to a higher level, the company started an initiative to develop a project management plan for a solar power plant project that will be executed by the company.

1.2. Statement of the problem

EBS Engineering department does not have a project management plan available to manage their capital projects in a professional manner. The engineering skills of the staff are excellent but when it comes to project management there is a lack of tools, knowledge and skills within the company. Stakeholders have been

complaining about projects being delivered much too late and way over budget. Scope changes that are not approved by the authorized persons are on the top of the list of issues and in some instances this has been the reason for work being completed without financial compensation. EBS' top management decided to deal with all those problems by training the companies' staff in the use of Project Management standards and practices and in parallel, develop a project management plan that can be used to improve project management inside the company. The project "24 hours Solar Power for Nieuw Aurora" is the first project for which such a plan will be developed.

1.3. Purpose

The purpose of this project is to develop a project management plan for the project "24 hours Solar Power for Nieuw Aurora. Nieuw Aurora is an isolated village in the interior of Suriname, approximately 220 km away from the capital city. The village is not connected to the national electricity grid and currently receives only 4 hours electricity service per day, from 7:00 PM to 11:00 PM. This limited electricity supply is hampering the development of the village community and therefore the government of Suriname decided to implement a project in which Nieuw Aurora will receive 24 hours electricity service per day, through the usage of solar power.

A project team from the EBS engineering department, has been assigned to execute the "24 hours Solar Power for Nieuw Aurora" project. In order to manage the project in a professional manner and perform Project Integration Management, a Project Management Plan will be developed using Project Management Institute standards. This Project Management Plan will provide the project team with a document that can be used for the various project management processes. This will help the team to execute the project within the project constraints and improve project success. The project management plan will provide the staff with a useful tool to manage the project and will bring along the following benefits:

1. Deliver the project within the project constraints such as time, budget, scope, quality, etc.
2. Enable top management to better manage the company resources
3. Reduce financial losses of the company
4. Built and improve the companies' reputation
5. Built and improve the companies organizational project assets
6. Provide a blue print document that can easily be replicated and tailored to fulfill the needs of future projects
7. On the long term improve business for the company

1.4. General objective

To create a Project Management Plan framed within the standards of the Project management Institute in order to manage the project "24 hours Solar Power for Nieuw Aurora".

1.5. Specific objectives

1) To develop a project charter in order to formally authorize the project and provide the project manager with the authority to apply organizational resources to the project
2) To develop a scope management plan to ensure that the project includes all the work required, and only the work required to successfully complete the project
3) To create a schedule management plan to manage the timely completion of the project
4) To create a cost management plan to define the processes for planning, estimating, budgeting, financing, funding, managing and controlling costs so that the project is completed within the approved budget
5) To develop a quality management plan to incorporate the organization's quality policy in order to meet stakeholders' objectives

6) To create a resource management plan to identify, acquire, and manage the resources needed for the successful completion of the project
7) To develop a communications management plan to ensure that the information needs of the project and its stakeholders are met
8) To create a risk management plan in order to optimize the chances of project success
9) To create a procurement management plan to purchase products services or results needed from outside the project team
10) To create a stakeholder engagement plan to develop strategies to engage stakeholders in the work of the project

2. THEORETICAL FRAMEWORK

2.1 Company/Enterprise framework

2.1.1 Company/Enterprise background

NV EnergieBedrijven Suriname (EBS) is a power production, transmission and distribution company that also distributes propane gas through its subsidiary OGANE. The company is 100% owned by the government of Suriname. EBS has more than 1,300 employees and 270 contractors. The current number of electricity connections is 148,000 nationwide. The EBS has power stations in Saramaccastraat, in Clarapolder, Apoera, Wageningen, Moengo, Albina, Coronie and Pokigron.

The project Engineering department from Suriname's National Electricity company (EnergieBedrijven Suriname (EBS)) was established in 2011, as a result of one of the strategic objectives from the former CEO. The engineering department has been delivering engineering and project management services for capital projects over the past 8 years. The most significant projects that were executed during this time are; projects to build institutional capacity, the installation of thermal power plants, expansion of the electricity network, upgrade of critical electrical infrastructure and the installation of a solar power plant.

2.1.2 Mission and vision statements

Mission

We will lead the industry by inspiring our people and creating added value for our consumers, the environment and shareholders through:

- providing the community with reliable, cost-effective electricity
- demonstrating environmental care through efficient use of resources in generating and distributing energy

- taking advantage of existing and new possibilities in the field of electrical energy
- being committed to 'First-class customer service', ensuring a good balance between profit motive and affordability
- being innovative and to incorporate industry's 'best practices'
- being an exemplary employer, and to foster best performance, striving for the highest level of workplace safety and satisfaction (EBS website, August 11, 2019).

Vision

By operating as a reliable development partner, we are the leading energy company in Suriname and the Caribbean (EBS website, August 11, 2019).

2.1.3 Organizational structure

The supervisory board supervises the Chief Executive Officer (CEO) from EBS. The companies' executive directors consists of a Chief Executive Officer (CEO), a Chief Financial Officer (CFO) and a Chief Technical Officer (CTO). The CTO and the CFO report to the CEO. The CTO leads several departments such as Distribution, Power generation, Engineering, while the CFO is in charge of other departments such as the Customer and Commercial Services department and the procurement department.

Below the organizational structure of the national electricity company can be seen.

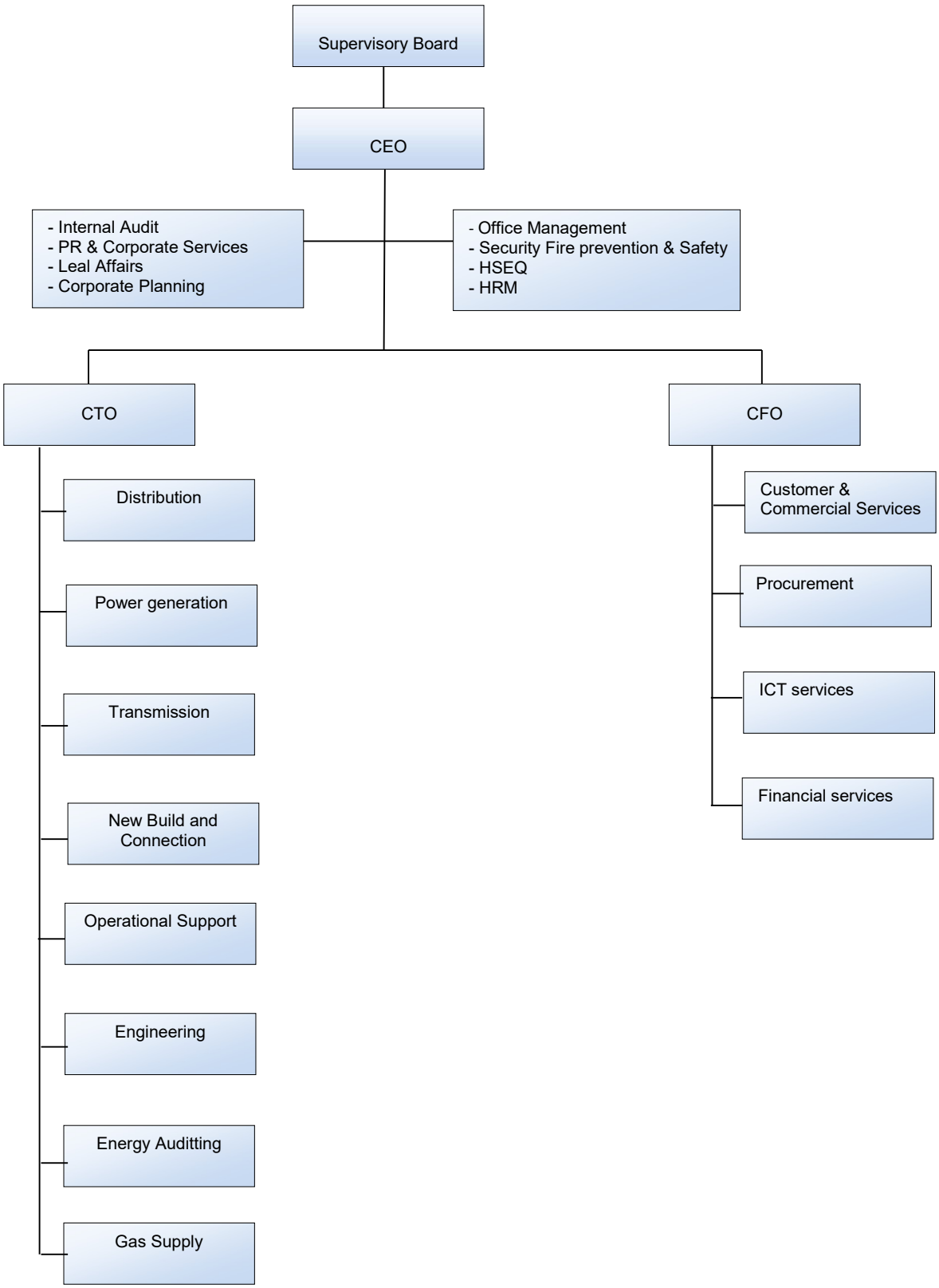


Figure 1 Organizational structure EBS (Source: EBS website, Aug 9, 2019)

The project will be executed by the engineering department. The engineering manager leads the company's engineering division that consist of several departments such as the civil-, electrical-, and mechanical department and a design room. The manager in collaboration with the department head of the applicable discipline decides who will be the project manager on a given project. In collaboration with the department heads, the project team consisting of engineers and supporting staff, is then formed by the project manager. Other company staff such as an administrative assistant, a planner scheduler, and a financial specialist provides support to the "day to day" operations and to the project teams. When needed, the administrative assistant also assumes the role of document controller and the financial specialist assumes the role of cost controller in the project teams. Furthermore, depending on the workload of the company, the engineering manager and department heads can also assume the role of project manager on projects in execution. Below the organizational structure of the engineering department is depicted.

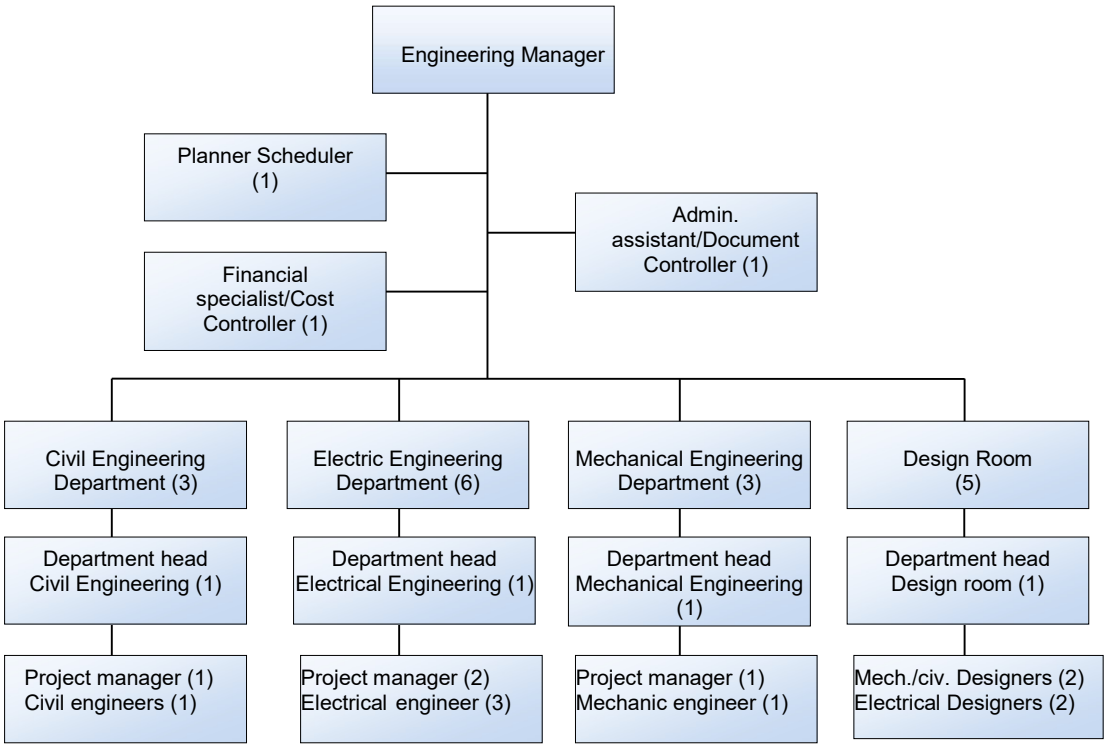


Figure 2 Organizational structure (Source: EBS engineering department, Aug 9, 2019)

2.1.4 Products offered

NV Energiebedrijven Suriname (EBS) is a power production, transmission and distribution company that also distributes propane gas through its subsidiary OGANE.

EBS engineering department is specialized in the execution of capital projects and delivers Engineering-, design- and Project Management services to internal- and external stakeholders. Those services include activities such as solution analysis, engineering and design, procurement, construction management and supervision, test and commissioning, project close out and project hand over.

The most relevant projects delivered by the engineering department are:

1. Installation of a 84 MW thermal power plant at the Saramacastraat

2. Building of critical infrastructure such as substation Powaka, substation Hannaslust and substation Surmac and related electricity network
3. Implementation of a Supervisory Control and Data Acquisition (SCADA) system to enable better control of EBS electricity network
4. Implementation of a Geographical Information System (GIS) project.
5. Implementation of an Enterprise Resource Planning (ERP) project
6. Upgrade of critical infrastructure such as Substation Paranam, Substation C and Substation D and related distribution and transmission network
7. Installation of a 0.5 MW solar power plant at Atjoni/Pokigron with the existing thermal power station as backup

2.2 Project Management concepts

2.2.1 Project

A Guide to the Project Management Body of Knowledge (PMBOK Guide), Sixth Edition from the Project Management Institute (PMI), describes a project as “a temporary endeavor undertaken to create a unique product, service or result” (Project Management Institute, 2017, p. 4).

In this context, the Final Graduation Project (FGP) which will develop a project management for the Nieuw Aurora project, can be defined as a project. The FGP is an endeavor that is temporary in nature because it must be completed within a period of three months. Simultaneously, the FGP will create a project management plan which is the unique result of the project.

2.2.2 Project management

PMI (2017) states that “Project Management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements” (p. 10). When naming the benefits of effective project management, PMI (2017) states:

Effective project management helps individuals, groups and public and private organizations to:

- ❖ Meet business objectives;
- ❖ Satisfy stakeholder expectation;
- ❖ Be more predictable;
- ❖ Increase chances of success;
- ❖ Deliver the right products at the right time;
- ❖ Resolve problems and issues;
- ❖ Respond to risk in a timely manner;
- ❖ Optimize the use of organizational resources;
- ❖ Identify, recover, or terminate failing projects;
- ❖ Manage constraints (e.g., scope, quality, schedule, cost, resources);
- ❖ Balance the influence of constraints on the project (e.g., increased scope may increase cost or schedule); and
- ❖ Manage change in better manner. (p.10)

Due to the fact that all those benefits are not being realized, the engineering department has decided to develop a project management plan for the Aurora project.

In the figure below the project execution workflow from the company can be seen.

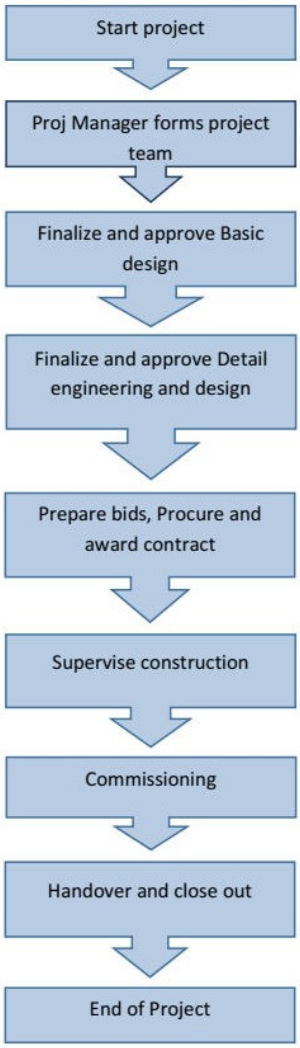


Figure 3 Project Execution Workflow (Source: EBS engineering department)

The project execution workflow is high level without much detail and provides insufficient directions and tools to properly manage the projects.

2.2.3 Project life cycle

The Project Life Cycle is framed as “the series of phases that a project passes through from its start to its completion” (PMI, 2017, p. 19). PMI further states “This

basic framework applies regardless of the specific project work involved. The phases may be sequential, iterative, or overlapping. All projects can be mapped to the generic life cycle" (PMI, 2017, p. 19). All project can be mapped to the generic life cycle shown in figure 4.

When mentioning the phases within a project life cycle, PMI (2017) states:

> Within a project life cycle there are generally one or more phases that are associated with the development of the product, service or result. These are called development life cycles. Development life cycles can be predictive, iterative, incremental, adaptive, or a hybrid model:
>
> - ❖ In a predictive life cycle, the project scope, time and cost are determined in the early phases of the life cycle. Any changes to the scope are carefully managed. Predictive life cycles may also be referred to as waterfall life cycles. (p. 19)

The FGP will go through the following project life cycle:

1. Starting the project
2. Organizing and Preparing
3. Carrying Out the Work
4. Ending the Project

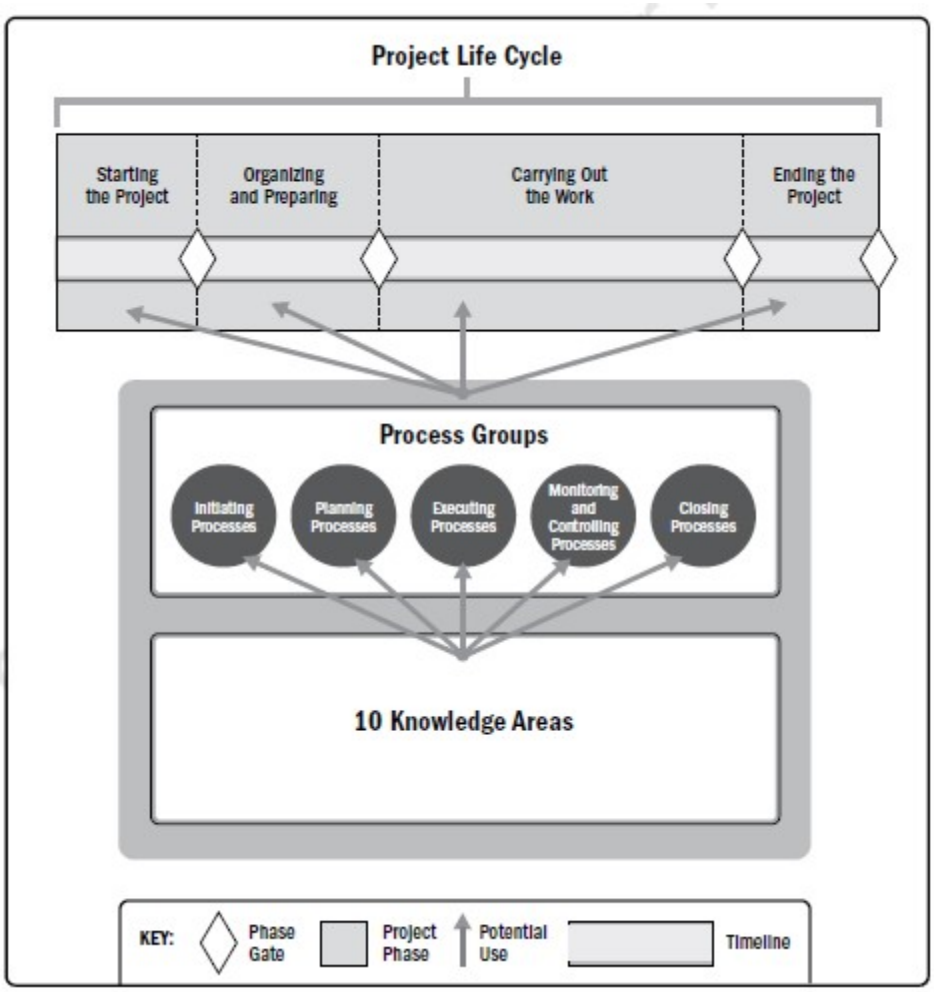


Figure 4 Interrelationship of PMBOK Guide key components in Projects. (Source PMI 2017, p. 18)

For the FGP we will use a predictive or waterfall development life cycle. The project scope, time and cost have been determined early in the project and in this project there is little room for changes to scope, time and budget.

The engineering department in general uses a predictive life cycle approach for the execution of their projects. Those are mostly construction projects and in order to receive approval to continue with a project, details such as scope, time and cost must be predetermined and presented to EBS top management.

2.2.4 Project management processes

PMI (2017) states that “The project life cycle is managed by executing a series of project management processes” (p. 22). According to PMI (2017) project management is accomplished through application and integration of project management processes. These processes are grouped into the following 5 process groups, PMI (2017):

- Initiating Process Group. Those processes performed to define a new project or a new or a new phase of an existing project by obtaining authorization to start the project or phase.
- Planning Process Group. Those processes required to establish the scope of the project, refine the objectives and define the course of action required to attain the objectives that the project was undertaken to achieve.
- Executing Process Group. Those processes performed to complete the work defined in the project management plan to satisfy the project requirements.
- Monitoring and Controlling Process Group. Those processes required to track, review and regulate the progress and performance of the project; identify any areas in which changes to the plan are required, and initiate the corresponding changes.
- Closing Process Group. Those processes performed to formally complete or close the project, phase or contract. (p. 23)

The FGP will evolve through all the process groups which include Initiating, Planning, Executing, Monitoring and Controlling and Closing. Initiating and Planning is done during the FGP seminar (Preparation for final graduation project) while Executing, Monitoring and Controlling and Closing are performed during the Final Graduation Project execution.

Because of the time constraint of 3 months, the deliverables for the Aurora project will primarily evolve around the Initiating and Planning process Groups. The most important deliverable coming out of this initiative will be the Project Management

Plan. However, since this Project Management Plan is a useful asset for the engineering department, the document will be further developed after completion of the FGP and will be a living document that will be subject to a continuous improvement cycle. This document will also serve to support the implementation of the strategy in working towards the company's vision.

2.2.5 Project management knowledge areas

According to PMI (2017), Processes are also categorized by knowledge areas. PMI further states that "A knowledge area is an identified area of project management defined by its knowledge requirements and described in terms of its component processes, practices, inputs, outputs, tools, and techniques" (PMI 2017, p. 23). The knowledge areas are presented in figure 15, and in more detail below.

1. Project Integration Management

According to (Project Management Institute, 2017) ''Project Integration Management. includes the processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities within the Project Management Process Groups.'' (p. 23).

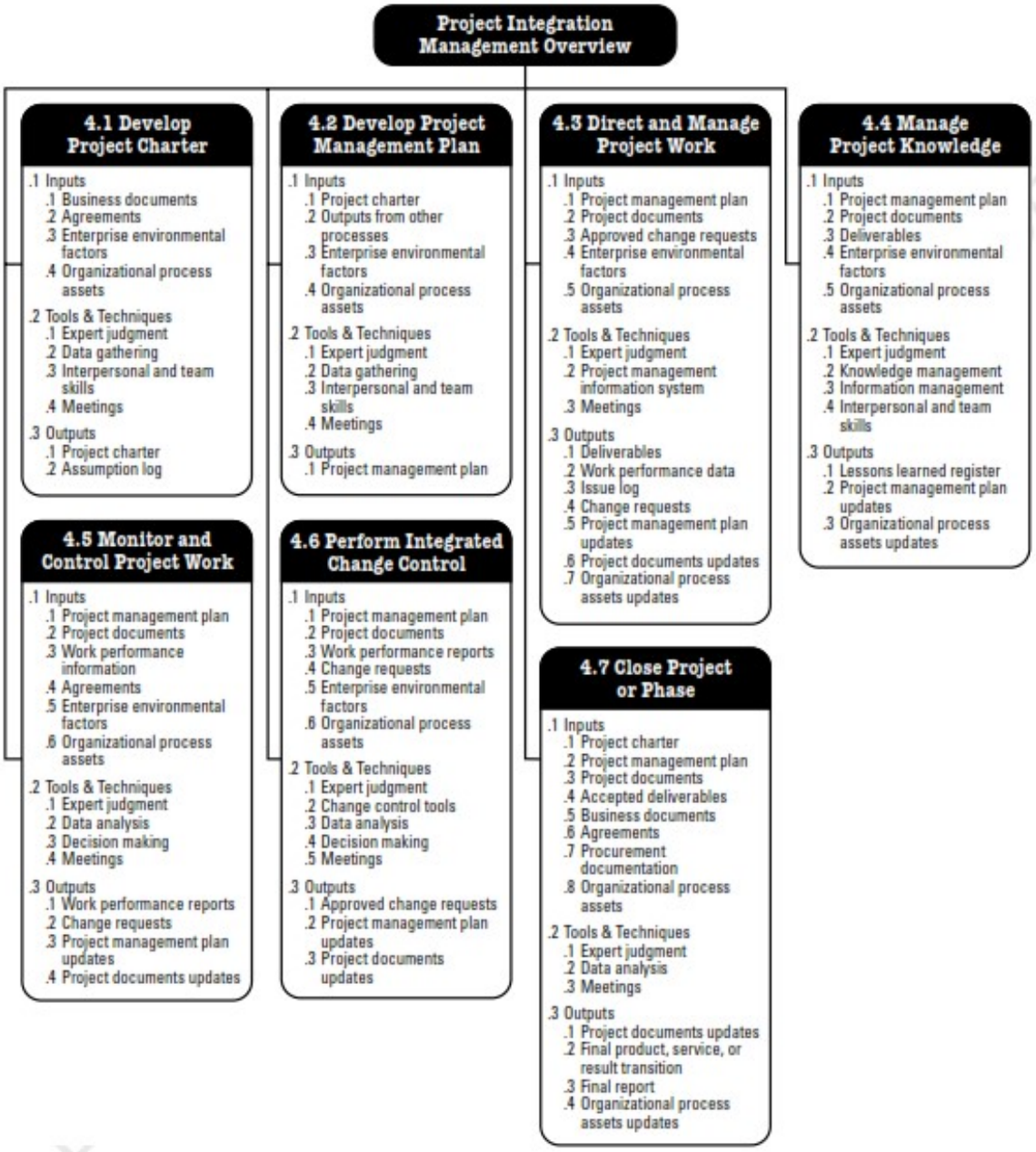


Figure 5 Project Integration Management Overview (Source: PMI, 2017)

When it comes to this knowledge area, the general objective of the FGP is to create a Project Management Plan framed within the standards of the Project management Institute in order to manage the project “24 hours Solar Power for Nieuw Aurora”.

One of the specific objectives of the FGP is to develop a project Charter in order to formally authorize the project and provide the project manager with the authority to apply organizational resources to the project.

2. Project Scope Management

Project Scope Management includes the processes required to ensure that the project includes all the work required, and only the work required, to complete the project successfully (Project Management Institute, 2017, p. 23).

One of the specific objective of the FGP is to develop a scope management plan to ensure that the project includes all the work required, and only the work required to successfully complete the project.

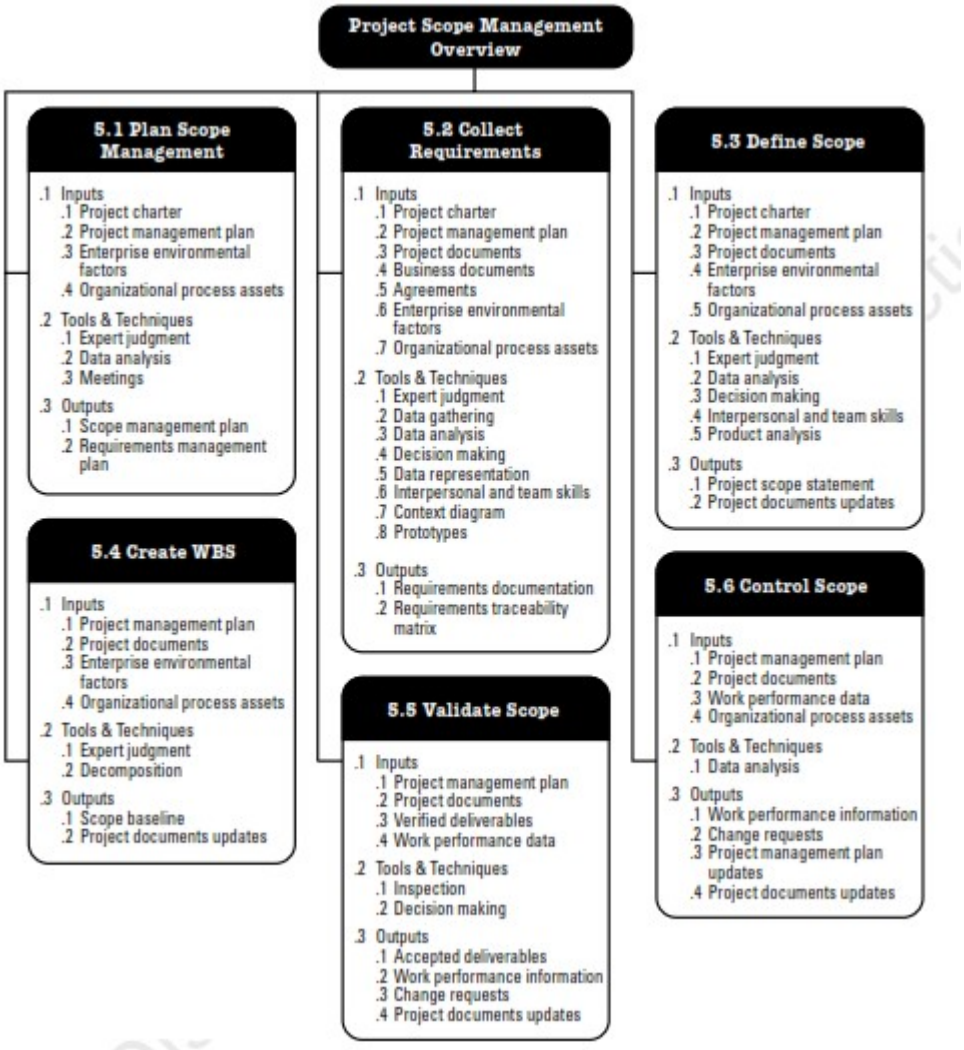


Figure 6 Project Scope Management Overview (Source: PMI, 2017)

3 Project Schedule Management

According to PMI (2017) “Project Schedule Management. includes the processes required to manage the timely completion of the project” (p. 24).

The creation of a time management plan is one of the specific objectives of the FGP in order to manage the timely completion of the project.

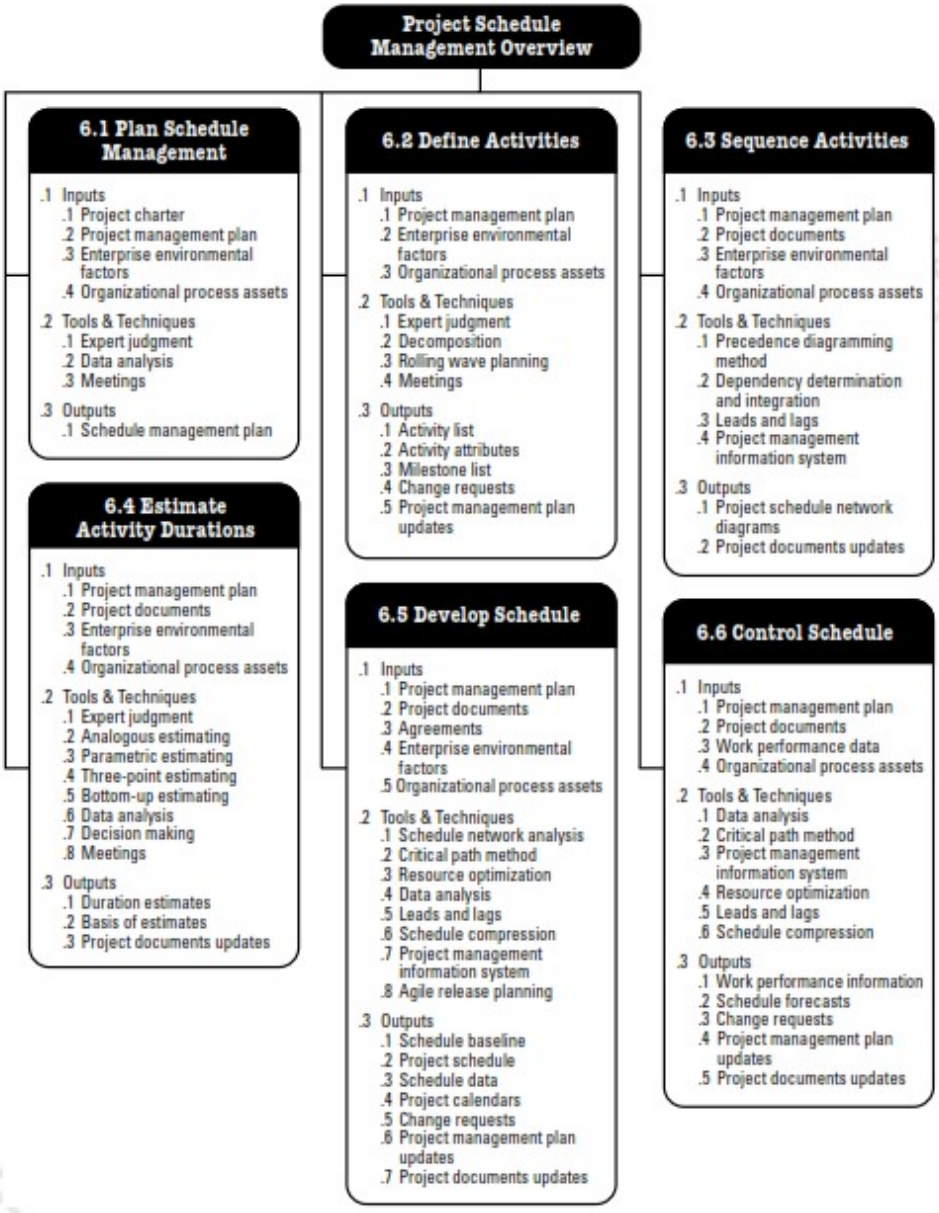


Figure 7 Project Schedule Management Overview (Source: PMI, 2017)

4 Project Cost Management

“Project Cost Management includes the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling costs so the project can be completed within the approved budget” (PMI, 2017, p. 24).

For the FGP one of the specific objectives is to create a cost management plan to define the processes for planning, estimating, budgeting, financing, funding, managing and controlling costs so that the project is completed within the approved budget.

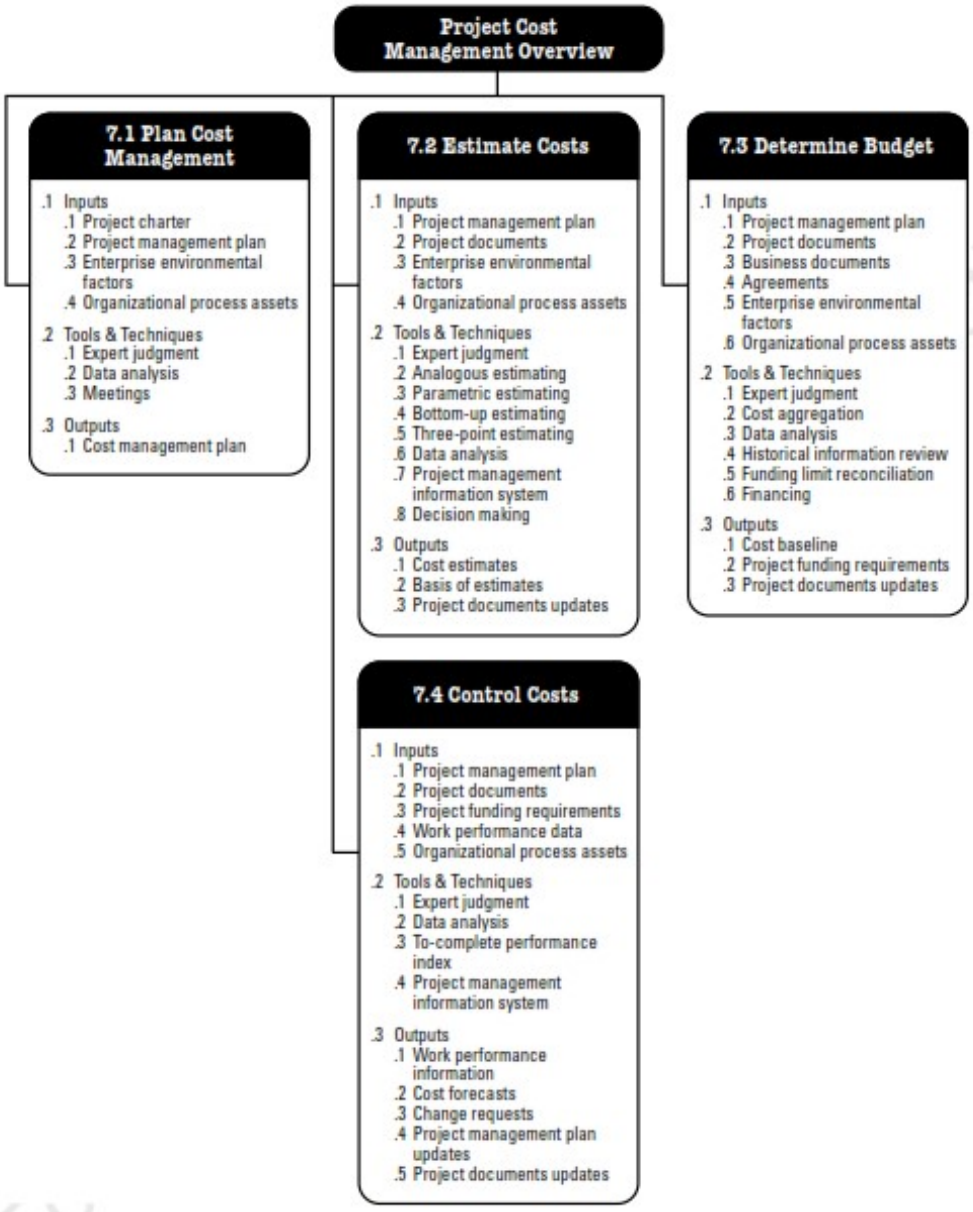


Figure 8 Project Cost Management Overview (Source: PMI, 2017)

5 Project Quality Management

According to PMI (2017) “Project Quality Management. Includes the processes for incorporating the organization’s quality policy regarding planning, managing, and controlling project and product quality requirements, in order to meet stakeholders’ expectations” (p. 24).

When it comes to this knowledge area, the applicable specific objective is to develop a quality management plan to incorporate the organization’s quality policy in order to meet stakeholders’ expectations.

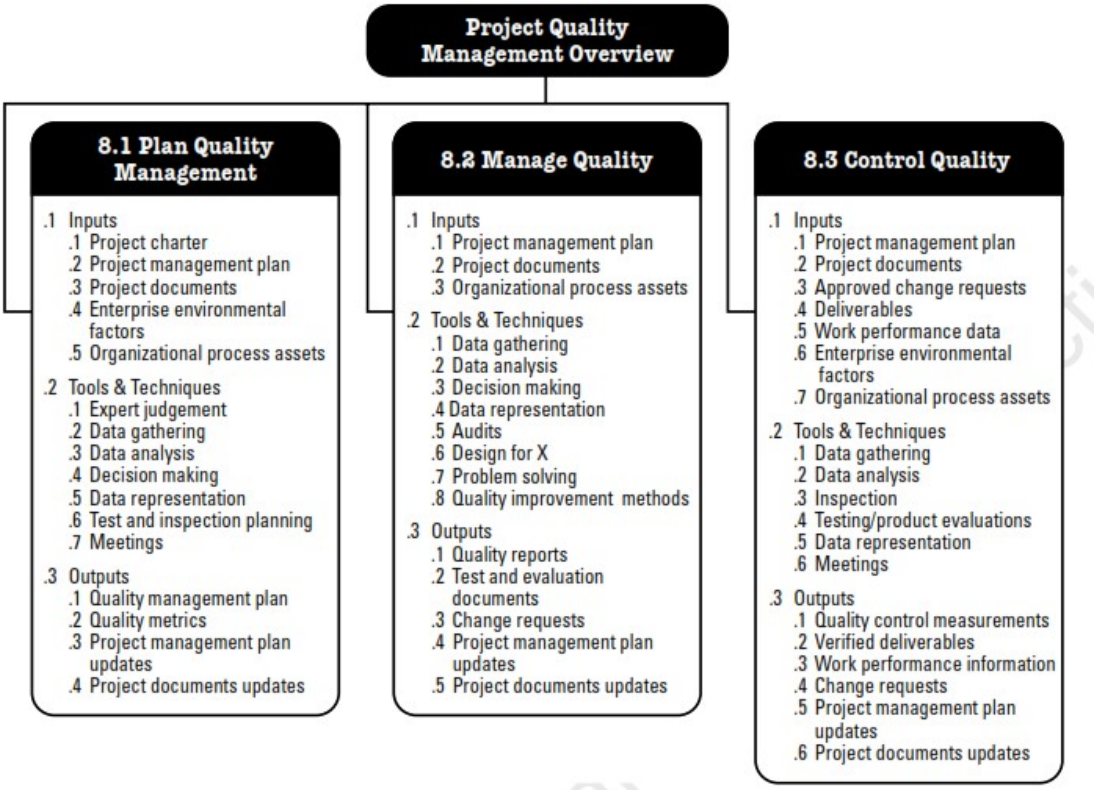


Figure 9 Project Quality Management Overview (Source: PMI, 2017)

6 Project Resource Management

"Project Resource Management includes the processes to identify, acquire, and manage the resources needed for the successful completion of the project" (PMI, 2013, p. 24). One of the specific objectives of the FGP is to create a resource management plan to identify, acquire, and manage the resources needed for the successful completion of the project.

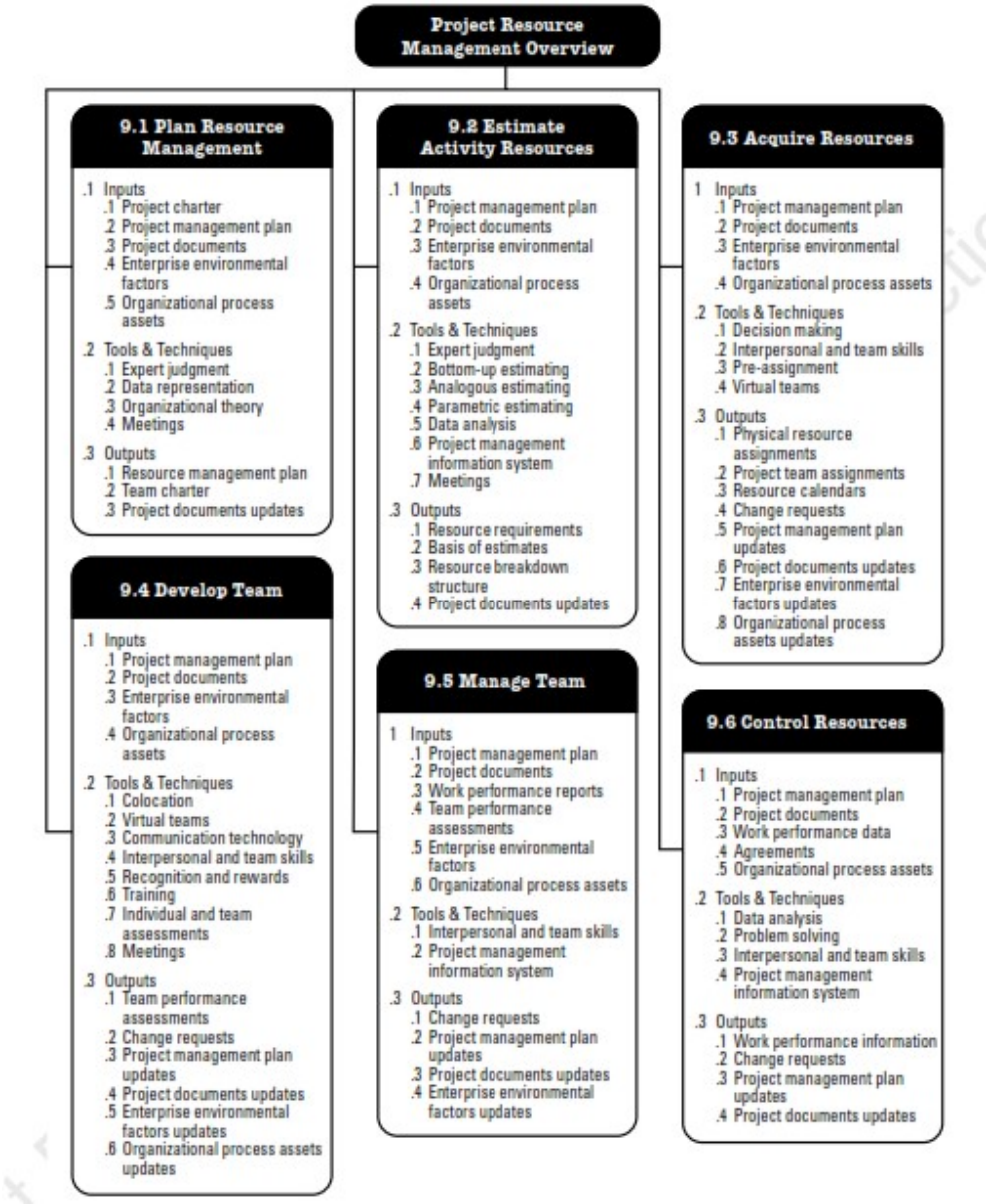


Figure 10. Project Resource Management Overview (Source: PMI, 2017)

7 Project Communications Management

“Project Communications Management includes the processes required to ensure timely and appropriate planning, collection, creation, distribution, storage, retrieval, management, control, monitoring, and the ultimate disposition of project information” (p. 24)

The FGP will develop a Communications Management plan to ensure that the information needs of the project and its stakeholders are met.

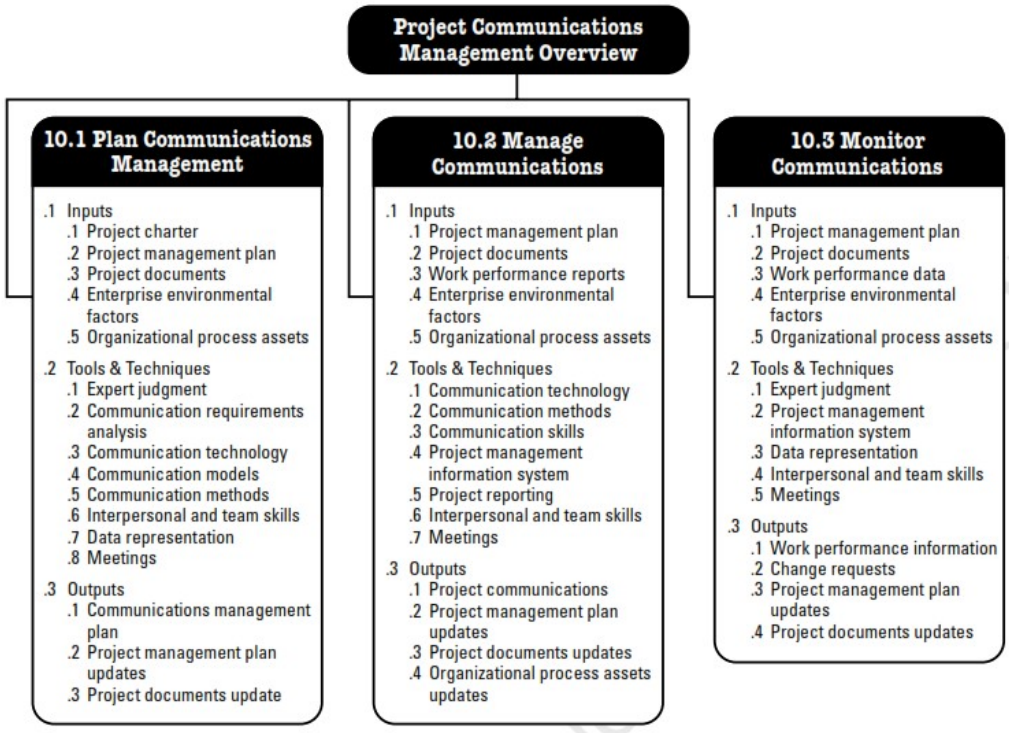


Figure 11 Project Communications Management Overview (Source: PMI, 2017)

8 Project Risk Management

According to Project Management Institute (2017) “Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, response implementation, and monitoring risk on a project” (p. 24).

The FGP will create a Risk Management Plan in order to optimize the chances of project success.

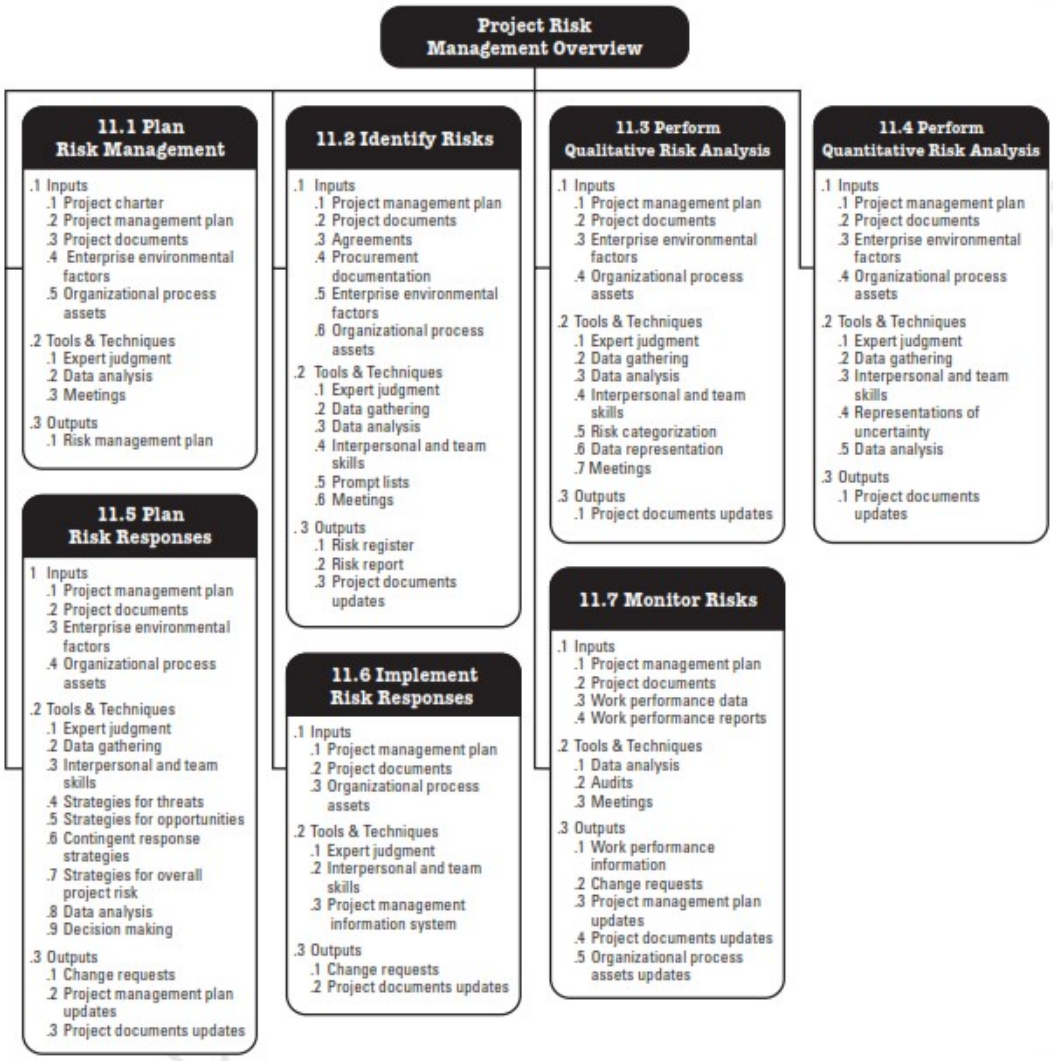


Figure 12. Project Risk Management Overview (Source: PMI, 2017)

9 Project Procurement Management

PMI states PMI (2017) “Project Procurement Management. includes the processes necessary to purchase or acquire products, services or results needed from outside the project team.

The FGP will create a Procurement Management Plan in order to purchase products services or results needed from outside the project team

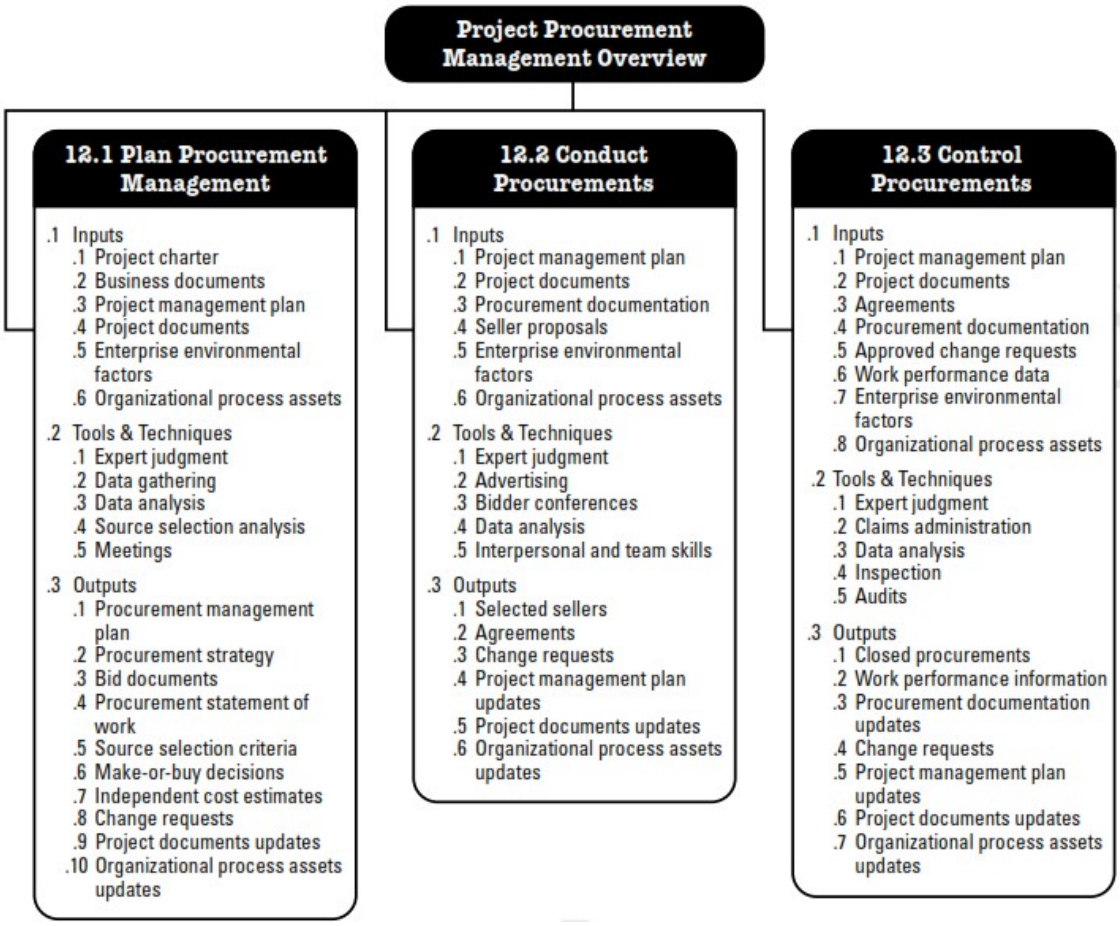


Figure 13 Project Procurement Management Overview (Source: PMI, 2017)

10 Project Stakeholder Management

“Project stakeholder management includes the processes required to identify the people, groups, or organizations that could impact or be impacted by the Project, to analyze stakeholder expectations and their impact on the project, and to develop appropriate management strategies for effectively engaging stakeholders in projects decisions and execution” (PMI, 2017, p. 24).

One of the specific objectives of the FGP is to create a stakeholder Management Plan to develop strategies to engage stakeholders in the work of the project.

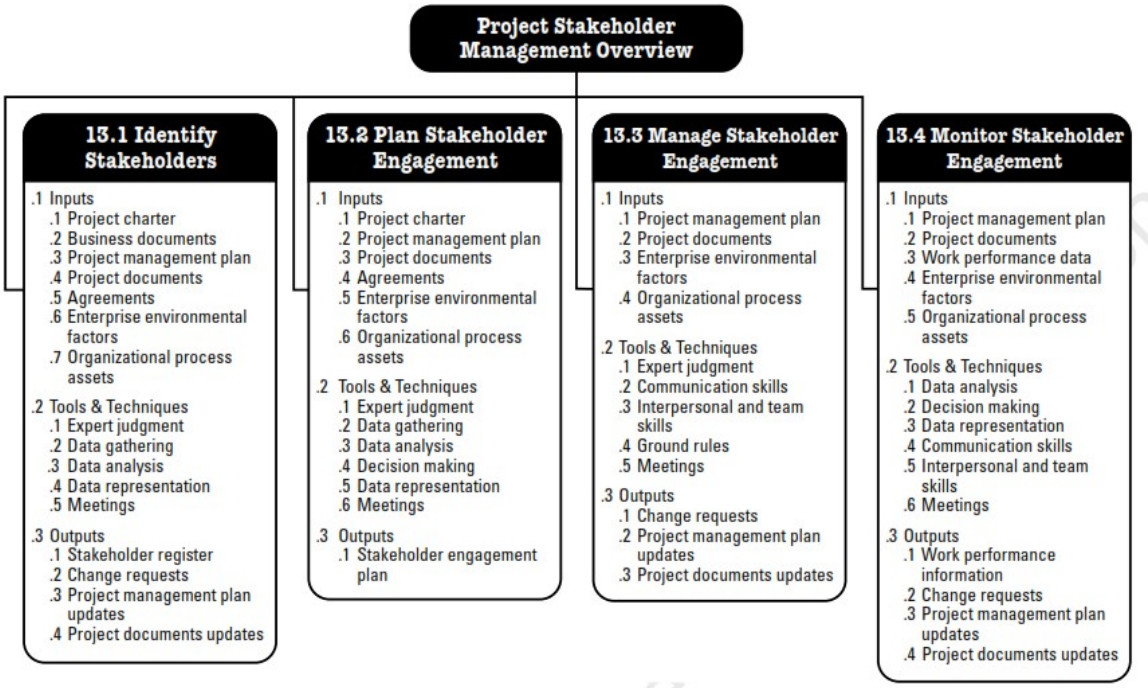


Figure 14 Project Stakeholder Management Overview (Source: PMI, 2017)

The figure below provides an overview of the Project Management process groups and Knowledge Area Mapping.

Knowledge Areas	Project Management Process Groups				
	Initiating Process Group	Planning Process Group	Executing Process Group	Monitoring and Controlling Process Group	Closing Process Group
4. Project Integration Management	4.1 Develop Project Charter	4.2 Develop Project Management Plan	4.3 Direct and Manage Project Work 4.4 Manage Project Knowledge	4.5 Monitor and Control Project Work 4.6 Perform Integrated Change Control	4.7 Close Project or Phase
5. Project Scope Management		5.1 Plan Scope Management 5.2 Collect Requirements 5.3 Define Scope 5.4 Create WBS		5.5 Validate Scope 5.6 Control Scope	
6. Project Schedule Management		6.1 Plan Schedule Management 6.2 Define Activities 6.3 Sequence Activities 6.4 Estimate Activity Durations 6.5 Develop Schedule		6.6 Control Schedule	
7. Project Cost Management		7.1 Plan Cost Management 7.2 Estimate Costs 7.3 Determine Budget		7.4 Control Costs	
8. Project Quality Management		8.1 Plan Quality Management	8.2 Manage Quality	8.3 Control Quality	
9. Project Resource Management		9.1 Plan Resource Management 9.2 Estimate Activity Resources	9.3 Acquire Resources 9.4 Develop Team 9.5 Manage Team	9.6 Control Resources	
10. Project Communications Management		10.1 Plan Communications Management	10.2 Manage Communications	10.3 Monitor Communications	
11. Project Risk Management		11.1 Plan Risk Management 11.2 Identify Risks 11.3 Perform Qualitative Risk Analysis 11.4 Perform Quantitative Risk Analysis 11.5 Plan Risk Responses	11.6 Implement Risk Responses	11.7 Monitor Risks	
12. Project Procurement Management		12.1 Plan Procurement Management	12.2 Conduct Procurements	12.3 Control Procurements	
13. Project Stakeholder Management	13.1 Identify Stakeholders	13.2 Plan Stakeholder Engagement	13.3 Manage Stakeholder Engagement	13.4 Monitor Stakeholder Engagement	

Figure 15 Project Management process group and Knowledge Area Mapping. (Source PMI 2017)

For the FGP the specific objectives are related to all the ten knowledge areas. However, the processes for the Aurora project will evolve around the Initiating and Planning Process groups.

3. METHODOLOGICAL FRAMEWORK

3.1 Information sources

According to Jennings (n.d.), “A source is the place where you gained information used in your writing. A source can be a printed document, an online document, a speech, a quote or even a television or radio program”. Jennings (n.d.) further states that “There are two types of sources: primary and secondary”.

3.1.1 Primary sources

Jennings (n.d.) defines a primary source as follows: “A primary source is the original place in which the information can be found, or the first person to make that information available”.

The primary sources that will be used for the FGP are personal knowledge and interviews with Engineering and project management staff, Subject Matter Experts (SME) and interviews with other stakeholders. Other primary resources are printed documentation, documentation obtained during the Master in Project Management course and documentation obtained from digital documents and internet research.

3.1.2 Secondary sources

“A secondary source is a source that simply relates information that was originally produced by someone else or somewhere else” (Jennings, n.d.). The secondary sources that will be used for the FGP are: information obtained from the engineering staff, printed documentation, documentation obtained during the Master in Project Management course and documentation obtained from digital documents and internet research.

For the development of the Final Graduation Project, both primary and secondary sources will be used.

Chart 1 provides a summary of the primary and secondary information sources that will be used for the development of the FGP.

Chart 1 Information sources (Source: R. Paal, Author of the FGP, June 2019)

Objectives	Information sources	
	Primary	**Secondary**
1 To develop a project Charter in order to formally authorize the project and provide the project manager with the authority to apply organizational resources to the project	Material obtained from the Master in Project Management (MPM) course. PMBOK Guide 6th edition. Information from Subject Matter Experts. Personal knowledge	PMBOK Guide 6th edition. Documentation obtained during the Master in Project Management course and documentation obtained from digital documents and internet research
2 To develop a scope management plan to ensure that the project includes all the work required, and only the work required to successfully complete the project	Material obtained from the MPM course. PMBOK Guide 6th edition. Information from Subject Matter Experts. Personal knowledge. Documentation obtained from the IDB website. Digital documents and internet research. Documents and information obtained from the Ministry of Regional development and the Ministry of Natural Resources. Possible site visits to collect relevant data	Project Management Institute (PMI) database. PMBOK Guide 6th edition. Documentation obtained during the MPM course and documentation obtained from digital documents and internet research. Documentation from the Ministry of Natural Resources and the Ministry of Regional Development
3 To create a Schedule management plan to manage the timely completion of the project.	Material obtained from the Master in Project Management course. PMBOK Guide 6th edition. Information from Subject Matter Experts. Personal knowledge. Historical project data	Project Management Institute (PMI) database. PMBOK Guide 6th edition. Documentation obtained during the MPM course and documentation obtained from digital documents and internet research
4 To create a cost management plan to define the processes for planning, estimating, budgeting, financing, funding, managing and controlling costs so that the project is completed within the approved budget	PMBOK Guide 6th edition. Documentation obtained during the Master in Project Management course and documentation obtained from digital documents and internet databases. Historical data. Quotes from local contractors and service providers	Documentation obtained during the MPM course and documentation obtained from digital documents and internet research. Documentation from the Ministry of Natural Resources and the Ministry of Regional Development

Objectives	Information sources	
	Primary	**Secondary**
5 To develop a quality management plan to incorporate the organization's quality policy in order to meet stakeholders' objectives	Material obtained from the Master in Project Management course. PMBOK Guide 6th edition. Information from Subject Matter Experts. Personal knowledge. Material from internet research. Information from the IDB website	PMBOK Guide 6th edition. Documentation obtained during the Master in Project Management course and documentation obtained from digital documents and internet research
6 To create a resource management plan to identify, acquire, and manage the resources needed for the successful completion of the project	Material obtained from the MPM course. PMBOK Guide 6th edition. Information from Subject Matter Experts. Personal knowledge. Material from internet research. Historical information	PMBOK Guide 6th edition. Documentation obtained during the Master in Project Management course and documentation obtained from digital documents and internet research
7 To develop a Communications Management plan to ensure that the information needs of the project and its stakeholders are met	Material obtained from several courses in communications. Material obtained from the MPM course. PMBOK Guide 6th edition. Information from Subject Matter Experts. Personal knowledge. Material from internet research	Material from internet research. Material obtained from several courses in communications. Material obtained from the MPM course
8 To create a Risk Management Plan in order to optimize the chances of project success	Material obtained from the MPM course. PMBOK Guide 6th edition. Information from Subject Matter Experts. Personal knowledge. Material from internet research	Documentation obtained from digital documents and internet research. Material obtained from the MPM course
9 To create a Procurement Management Plan to purchase products services or results needed from outside the project team	Material obtained from the MPM course. PMBOK Guide 6th edition. Information from Subject Matter Experts. Personal knowledge	Documentation obtained from digital documents and internet research. Material obtained from the MPM course
10 To create a stakeholder Engagement Plan to develop strategies to engage stakeholders in the work of the project.	Material obtained from the MPM course. PMBOK Guide 6th edition. Information from Subject Matter Experts. Personal knowledge. Possible site visits to engage with community stakeholders	Documentation obtained from digital documents and internet research. Material obtained from the MPM course and other courses in Project Management

3.2 Research methods

According to Surbhi (2018), “Research method pertains to all those methods, which a researcher employs to undertake research process, to solve the given problem. The techniques and procedures, that are applied during the course of studying research problem are known as the research method”.

The author further states that research methods “encompasses both qualitative and quantitative methods of performing research operations, such as survey, case study, interview, questionnaire, observation, etc.” (Surbhi, 2018).

3.2.1 Qualitative method

Bhat (n.d.), states in his article "Qualitative research is defined as a market research method that focuses on obtaining data through open-ended and conversational communication”.

For the FGP the qualitative research methods will allow questioning of stakeholders and subject matter experts.

For the FGP the qualitative research methods that will be used are interviews and record keeping. Interviews allow for the collection of data by asking people questions on a particular subject or situation.

Bhat (n.d.), further elaborates on record keeping by stating that “This method makes use of the already existing reliable documents and similar sources of information as the data source. This data can be used in a new research”.

3.2.2 Quantitative method

DeFranzo (2011) states that “Quantitative Research is used to quantify the problem by way of generating numerical data or data that can be transformed into usable statistics”. The author further elaborates on this by stating that “Quantitative Research uses measurable data to formulate facts and uncover patterns in research”. We can see that when compared to the qualitative research

method, this research method is much more focused on the collection and analysis of numerical data and statistics.
For the collection of quantitative data for the FGP interviews and observations will be used.

3.2.3 Analytical method

The online article, What Is Analytical Research states, “Analytical research is a specific type of research that involves critical thinking skills and the evaluation of facts and information relative to the research being conducted”.

According to the article, analytical research is conducted in a variety of ways including literary research, public opinion and scientific trials.

For the FGP, data and other important facts that pertain to the project, will be compiled and analyzed.

The research methods used for each specific objective of the FGP are indicated in Chart 2 below.

Chart 2 Research methods (Source: R. Paal, Author of the FGP, June 2019)

Objectives	**Research methods**		
	Qualitative method	Quantitative method	Analytical method
1 To develop a project Charter in order to formally authorize the project and provide the project manager with the authority to apply organizational resources to the project.	Existing documentation will be used to support the development of the project charter	Basic Project data obtained from project documentation will be used to support the development of the project charter	Basic Project data obtained from project documentation and from the quantitative method will be used to support the development of the project charter
2 To develop a Scope Management Plan to ensure that the project includes all the work required, and only the work required to successfully complete the project.	Subject Matter Experts (SME's) will be interviewed. Existing documentation will be used to support the development of the Scope Management Plan	Project data obtained from project documentation and historical data will be used to support the development of the Scope Management Plan	Project data obtained from the quantitative method will analyzed and used to support the development of the Scope Management Plan
3 To create a Schedule management plan to manage the timely completion of the project.	Subject Matter Experts (SME's) will be interviewed. Existing documentation will be used to support the development of the Schedule Management Plan	Project data obtained from project documentation and historical data will be used to support the development of the Schedule Management Plan	Project data obtained during the quantitative method will be analyzed and used to support the development of the Schedule Management Plan
4 To create a cost management plan to define the processes for planning, estimating, budgeting, financing, funding, managing and controlling costs so that the project is completed within the approved budget.	Subject Matter Experts (SME's) will be interviewed. Existing documentation will be used to support the development of the Cost Management Plan	Project data obtained from project documentation and historical data will be used to support the development of the Cost Management Plan	Data obtained during the quantitative research will be further analyzed to support the development of the Cost Management Plan
5 To develop a quality management plan to incorporate the organization's quality policy in order to meet stakeholders' objectives.	Existing documentation will be used to support the development of the Quality Management Plan	Project data obtained from project documentation and historical data will be used to support the development of the Quality Management Plan	Data obtained during the quantitative research will be further analyzed to support the development of the Quality Management Plan

Objectives	Research methods		
	Qualitative method	Quantitative method	Analytical method
6 To create a resource management plan to identify, acquire, and manage the resources needed for the successful completion of the project.	Existing documentation will be used to support the development of the Resource Management Plan	Project data obtained from project documentation and online data basis will be used to support the development of the Resource Management Plan	Data obtained during the quantitative research will be further analyzed to support the development of the Resource Management Plan
7 To develop a Communications Management plan to ensure that the information needs of the project and its stakeholders are met.	Existing documentation will be used to support the development of the Communications Management Plan		
8 To create a Risk Management Plan in order to optimize the chances of project success.	Subject Matter Experts (SME's) will be interviewed. Existing documentation will be used to support the development of the Cost Management Plan	Project data obtained from project- and other documentation will be used to support the development of the Risk Management Plan	Data obtained during the quantitative research will be further analyzed to support the development of the Risk Management Plan
9 To create a Procurement Management Plan to purchase products services or results needed from outside the project team.	Subject Matter Experts (SME's) will be interviewed. Existing documentation will be used to support the development of the Procurement Management Plan	Project data obtained from project- and other documentation will be used to support the development of the Procurement Management Plan	Data obtained during the quantitative research will be further analyzed to support the development of the Procurement Management Plan
10 To create a stakeholder Engagement Plan to develop strategies to engage stakeholders in the work of the project.	Existing documentation will be used to support the development of the Stakeholder Engagement Plan		

3.3 Tools

The PMBOK® Guide defines a tool as “Something tangible, such as a template or software program, used in performing an activity to produce a product or result” (Project Management Institute, 2017, p. 725).

Due to the time constraint, the tools used to develop the Final Graduation Project objectives, emphasize on the initiating and the planning process groups. The tools are in line with the PMBOK Guide 6th edition material and are described below.

1. The Project charter template. The template was provided during the Master in Project Management Course. It will be used to develop the project charter.
2. Checklists. Checklists may guide the project manager to develop several of the subsidiary plans from the project management plans. “A checklist is a structured tool, usually component-specific, used to verify that a set of required steps has been performed or to check if a list of requirements has been satisfied” (PMI, 2017, p. 292).
3. Software such as Microsoft project and Microsoft Excel will be used by the project manager to obtain some of the specific objectives.
4. Requirements traceability matrix template - ensures that project requirements are necessary and will be met.
5. Lessons learned register: According to the PMBOK Guide “The lessons learned register can include the category and description of the situation. The lessons learned register may also include the impact, recommendations, and proposed actions associated with the situation” (PMI, 2017, p. 104). PMI (2017) further states that “The lessons learned register may record challenges, problems, realized risks and opportunities, or other content as appropriate” (p. 104).

6. Work Breakdown Structure (WBS) template developed through Microsoft word will be used to develop the project work breakdown structure in order to decompose the project work.
7. Requirements traceability matrix template. This template can be used as a tool that will result in an output document. According to PMI (2017) “The requirements traceability matrix is a grid that links product requirements from their origin to the deliverables that satisfy them” (p. 149).
8. WBS dictionary template obtained during the MPM course. The WBS dictionary is a document that provides detailed deliverable, activity and scheduling information about each component in the WBS.
9. Spreadsheets created in Microsoft Excel will be used to support the project manager to obtaining the cost management plan.
10. Milestone list. This list is used to identify project milestones.
11. Flowcharts. According to PMI (2017) “Flowcharts are also referred to as process maps because they display the sequence of steps and the branching possibilities that exist for a process that transforms one or more inputs into one or more outputs” (p. 284).
12. Responsibility Assignment Matrix. This matrix identifies team members and assigns them responsibilities. For example RACI chart. Responsible, Accountable, Consult, and Inform (RACI) chart. Is a tool that helps to clearly assign roles and responsibilities of the project team.
13. Text-oriented formats. “Team member responsibilities that require detailed descriptions can be specified in text-oriented formats. Usually in outline form, these documents provide information such as responsibilities, authority, competencies, and qualifications” (PMI, 2017, p. 317).
14. Resource Breakdown Structure “is a hierarchical representation of resources by category and type” (PMI, 2017, p. 326).
15. Communication Technology such as shared portals, video and audio conferencing and email and chat

16. Communication methods. PMI (2017) states that “These are the methods used to share information among project stakeholders”.
17. Communication Matrix. Plans communications between project team and stakeholders.
18. Project Management Information Systems (PMIS). According to PMI (2017) “ensure that stakeholders can easily retrieve the information they need in a timely way” (p. 385). PMIS include Email, voice mail, audio, video and web conferencing and websites.
19. Risk Breakdown Structure (RBS). The RBS “is a hierarchical representation of potential sources of risk” (PMI, 2017, p. 405).
20. Template to define risk probability and impact, and probability and impact matrix. These can be used to evaluate risks and opportunities.
21. Risk Register template – developed in Microsoft Excel 2016, identifies and classifies risks, and plans risk responses.
22. Bid documents templates such as Request for Proposals (RFP) or Request for Quotations (RFQ) templates. Terms of Reference (TOR) templates. Those documents are used to obtain proposals from sellers
23. Stakeholder analysis template. This will result in a list of stakeholders and information such as roles and responsibilities on the project, expectations and attitude.
24. Power Interest grid, Power/Influence grid, or Impact/Influence grid. According to PMI (2017) these are used to group stakeholders according to their level of power, interest, influence or impact.
25. Stakeholder Engagement Assessment Matrix, details how each stakeholder should be engaged based on their level of involvement.
26. Stakeholder Register template, aids in identification of project stakeholders.

An overview of the tools to be used for the FGP is provided in Chart 3.

Chart 3 Tools (Source: R. Paal, Author of the FGP, June 2019)

Objectives	Tools
1 To develop a project Charter in order to formally authorize the project and provide the project manager with the authority to apply organizational resources to the project	Project charter template, PMIS (such as scheduling software) will be used to generate relevant data for the project charter
2 To develop a Scope Management Plan to ensure that the project includes all the work required, and only the work required to successfully complete the project	Requirements traceability matrix template, WBS template, WBS dictionary template, inspection check sheets
3 To create a Schedule management plan to manage the timely completion of the project	Microsoft project, Milestone list template, WBS template
4 To create a cost management plan to define the processes for planning, estimating, budgeting, financing, funding, managing and controlling costs so that the project is completed within the approved budget	Microsoft Excel sheets and software will be used to support the development of the cost management plan
5 To develop a quality management plan to incorporate the organization's quality policy in order to meet stakeholders' objectives	Tools such as Flowcharts, check sheets and Matrix diagrams will be used to develop the schedule management plan
6 To create a resource management plan to identify, acquire, and manage the resources needed for the successful completion of the project	RACI chart, text oriented formats, resource breakdown structure templates and communication technologies will support the development of the resource management plan
7 To develop a Communications Management plan to ensure that the information needs of the project and its stakeholders are met	Organizational communication technologies, communication methods, PMIS (PMIS include Email, voice mail, audio, video and web conferencing and websites), stakeholder engagement assessment matrix
8 To create a Risk Management Plan in order to optimize the chances of project success	Risk Breakdown Structure template, Template to define risk probability and impact, Probability and Impact matrix, risk checklist, PMIS (schedule software etc.) Risk register template
9 To create a Procurement Management Plan to purchase products services or results needed from outside the project team	Bid request templates, Terms of Reference (TOR) templates, Evaluation sheet templates, templates to perform inspections, procurement plan template
10 To create a stakeholder Engagement Plan to develop strategies to engage stakeholders in the work of the project	Stakeholder analysis template, Power Interest grid, Power/Influence grid, or Impact/Influence grid, stakeholder engagement assessment matrix, Stakeholder Register template are the tools that will be used to develop the stakeholder management plan

3.4 Assumptions and constraints

Project Management Institute (2017) defines an assumption as “A factor in the planning process that is considered to be true, real, or certain, without proof or demonstration” (p. 699).

A constraint is “A limiting factor that affects the execution of a project or process” (Project Management Institute, 2017, p. 701).

The following assumptions are applicable to the FGP:

1. All the information required to develop the Project Management Plan and related documentation for this project will be available or be made available in a timely fashion.
2. There will be sufficient resources (tutor and reviewers, software, IT technologies etc.) available to allow the development of the Project Management Plan within a maximum time limit of 3 months
3. The requirements to start with the Final Graduation Project (e.g. successful completion all of the previous courses in the program, payment and registration) will have been fulfilled by July 28 2019
4. The tutor's approval of the final version of the FGP document profile will be obtained ultimately June 23, 2019

The following constraints are applicable to the FGP:

1. There will be no time to include the elements related to the implementation, control or closure process groups of the project or of its phases because the FGP has limited execution times (three months or less).
2. The FGP must be developed on a tight and stringent schedule and must be completed by November 2019.
3. There is very little time available to develop the several plans and deliverables associated with this FGP. Because of this, the development of the plans will mostly be based upon historical data and templates and

documents will be produced on a summary- or high level and might lack detailed information.

4. The Project Management Plan and subsidiary plans must be developed according to PMI standards and guidelines.

A summary of the FGP assumptions and constraints is presented below in Chart 4:

Chart 4 Assumptions and constraints (Source: R. Paal, Author of the FGP, June 2019)

Objectives	Assumptions	Constraints
1 To develop a project Charter in order to formally authorize the project and provide the project manager with the authority to apply organizational resources to the project.	1) Information required will be available or be made available. 2) Requirements to start with the Final Graduation Project will be fulfilled by July 28, 2019. 3) Tutor's approval of the final version of the FGP document profile will be obtained by June 23, 2019	1) Development of the charter will mostly be based upon historical data and expert judgment. 2) The document will be produced on a summary- or high level and might lack some specific detail information.
2 To develop a Scope Management Plan to ensure that the project includes all the work required, and only the work required to successfully complete the project.	1) Information required will be available or be made available. 2) Sufficient resources for review of the Scope Management Plan	1) Development of the scope management plan will mostly be based upon historical data and expert judgment 2) PMI standards and guidelines apply.
3 To create a Schedule management plan to manage the timely completion of the project.	1) Information required will be available or be made available. 2) Sufficient resources for review of the Schedule Management Plan 3)Scheduling software will be available	1) Development of the schedule management plan will mostly be based upon historical data and expert judgment 2) PMI standards and guidelines apply.
4 To create a cost management plan to define the processes for planning, estimating, budgeting, financing, funding, managing and controlling costs so that the project is completed within the approved budget.	1) Information required will be available or be made available. 2) Sufficient resources for review of the Cost Management Plan 3) Software will be available to support obtaining this objective	1) Development of the cost management plan will mostly be based upon historical data, expert judgment and internet research 2) PMI standards and guidelines apply.

Objectives	Assumptions	Constraints
5 To develop a quality management plan to incorporate the organization's quality policy in order to meet stakeholders' objectives.	1) Information required will be available or be made available. 2) Sufficient resources for review of the quality Management Plan	1) The documents will be produced on a summary- or high level and might lack some specific detail information. 2) PMI standards and guidelines apply.
6 To create a resource management plan to identify, acquire, and manage the resources needed for the successful completion of the project.	1) Information required will be available or be made available. 2) Sufficient resources for review of the resource Management Plan	1) Development of the cost management plan will mostly be based upon historical data and the documents will be produced on a summary- or high level and might lack some specific detail information. 2) PMI standards and guidelines apply.
7 To develop a Communications Management plan to ensure that the information needs of the project and its stakeholders are met.	Village captains have access to social media and other communication tools such as sms, whatsapp etc	1) Must be developed on a tight schedule. 2) PMI standards and guidelines apply.
8 To create a Risk Management Plan in order to optimize the chances of project success.	1) Information required will be available or be made available. 2) Sufficient resources for review of the risk Management Plan	1) Development of the risk management plan will mostly be based upon historical data, expert judgment and internet research 2) PMI standards and guidelines apply.
9 To create a Procurement Management Plan to purchase products services or results needed from outside the project team.	1) Information required will be available or be made available. 2) Sufficient resources for review of the Procurement Management Plan	1) Must be developed on a tight schedule 2) The documents will be produced on a summary- or high level and might lack some specific detail information. 3) PMI standards and guidelines apply.
10 To create a stakeholder Engagement Plan to develop strategies to engage stakeholders in the work of the project.	Village captains have access to social media and other communication tools such as sms, whatsapp etc	1) Must be developed on a tight schedule 2) PMI standards and guidelines apply.

3.5 Deliverables

Project Management Institute (2017) defines a deliverable as “any unique and verifiable product, result, or capability to perform a service that is required to be produced to complete a process, phase, or project” (p. 704).

The deliverables for the FGP are directly related to the objectives of the Project and can be found in the chart below.

Chart 5 Deliverables (Source: R. Paal, Author of the FGP, June 2019)

Objectives	Deliverables
1 To develop a project Charter in order to formally authorize the project and provide the project manager with the authority to apply organizational resources to the project.	Project Charter Assumption log
2 To develop a Scope Management Plan to ensure that the project includes all the work required, and only the work required to successfully complete the project.	Scope management plan Requirements Traceability Matrix Project Scope Statement Scope baseline
3 To create a Schedule management plan to manage the timely completion of the project.	Schedule management plan Project Schedule Network diagram Change request template
4 To create a cost management plan to define the processes for planning, estimating, budgeting, financing, funding, managing and controlling costs so that the project is completed within the approved budget.	Cost Management plan Cost estimates
5 To develop a quality management plan to incorporate the organization’s quality policy in order to meet stakeholders’ objectives.	Quality Management plan Quality metrics
6 To create a resource management plan to identify, acquire, and manage the resources needed for the successful completion of the project.	Resource Management plan Resource breakdown structure
7 To develop a Communications Management plan to ensure that the information needs of the project and its stakeholders are met.	Communications Management plan
8 To create a Risk Management Plan in order to optimize the chances of project success.	Risk Management plan Risk Register Change request template
9 To create a Procurement Management Plan to purchase products services or results needed from outside the project team.	Procurement Management plan Procurement statement of work Change request template
10 To create a stakeholder Engagement Plan to develop strategies to engage stakeholders in the work of the project.	Stakeholder Register Change request template Stakeholder engagement plan

4. RESULTS

4.1 Project Integration Management

According to (Project Management Institute, 2017) ‘‘Project Integration Management. Includes the processes and activities to identify, define, combine, unify, and coordinate the various processes and project management activities within the Project Management Process Groups.’’ (p. 23).

The Project Charter

Develop Project Charter is the first process in the Project Integration Management knowledge area (see figure 5). Develop Project Charter is also the first process in the Initiating process group. One of the specific objectives of the FGP is to develop a project Charter in order to formally authorize the project and provide the project manager with the authority to apply organizational resources to project activities.

The charter template provided during the Master in Project Management Course from the University for the International Cooperation (UCI), course item MPM-10, was used to develop the project charter. One of the input documents is an amended implementing agreement, that was signed between the government of Suriname and the European Union on June 7, 2019. Enterprise Environmental factors, such as marketplace conditions were also used; in this particular case for example, it was clear that a solar power plant of this size cannot be delivered by a local company in Suriname. This means that a company from abroad would need to provide the solar plant.

Organizational process assets that were used are e.g. the company’s procurement policies combined with the procurement policies from the Inter-American Development Bank (IDB). According to the implementing agreement, the procurement and contracting process for the acquisition of goods, works, services and consultancies to be financed by the EU Contribution will be carried out in accordance with the Policies for the Procurement of Goods and Works financed by the Inter-American Development Bank, and the Policies for the Selection and

Contracting of Consultants Financed by the Inter-American Development Bank and applicable Bank rules and procedures regarding procurement.

Tools and Techniques used are Expert judgment, such as Technical knowledge of the industry and focus area of the project, knowledge regarding project duration, project budget and project risk and organizational strategy were used to develop the project charter. Data gathering took place by means of interviews for example, interviews with the procurement specialist from EBS. Meetings were also conducted to identify project objectives, summary milestones and other summary information necessary for the development of the project charter. As an output of the “Develop Project Charter” process the project charter was developed. The project charter can be seen in appendix 4.

The Assumption log

The Assumption log is an output from the “create project charter” process (see figure 5) and is used to record all assumptions and constraints throughout the project life cycle. According to PMI (2017) “Lower level activity and task assumptions are generated throughout the project, such as defining technical specifications, estimates, the schedule, risks, etc. (p. 81).

Below in chart 6, the assumption (and constraints) log that will be used for the Nieuw Aurora project can be seen. This log will be reviewed twice a month by the project team and updated by the project manager, if necessary.

Chart 6 Assumption log (Source: R. Paal, Author of the FGP, Aug 2019)

	Assumptions	Date Identified	Date confirmed/ materialized	Status Aug 18, 2019
1	A plot of land will be made available by the village community in order to install the solar panels	August 15, 2019		The villagers were informed on June 26, 2019 that a plot of land will be needed to install the solar panels.
2	The growth of the number of households after project start will be according to a business as usual scenario	August 15, 2019		Data obtained from the Birth Certificate Office shows that in 2017 there were 477 customers in the village. Data collection must still take place in order to determine the actual number of connections and extrapolate this number toward the project completion date of May 11, 2022
3	Transportation cost over the river will conform to the rates used by the local boat owners			Those costs should be negotiated early in the project and be included in an agreement in order to ensure that the transportation costs will not exceed the regular rates.

	Constraints	Date Identified	Date revised	Status Aug 18, 2019
1	The project budget is set at USD 1.47 MM	June 11, 2019		This is still valid
2	The project must be completed ultimately June 9, 2022 (this is when the Implementing agreement expires)	June 11, 2019		This is still valid
3	Approximately 500 customers will be connected to the solar system	June 11, 2019		This is still valid until field data collection proves otherwise

Develop Project management Plan

The “Develop Project Management Plan” process is the second process from the Project Integration Management knowledge area (see figure 5). According to PMI (2017), “Develop project management plan is the process of defining, preparing, and coordinating all plan components and consolidating them into an integrated project management plan” (p. 82).

The inputs that will be used for the development of the Nieuw Aurora Project Management Plan are the project charter, outputs from other processes, enterprise environmental factors and organizational process assets. Tools and Techniques are expert judgment, interviews and meetings.

The Project Management Plan for the Nieuw Aurora project which is an output of the “Develop Project Management Plan” process will include the following subsidiary management plans:

1) A scope management plan to ensure that the project includes all the work required, and only the work required to successfully complete the project.
2) A schedule management plan to manage the timely completion of the project
3) A cost management plan to define the processes for planning, estimating, budgeting, financing, funding, managing and controlling costs so that the project is completed within the approved budget
4) A quality management plan to incorporate the organization’s quality policy in order to meet stakeholders’ objectives
5) A resource management plan to identify, acquire, and manage the resources needed for the successful completion of the project

6) A communications management plan to ensure that the information needs of the project and its stakeholders are met
7) A risk management plan in order to optimize the chances of project success
8) A procurement management plan to purchase products services or results needed from outside the project team
9) A stakeholder engagement plan to develop strategies to engage stakeholders in the work of the project

4.2 Scope Management Plan

“Project Scope Management includes the processes required to ensure that the project includes all the work required, and only the work required to complete the project successfully (Project Management Institute, 2017, p. 23).

In figure 6 all the processes for the Project Scope Management are depicted. together with their Inputs, Tools and Techniques, and Outputs.

Those processes are:

1. Plan Scope Management
2. Collect Requirements
3. Define Scope
4. Create WBS
5. Validate Scope
6. Control Scope

The Project Scope Management Plan for the Aurora project was developed by using the processes above and a free template from the Project Management Docs website (August 25, 2019). Information obtained from online article “Which Solar Panel Type is Best?” and “What is the lifespan of a lead acid battery?”, was also used to define some of the project requirements.

SCOPE MANAGEMENT PLAN

24 HOURS SOLAR POWER FOR NIEUW AURORA

N.V. ENERGIEBEDRIJVEN SURINAME (EBS)
NOORDERKERKSTRAAT
PARAMARIBO, SURINAME

AUGUST 25, 2019

TABLE OF CONTENTS

1. Introduction

This Scope Management Plan details how the “24 hours Solar Power for Nieuw Aurora” project scope will be defined, developed, and verified. It clearly defines who is responsible for managing the project’s scope and acts as a guide for managing and controlling the scope.

The Scope Management Plan also provides the scope framework for this project. It documents the scope management approach; roles and responsibilities as they pertain to project scope; scope definition; verification and control measures; scope change control; and the project’s work breakdown structure. Any project communication which pertains to the project’s scope should adhere to the Scope Management Plan.

This project is for designing, procuring, installation and testing of a solar power plant that will be used to provide the Nieuw Aurora Village in Suriname with 24 hours per day electricity service. This includes design of the system, procuring the solar system, Installation of the solar panels, testing and commissioning of the system, close out of the project and hand over of the project to operations. The solar system will be procured through a turnkey delivery from a solar system provider. Other external resources that will be acquired for this project are resources for the preparation of the solar sites.

2 Plan Scope Management

For this project, scope management will be the sole responsibility of the Project Manager. The scope for this project is defined by the Scope Statement, Work Breakdown Structure (WBS) and WBS Dictionary.

As input for this process the Project Charter was used. Other inputs used are the Project Management Plan, Enterprise Environmental Factors and Organizational Process assets. Tools and Techniques that were used are Expert Judgment and meetings. Once the project enters into the execution phase, the Project Manager,

Sponsor and Stakeholders will establish and approve documentation for measuring project scope which includes deliverable quality checklists and work performance measurements. In order to ensure that key stakeholders has a clear understanding of the project, the project manager must review the project scope baseline with those key stakeholders. Proposed scope changes may be initiated by the Project Manager, Stakeholders or any member of the project team. All change requests will be submitted to the Project Manager who will then evaluate the requested scope change. Upon acceptance of the scope change request, the Project Manager will submit the scope change request to the Project Sponsor for acceptance. Upon approval of scope changes by the Project Sponsor, the Project Manager will update all project documents and communicate the scope change to all stakeholders. Based on feedback and input from the Project Manager and Stakeholders, the Project Sponsor is responsible for the acceptance of the final project deliverables and project scope.

3 Roles and Responsibilities

In order to successfully manage a projects' scope it is important that all roles and responsibilities for scope management are clearly defined. This section defines the role of the Project Sponsor, Project Manager, Project Team, Stakeholders and other key persons who are involved in managing the scope of the project.

The project sponsor, manager, and team members must be aware of their responsibilities in order to ensure that work performed on the project is within the established scope throughout the entire duration of the project. The project manager will convene a meeting to elaborate on the role and responsibilities of the team and the stakeholders. Chart 7 below defines the roles and responsibilities for the scope management of this project.

Chart 7 Scope Management Roles and Responsibilities (Source: R. Paal, Author of the FGP, Aug 2019)

Name	Role	Responsibilities
IDB	external stakeholder for overall project management	- Overall management of the project - Approve or deny scope change requests as appropriate - Evaluate the need for scope change requests
Marcel Eijndhoven	Sponsor	- Approve or deny scope change requests as appropriate - Evaluate need for scope change requests - Accept project deliverables
Richard Paal	Project Manager	- Successful completion of the project - Measure and verify project scope - Facilitate scope change requests - Facilitate impact assessments of scope change requests - Organize and facilitate scheduled change control meetings - Communicate outcomes of scope change requests - Update project documents upon approval of all scope changes
Andy Aboikoni	Renewable Energy Engineer	- Measure and verify project scope - Validate scope change requests - Participate in impact assessments of scope change requests - Communicate outcomes of scope change requests to team - Facilitate team level change review process
Ernesto Kasban	Electrical Engineer	- Participate in defining change resolutions - Evaluate the need for scope changes and communicate them to the project manager as necessary
Richard Baidjnath-Panday	Electrical Engineer & Subject Matter Expert	- Provide advice to the team regarding the project

4 Collect Requirements

This section defines how the requirements for the project will be collected. The collected requirements will be used as an input to define the project scope.

For the initial collect requirements process, the project charter together with the assumption log and the stakeholder register will be used as input documents. Other input documents are the implementing agreements, enterprise environmental factors and organizational process assets. Once developed, the scope management plan and requirements management plan will also be used as input documents. Several tools and techniques will be used to collect the requirements. For example, the project team will engage with the village community and have meetings with the community in the Aurora village. Furthermore, the team will also conduct site visits to collect data regarding the number of customers that must be connected to the grid, the electricity consumption of the community and data regarding possible location of the solar panels. Information will also be obtained from solar project experts and interviews with other stakeholders. The output from this process are the requirements documentation and the requirements traceability matrix.

The Requirements Traceability Matrix for the project can be seen below in chart 8. Those requirements will be further developed as the project progresses.

Chart 8 Requirements Traceability Matrix (Source: R. Paal, Author of the FGP, Aug 2019)

	Requirements	WBS element	Validation					
			Inspection/ Verification	measur ement	Manufact urer's Warranty	Renewab le Energy Engineer	Electrical Engineer	Project Manager
1	**Solar System**	1.0	x	x		x	x	x
1.1	**Solar Panels**	1.5	x	x		x	x	x
1.1.1	Total capacity of 180 kW peak	1.5.9	x	x		x		
1.1.2	Voltage output level of 240 Volt	1.5.9	x	x			x	
1.1.3	Minimum lifetime of 25 years	1.5.4	x		x	x		x
1.1.4	Mono crystalline panels	1.5.4	x	x		x	x	
1.1.5	Panels Efficiency ≥ 18%	1.5.9	x	x		x		
1.2	**Battery system**	1.5	x	x		x	x	x
1.2.1	Backup must last at least 3 days	1.5.9	x	x		x		
1.2.2	Lead acid batteries	1.5.9	x				x	
1.2.3	Minimum lifetime of 5 years	1.5.4	x		x			x
1.3	**Solar Plant Site**	1.3	x			x		
1.3.1	Objects at the site must not cast shadings on the solar panels	1.3.3	x			x		
1.3.2	Site should not be subject to flooding	1.3.1	x			x		
1.3.3	The site must have an area of 2ha	1.3.1	x			x		
1.4	**Training**	1.5	x					x
1.4.1	Operators training to be provided	1.5.8	x					x
1.4.2	Maintenance training to be provided	1.5.8	x					x

5 Define Scope

The project description and deliverables will be developed based on the requirements collected in the “collect requirements” chapter above and input from subject matter experts in pv solar systems. Expert judgment will be used to obtain the most effective ways to meet the original requirements to provide a pv solar plant that will deliver 24 hours electricity service to the Nieuw Aurora village community.

6 Project Scope Statement

The project scope statement provides a detailed description of the project, objectives, deliverables, the work necessary to create these deliverables, the project constraints, exclusions, assumptions, and acceptance criteria. Additionally, the scope statement includes what work should not be performed in order to eliminate any unnecessary work which falls outside the project’s scope.

Project objectives and Project scope description:

The objective of this project is to install a solar photovoltaic system at Nieuw Aurora in order to provide reliable electricity access to the village.

The system must deliver 24 hours electricity service to the community through the existing power distribution network. The deliverables for this project are a Solar Photovoltaic system complete with a battery back-up system in order to ensure the provision of electricity when there is a lack of solar power. Operators training and maintenance training must also be provided to EBS employees that will operate and maintain the solar power plant after project completion.

The provision of start up- and critical spares is also included in the scope of work. The project also includes backfilling and upgrading of the solar panel site and will connect the solar power plant to the existing electricity network from Aurora in

order to distribute the power to the customers. Therefore, the physical boundary of the project is at the point where the new solar system connects to the existing network. Upgrade or extension of the existing electricity network is not included in the scope of work of the project. Neither does the project include the delivery of operational spares. Once in Suriname, the solar panels and related materials and equipment must be shipped from the village of Pokigron across the Suriname river over a distance of approximately 20 km in order to reach the project site. The project site will be provided to the solar system contractor free from trees or vegetation. Upgrading and backfilling of the solar panels' site will be the responsibility of the turnkey contractor. The solar system will be delivered turnkey by a contractor. Basic engineering will be done by EBS and the procurement processes that will be followed will be in line with the IDB procurement guidelines and procedures. This means that an international competitive bidding procurement process will be followed for the delivery of the solar PV system.

Project Acceptance

This project will be accepted after commissioning and testing of the solar plant have been satisfactory completed and the system has continuously been in operation for 30 days and has been providing the electricity to the community 24 hours per day, 7 days a week without interruptions or significant problems. Commissioning and Testing must be witnessed and signed off by appointed EBS employees and the commissioning and testing results must be documented by the contractor and presented to EBS for approval. Acceptance of the project will be done by the EBS' operations department manager, the project manager, and the project sponsor through the signing of a project acceptance form.

Project assumptions, constraints and risks

Assumptions for this project are that support will be provided by the project sponsor and all relevant department managers and that adequate internal resources are available for the successful completion of this project. Other

assumptions are that a plot of land will be made available by the village in order to install the solar panels, the growth of the number of households after project start will be according to a business as usual scenario and transportation cost over the river will conform to the rates used by the local boats men.

Project constraints are that the project completion date is scheduled for May 11, 2022 and the project budget is set at 1.47 MM. Approximately 500 customers will be connected to the solar system.

The risks identified for this project are that solar power projects are new to Suriname and if the required knowledge, skills and expertise to implement the project are insufficient, this will negatively impact the project progress and success. Other risks identified are that equipment or material can be damaged during transport and handling, especially during transportation over the rapids in the river. The village may also be flooded during the rainy season, thus hampering project activities.

Project stakeholders and approval

The project stakeholders identified are the Government of Suriname, the Inter-American Development Bank (IDB) and the European Union (EU). The end users of the project are the people living in the village. Other stakeholders are the project team and the project manager, EBS internal stakeholders, such as the engineering department and operation and maintenance. The project sponsor is EBS' Chief Executive Officer. Contractors have also been identified as important project stakeholders.

The documents, such as engineering and design documents must be signed by the project engineer and the engineering department head. The documents are then to be sent to the project manager for approval and final approval is given by the project sponsor. Contracts, agreements and similar documents between EBS and third parties can only be signed by the EBS CEO, CTO and CFO.

The project schedule

The project schedule with the major milestones are presented in chart 9 below

Chart 9 Nieuw Aurora Project Schedule (Source: R. Paal, Author of the FGP, Aug 2019)

Milestone/activity	Start date	End date
Nieuw Aurora Project	Jun 5, 2019	May 11, 2022
Project start	Jun 5, 2019	Jun 5, 2019
Mobilization	Jun 5, 2019	Jun 25, 2019
Site visits and data collection	Jun 26, 2019	Oct 15, 2019
Basic Engineering and Design	Aug 07, 2019	Dec 10, 2019
Procurement for turnkey delivery of solar plant	Dec 11, 2019	Jun 10, 2020
Detail engineering	Jun 11, 2020	Oct 14, 2020
Fabrication of solar panels	Oct 15, 2020	Mar 31, 2021
Solar panels fabricated	Mar 31, 2021	Mar 31, 2021
Factory Acceptance Testing of solar system	Apr 01, 2021	Apr 07, 2021
Shipping of solar panels	Apr 08, 2021	May 19, 2021
Solar panels to site	May 20, 2021	Jun 02, 2021
Construction	Jun 03, 2021	Oct 06, 2021
Construction complete	Oct 06, 2021	Oct 06, 2021
Commissioning	Oct 07, 2021	Nov 03, 2021
Commissioning complete	Nov 03, 2021	Nov 03, 2021
Punch list Items	Nov 03, 2021	Dec 15, 2021
Contingency (Schedule)	Dec 16, 2021	Mar 30, 2022
Close out project and Hand over to operations	Mar 31, 2022	May 11, 2022

7 Work Breakdown Structure

In order to effectively manage the work required to complete this project, the project scope is subdivided into smaller, more manageable components and deliverables called the WBS and WBS Dictionary. For the development of the WBS structure, we used a top down approach in which first the final product of the project was identified. Based upon this, the major deliverables and related works

were identified and those were decomposed in order to allow better management of the deliverable and the work.

The WBS for the project can be seen below in figure 16

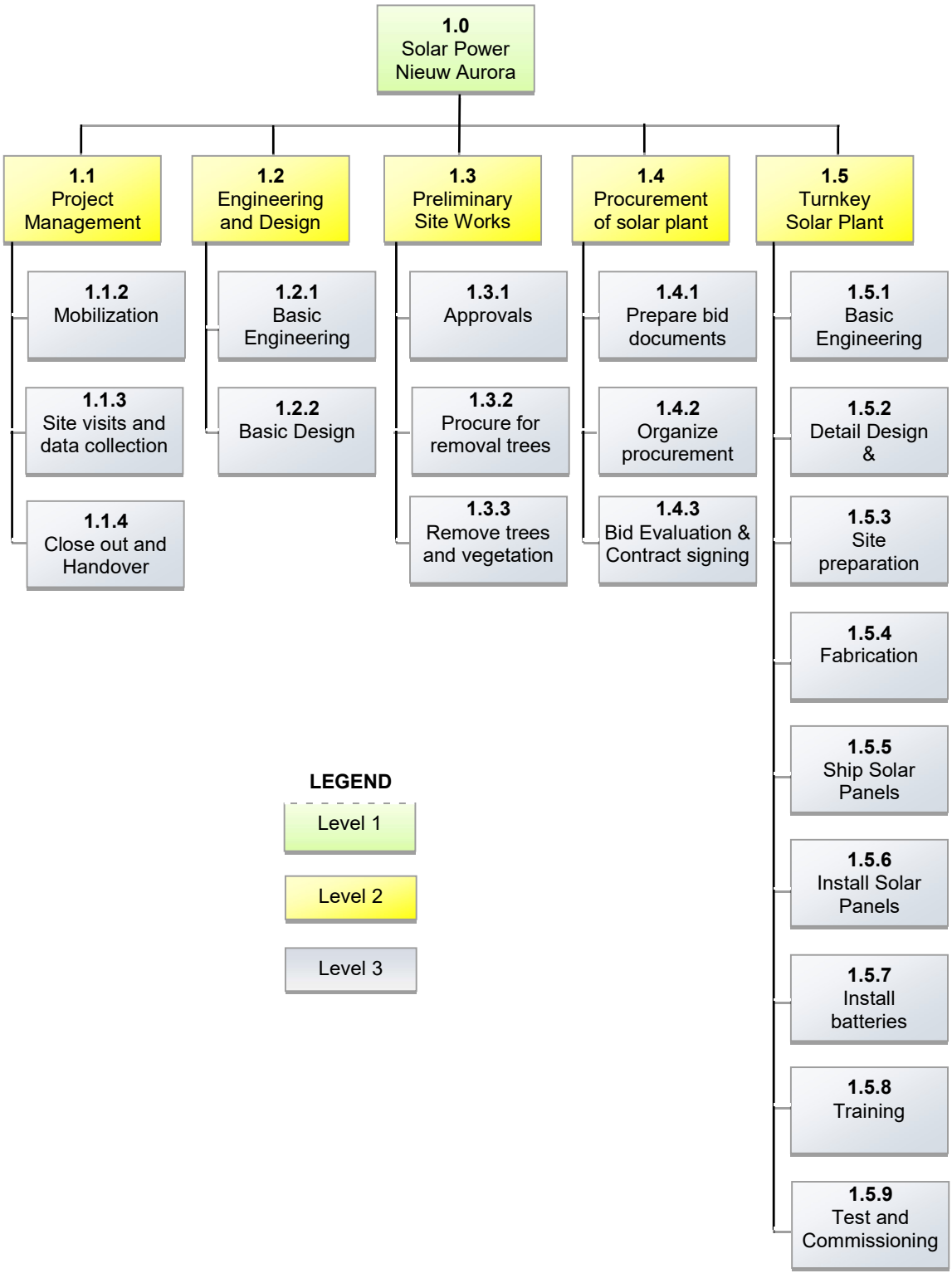


Figure 16 Work Breakdown Structure (WBS) (Source R. Paal Author of the FGP)

WBS Dictionary

In order to more clearly define the work necessary for project completion, the WBS Dictionary is used. The “WBS Dictionary” provides a description of the work to be done for each WBS element and the deliverables. In the chart below, the WBS dictionary can be seen. This dictionary will further be elaborated as the project progresses.

Chart 10 WBS dictionary (Source: R. Paal, Author of the FGP, Aug 2019)

level	WBS Code	Element Name	Description of Work	Deliverables	Resources
1	1.0	Solar Power Nieuw Aurora	All work related to the delivery of the 24 hrs. Solar Power for Nieuw Aurora project	Solar Power plant	Contractors, Equipment, Materials, EBS employees, transportation
2	1.1	Project Management	Project Management and Integration	Reports, meeting minutes, planning documents	Project Manager
3	1.1.2	Mobilization	Mobilization of team for site visits and logistics	Planning documents	Project Manager, Department heads, Engineers
3	1.1.3	Site visits and data collection	Carry out Site visits, engage stakeholders and collect data	Reports, meeting minutes, data	EBS employees, Project Manager, Project Engineers
3	1.1.4	Close out and Handover	Close out project and Handover to operations	Close out documents	Project Manager, Engineers, EBS operations
2	1.2	Engineering and Design	Engineering and Design	Basic engineering documents	Project Manager, Engineers, Designers
3	1.2.1	Basic Engineering	Perform Basic Engineering of solar plant	Basic engineering documents	Project Manager, Engineers
3	1.2.2	Basic Design	Perform Basic Design of solar plant	Basic Design documents	Project Manager, Engineers, Designers
2	1.3	Preliminary Site Works	Works related to prepare the site for the turnkey contractor	Agreements, site maps	Project Manager, Land Surveyor, Designers, Engineers, Village captain
3	1.3.1	Approvals	Obtain approval from village community for the solar site, sign agreements	Agreement	Project Manager, Village Captain

level	WBS Code	Element Name	Description of Work	Deliverables	Resources
3	1.3.2	Procurement for removal trees	Procurement activities for removal of trees and vegetation and sign contract	Bid request and evaluation documents, signed contracts	Procurement Specialist, Engineers, Project Manager
3	1.3.3	Remove trees and vegetation	Remove trees and vegetation	Cleaned site ready for handover to turnkey contractor	Contractor, Project Manager, Project Engineer
2	1.4	Procurement of solar plant	Procurement activities for procurement of solar plant	Bid request and bid evaluation documents, signed contracts	Project Manager, Procurement Specialist, Engineers
3	1.4.1	Prepare bid documents	Prepare bid documents for procurement of solar plant	Bid request documents	Project Manager, Procurement Specialist, Engineers
3	1.4.2	Organize procurement	Organize procurement for procurement of solar plant	Bid attendance sheets	Project Manager, Procurement Specialist
3	1.4.3	Bid Evaluation & Contract signing	Evaluate Bids from Solar Contractors and sign contracts	bid evaluation documents, signed contracts	Project Manager, Procurement Specialist, Project Sponsor
2	1.5	Turnkey Delivery Solar Plant	Turnkey Delivery of Solar Plant	Solar power plant	Project Manager, Contractor
3	1.5.1	Basic Engineering and Design	Perform Basic Engineering and Design	Basic Engineering and Design documents	Contractor, Project Manager, Engineers
3	1.5.2	Detail Design & Engineering	Perform Detail Design & Engineering	Detail Design & Engineering documents	Contractor, Project Manager, Engineers
3	1.5.3	Site preparation	Preparation Site, backfill	Site ready for installation of solar panel	Contractor, Project Manager, Engineers
3	1.5.4	Fabrication	Fabrication of solar panels and batteries	Fabricated solar panels	Contractor, Manufacturer
3	1.5.5	Ship Solar Panels	Ship Solar Panels to Pokigron and to the site	Solar panels on site	Contractor, Shipping Company
3	1.5.6	Install Solar Panels	Install brackets, install Solar Panels, connect plant to the existing grid	Installed panels and batteries and system connected to the network	Contractor
3	1.5.7	Install batteries	Install batteries	Installed battery system	Contractor
3	1.5.8	Training	Provide Operators and maintenance training	Attendance sheets, Certificates, trained employees	Contractor, EBS employees
3	1.5.9	Test and Commissioning	Test and Commissioning of solar plant	Test and Commissioning reports of solar plant	Project Manager, Contractor, EBS employees from operations, Engineers

8 Scope Baseline

The project scope baseline consists of the approved statement of work, the WBS and the WBS dictionary. Once those documents have been reviewed and approved by the project sponsor, the project manager will use them to establish the scope baseline. The scope baseline will be used to compare the changes to the project to the initial approved situation and can only be changed through the perform integrated change control process.

9 Validate Scope

Validate Scope verifies the deliverables against the original scope and then formally accepts the project deliverables. The deliverables for the Nieuw Aurora project will be formally accepted and signed off/ on by the project manager, the project sponsor and/or the operation department throughout the life cycle of the project.

The Project Manager will verify interim project deliverables against the original scope as defined in the scope statement, WBS and WBS Dictionary. Once the Project Manager verifies that the scope meets the requirements defined in the project plan, the Project manager will prepare a form and present it to the project sponsor. The project sponsor will accept the deliverable by signing a project deliverable acceptance document. After successful completion of the project Test and Commissioning activities, a formal document will be signed by the project manager, EBS operations' manager, the project sponsor and the turnkey contractor. A formal handover document will be signed by the project manager, the project sponsor and EBS operations' manager in order to formally hand the project over to EBS operations and start with the operation of the solar plant.

10 Control Scope

The control scope process is used to monitor the status of the project and product scope and to manage changes to the scope baseline.

The Project Manager and the project team will work together to control the scope of the project and ensure that they perform only the work described in the WBS dictionary and generate the defined deliverables for each WBS element. The Project Manager will oversee the project team and the progression of the project to ensure that this scope control process is followed.

Any project team member can request modifications to the project scope. The project sponsor can request any of the team members to prepare a change request All change requests must be submitted to the Project Manager in the form of a project change request document. The Project Manager will then review the suggested change to the scope of the project. The Project Manager will then either deny the change request if it does not apply to the intent of the project or convene a change control meeting between the project team and Sponsor to review the change request further and perform a high level impact assessment of the change. If the change request receives initial approval from the project Sponsor, the Project Manager will perform a more in depth assessment of the request together with the project team. The change will then again be presented to the project Sponsor. If the project sponsor agrees with the change, the Sponsor must formally accept the change by signing the project change control document. Upon acceptance of the scope change by the Project Sponsor the Project Manager will update all project documents and communicate the scope change to all project team members stakeholders.

4.3 Schedule Management Plan

According to PMI (2017) “Project Schedule Management includes the processes required to manage the timely completion of the project” (p. 173). Figure 7 provides an overview of the project schedule management processes together with their Inputs, Tools and Techniques and Outputs. Those processes are

1. Plan Schedule Management
2. Define Activities
3. Sequence activities
4. Estimate Activity Durations
5. Develop schedule
6. Control Schedule

The Schedule Management Plan for the Nieuw Aurora Project was composed using those processes and can be seen below.

SCHEDULE MANAGEMENT PLAN

24 HOURS SOLAR POWER FOR NIEUW AURORA

SEPTEMBER 02, 2019

Table of Contents

1. Introduction

This document establishes the policies and procedures for planning, developing, managing, executing and controlling the schedule for the “24 hours Solar Power for Nieuw Aurora” project. The project schedule serves several purposes including project planning and communicating, monitoring progress and changes, evaluating time impacts, forecasting and providing a historic record of what happened.

This project is for designing, procuring, installation and testing of a solar power plant that will be used to provide the Nieuw Aurora Village in Suriname with 24 hours per day electricity service. This includes design of the system, procuring the solar system, installation of the solar panels, testing and commissioning of the system, close out of the project and hand over of the project to operations. The solar system will be procured through a turnkey delivery from a solar system provider. Other external resources that will be acquired for this project are resources for the preparation of the solar sites.

2. Plan Schedule Management

The project manager will assume overall responsibility for schedule management.
The several schedule management processes will be integrated and produce the project schedule. MS project software was used to define the activities, sequence them, estimate the duration and as a final step devop the project schedule. Resource availability also plays a critical role in the development of the schedule management plan historical data from the Pokigron project will also be used as an input for this proces. Tools and Techniques that will be used are expert judgment, analysis of data and meetings. Once developed and approved the initial approved project schedule will serve as a baseline for the project and can only be changed through the Integrated Change Control process. The schedule will be reviewed at least twice a month by the project manager together with the project team. MS project allows to keep track of the actual project progress versus the planning and

the project manager will update the schedule prior to the schedule review meeting with the team and take action where/when necessary. It will be the responsibility of the project manager to present and discuss the project schedule to the project sponsor at least once a month.

3. Define Activities

In order to define the activities the scope baseline will be used as an input document. Enterprise environmental factors that will be used are the organizational culture and structure. Organizational process assets are lessons learned from the Pokigron solar project and policies and procedures from the Inter-American Development Bank (IDB). Tools and techniques used are expert judgment, decomposition and meetings. The activity list and milestone lists are outputs from this process and can be seen in the project schedule in figure 17.

4. Sequence activities

Sequence activities identify and document the relationships among the project activities. In order to identify and document the relationships among the project activities the scope baseline will be used as an input document together with the milestone list and the assumption log. Enterprise environmental factors that will be used are the organizational culture and structure. Organizational process assets are lessons learned from the Pokigron solar project and policies and procedures from the Inter-American Development Bank (IDB). Tools and techniques used are expert judgment, decomposition and meetings. The project schedule network diagram, activity list and milestone lists are outputs from this process and can be seen in the project schedule in figure 17.

5. Estimate Activity Durations

For scheduling and planning purposes it is necessary to estimate the activity durations. In order to do so, the scope baseline is used to provide input information. Other documentation that will be used for this project are the activity

list, the assumption log, the milestone list, lessons learned from a previous project the risk register, resource availability, enterprise environmental factors and organizational process assets. Expert judgment and project team meetings combined with analogous and parametric estimating techniques will be used to develop the initial schedule. Once the project once the project is in process, the estimating techniques will be reviewed and adjusted if needed. Since this project is the first project that is carried out by the EBS in which solar panels will be installed in a remote location that only can be reached by small boats, schedule contingency has been built into the project schedule. The duration estimates can be seen in the project schedule in figure 17.

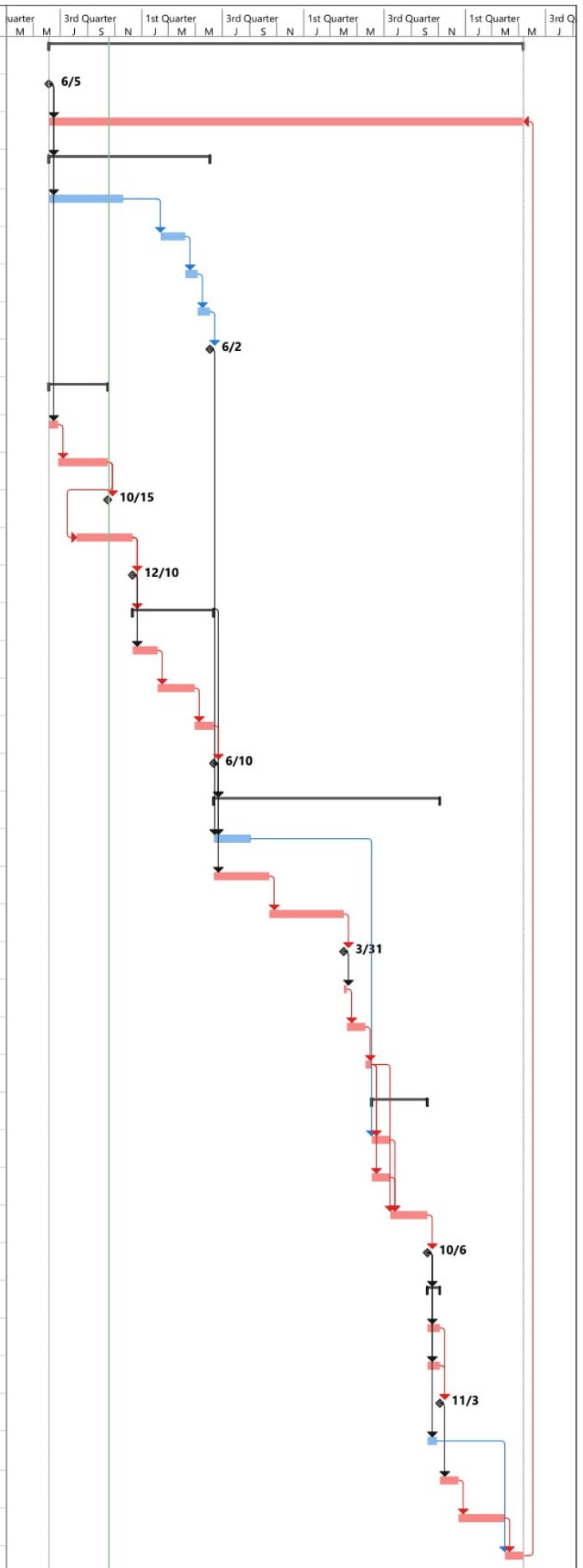
6. Develop schedule

The several schedule management processes have been integrated in the project schedule. MS project software was used to define the activities, sequence them, estimate the duration and as a final step develop the project schedule. Once approved the project schedule also establishes the schedule baseline for the Nieuw Aurora project.

The method of contingency reserve has been used to formulate time reserves for the project.

The project schedule can be seen in figure 17 below.

ID	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		**Nieuw Aurora solar Project**	**766 days**	**Wed 6/5/19**	**Wed 5/11/22**	
2		Project start	0 days	Wed 6/5/19	Wed 6/5/19	
3		Project Management	766 days	Wed 6/5/19	Wed 5/11/22	2,41FF
4		**Preliminary Site Works**	**260 days**	**Wed 6/5/19**	**Tue 6/2/20**	**2**
5		Approvals	120 days	Wed 6/5/19	Tue 11/19/19	2
6		Procurement for removal trees	40 days	Wed 2/12/20	Tue 4/7/20	5FS+60 days
7		mobilization to site	20 days	Wed 4/8/20	Tue 5/5/20	6
8		Remove trees and vegetation	20 days	Wed 5/6/20	Tue 6/2/20	7
9		site ready for handover to solar contractor	0 days	Tue 6/2/20	Tue 6/2/20	8
10		**Site visits and data collection**	**95 days**	**Wed 6/5/19**	**Tue 10/15/19**	
11		mobilization	15 days	Wed 6/5/19	Tue 6/25/19	2
12		Site visits and data collection	80 days	Wed 6/26/19	Tue 10/15/19	11
13		**Site visits and data collection complete**	0 days	Tue 10/15/19	Tue 10/15/19	12
14		Basic Engineering and Design	90 days	Wed 8/7/19	Tue 12/10/19	12FS-50 days
15		Basic Engineering and Design complete	0 days	Tue 12/10/19	Tue 12/10/19	14
16		**Procurement process for turn key delivery of solar plant**	**131 days**	**Wed 12/11/19**	**Wed 6/10/20**	**14**
17		Prepare bid documents	40 days	Wed 12/11/19	Tue 2/4/20	15
18		Organize procurement	60 days	Wed 2/5/20	Tue 4/28/20	17
19		Bid Evaluation & Contract signing	31 days	Wed 4/29/20	Wed 6/10/20	18
20		Contract for delivery of solar plant signed	0 days	Wed 6/10/20	Wed 6/10/20	19
21		**Turn Key Delivery Solar Plant**	**365 days**	**Thu 6/11/20**	**Wed 11/3/21**	**16,20**
22		Preparation Site, backfill	60 days	Thu 6/11/20	Wed 9/2/20	20,9
23		Detail engineering	90 days	Thu 6/11/20	Wed 10/14/20	20
24		Fabrication of solar panels	120 days	Thu 10/15/20	Wed 3/31/21	23
25		Solar panels fabricated	0 days	Wed 3/31/21	Wed 3/31/21	24
26		Factory Acceptance Testing of solar system	5 days	Thu 4/1/21	Wed 4/7/21	25
27		Shipping of solar panels	30 days	Thu 4/8/21	Wed 5/19/21	26
28		Solar panels to site	10 days	Thu 5/20/21	Wed 6/2/21	27
29		**Construction**	**90 days**	**Thu 6/3/21**	**Wed 10/6/21**	
30		Install brackets,	30 days	Thu 6/3/21	Wed 7/14/21	28,22
31		Install batteries	30 days	Thu 6/3/21	Wed 7/14/21	28
32		install Solar Panels, connect plant to the existing grid	60 days	Thu 7/15/21	Wed 10/6/21	28,30,31
33		Construction complete	0 days	Wed 10/6/21	Wed 10/6/21	32
34		**Commissioning**	**20 days**	**Thu 10/7/21**	**Wed 11/3/21**	**33**
35		Commissioning of solar panels	20 days	Thu 10/7/21	Wed 11/3/21	33
36		Commissioning of battery system	20 days	Thu 10/7/21	Wed 11/3/21	33
37		Commissioning complete	0 days	Wed 11/3/21	Wed 11/3/21	36,35
38		O&M Training	15 days	Thu 10/7/21	Wed 10/27/21	33
39		Punchlist Items	30 days	Thu 11/4/21	Wed 12/15/21	37
40		Contingency	75 days	Thu 12/16/21	Wed 3/30/22	39
41		Close out and Handover to operations	30 days	Thu 3/31/22	Wed 5/11/22	40,38



Project: 01 Nw Aurora schedule

Task, Split, Milestone, Summary, Project Summary, Inactive Task, Inactive Milestone, Inactive Summary, Manual Task, Duration-only, Manual Summary Rollup, Manual Summary, Start-only, Finish-only, External Tasks, External Milestone, Deadline, Critical, Critical Split, Progress, Manual Progress

Page 1

Figure 17 Nieuw Aurora Project Schedule (Source: R. Paal, Author of the FGP, Aug 2019)

7. Control Schedule

Control schedule is the process of monitoring the status of the project to update the project schedule and manage changes to the schedule baseline. In order to monitor and control the Nieuw Aurora project schedule and project performance, the variances will be measured by comparing the project actual schedule and status to the schedule baseline. This variance analysis will be done by the project manager. Schedule variance analysis determines the amount by which the project is ahead or behind the planned delivery date and is a measure of the schedule performance on a project. The equations that will be used for performing schedule variance analyses for the Aurora project can be seen below.

Chart 11 Schedule variance analysis overview (Source: R. Paal, Author of the FGP, November 2019)

Schedule variance analysis overview			
Planned Value (PV)	Is the authorized budget assigned to scheduled work		
Earned Value (EV)	Is a measure of work performed in terms of the budget authorized for that work		
Schedule Variance (SV)	Amount by which the project is ahead or behind the planned delivery date on a given point in time		
Schedule Performance Index (SPI)	A measure of schedule efficiency expressed as the ratio of earned value to planed value		
SV = Schedule Variance	SV = EV - PV	SV > 0 SV = 0 SV < 0	The project is ahead of schedule The project is on schedule The project is behind schedule
Schedule Performance Index (SPI)	SPI = EV/PV	SPI > 1 SPI = 1 SPI < 1	The project is ahead of schedule The project is on schedule The project is behind schedule

When the Schedule Performance Index (SPI) is less than one, or the Schedule Variance (SV) is less than zero, less work has been completed than initially planned which means that the project is behind schedule. In that case, the project manager should take corrective actions to bring the project back on schedule. If the project manager cannot bring the project back on schedule, the project sponsor must be informed immediately.

Changes to the schedule baseline will be managed through the perform integrated change control process by the project manager. Work performance information and schedule forecasts must be presented by the project manager to the project sponsor on a monthly basis.

4.4 Cost Management Plan

The cost management plan establishes how the project costs will be planned, structured, and controlled. According to PMI (2017) “Project Cost Management includes the processes involved in planning, estimating, budgeting, financing, funding, managing, and controlling costs so that the project can be completed within the approved budget” (p. 231). Figure 8 provides an overview of the project cost management processes together with their Inputs, Tools and Techniques and Outputs.

Those processes are

1. Plan Cost Management
2. Estimate costs
3. Determine budget
4. Control costs

The Cost Management Plan for the Nieuw Aurora Project was composed using those processes and can be seen below.

COST MANAGEMENT PLAN

24 HOURS SOLAR POWER FOR NIEUW AURORA

SEPTEMBER 12, 2019

Table of Contents

1. Introduction

This Cost Management Plan details how the “24 hours Solar Power for Nieuw Aurora” project cost will be estimated, budgeted and controlled. It clearly defines who is responsible for managing the project’s cost and acts as a guide for determining the project budget and controlling the project costs.

This project is for designing, procuring, Installation and testing of a solar power plant that will be used to provide the Nieuw Aurora Village in Suriname with 24 hours per day electricity service. This includes design of the system, procuring the solar system, Installation of the solar panels, testing and commissioning of the system, close out of the project and hand over of the project to operations. The solar system will be procured through a turnkey delivery from a solar system provider. Other external resources that will be acquired for this project are resources for the preparation of the solar sites.

2. Plan Cost Management

The project manager will be responsible for determining, managing and controlling the project costs and successful completion of the project within the approved project budget.

The project charter, the schedule management plan and risk management plan will be used as input documents. The cost information for this project will be entered in a software program called Quickbooks. Quickbooks will also be used to generate cost data. Microsoft Excel will be used as well to develop templates for progress reporting and data inputting on schedule activities and costs

The project is financed by the European Union in Euros. The exchange rate off the Suriname Dollars is increasing and in order to prevent exchange rate losses only the amount needed for payments in the near future will be converted from Euros to Suriname Dollars. Historical information with financial data from the Pokigron Solar Project will also be used for cost estimating purposes.

The Project Manager and Project Sponsor will establish and approve documentation for monitoring and controlling project scope which includes Earned Value Measurements (EVM). Financial data must be provided by the Financial Specialist on a weekly basis and must be reviewed by the project manager.

3. Roles and Responsibilities

In order to properly manage the costs of the Nieuw Aurora Project, the roles and responsibilities must be clearly defined.

Chart 12 below defines the roles and responsibilities for the cost management of this project.

Chart 12 Project Cost Management Roles and Responsibilities (Source: R. Paal, Author of the FGP, Sep 2019)

Name	Role	Responsibilities
IDB	external stakeholder for overall project management	- Responsible for the overall management of the project. The IDB will approve or deny financial disbursement requests - Evaluate cost change requests
Marcel Eijndhoven	Sponsor	- Approve or deny cost change requests - Evaluate need for cost change requests
Richard Paal	Project Manager	- Completion of the project within the approved budget - Monitor and Control project costs - Initiate cost change requests - Perform impact assessments of cost change requests - Communicate outcomes of cost change requests - Update project documents upon approval of all cost changes
Maitrie Mahabir	Financial Specialist	- Process invoices provided by the project manager - Enter cost information into Quickbooks - Provide cost data to the project manager on a weekly basis

4. Estimate costs

This project is the second solar panel project that is being executed by the EBS therefore very little historical data are available internally. This is also the first time for EBS that a project is being executed in a remote location in the hinterlands that is only reachable by small boats. On top of that, the project is still in the basic design phase. Estimate methodologies used are capacity factored, analogues estimating, expert judgment and parametric estimating. Based upon the above, the contingency reserves percentage is set at 30% to cover estimate uncertainty. The scope baseline is used as input document together with the schedule management plan and the risk management plan to estimate the project costs. Historical information from the Pokigron project will be combined with expert judgment, analogue- and parametric estimating techniques in order to produce the cost estimate for the Nieuw Aurora Project. Microsoft Excel sheets will be used to support the cost estimation process.

The cost baseline for the Aurora project amounts USD 1,339,000.

The cost estimates for the Nieuw Aurora project can be seen in chart 13 below

Chart 13 Project Cost Estimate (Source: R. Paal, Author of the FGP, Nov 2019)

n	Nieuw Aurora solar Project	Cost Estimate [USD]	Basis of Estimate
1	**Project Management**	**43,200**	Average 40 hrs. per month; 30 USD per hr. for 36 months
2	**Preliminary Site Works**		
2.1	Approvals incl. works land surveyor	10,000	historical data from procurement department
2.2	Procurement for removal trees	2,000	100 hrs. @ USD20 per hr. from Proc. Dept.
2.3	mobilization to site	10,000	Estimated lump sum
2.4	Remove trees and vegetation	28,000	Historical data from engineering department
	Subtotal preliminary site works	**50,000**	
3	**Site visits and data collection**		
3.1	mobilization	2,000	Labor hrs. from Project Manager and Engineers
3.2	Site visits and data collection	16,000	site visits costs 4 visits @ USD 4,000 average
	Subtotal visits collection mobilization	**18,000**	
4	**Basic Engineering and Design**	**56,800**	Average 2 engineers; 40 hrs. per month per engineer; at 19USD per hr. for 36 months = 2*40*19*36=54,720 plus 2,080 USD for basic design
5	**Procurement process for turnkey delivery of solar plant**		
5.1	Prepare bid documents	2,000	For admin and proc. specialist
5.2	Organize procurement	6,000	For admin and proc. specialist and financial specialist and advertising
5.3	Bid Evaluation & Contract signing	4,000	For admin, proc. specialist and auditor
	Subtotal Procurement Process	**12,000**	
6	**Turnkey Delivery Solar Plant**		Estimates based upon historical data; expert judgment and internet Research
6.1	Preparation Site, backfill	30,000	Historical data;
6.2	Detail engineering	85,000	Expert judgment
6.3	Solar panels	180,000	Historical data; expert judgment and internet Research

n	Nieuw Aurora solar Project	Cost Estimate [USD]	Basis of Estimate
6.4	Batteries	90,000	Expert judgment
6.5	Factory Acceptance Testing of solar system	30,000	Historical data
6.6	Shipping of panels and batteries to Suriname	60,000	Expert judgment and internet Research
6.7	Solar panels and batteries to site	40,000	Expert judgment and internet Research
6.8	Construction	212,500	Expert judgment
6.9	Connect plant to the existing grid	52,500	Expert judgment
6.10	Commissioning	30,000	Expert judgment
6.11	O&M Training	20,000	Expert judgment
6.12	Punch list Items and Close out	20,000	Expert judgment
	Subtotal turnkey solar plant	**850,000**	
8	**Total Cost Estimate**	**1,030,000**	**= Base cost Estimate**
9	Contingency Reserve (30%)	309,000	
10	**Total Cost Estimate**	**1,339,000**	**= Cost Baseline**

5. Determine budget

The Scope baseline, cost management plan, cost estimates, risk register and project schedule will be used as input documents. Agreements and historical information and lessons learned from the Pokigron Project are also input documents for determining the project budget. Expert judgment and reserve analysis are the most important tools that will be used for the determination of the project budget. An amount of 10% will be added to the cost estimates in order to include management reserve and establish the project budget.

The project budget amounts USD 1,472,900

An overview of the Nieuw Aurora project budget can be seen in chart 14 below

Chart 14 Project Budget (Source: R. Paal, Author of the FGP, Sep 2019)

n	Nieuw Aurora solar Project	Cost Estimate [USD]	
1	**Total Cost Estimate**	1,030,000	**= Base cost Estimate**
2	contingency Reserve (30%)	309,000	
3	**Total**	1,339,000	**= Cost Baseline**
4	management reserve (10%)	133,900	
5	**Total**	**1,472,900**	**= Project Budget**

6. Control costs

In order to control the costs of the project, it is necessary to monitor the status of the project, update the project cost and manage changes to the cost baseline.

If changes to the cost baseline are considered necessary, the cost change requests must be prepared by the Project Manager and submitted to the Project Sponsor for acceptance. Changes to the cost baseline will be managed through the perform integrated change control process. Upon approval of cost change request by the Project Sponsor, the Project Manager will update all project documents and communicate the cost change to all relevant stakeholders. The project cost status, together with work performance information and cost forecasts must be presented to the project sponsor and other key stakeholders by the project manager on a monthly basis.

In order to analyze project cost performance, the project manager will perform cost analysis according to chart 15 below:

Chart 15 Cost variance analysis overview (Source: R. Paal, Author of the FGP, November 2019)

Cost variance analysis overview			
Planned Value (PV)	Is the authorized budget assigned to scheduled work		
Earned Value (EV)	Is a measure of work performed in terms of the budget authorized for that work		
Actual Cost (AC)	Is the actual cost of the work completed		
Estimate At Completion (EAC)	Actual cost for the work completed plus estimate to complete the remaining work		
Estimate To Complete (ETC)	The expected cost to finish all the remaining work		
Cost Performance Index (CPI)	A measure of the cost efficiency of budgeted resources expressed as a ratio of earned value to actual cost		
CV = Cost Variance	CV = EV - AC	CV > 0 CV = 0 CV < 0	Cost underrun for work completed The costs are according to plan Cost overrun for work completed
Cost Performance Index (CPI)	CPI = EV/AC	CPI > 1 CPI = 1 CPI < 1	Cost underrun for work completed The Costs are according to plan Cost overrun for work completed
Estimate At Completion (EAC)	EAC = AC + ETC		

When the Cost Performance Index (CPI) is less than one, or the Cost Variance (CV) is less than zero, this means that there is a cost overrun. The project manager should then take corrective actions to bring the project back within budget. If the project manager cannot do so, the project sponsor must be informed immediately. If the forecast shows that the project cost baseline will be exceeded, the project manager must inform the project sponsor immediately in order to determine the way forward.

4.5 Quality Management Plan

According to PMI (2017), the quality management plan establishes how an organization's quality policies, methodologies, and standards will be implemented in the project. It includes the processes for incorporating the organization's quality policy regarding planning, managing and controlling of project and product quality requirements that will take place.

Figure 9 provides an overview of the project quality management processes together with their Inputs, Tools and Techniques and Outputs.

The quality management processes are:

1. Plan Quality Management
2. Manage Quality
3. Control Quality

The quality management processes that will be used to develop the Quality Management Plan for the Aurora Project can be found below.

QUALITY MANAGEMENT PLAN

24 HOURS SOLAR POWER FOR NIEUW AURORA

SEPTEMBER 09, 2019

Table of Contents

1. Introduction

This document establishes the policies and procedures to Plan, Manage and Control the quality of the Project “24 hours Solar Power for Nieuw Aurora”.

This project is for designing, procuring, installation and testing of a solar power plant that will be used to provide the Nieuw Aurora Village in Suriname with 24 hours per day electricity service. This includes design of the system, procuring the solar system, installation of the solar panels, testing and commissioning of the system, close out of the project and hand over of the project to operations. The solar system will be procured through a turnkey delivery from a solar system provider. Other external resources that will be acquired for this project are resources for the preparation of the solar sites.

2. Plan Quality Management

Plan Quality Management is concerned with the quality that the work needs to have. Documents that will be used as input documents are the Project Charter, enterprise environmental factors and quality check sheets. Together with the project requirements from chart 8, Quality Factors, Quality Metrics and Quality Activities shall be defined for the Nieuw Aurora project. Tools and techniques that will be used for this process are expert judgment and meetings.

3. Key Factors related to Quality

The key quality factors for the Nieuw Aurora Project can be seen in chart 16 below. It will be the responsibility of the project manager to ensure that the key quality factors, as defined below are in place.

Chart 16 Key Quality factors Nieuw Aurora Project (Source: R. Paal, Author of the FGP, Sep 2019)

Factor	Factor Definition	Quality Objective
Specifications, codes and standards	All the components for the solar system, such as PV panels, charge controller, inverter, storage battery, cables, circuit breakers, junction boxes, etc., shall conform to the technical specifications /requirements and quality standards specified by the electricity company All the components for the electricity hardware and system such as cables, junction boxes circuit breakers, etc., shall conform to the technical specifications /requirements and quality standards specified by the electricity company	Delivery of a solar system and electricity system that is according to standard and customers' expectation
Project team	Skilled and well trained team with required competencies	Delivery of a system that has the expected requirements and specifications such as capacity, lifetime, etc…
Stakeholder engagement, participation and communication	Engage stakeholders through different activities such as meetings, visits to the community	Collect requirements from the client, the beneficiaries. This will also create support for the project, Improve acceptance and built ownership.
Organizational chart	Develop an organizational chart with clear roles and responsibilities, reporting structure, communication and escalation path	Assignment of tasks for the project will be easier. Create an environment that provides clear direction for the team
Processes	Document the processes that must be followed during execution of the project with review gates, deliverables and approval routing matrix.	Having a documented process flow will make it easier and clear for the team how to do their job. The approval routing with review gates will also enforce the team to follow the process thus increasing quality assurance
Resources	Resources such as funding, skilled human resources, materials and equipment	Deliver the project according to the requirements and specifications
Documentation	Develop and maintain proper project documentation e.g. Design documentation, Standards, meeting minutes, project status reports, lessons learned etc.	Allows the project manager to monitor and control the project, report to top management, enhance the company database

4. Quality Metrics

Below in chart 17, the metrics that will be used to determine the degree of conformance to specifications for the Nieuw Aurora Project, have been described.

Chart 17 Quality Metrics Nieuw Aurora Project (Source: R. Paal, Author of the FGP, Sep 2019)

Factor	Metric definition	Expected outcome/result	Measurement frequency	Responsible
Specifications, codes and standards	Capacity of 180 kWp of the solar system	Solar panels installed with a capacity of 180 kWp	Once during test and commissioning	The project engineer
Specifications, codes and standards	Battery backup system of 3 days	A battery backup system that lasts at least 24 hrs.	Once during test and commissioning	The project engineer
Specifications, codes and standards	Efficiency of the panels ≥ 18%	Solar system installed with an efficiency ≥ 18%	Once during test and commissioning	The project engineer
Processes	100% of the formal project documentation such as drawings, for construction documents must be approved by the designated signatories	100% signed documentation	Throughout project execution	The project Manager
Companies internal best practices and standards	The project must be completed within the budget, schedule, or scope.	Project is completed within budget, schedule and scope	This is measured after project completion but the project manager must constantly measure and monitor those parameters in order to take action when needed	The project manager
Project team	The project team must consists of skilled engineers and specialists	Project team with Renewable energy engineer, Electrical Engineer, Procurement- and Financial specialist	At the beginning phases of the project	The project manager

5. Quality Activities Matrix

In order to guarantee the quality of the project, quality activities for the Aurora Project have been defined in chart 18. Those activities will be carried out by the project team at certain points in time, but the accountability of executing the quality activities is with the project manager.

Chart 18 Quality Activities Nieuw Aurora Project (Source: R. Paal, Author of the FGP, Sep 2019)

Deliverable	Requirement	Manage and Control activities	Frequency/ Responsible
Design documents up to codes, standards and requirements	Approved design docs will contribute to fulfilling of all of the requirements such as capacity, reliability, compliance etc.	Manage: having a skilled team to make or review the design and have defined workflows and codes	ongoing throughout the project /The project manager
		Control: sign off by subject matter expert	Once, after completion of the designs/ Subject Matter Expert
Signed acceptance form for accepting the solar plant site	Will ensure that the solar plant site is according to the requirements	Manage: Develop a requirements sheet for the solar plant site and perform a conformance walk through	Once prior to obtaining the solar plant site/Project Manager.
		Control: Sign a site acceptance form when the site is handed over to the turnkey contractor	Once, after the turnkey solar plant contractor inspects the solar plant site/Project Manager
Trainings manual for operation and maintenance	A good manual will be the basis for development of skilled workers	Manage: Having a manual delivered by the turnkey contractor	At the beginning of the execution phase/Project Manager
		Control: sign off on the final manual by the project manager and subject matter expert	Sign off once after completion of the manual/ Subject Matter Expert and project manager
Certificates for trained maintenance personnel and operators	Certifications for employees will be used to demonstrate that required skills have been obtained	Manage: Ensure that training is included in the contract for the delivery of the solar plant	Once during the development of the bid documents/Project Manager and Procurement Specialist

Deliverable	Requirement	Manage and Control activities	Frequency/ Responsible
		Control: Training attendance lists, Reports of training provided	After each training session/ Project Manager
Inspection and Test & commissioning reports	Will contribute to fulfilling of all of the requirements such as capacity, lifetime, etc.	Manage: Develop or request test and comm. documents, perform inspections during construction	Develop or request test and comm. docs during quality planning while updating as required. Inspections to be performed regularly during construction/ The project team and the project manager
		Control: collecting Test and commissioning and construction inspection data	Ongoing inspections during construction and at project completion/ The project team and the project manager
process flow with a review and approval points	Will contribute to the processes that must be followed during project execution thus contributing to the overall quality of the project	Manage: Develop a workflow and an approval matrix for each formal document (where applicable) with status and signatures (e.g. for quotation, basic design, for construction, as built etc.)	Develop the process flow at the project start and update when necessary during execution as part of the quality improvement process / Project Manager
		Control: enforce that the approved flow is used and only approved documentation is used as input for the next process	Once when the flow is developed and update when it is approved / Project Manager
Project close out documentation	Project close out meetings with project metrics review (scope, schedule, cost, performance, safety)	Manage: Develop during project planning and management	Once during planning while updating when required / Project Manager
		Control: Fill in project close out documentation after project completion	Once at project completion/ Project Manager

6. Control Quality

Control Quality will monitor and record the results of the execution of the quality management activities in order to assess performance and to ensure that the project meet customer expectations. As part of the Project Quality Control, check sheets will be used to document if the components for the solar systems, such as PV panels, charge controller, inverter, storage battery, cables, circuit breakers, junction boxes etc. conform to the technical specifications, requirements and quality standards specified or approved by the electricity company.

The same applies to all the components for the electricity hardware and system such as cables, outlets, junction boxes, circuit breakers etc.

Quality control will take place throughout the project when needed but especially during the test and commissioning phases of the project there will be a strong emphasis on quality control activities.

4.6 Resource Management Plan

According to PMI (2017) “Project Resource Management includes the processes required to identify, acquire, and manage the resources needed for the successful completion of the project” (p. 307). Figure 10 provides an overview of the project resource management processes together with their Inputs, Tools and Techniques and Outputs. Those processes are

1. Plan Resource Management
2. Estimate Activity Resources
3. Acquire Resources
4. Develop Team
5. Manage Team
6. Control Resources

The Resource Management Plan for the Nieuw Aurora Project was composed using those processes and can be seen below.

RESOURCE MANAGEMENT PLAN

24 HOURS SOLAR POWER FOR NIEUW AURORA

SEPTEMBER 15, 2019

Table of Contents

1. Introduction

The purpose of this document is to provide a Resource Management Plan that will provide guidance on how to identify, acquire and manage the resources needed for the successful completion of the Aurora Project. This document will help to ensure that the right resources will be available to the project at the right time and the right place in order to successful complete the project.

Nieuw Aurora is an isolated village in the interior of Suriname, approximately 220 km away from the capital city. The village is not connected to the national electricity grid and currently receives only 4 hours electricity service per day, from 7:00 PM to 11:00 PM from diesel generators. This limited electricity supply is hampering the development of the village community and therefore the government of Suriname has decided to implement a project in which Nieuw Aurora will receive 24 hours electricity service per day, through the usage of solar power. This project is for designing, procuring, installation and testing of a solar power plant that will be used to provide the Nieuw Aurora Village in Suriname with 24 hours per day electricity service. This includes design of the system, procuring the solar system, installation of the solar panels, testing and commissioning of the system, closing out of the project and handing over of the project to operations. The solar system will be procured through a turnkey delivery from a solar system provider. Other external resources that will be acquired for this project are resources for the preparation of the solar sites.

2. Plan Resource Management

In order to develop the Resource Management Plan we also need the Project Organization Structure. The organizational structure of the Aurora Project is depicted below in figure 18.

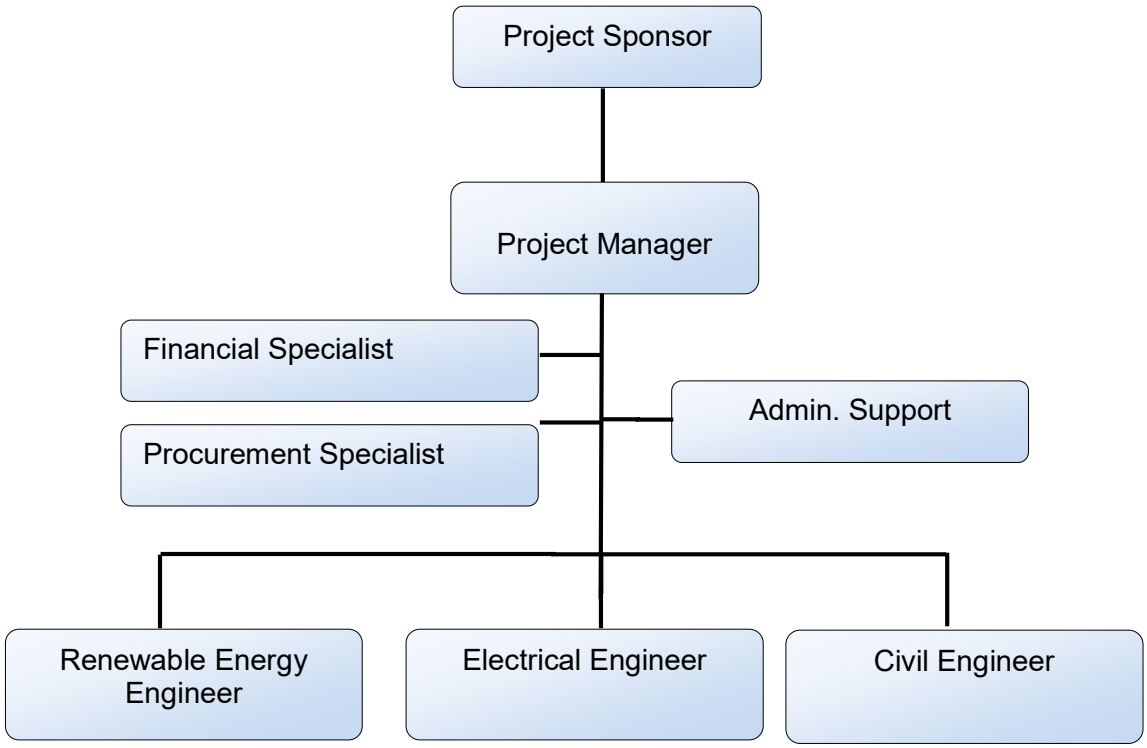


Figure 18 Nieuw Aurora Project Organizational structure (Source: R. Paal, Author of the FGP, Sep 2019)

Based upon the project organizational structure and the stakeholders identified in the Project Charter, the roles and responsibilities of the project team members and stakeholders responsible for the identification, planning, acquiring, and managing of the resources has been depicted in chart 19 below.

Chart 19 Resource Management Roles, Responsibilities, Authority and Competencies (Source: R. Paal, Author of the FGP, Nov 2019)

Role	Responsibilities	Authority	Competencies
Sponsor	For this project, the CTO from EBS is the project sponsor. The sponsor is accountable for enabling success	The project sponsor must be at the executive level The sponsor provides resources and support for the project. and will approve or deny resource change requests and accept project deliverables	Has excellent leadership and negotiation skills. Has strategic and business management skills. Must be able to make go/no go decisions. Must have at least some project management knowledge
Project manager	The project manager is the person ultimately responsible for the successful completion of the project. As such the project manager will measure and verify the project resources against project progress, prepare resource change requests, facilitate impact assessments of resource change requests, organize and facilitate scheduled change control meetings, communicate outcomes of resource change requests, Update project documents upon approval of all scope changes, Review and final approve invoices	The project manager will have the full authority over the project resources within the project constraints such as scope schedule and budget. The project manager will have the authority to approve the final project documents such as the engineering documents, bid request documents, bid evaluation documents and invoices. The project manager will also have the authority to sign off on the completed project deliverables	Behaves ethically and with integrity. He or she must have superior leadership - and relationship skills. Must have excellent project management skills and effective communication skills. Must also have knowledge of and expertise in the electric utility sector and the electric utility company. Must have strong organizational skills and must be able to manage the project risks
Engineers	The team of project engineers consists of subject matter experts and is responsible for the basic engineering and design of the solar	The engineers will sign of on technical documentation delivered by the contractor, review and approve design documentation from the	Must have strong analytical skills and good engineering and design skills. Must be able to work as a team member in the project

Role	Responsibilities	Authority	Competencies
	systems. The engineers will also measure and verify project resources against project progress, participate in impact assessments of resource change requests, and collaborate with the project manager to determine the resources required for the project	project designers. The engineers will also initially approve documents such as invoices and resource change requests from the contractors and submit them to the project manager for approval	execution team and collaborate with other team members. Must have a strong drive for achievement. Must have in depth knowledge of regulations, codes and standards related to renewable energy systems. Must be familiar with safety rules and standards in the electric utility and the renewable energy sector
Procurement specialist	The procurement specialist is responsible for preparing the bid requests based upon the technical documentation received from the project engineers. He or she is also responsible for organizing bid requests and bid openings and supporting of bid evaluations. The specialist will also review and further process invoices sent to him or her by the project manager	The procurement specialist will have a supporting role and has little to no authority when it comes to project related matters	Behaves ethically and with integrity. Has at least basic knowledge of project management principles. Has strong negotiation and relationship management skills. Must be familiar with procurement policies and guidelines of international funding institutions
Financial Specialist	The financial specialist is responsible for all aspect related to cost reporting and cost control. As such the financial specialist will set up the charge accounts, review and further process invoices sent o him or her by the procurement specialist, facilitate payments to contractors as required, provide financial data to the project	The financial specialist will have a supporting role and has little to no authority when it comes to project related matters	Must have accounting skills and must be familiar with basic project management principles. Must have good interpersonal skills and must be able to work with the team as one of the team members. Must have strong analytical skills and attention for detail

Role	Responsibilities	Authority	Competencies
	manager at least twice a month and provide support during project close out		
Contractors	For (turnkey) contractors this project provides a business opportunity. They will be responsible for the delivery of good quality equipment, materials and personnel. Also for a timely delivery of the various services and materials and equipment	The contractors have to execute the contract according to the contractual terms and conditions. Changes to the scope of work must be agreed upon and approved in writing by the EBS	Must be skilled in the execution of solar energy projects. Must have the ability to communicate, work and collaborate with EBS and other contractors. Must have excellent planning, scheduling and organizing skills. Must have good people management skills. Must behave ethically and with integrity
EBS Operations and Maintenance team	EBS personnel will support during test and commissioning and will receive training to maintain and operate the project after installation of the solar system. EBS personnel will also be responsible for keeping the project materials and equipment in good condition and must be available for the training as required.	The EBS Operations and Maintenance team will have a supporting role and has little to no authority when it comes to project related matters	Must be familiar with and skilled in the operation and maintenance of electrical equipment. Must have a good understanding of technical systems used in the electrical utility sector. Must have hands on knowledge of electrical safety

RACI Chart

In order to provide a clear understanding within the team regarding roles and responsibilities of the team members and other stakeholders, the RACI (Responsible, Accountable, Consult, Inform) Chart was developed. The RACI Chart provides an overview of who is responsible or accountable for which of the activities. The chart also indicates who can be consulted with respect to an activity and who should be informed of the activity.

Chart 20 RACI Chart (Source: R. Paal, Author of the FGP, Sep 2019)

Activity	**Sponsor**	**Project manager**	**Engineers**	**procurement**	**Financial Specialist**	**Contractors**	**Admin Assistant**	**EBS O&M team**
Engineer & Design	I	A	R	I	I	C	I	I
Prepare bid packages and Organize procurement	C	A	I	R	I	I	I	I
Install Solar panels and Systems	I	C	A	I	I	R	I	I
Train EBS team	C	A	I	I	I	R	I	R
Perform Commissioning	C	A/R	R	I	I	R	I	R
Close project	C/I	A/R	R	C	C	I	R	I

R=responsible; A=accountable; C=consult; I=inform

3. Estimate activities resources

Identification of resources

The most important resources identified for this project can be seen in chart 21.

Chart 21 Nieuw Aurora Project Resources overview (Source: R. Paal, Author of the FGP, Sep 2019)

n	Description	UoM	Amount	Estimating method
1	**Contracting**			
	Turnkey delivery solar plant by contractor (Solar system; panels, batteries, inverters and cables, poles, to connect the solar system to the grid)	Lot	1	Analogous; historical data, expert Judgment
	Contractor for cleaning of the solar panels site	Lot	1	Analogous; historical data, expert judgment
2	**Human Resources**			
	Engineers (Electric, Civil, RET Engineer)	Ea.	3	Analogous; historical data, expert judgment
	Project Manager	Ea.	1	Analogous; historical data, expert judgment
	Project Support team (Procurement Specialist, Financial Specialist, administrative assistant)	Ea.	3	Analogous; historical data
	EBS operations and Maintenance team	Ea.	8	Analogous; historical data, expert judgment
3	**Transportation**			
	boat transportation	lot	1	Analogous; historical data and parametric

Project Resource Histogram

The project work is scheduled to be completed within 36 months. Based upon the project schedule and the roles and responsibilities, a chart depicting the EBS resources required for the project was composed. This chart can be seen in chart 22 below.

Chart 22 Project Resource overview (Source: R. Paal, Author of the FGP, Sep 2019)

Description	Q2 2019	Q3 2019	Q4 2019	Q1 2020	Q2 2020	Q3 2020	Q4 2020	Q1 2021	Q2 2021	Q3 2021	Q4 2021	Q1 2022	Q2 2022
Electric Engineer	1	1	1	1	1	1	1	1	1	1	1	1	
Civil engineer			1	1	1		1		1		1		
RET engineer	1	1	1	1	1	1	1	1	1	1	1	1	
Project Manager	1	1	1	1	1	1	1	1	1	1	1	1	1
Procurement specialist			1	1	1							1	
Financial specialist		1	1	1	1	1	1	1	1	1	1	1	
Admin assistant	1	1	1	1	1	1	1	1	1	1	1	1	1
EBS O&M team									8	8	8		

The resource histogram from figure 19 below provides a clear overview of the amount of human resources the project will require each month during the execution period of the project.

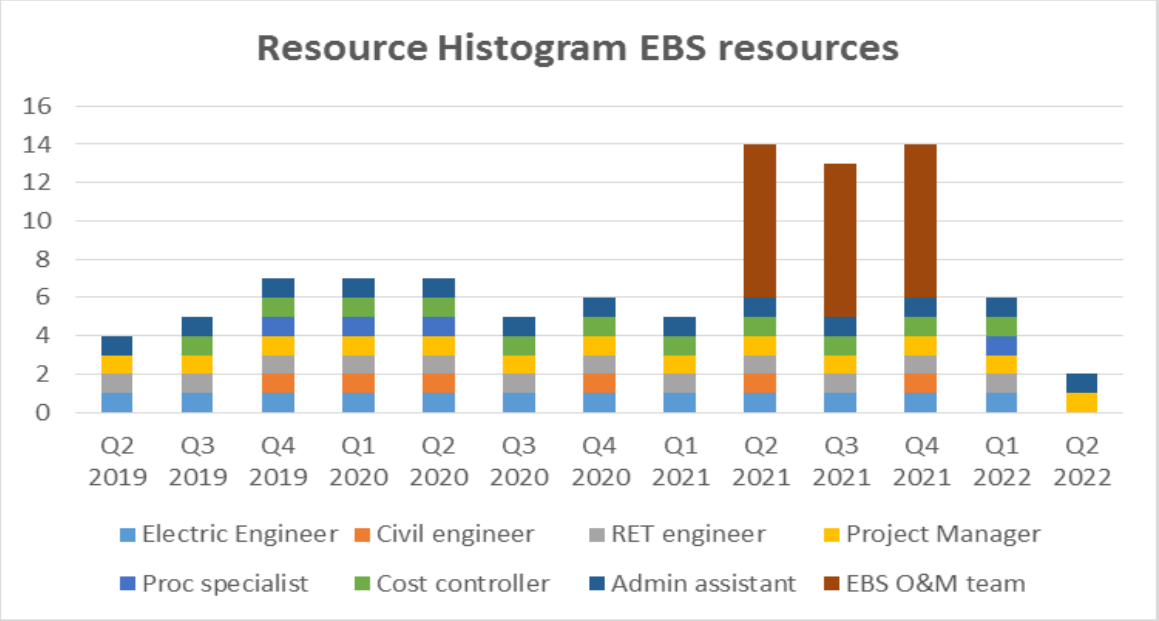


Figure 19 Nieuw Aurora Project Histogram (Source: R. Paal, Author of the FGP, Sep 2019)

4. Acquire resources

Acquire resources is the process of obtaining team members, facilities, equipment, materials, supplies and other resources necessary to complete the project. In the chapters above, the resources necessary to successfully execute the 24 hours solar power for Aurora project have been identified and estimated. The next step will be to determine what the approach will be to acquire these resources.

Human Resources - The project manager will collaborate with the engineering manager to put the project team together and they will select EBS personnel based on a ranking of 1-5 based on the following criteria:

- Experience - how much does the person match the experience requirement for that skill? 1-no match, 5-matches perfectly
- Knowledge - how much does the person's education match the knowledge requirement? 1-no match, 5-matches perfectly

- Skills - does the person have the skills required for the job? 1-does not possess at all, 5-possess skills fully
- Availability - Will the person be available to start as required? 1-cannot start within time frame, 5-can start on the start date

Each person must obtain at least the minimum scores depicted in chart 23 below. The person with the highest total score will be selected to be part of the project team.

If the person cannot start on the date required as per project schedule, the project manager must enter into negotiations with the department head and try to have the resource available as required.

Chart 23 Human Resources minimum score requirements (Source: R. Paal, Author of the FGP, Sep 2019)

Descrpition	Experience	Knowledge	Skills	Availability
RET Engineer	4	4	4	4
Engineers	4	4	4	4
Support team incl. admin	3	3	3	4

Physical Resources

Physical resources will be acquired through the IDB's procurement process which is a contractual requirement for the procurement of goods and services for the Aurora project.

Tendering for this project is broken down into two groups –

1. Tendering for the cleaning of the solar site
2. Tendering for the turnkey delivery of the solar panel system

Develop team

The develop project team process intent is to improve the competencies of team members through training and enhance the interactions of team members through team-building.

To develop the team, the project manager will:

- Communicate roles, responsibilities, expectations, and project objectives to the team and work with the team members to fulfill or accomplish them
- Delegate tasks and allocate resources to help the team achieve its goals and objectives.
- Encourage teamwork and foster commitment and ownership among team members through meetings and workshops
- Monitor and evaluate team progress and performance in achieving its goals and objectives
- Communicate feedback to the team using the most suitable means and provide recommendations to improve its performance
- Allow time out for professional development opportunities
- Respond to conflicts in a professional and positive manner

Training and development of team members

In developing the project team, it is important to acknowledge that team members will need training to be able to fulfill the roles and responsibilities or in order to improve performance.

Different trainings and workshops will be provided and organized by the IDB, such as:

Procurement training

Project Management training

Planning workshops

Financial training

6 Manage team

The project manager will track team member performance, provide feedback to the team members and resolve issues to optimize project performance. The project manager will escalate issues beyond his or her control to the project sponsor.

7. Control resources

Once this project enters into the execution phase, it will require close monitoring and control in order to successfully complete the project within the project constraints. The Control resources process is concerned with the physical resources of the project.

Close monitoring and control can be obtained by using project documents, such as the resource histogram, the cost baseline, the project schedule and the RACI chart as input documents and comparing them to the project plans.

The following analysis must be performed by the project manager in order to control the project resources:

1. Alternatives analysis: can be used to select the best resolution for correcting resource variances.
2. Cost-benefit analysis: will help to determine the best corrective action when there are project resource deviations
3. Performance reviews: to compare and analyze resource utilization
4. Trend analysis: will be used to determine the resource needed in the future
5. Quickbooks: will provide cost data that must be further analyzed by the project manager

Change requests can be submitted by the project team members or the contractors to the project manager. The project manager may prepare or review a change requests, analyze it and submit the request to the project sponsor for final approval through the perform integrated change control process. If the change is approved this will be communicated by the project manager to all relevant stakeholders.

4.7 Communications Management Plan

According to PMI (2017) “Project Communications Management includes the processes necessary to ensure that the information needs of the project and its stakeholders are met through development of artifacts and implementation of activities designed to achieve effective information exchange” (p. 359).

In figure 11, the processes for the Project Communications Management are depicted together with their Inputs, Tools and Techniques, and Outputs.
The project Communications Management processes are:

1. Plan Communications Management
2. Manage Communications
3. Monitor Communications

The Communications Management Plan for the Aurora project was developed by using the processes above and combining them with a free template retrieved from the Project Management Docs website (August 25, 2019).

COMMUNICATIONS MANAGEMENT PLAN

24 HOURS SOLAR POWER FOR NIEUW AURORA

SEPTEMBER 15, 2019

Table of Contents

1. Introduction

This Communications Management Plan can be used to identify, establish and manage the communication needed for the successful completion of the Aurora Project. The plan will serve as a guide for communications throughout the life cycle of the project and will be updated as communication needs change. This plan identifies and defines the roles of team members and stakeholders involved in the communications of this project. It also includes a Stakeholders Engagement Assessment Matrix that shows the gaps between the current and desired level of engagement of the stakeholders, and a stakeholders communications matrix which maps the communication requirements of this project.

Nieuw Aurora is an isolated village in the interior of Suriname, approximately 220 km away from the capital city. The village is not connected to the national electricity grid and currently receives only 4 hours electricity service per day, from 7:00 PM to 11:00 PM from diesel generators. This limited electricity supply is hampering the development of the village community and therefore the government of Suriname decided to implement a project in which Nieuw Aurora will receive 24 hours electricity service per day, through the usage of solar power. This project is for designing, procuring, installation and testing of a solar power plant that will be used to provide the Nieuw Aurora Village in Suriname with 24 hours per day electricity service. This includes design of the system, procuring the solar system, installation of the solar panels, testing and commissioning of the system, closing out of the project and handing over of the project to operations. The solar system will be procured through a turnkey delivery from a solar system provider. Other external resources that will be acquired for this project are resources for the preparation of the solar sites.

2. Plan Communications Management

The Project Manager will fulfill a proactive role in ensuring effective communications on this project. The communications requirements are documented in the Communications Matrix presented in this document. The Communications Matrix will be used as the guide for what information to communicate, who is to do the communicating, when to communicate it and to whom to communicate.

As part of identifying the project stakeholders communication requirements, the stakeholders roles and responsibilities have been mapped below in chart 24.

Chart 24 Plan Communications Management Roles and Responsibilities (Source: R. Paal, Author of the FGP, Sep 2019)

Role	Responsibilities
The government of Suriname	The Government of Suriname (GoS) received parallel financing (a grant) from the European Union for the execution of this project. The GoS is not directly involved in the execution of the project. In this project, the aim of the Government is to bring good quality electricity to the community on a 24 hours per day basis. The GoS must receive project updates at least twice a year from EBS and must have meetings at least twice a year with the EU regarding the project.
Funding institution (The European Union)	The European Union provided parallel financing (a grant) for this project but is not directly involved in the execution of the project. It will be the responsibility of the EU to provide funding for this project in a timely fashion and to put measures in place to ensure that this project is successfully completed. The EU must receive project updates at least twice a year from EBS and must have meetings at least twice a year with the EU regarding the project.
IDB (overall project management)	IDB is an external stakeholder responsible for the overall project management. As such, the IDB requires several plans and reports to be provided to them throughout the lifetime of the project. Those plans are semi-annual reports, annual

Role	Responsibilities
	operating plans, procurement plans. The IDB will also meet with the project sponsor and the project manager on a regular basis but at least once a month to discuss detail project status and progress
Sponsor	For this project, the CTO from EBS is assigned to be the project sponsor. The sponsor provides resources and support for the project. He also ensures continuity of sponsorship and is accountable for enabling success. The Project Sponsor is at the executive level so communications should be presented in summary format unless the Project Sponsor requests more detailed communications.
Project manager	The project manager is the person ultimately responsible for the successful completion of the project. As such the project manager will take a proactive role in ensuring effective communications on this project, prepare project status reports and distribute to all relevant stakeholders, review, manage and implement the Communications Management Plan, communicate outcomes of change requests to the project team, organize weekly team meetings and escalate issues beyond his or her control to the project sponsor. The project manager will be accountable for the storage and distribution of project information and will be responsible for adding project information to EBS database.
Engineers	This team of project engineers consists of subject matter experts and is responsible for the basic engineering and design of the solar systems and the engineering and design of the balance of the project. The team requires a detailed level of communications which must be achieved through day to day interactions with the Project Manager and other team members along with weekly team meetings.
Procurement specialist	The procurement specialist is responsible for preparing the bid requests and organizing bid openings and support bid evaluations The specialist must be included and updated on the communications as required. The project manager will be responsible for including and updating the procurements specialist in the communications. The procurement specialist will be responsible for communications with potential bidders. Invitations to bidders must be posted on EBS website, the UNDP website and or local newspapers and this must be

Role	Responsibilities
	coordinated by the procurement specialist
Financial Specialist	The financial specialist is responsible for all aspect related to cost reporting and cost control. As such the financial specialist will provide financial data to the project manager at least twice a month.
The administrative assistant	The administrative assistant will provide administrative support to the project team especially to the project manager. As such this person will write the meeting minutes and present them to the project manager for approval. Upon clear instructions from the project manager, this person will be responsible for the storage and distribution of project information.
Contractors	For (turnkey) contractors this project provides a business opportunity. They will be responsible for the delivery of good quality equipment, materials and personnel. They will also be responsible for the timely delivery of the various services, materials and equipment. The contractors will be invited to provide bids for project works. During the procurement phase of the project communications will be limited to communications with the procurement department. After bid evaluation and if the contractor is selected for contract negotiations, communications will expand and include communications with the project manager and the engineers as well. During contract execution detail formal communication guidelines will be provided to the contractor.
EBS Operations and Maintenance team	EBS personnel will support during test and commissioning and will be trained to maintain and operate the project after installation of the solar system EBS employees will be involved in project communications in a timely fashion by the project manager and have the obligation to escalate issues to the project engineers or the project manager where applicable.

Stakeholder Engagement Assessment

The Stakeholder Engagement Assessment matrix in chart 25 identifies gaps between the current (C) and desired (D) level of engagement of the stakeholders. The results of the analysis will help to determine additional communications measures and close engagement gaps.

Chart 25 Stakeholder Engagement Assessment matrix (Source: R. Paal, Author of the FGP, Sep 2019)

	Stakeholder	Unaware	Resistant	Neutral	Supportive	Leading
1	GoS				C D	
2	EU				C D	
3	IDB					C D
4	Sponsor					C D
5	Project manager					C D
6	Project team					C D
7	Contractors	C				D
8	EBS Operations and Maintenance team			C		D

Unaware = unaware of the project and the potential impacts
Resistant = aware of the project and potential impacts but resistant to changes that may occur and therefore not supportive
Neutral = aware of the project but not supportive or unsupportive
Supportive = aware of the project and potential impacts and supportive of the work
Leading = aware of the project and potential impacts and actively engaged in ensuring that the project is a success.
C =current
D = Desired

The results from the Stakeholder Engagement Assessment matrix show that the contractors are unaware of the Aurora Project. The procurement department will collaborate with the project manager and engage with the contractors to bring awareness with respect to the project by means of emailing, telephone conversation, conference calls and presentations. This will be done in order to get them to a leading level of engagement, which will contribute to project's success.

The matrix also shows that the desired level of engagement of EBS operations- and maintenance employees is currently neutral. It will be the responsibility of the project manager to engage with the employees and change their engagement level from neutral to leading in order to enhance project's success.

Communication Matrix

Chart 26 identifies the communications requirements for this project. In this chart we can see the stakeholders, the required communication, the reason why the information is needed, the person responsible for the communications and the methods and technologies used for the communications.

Chart 26 Communications Matrix (Source: R. Paal, Author of the FGP, Sep 2019)

Stakeholder needs, requirements & expectations)	Required communication (language, format, level of detail, content)	Why is the information needed	Timeframe and frequency	Person responsible	Methods or technologies used
The GoS: the GoS received a grant for the execution of this project and aims to bring 24 hours per day electricity service to the community.	The GoS must receive detail project status reports in English or in Dutch twice a year. Face to face meetings will also be conducted with EBS, IDB and the GoS at least twice a year	The GoS must be kept informed in order to take decisions at a high level and release the financial resources to EBS for project execution	Project status reports will be provided twice a year. Face to face meetings with EBS, IDB and the GoS will be conducted at least twice a year	The project manager and the project sponsor	Detail Project Status- and progress Reports, Semi Annual reports, Presentations.
The EU: this is an external stakeholder that wants the project to be completed successfully and in a timely fashion.	The EU must receive detail project status reports in English, twice a year. Face to face meetings will also be conducted with EBS, IDB and the GoS at least twice a year	The EU is the funding institution so they need to be informed properly in order to continue financing for this project	Project status reports will be provided twice a year. Face to face meetings with EBS, IDB and the GoS will be conducted at least twice a year	The project manager	Detail Project Status- and progress Reports, Semi Annual reports, Presentations.
IDB: This is an external stakeholder that expects the project to be successfully completed	Information regarding the project status and progress, project timeline, estimate to complete, risks etc.. In English language	The IDB is responsible for the overall project management so this stakeholder must be informed in order to provide support and guidance	Reports must be provided once a month. Presentations will be provided on a quarterly basis. Meetings, Emails and telephone calls will be sent and held as required	The project Manager	Detail Project Status- and progress Reports, Semi Annual reports, Presentations, emails, Telephone calls, MoM
Sponsor: This stakeholder expects the project to be successfully completed in order to obtain strategic goals for the company	High level Information regarding the project status and progress, project timeline, estimate to complete, cost analysis, risks In Dutch or English	This stakeholder is accountable for project success and must regularly be informed in order to support the project	Monthly	The project Manager	Project Status- and progress Reports, Presentations, MoM, emails, Telephone calls, face to face meetings

Stakeholder needs, requirements & expectations)	Required communication (language, format, level of detail, content)	Why is the information needed	Timeframe and frequency	Person responsible	Methods or technologies used
Project manager: This stakeholder expects the project to be successfully completed in order to build reputation for the company and or improve position or get a sense of accomplishment	Information from the project team regarding project status, progress, cost information, timelines, ETC and EAC. Language in Dutch or English	This stakeholder is responsible for project success and must be informed in detail in order to manage the project and provide leadership	daily or as required	All the project team members and the contractors	Face to face Meetings, emails, telephone calls, one on one discussions, presentations, conference calls, Memos
Project team: Those stakeholders expects the project to be successfully completed in order to build reputation and or improve position or get a sense of accomplishment	Information from the project team members regarding project status, progress, cost information, timelines, ETC and EAC, objectives, strategy. Language in Dutch or English	Those stakeholders are as a team responsible for project success thus must be well informed in order to take the right actions	daily or as required	All the project team members and the contractors	Face to face Meetings, emails, telephone calls, one on one discussions
Contractors: This stakeholder expects to get the contract awarded and thereafter execute the works in a successful manner in order to build business	Information regarding upcoming and ongoing procurement activities and information regarding project timeline and other construction related activities. Language in English or Dutch	To participate in the bidding process and if successful, participate in delivery of materials and construction activities	Initially as required in order to participate in the bidding. After contract signing information to be provided weekly or as required	Prior to - and during the bidding process the procurement department will be responsible for communication During construction the project team and other suppliers must communicate with the contractors	Emails, telephone calls, website postings, Construction progress meetings, walk through, meeting minutes, emails

Stakeholder needs, requirements & expectations)	Required communication (language, format, level of detail, content)	Why is the information needed	Timeframe and frequency	Person responsible	Methods or technologies used
EBS O&M team: This stakeholder expects to receive proper training to support the project	Information regarding technical aspects of the project and Training material language in Dutch	The information will prepare the team to support the project	Start with selection of the candidates early at project start and engage once a month and then increase the frequency when construction is about to be completed	The project manager, the project engineers, contractors	Meetings, MoM, Class room and hands on training. Training materials such as manuals
Villagers: This stakeholder expects to receive reliable 24 hrs. electricity service after project completion and according to the project schedule	Information regarding project objectives, status, progress, cost, timelines. Language in village dialect and Dutch	The information will prepare the community for the 24 hrs. electricity service	Monthly or as required	The project manager and the project sponsor	Face to face meetings, social media, village meetings, one on one discussions

3. Manage Communications

Throughout the execution of the project, the project manager will be responsible for an efficient and effective information flow between all stakeholders.

The communication matrix from chart 24 will be used by the project manager to manage and tailor communications for this project according to each stakeholder's communications needs.

Project Management Information System

For proper management of the project communication, the project manager will create a project management information system, in order to ensure that the project team has access to the tools they need or can easily retrieve the information they need in a timely way. This will be done by engaging with the IT department and establishing the following:

1. Project management software, such as QuickBooks and Microsoft projects which will be used for cost control and schedule management.
2. Video and voice conferencing will be made available as required for meetings and interactions.

4. Monitor Communications

Monitor Communications will ensure that the Communications Management Plan is effective, by comparing the plan with the outcome of the Manage Communication process and, eventually, making the required adjustments.

The project manager shall monitor and control the information throughout the life cycle of the project and shall ensure that every stakeholder gets the information he is supposed to get, at the time he is expecting it and using the method he is supposed to get it by. If it appears that there is a gap in the communication or that the communication flow is insufficient, the project manager must make the necessary adjustments to the communications plan.

Change requests

Updates and changes will be required as the project progresses or changes are approved. The project manager is responsible for managing all proposed and approved changes to the Communications Management Plan. Once the change is approved, the project manager will update all relevant documentation and will distribute the updates to the project team and all stakeholders.

All change requests will be processed through the Perform Integrated Change Control process.

4.8 Risk Management Plan

“Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning, response implementation, and monitoring risk on a project. (Project Management Institute, 2017, p. 397).
In figure 12 the processes for the Project Risk Management are depicted together with their Inputs, Tools and Techniques, and Outputs.

Those processes are:

1. Plan Risk Management
2. Identify Risks
3. Perform Qualitative Risk Analysis
4. Plan Risk Response
5. Implement Risk Response
6. Monitor Risk

The Risk Management Plan for the Aurora Project was developed by using the processes above and a free template from the Project Management Docs website (August 25, 2019).

RISK MANAGEMENT PLAN

24 HOURS SOLAR POWER FOR NIEUW AURORA

SEPTEMBER 25, 2019

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1. Introduction

This Risk Management Plan identifies the risks for the “24 hours Solar Power for Nieuw Aurora” project, performs a qualitative risk analysis in order to be able to determine the most significant risks of the project and develops risk responses to those risks. The plan also details how risks responses will be implemented and how the risks on the project will be monitored. It also identifies and defines the roles of team members and stakeholders involved in the risk management of this project and includes a Risk Breakdown Structure and the Risk Matrix.

The purpose of the risk management plan is to establish the framework in which the project team will identify risks and develop strategies to decrease the probability and/or impact of negative risks and increase the probability and/or impact of positive risks.

Nieuw Aurora is an isolated village in the interior of Suriname, approximately 220 km away from the capital city. The village is not connected to the national electricity grid and currently receives only 4 hours electricity service per day, from 7:00 PM to 11:00 PM from diesel generators. This limited electricity supply is hampering the development of the village community and therefore the government of Suriname decided to implement a project in which Nieuw Aurora will receive 24 hours electricity service per day, through the usage of solar power. This project is for designing, procuring, installation and testing of a solar power plant that will be used to provide the Nieuw Aurora Village in Suriname with 24 hours per day electricity service. This includes design of the system, procuring the solar system, installation of the solar panels, testing and commissioning of the system, closing out of the project and handing over of the project to operations. The solar system will be procured through a turnkey delivery from a solar system provider. Other external resources that will be acquired for this project are resources for the preparation of the solar sites.

2. Plan Risk Management

This paragraph defines how risk management will be conducted for the Aurora Project. In order to carry out the risk analysis, the project charter will be used as one of the main input documents and the preliminary risks and assumptions from this document will also be further analysed. The stakeholder register must also be used as an input document in order to determine the roles and responsibilities for managing risk on the Aurora Project. Risk categories will be used to develop the risk breakdown structure.

Several risk management tools and techniques such as brainstorming, meetings and expert judgment will be utilized to categorize and identify the project risks. After completion of the risk identification process, those risks will be further analysed in order to determine the most significant risks and their cause, consequence, probability and impact. Since the environment in which projects are being executed is very dynamic, the remaining risks will be put on a watch list that will be revisited during the execution of the project. In order to properly manage the risks, a trigger must be assigned for each risk and each risk will be assigned a risk owner. Possible opportunities in the project will also be considered and strategies will be developed to decrease the probability and/or impact of negative risks and increase the probability and/or impact of positive risks.

3. Identify Risks

As part of identifying the project risks, the stakeholders roles and responsibilities have been mapped below in chart 27.

Chart 27 Plan Risk Management Roles and Responsibilities (Source: R. Paal, Author of the FGP, Sep 2019)

Role	Responsibilities
IDB (overall project management)	IDB is an external stakeholder responsible for the overall project management. As such the IDB will initiate and participate in risk review sessions throughout the lifetime of the project. The IDB will also approve high level risk management documents and meet with the project sponsor and the project manager on a regular basis but at least every quarter to discuss the project risks. This review may be part of a project status and progress review meeting.
Sponsor	The CTO from EBS is assigned to be the project sponsor. The sponsor provides resources and support for the project. He also ensures continuity of sponsorship and is accountable for enabling success. The Project Sponsor is at the executive level so risk information should be presented in summary format unless the Project Manager finds it necessary to provide more detail information regarding project risks or the sponsor request more detail risk information.
Project manager	The project manager is the person ultimately responsible for the successful completion of the project. As such the project manager will take a proactive role in ensuring that the risks are documented and managed and risk responses are properly implemented. The project manager will also be responsible for managing risks on a day to day basis and escalating risks to the stakeholders, the project team and the sponsor if they materialize.
Engineers	This team of project engineers consists of subject matter experts and is responsible for the basic engineering and design of the solar systems and the engineering and design of the balance of the project. The team will participate in detail risk review sessions together with the Project Manager and relevant stakeholders.

Role	Responsibilities
Procurement specialist	The procurement specialist is responsible for preparing the bid requests and organizing bid openings and support bid evaluations The specialist must also participate in risk review sessions together with the project team
Financial Specialist	The financial specialist is responsible for all aspect related to cost reporting and cost control. As such the financial specialist will inform the project manager of financial risks to the project.
Contractors	Contractors will be responsible for the delivery of good quality equipment, materials and personnel. They will also be responsible for the timely delivery of the various services, materials and equipment. After the contract has been awarded, the contractors will be invited by the project manager to participate in risk meetings. They will be responsible for communicating identified project risks to the project manager and escalate as required.
EBS Operations and Maintenance team	EBS personnel will provide support during test and commissioning and will be trained to maintain and operate the project after installation of the solar system. EBS employees will be involved in risk review sessions by the project manager and have the obligation to escalate issues to the project engineers or the project manager where needed.

In order to identify the risks associated with the Aurora Project a brainstorming session initiated by the IDB was held together with the project team. During this meeting the project manager from the Atjoni/Pokigron Solar Project was also invited to share historical risk data from the Atjoni/Pokigron Project with the other participants.

The risks were first categorized according to their source and the Risk Breakdown Structure (RBS) was developed. The Risk Breakdown Structure can be seen below in Chart 28.

Chart 28 Risk Breakdown Structure (Source: R. Paal, Author of the FGP, Sep 2019)

Risk level 0	Risk level 1	Risk level 2
All Sources of Aurora project risks	1. Technical Risk	1.1 Estimates, assumptions and constraints
		1.2. Technology
	2. Management Risk	2.1 Project Management
		2.2 Resourcing
	3. Commercial Risk	3.1 Contractual terms and conditions
		3.2 Internal Procurement
		3.3 Suppliers and Vendors, Contractors
	4. External Risk	4.1 Market Conditions
		4.2 Site/Facilities
		4.3 Environment/weather
		4.4 Political

After the RBS has been developed the project risks must be identified together with their cause and consequence. The results can be seen in the Risk Register in chart 33.

4. Perform Qualitative Risk Analysis

In order to determine the level of risk and its associated severity, a probability and impact factor must be assigned to each risk. This allows the project manager to determine the level of risk and prioritize them based upon the effect they may have on the project. Risks which are more likely to occur and have a significant impact on the project will have the highest priority, while those which are more unlikely to

occur or have a low impact will have a much lower priority. The probability factors and impact factors for the project can be found in chart 29 respectively chart 30.

Chart 29 Probability factors (Source: R. Paal, Author of the FGP, Sep 2019)

Factor	Description	Probability
1	Very low	Event may only occur in exceptional situations
2	Low	Event has a slight chance of occurrence
3	Moderate	Event is possible to occur on the project
4	High	Event is likely to occur
5	Very high	Event is highly likely to occur

Chart 30 Impact factors (Source: R. Paal, Author of the FGP, Sep 2019)

		+/- Impact on project objectives			
Factor	**Description**	**Time**	**Cost [USD]**	**Scope**	**Quality**
1	Very low: Impact is insignificant and may be ignored	<1 month	< 20,000	No significant impact on scope	No significant impact on quality
2	Low: Impact is minor and risk may be handled by the project manager	1 - 2 months	20,000 - 40,000	Minor scope impact	Minor quality impact
3	Moderate: Impact is moderate and risk may be handled by the project manager	2 - 4 months	40,000 - 60,000	Moderate scope impact	Moderate quality impact
4	High: Impact is high with high consequences for scope, cost, schedule or quality	4 - 6 months	60,000 - 80,000	High impact on scope	High quality impact
5	Very high: Impact is very high with very high consequences for scope, cost, schedule or quality	> 6 months	> 80,000	Very high impact on scope	Very high quality impact

Risk Score

The risk score is a value calculated as a product of probability of occurrence and impact. **T**he classification of the risk scores can be seen in chart 31. The values range from 1 to 25. Risks with a score between 1 and 5 are considered low priority risks, risks from 6 to 14 are moderate priority risks and risk scores from 15 to 25 are considered high priority risks. The general actions to be taken are outlined in the chart, while the specific actions are listed in the risk register. For positive high priority risks, the intention is to make the risk occur in order to gain positive impact.

Chart 31 Probability x Impact (PxI) score classification (Source: R. Paal, Author of the FGP, Sep 2019)

Probability x impact (score)	Priority level	Description	Action
15 - 25	Red	High priority	High Impact and High probability: Take action to manage this risk because if the risk is negative it is a threat to the project objectives. Positive risks will enhance project success.
6-14	Yellow	Moderate priority	Low impact and high probability of occurrence: Even if those risks occur, they will have little impact. Those risks will be managed by the project manager once they occur. Low probability and high impact: Those risks will have a high impact if they occur. Monitor those risk closely and take action if the probability increases.
1 - 5	Green	Low priority	Low probability and low impact: Put those risks on the watch list and review periodically

The numeric values for probability and impact were multiplied to provide a probability x impact score with related priority levels, that will be used for the Aurora project. The results can be seen in the probability and Impact matrix in chart 32. The priority level of the risks will be determined based upon this chart and will be depicted in the risk register.

Chart 32 Probability x Impact (PxI) Matrix (Source: R. Paal, Author of the FGP, Sep 2019)

Probability		Threats					Opportunities						Probability
	5	5	10	15	20	25	25	20	15	10	5	5	
	4	4	8	12	16	20	20	16	12	8	4	4	
	3	3	6	9	12	15	15	12	9	6	3	3	
	2	2	4	6	8	10	10	8	6	4	2	2	
	1	1	2	3	4	5	5	4	3	2	1	1	
		1	2	3	4	5	5	4	3	2	1		
		Negative Impact					Positive Impact						

RISK REGISTER

The Risk Register for this project is a log of all identified risks, their probability and impact to the project, the category they belong to, mitigation strategy, their trigger and the risk owner. The risk responses are also included in the risk register. The risk register will be used to track the project risks and their associated actions throughout the lifetime of the project. In chart 33 the risk register for the Aurora Project is depicted.

Chart 33 Risk Register (Source: R. Paal, Author of the FGP, Sep 2019)

RBS Code	Cause	Risk Description	Consequence	Probability	Impact	Probability x Impact [PxI]	Trigger	Owner	Strategy and revised probability factor
4.2	Severe weather	Flooding of the site	Project delays and damage to equipment	4	5	20	Heavy and Continuous rain events and rising river water levels	Project Manager	**Eliminate:** Obtain a site that will not be subject to flooding. Because of this the probability factor will reduce to 0
2.2	Need of workers to support the execution of the project	Use of local villagers for low skilled labor on the project	Reduction of project costs and increase of project support from the local community	4	5	20	As soon as project planning starts	Project Manager	**Exploit**: a hiring process must be initiated for hiring of village employees. Because of this the probability factor will increase to 5
2.1	Projectized Organizational Structure	Optimal project conditions (highly authorized project manager, high resource and employee availability)	Clear reporting structure and escalation chain	4	5	20	As soon as the project starts	Sponsor and Project Manager	**Exploit**: Project manager to work with sponsor to establish a project execution unit. (this has already been implemented on the project). Because of this the probability factor will increase to 5.

RBS Code	Cause	Risk Description	Consequence	Probability	Impact	Probability x Impact [PxI]	Trigger	Owner	Strategy and revised probability factor
3.3	Multiple contractors working on the same project	Remaining and/or unassigned work	Some of the work that should have been done is outstanding	4	4	16	Outstanding work not included in the scope of work of any contractor	Engineers and project manager	**Mitigate** : Develop detailed description of the work for contractors prior to entering into the procurement phase. Organize mandatory site visits with the contractors prior to bid submission. Because of this the probability factor will reduce to 1
4.2	Lack of security measures	Theft of panels and or equipment	Additional costs for replacement and delay in project completion	4	4	16	As soon as material is on site	Project Engineers	**Mitigate**: Use of security guards to protect the panels and equipment during construction. Store the panels and equipment in closed containers. Because of this the probability factor will reduce to 2
3.2	Inadequate procurement system and insufficient market research	Prices received from contractors are higher than expected	Budget overrun and insufficient financial resources to complete the project	3	5	15	Cost forecast indicate a budget overrun	Project Manager and Financial Specialist	**Mitigate:** Competitive bidding processes, close collaboration with the procurement department, thorough evaluation of received

RBS Code	Cause	Risk Description	Consequence	Probability	Impact	Probability x Impact [PxI]	Trigger	Owner	Strategy and revised probability factor
									bids, close monitoring and control of the financial resources and project progress, avoid over usage of the contingency and management reserves. Because of this the probability factor will reduce to 1
1.2	Limitations in technical knowledge and capacity of the EBS team regarding solar systems	Delivery of an unsuccessful project	Schedule and scope delays and cost overruns, poor quality project	3	5	15	During project planning	Project Manager	**Transfer**: The solar plant will be acquired through an international competitive process for turnkey delivery of the plant. Because of this the probability factor will reduce to 1
4.2	Hazards from river transport	Boat may capsize during transportation	Potential Injury to personnel and damage to solar panels and equipment	3	5	15	Prior to the start of transportation activities	Project Manager	**Transfer:** the local community will be requested to present the skilled boat owners that can safely provide transportation over the rapids. **Transfer:** Contractor to

RBS Code	Cause	Risk Description	Consequence	Probability	Impact	Probability x Impact [PxI]	Trigger	Owner	Strategy and revised probability factor
									obtain insurance that covers employees, materials and equipment. Because of this the probability factor will reduce to 2
1.1	High transportation costs over the river	The project budget might be exceeded	Insufficient financial resources to complete the project	3	5	15	Prior to the start of transportation activities	Project Manager	**Mitigate:** Enter into a contract that establishes the prices with boat owners through a competitive bidding process. Because of this the probability factor will reduce to 1
3.1	Poor quality of solar panels	Lifespan of solar panels are below expectation	Operational life time of the solar panels or other components is too short	3	5	15	Prior to the start of procurement activities	RET engineer	**Mitigate:** Use of performance and lifetime warranties in the contract. Because of this the probability factor will reduce to 1

RBS Code	Cause	Risk Description	Consequence	Probability	Impact	Probability x Impact [PxI]	Trigger	Owner	Strategy and revised probability factor
3.3	Selection of solar contractor with poor performance	Solar Panels performance below target	Lower electricity output than expected	3	5	15	At the beginning of the procurement phase	Procurement specialist	Mitigate: Organize competitive bidding process. Include Factory Acceptance Test witnessing by company employee in the contract. Include performance guidelines in the contract and non-acceptance- and penalty clause. Because of this the probability factor will reduce to 1
1.1	The increase in the amount of connections can be more than foreseen during project execution	More solar capacity will be required than estimated	The project cannot meet the objectives	2	5	10	Collected data shows a significant increase in the number of connections > 5% per year	Project Manager	**Mitigate**: Organize site visits to conduct surveys early in the project to collect the number of connections and monitor the growth of the number of connections closely. Use contingency reserve to deal with village growth. The

RBS Code	Cause	Risk Description	Consequence	Probability	Impact	Probability x Impact [PxI]	Trigger	Owner	Strategy and revised probability factor
									probability factor will not change
2.2	Land Acquisition	It may be impossible to obtain the land needed for the project	Project must be terminated	2	5	10	As soon as the project starts, the community must be engaged	Environmental Specialist & Project Manager	**Avoid:** Sign agreement with villagers regarding land needed for the solar plant; Additional time and resources need to be allocated for stakeholder engagement. Because of this the probability factor will reduce to 1
3.3	Selection of contractor with poor performance	Delay in the delivery of the project work by contractors	Unhappy customers	3	3	9	At the beginning of the procurement phase	Project Manager	**Mitigate:** include reserve contingency in the schedule and also enter into a competitive bidding process and include penalties for late delivery in the contract. Because of this the probability factor will reduce to 2
4.4	Change in sitting government	New government cancels the project	Project will not be completed	1	5	5	Change in government	Project Manager	**Accept**: passive acceptance of the risk with periodical reviews. The probability factor

RBS Code	Cause	Risk Description	Consequence	Probability	Impact	Probability x Impact [PxI]	Trigger	Owner	Strategy and revised probability factor
									stays the same
4.3	Bad weather conditions	Delays in the installation process due to bad weather conditions	Delay in project completion	4	1	4	If a delay of 4 weeks occurs in the project execution due to bad weather	Project Manager	**Accept**: Built in contingency reserve in the project schedule. The probability factor stays the same.
4.1	Poor economy	Exchange rate increase	Financial losses for the project	2	1	2	Exchange rate increase of > 15%	Financial Specialist and Project Manager	**Accept**: Establish contingency reserve for the project. The grant is provided in USD so conversion to the Suriname currency should be kept at a minimum. The probability factor stays the same

5. Perform Quantitative Risk Analysis

In this paragraph a quantitative risk analysis will be performed in order to cover the risk exposure of the Aurora Project. The total cost impact of the occurrence, should the risk occur, is determined by totalizing the cost impact and the monetized schedule and quality impact that the risk would have on the project. Thereafter the Expected Monetary Value (EMV) is determined by multiplying the total cost impact with the probability of occurrence. The sum of the EMV's determines the risk contingency reserves of the project. For this analysis the revised probability factors of the risks as set forth in chart 29 have been used.
The assessment is done with input data from the cost management plan. The results of this assessment shows that for the Aurora Project an amount of USD143,970 is needed to cover the risk exposure. Chart 34 below provides the details of the assessment.

Chart 34 Quantitative Risk Analysis overview (Source: R. Paal, Author of the FGP, Sep 2019)

RBS Code	Risk Description	Probability factor	Revised Probability factor	Impact (cost plus monetized schedule and quality impact)	EMV = Impact x Probability (in %) [USD]	Remarks
4.2	Flooding of the site	4	0	> 1 MM	0	The cost impact also highly depends on when the risk occurs. Because this risk will be eliminated the probability is zero
2.2	Use of local villagers for low skilled labor on the project	4	5	55,000	- 55,000	6 villagers from Jun 2020 to Sep 2020 and from May 2021 to Dec 2021 @ USD5,000 per month on average for all the village workers = 11 x 5,000
2.1	Optimal project conditions (highly authorized project manager, high resource and	4	5	-133,900	- 133,900	If no delay in the project execution occurs due to an experienced project team and high availability of resources, this will have a positive cost impact. Because of this

RBS Code	Risk Description	Probability factor	Revised Probability factor	Impact (cost plus monetized schedule and quality impact)	EMV = Impact x Probability (in %) [USD]	Remarks
	employee availability)					the cost impact has been estimated at 10% of the project baseline
3.3	Remaining and/or unassigned work	4	1	66,950	13,390	Remaining or unassigned work can cause schedule delays and cost impacts. This is estimated at 5% of the cost baseline
4.2	Theft of panels and or equipment	4	2	25,000	10,000	The turnkey delivery of the solar system is estimated at 850,000. The monetary value of theft is estimated at USD25,000.
3.2	Prices received from contractors are higher than expected	3	1	351,200	70,240	Prices can vary significantly. For this activity, the cost impact is determined at 40% of the estimated contract works. This amounts 40% of USD (850,00 + 28,000)
1.2	Delivery of an unsuccessful project	3	1	535,600	107,120	If the project is not successful, this means that the financial impact will be significant. Because of this the impact is estimated to be 50% of the project cost baseline
4.2	Boat may capsize during transportation	3	2	10,000	4,000	The materials and equipment will be transported in small boats. The financial impacts of one capsized boat is not considered significant

RBS Code	Risk Description	Probability factor	Revised Probability factor	Impact (cost plus monetized schedule and quality impact)	EMV = Impact x Probability (in %) [USD]	Remarks
1.1	The budget might be exceeded due to high river transportation costs	3	1	25,000	5,000	According to a subject matter expert the costs can be overcharged with 50% by the boat owners. We estimate a total of 100 river transportation @ USD500
3.1	Lifespan of solar panels are below expectation	3	1	0	0	This will only be possible to detect after the project is in operation so those costs are not included in the quantitative assessment
3.3	Solar Panels performance below target	3	1	401,700	80,340	If the solar panels perform below target this will have a significant cost impact and schedule impact Because of this the cost impact has been estimated as 30% of the project baseline
1.1	More solar capacity will be required than estimated	2	2	66,950	26,780	There is nothing that can be done about an increase in the number of connections due to unexpected population growth. Therefore the probability factor was not revised Early discovery of the increase will allow more time to mitigate this risk. The cost impact is estimated at 5% of the cost baseline
2.2	It may be impossible to obtain the land needed for the	2	1	40,000	8,000	In this case the land will be purchased from the community as a worst case scenario. The cost

RBS Code	Risk Description	Probability factor	Revised Probability factor	Impact (cost plus monetized schedule and quality impact)	EMV = Impact x Probability (in %) [USD]	Remarks
	project for free					are estimated at USD 2 per square meter with a total area of 2ha.
3.3	Delay in the delivery of the project work by contractors	3	2	20,000	8,000	The cost impact will be carried by the contractor and will not have a significant impact on the project budget
4.4	New government cancels the project	1	1	0	0	The financial implications of this decision will not be carried by the project
4.3	Delays in the installation process due to bad weather conditions	4	4	0	0	Bad weather conditions will be covered in the contract so minimal financial impacts are expected. The additional costs will be limited to the cost of the EBS staff
4.1	Exchange rate increase	2	2	0	0	The grant is provided in USD so conversion to the Suriname currency should be kept at a minimum. In that case the cost implications will be minimal
	Total risk contingency				**143,970**	

6. Implement Risk Responses and Monitor Risks

The project manager, with the assistance of the project team, will determine the best way to implement the risk responses. The risks must be monitored throughout the life cycle of the project. If more risks are identified throughout the execution of the project, they will be added to the Risk Register to ensure they are monitored at the appropriate times and are responded to accordingly. It will be the responsibility of the project manager to monitor the project risks and ensure that they are analyzed by the project team. Therefore the project manager must schedule risk review meetings with the project team frequenting at least once a month.

4.9 Procurement Management Plan

“Project Procurement Management includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team”. (Project Management Institute, 2017, p. 459). According to PMI 2017, it includes the management and control processes required to develop and administer agreements, such as contracts, purchase orders, memoranda of agreements (MOAs) or internal service level agreements (SLAs).

In figure 13, the processes for the Project Procurement Management are depicted. together with their Inputs, Tools and Techniques, and Outputs.

Those processes are:

1. Plan Procurement Management
2. Conduct Procurement
3. Control Procurement

The Procurement Management Plan for the Aurora Project was developed by using the processes above.

PROCUREMENT MANAGEMENT PLAN

24 HOURS SOLAR POWER FOR NIEUW AURORA

OCTOBER 02, 2019

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1. Introduction

This Procurement Management Plan defines how products, services, or results for the “24 hours Solar Power for Nieuw Aurora” Project will be procured. It details how the Aurora Project agreements will be developed and administered, and specifies the products and services that will be procured and the type of contracts that will be used to procure them. The project is still in the planning phase so the emphasis will be on the “Plan Procurement Management” process.

Nieuw Aurora is an isolated village in the interior of Suriname, approximately 220 km away from the capital city. Atjoni is the last location that can be reached over land. Nieuw Aurora is located at a distance of 20 km from Atjoni and from Atjoni, the village can only be reached by boat over the Suriname River. The village is not connected to the national electricity grid and currently receives only 4 hours electricity service per day, from 7:00 PM to 11:00 PM from diesel generators. This limited electricity supply is hampering the development of the village community and therefore the government of Suriname has decided to implement a project in which Nieuw Aurora will receive 24 hours electricity service per day, through the usage of solar power. This project is for designing, procuring, installation and testing of a solar power plant that will be used to provide the Nieuw Aurora Village in Suriname with 24 hours per day electricity service. This includes design of the system, procuring the solar system, installation of the solar panels, testing and commissioning of the system, closing out of the project and handing over of the project to operations. The solar system will be procured through a turnkey delivery from a solar system provider. Other external resources that will be acquired for this project are resources for the preparation of the solar sites.

2. Plan Procurement Management

This paragraph defines how procurement management will be conducted for the Aurora project. According to the implementing agreement between the government

of Suriname and the European Union, the procurement and contracting processes for the acquisition of goods, works, services and consultancies for this project will be carried out in accordance with the Policies for the Procurement of Goods and Works financed by the Inter-American Development Bank, and the Policies for the Selection and Contracting of Consultants financed by the Inter-American Development Bank and applicable Bank rules and procedures regarding procurement. Below in figure 20, some of the clauses from the procurement policies from the IDB can be seen.

Notification and Advertising

2.7. Timely notification of bidding opportunities is essential in competitive bidding. For projects that include ICB the Borrower is required to prepare and submit to the Bank a draft General Procurement Notice. The Bank will arrange for its publication in *UN Development Business online (UNDB online*) and on the Bank's Internet website.[23] The Notice shall contain information concerning the Borrower (or prospective Borrower), amount and purpose of the loan, scope of procurement under ICB, and the name, telephone (or fax) number, and address of the Borrower's agency responsible for procurement and the address of the website where specific procurement notices will be posted. If known, the scheduled date for availability of prequalification or bidding documents should be indicated. The related prequalification or bidding documents, as the case may be, shall not be released to the public earlier than the date of publication of the General Procurement Notice.

B. Bidding Documents

General

2.11. The bidding documents shall furnish all information necessary for a prospective bidder to prepare a bid for the goods and works to be provided. While the detail and complexity of these documents may vary with the size and nature of the proposed bid package and contract, they generally include: invitation to bid; instructions to bidders; form of bid; form of contract; conditions of contract, both general and special; specifications and drawings; relevant technical data (including of geological and environmental nature); list of goods or bill of quantities;

delivery time or schedule of completion; and necessary appendices, such as formats for various securities. The basis for bid evaluation and selection of the lowest evaluated bid shall be clearly outlined in the instructions to bidders and/or the specifications. If a fee is charged for the bidding documents, it shall be reasonable and reflect only the cost of their printing and delivery to prospective bidders, and shall not be so high as to discourage qualified bidders. The Borrower may use an electronic system to distribute bidding documents, provided that the Bank is satisfied with the adequacy of such system. If bidding documents are distributed electronically, the electronic system shall be secure to avoid modifications to the bidding documents and shall not restrict the access of bidders to the bidding documents. Guidance on critical components of the bidding documents is given in the following paragraphs.

2.12. Borrowers shall use the appropriate Standard Bidding Documents (SBDs) issued by the Bank with minimum changes, acceptable to the Bank, as necessary to address project-specific conditions. Any such changes shall be introduced only through bid or contract data sheets, or through special conditions of contract, and not by introducing changes in the standard wording of the Bank's SBDs. Where no relevant standard bidding documents have been issued, the Borrower shall use other internationally recognized standard conditions of contract and contract forms acceptable to the Bank.

2.18. All prospective bidders shall be provided the same information, and shall be assured of equal opportunities to obtain additional information on a timely basis. Borrowers shall provide reasonable access to project sites for visits by prospective bidders. For works or complex supply contracts, particularly for those requiring refurbishing existing works or equipment, a pre-bid conference may be arranged whereby potential bidders may meet with the Borrower's representatives to seek clarifications (in person or online). Minutes of the conference shall be provided to all prospective bidders with a copy to the Bank (in hard copy or sent electronically). Any additional information, clarification, correction of errors, or modifications of bidding documents shall be sent to each recipient of the original bidding documents in sufficient time before the deadline for receipt of bids to enable bidders to take appropriate actions. If necessary, the deadline shall be extended. The Bank shall receive a copy (in hard copy format or sent electronically) and be consulted for issuing a "no objection" when the contract is subject to ex-ante review.

Figure 20 Examples of IDB procurement policies (Source: Policies for the Procurement of Goods and Works financed by the Inter-American Development Bank GN-2349-9, March 2011)

The Project Charter together with the milestone list will also be used as input documents for the planning of the procurement. Tools and techniques that will be used for this process are expert judgment from the procurement specialist, historical data from the Atjoni/Pokigron Solar Project, and meetings with the project team.

Roles and Responsibilities

In order to plan the procurement management of the project, it is important that the roles and responsibilities of the different stakeholders are determined and documented. The roles and responsibilities regarding the procurement activities are depicted below in chart 35.

Chart 35 Plan Procurement Management Roles and Responsibilities (Source: R. Paal, Author of the FGP, Oct 2019)

Role	Responsibilities
IDB (overall project management)	IDB is an external stakeholder responsible for the overall project management. The IDB will review and approve all the purchases and key procurement documents of the project. Key documents are for example, the procurement plan, bid request documents and bid evaluation documents including draft contracts. The IDB will also meet with the project manager on a regular basis but at least once a month to review the procurement activities and their progress. This review may be part of a project status and progress review meeting.
Sponsor	The CTO from EBS is assigned to be the project sponsor. The sponsor provides resources and support for the project. He also ensures continuity of sponsorship and is accountable for enabling success. The Project Sponsor will review and approve all the purchases and key documents of the project. The sponsor will also co-sign the contracts together with the companies' CEO and CFO.
Project manager	The project manager is the person ultimately responsible for the successful completion of the project. As such the project manager will ensure that the procurement activities are documented, managed and conducted properly. The project manager will coordinate the preparation of the bid request- and bid evaluation documents and will also be responsible for reviewing and approving all procurement documents prior to sending them to the IDB for review and approval. The project manager will also monitor contract performance, review and approve invoices from contractors and close out the contract.
Engineers	This team consists of engineers and subject matter experts and is responsible for the basic engineering and design of the solar systems and the engineering and design of the balance of the project. The team will provide the technical procurement documents and information to the Project Manager. The engineers will also participate in bid evaluation teams.

Role	Responsibilities
Procurement specialist	The procurement specialist is responsible for preparing the bid requests, sending out the bid invitations, organizing bid openings and support bid evaluations. The specialist will be heavily involved in the majority of the procurement related activities and must also take the lead during bid evaluations.
Financial Specialist	The financial specialist is responsible for all aspect related to cost reporting and cost control. As such the financial specialist will also review and approve the bid request- and bid evaluation documents and invoices from the contractors.
Contractors	Contractors will be responsible for the delivery of good quality equipment, materials and personnel. They will be responsible for the timely delivery of the various services, materials and equipment. The contractors will be responsible for the submission of the bids according to the requests for proposals and the delivery of the contract products, services or results after contract awarding.
EBS Operations and Maintenance team	EBS personnel will support during test and commissioning and will be trained to maintain and operate the project after installation of the solar system. As such the EBS employees can provide basic data that can be used as an input to determine if some of the contractual terms and conditions have been fulfilled.

Procurement Processes

For the Aurora Project 2 main procurement processes will be conducted;

1. Solar site preparation; this activity involves the removal of trees and vegetation from the site where the solar panels will be installed. The solar site has an area of 2 ha and the levelling of the site will also be part of the work to be performed by the contractor. This procurement will be conducted through a National Competitive Bidding (NCB) process, in which local contractors will be requested to submit their proposal for the work.

2. Turnkey delivery of the solar plant; This activity involves the turnkey delivery of the solar system consisting of the solar panels together with the battery back-up system and the connection between the solar plant and the existing electricity network. This procurement will be conducted through an International Competitive

Bidding (ICB) process, in which local and international contractors will be requested to submit their proposal for the delivery and installation of the solar plant.

For both procurements two separate lump sum contract will be signed between the EBS and the contractors. The cost management plan and the schedule management plan were used to provide data regarding cost estimates and start and final dates of the procurement activities. The procurement activities to be carried out for the Aurora project are mapped in chart 36 below.

Chart 36 Procurement Plan (Source: R. Paal, Author of the FGP, Sep 2019)

n	Description	Start date	End date	Process	Estimated Cost [USD]	Contract type
1	solar site preparation (removal of trees, site levelling etc.)	Feb 12, 2020	Jun 2, 2020	NCB	28,000	Lump Sum
2	Turnkey delivery of the solar plant	Dec 11, 2019	Dec 15, 2021	ICB	850,000	Lump Sum

3. Conduct procurement

After the Request for Proposals (RFP) have been developed by the project team and approved by the IDB, the project specialist will advertise the RFP's in the local newspapers and solicit proposals from prospective sellers. The RFP's will also be posted on the EBS website. For the delivery of the solar plant, apart from the local newspapers and the EBS website, the RFP will also be posted on the development business and the IDB website in order to solicit proposals from prospective international sellers as well.

After the bids have been received, a team will be formed to evaluate the bids. The bid evaluation team will consist of at least the procurement specialist, an engineer and a cost controller. The project manager will also participate in the bid evaluation or review and approve the bid evaluation document and submit the document to the project sponsor for approval. Thereafter the document will be sent to the IDB for final approval. After approval from the IDB, the contracts with the selected sellers can be negotiated by the project manager and signed by the CEO, CFO and CTO from EBS.

4. Control Procurement

When the execution of the contract starts, the project manager must monitor contract performance and take actions where required. The project manager must have weekly meetings with the project team and contractors in order to keep track of the progress of the works and take action where required. The contractors, especially the solar system contractor will be required to submit a detailed project progress and status report on a monthly basis to the project manager. The exact format of the report will be determined during contract negotiations between EBS and selected contractors. Site visits will be conducted by the project manager in order to witness the physical progress of the works. Inspections will be carried out by the project engineers and approval gates will be built into the contract works in order to guarantee and safeguard the quality of the delivered works.

During the execution of the works, the project manager will be responsible for the review and approval of invoices submitted by the contractor. The project manager will ensure that the payment terms are met and that the invoices are linked to the progress of the works. After completion of the works, the project manager will be responsible for closing out of the contract. The project manager will finalize this procurement process by conducting a contract close out meeting together with the project team and the contractor.

4.10 Stakeholder Management Plan

According to PMI (2017), “Project Stakeholder Management includes the processes required to identify the people, groups or organizations that could impact or be impacted by the project, to analyze stakeholder expectations and their impact on the project, and to develop appropriate management strategies for effectively engaging stakeholders in project decisions and execution” (p. 503).

In figure 14, the processes for the Project Stakeholder Management are depicted together with their Inputs, Tools and Techniques, and Outputs.

Those processes are:

1. Identify Stakeholders
2. Plan Stakeholder Engagement
3. Manage Stakeholder Engagement
4. Monitor Stakeholder Engagement

The Stakeholder Management Plan for the Aurora Project was developed by using the processes above.

STAKEHOLDER MANAGEMENT PLAN

24 HOURS SOLAR POWER FOR NIEUW AURORA

OCTOBER 06, 2019

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1. Introduction

This Stakeholder Management Plan identifies the stakeholders for the “24 hours Solar Power for Nieuw Aurora” Project and analysis their expectations and impact on the project. The plan also defines the roles and responsibilities of the stakeholders, determines their power and interest and develops strategies to engage the stakeholders in project decisions and executions.

Nieuw Aurora is an isolated village in the interior of Suriname, approximately 220 km away from the capital city Paramaribo. Atjoni is located at a distance of 200 km from the capital city Paramaribo and is the farthest location that is reachable over land. Nieuw Aurora is located at a distance of 20 km from Atjoni and from Atjoni, the village can only be reached by boat across the Suriname River. The village is not connected to the national electricity grid and currently receives only 4 hours electricity service per day, from 7:00 PM to 11:00 PM from diesel generators. This limited electricity supply is hampering the development of the village community and therefore the government of Suriname has decided to implement a project in which Nieuw Aurora will receive 24 hours electricity service per day, through the usage of solar power. This project is for designing, procuring, installation and testing of a solar power plant that will be used to provide the Nieuw Aurora Village in Suriname with 24 hours per day electricity service. This includes design of the system, procuring the solar system, installation of the solar panels, testing and commissioning of the system, closing out of the project and handing over of the project to operations. The solar system will be procured through a turnkey delivery from a solar system provider. Other external resources that will be acquired for this project are resources for the preparation of the solar sites.

2. Identify stakeholders

The Project Charter and the implementing and management agreement were used as input documents for the identification of the project stakeholders. An

implementing agreement was signed between the government of Suriname and the European Union and a management agreement was signed between the European Union and the IDB, prior to the start of the project. Tools and techniques that will be used for the identification process are expert judgment from relevant stakeholders, historical data from the Atjoni/Pokigron Solar Project, and meetings with the project team.

Roles and Responsibilities

In order to develop the Stakeholder Management Plan of the project, it is important that the roles and responsibilities of the different stakeholders are determined and documented. The roles and responsibilities and power and interest of the stakeholders have been listed below in chart 37.

Chart 37 Stakeholder Roles and Responsibilities, Power and Influence (Source: R. Paal, Author of the FGP, Oct 2019)

Role	Responsibilities, Power and Influence
The government of Suriname	The Government of Suriname (GoS) received parallel financing (a grant) from the European Union for the execution of this project. In terms of politics, the GoS might significantly be impacted by the outcome of this project. As such, this external stakeholder has high power and high interest in the project
Funding institution (The European Union)	The European Union provided parallel financing (a grant) for this project but will not be impacted by the project. As such this external stakeholder has high power but low interest in the project
IDB (overall project management)	IDB is an external stakeholder responsible for the overall project management. Up to a certain level the IDB can also be held responsible for overall project success. As such, the IDB is classified as having high power and high interest in the project

Role	Responsibilities, Power and Influence
Sponsor	The CTO from EBS is assigned to be the project sponsor. The sponsor provides resources and support for the project, and is accountable for enabling success. The CTO is classified as an internal stakeholder that has high power and high interest in the project
Project manager	The project manager is the person ultimately responsible for the successful completion of the project. The project manager is an internal stakeholder involved in the daily execution of the project. As such the project manager is classified as having high power and high interest in the project The project manager will be responsible for all aspects related to stakeholder engagement
Engineers, Procurement specialist, Financial Specialist, Administrative assistant	Those internal stakeholders are involved in the daily execution of the project but have relatively little power compared to the project manager. They have been classified as having low power but high interest in the project
Contractors	Contractors are external stakeholders responsible for the timely delivery of the various services, materials and equipment. This must be done according to the signed contracts. As such the contractors have been classified as a group with high interest but low power
EBS Operations and Maintenance team	EBS personnel are internal stakeholders that will support during test and commissioning and will be trained to maintain and operate the project after installation of the solar system. As such the EBS employees are classified as having low power but high interest in the project
Villagers	The villagers are the end users of the project but have no formal power when it comes to the project. They have been classified as external stakeholders that have low power and high interest in the project.

3. Plan Stakeholder Engagement

Based upon the results from the “identify stakeholders” process, the Stakeholder Register was developed, and the strategies for involving the stakeholders in project decisions and executions were documented. The communication plan will provide guidance regarding the methods, formats and technologies used for communicating with those stakeholders. One important aspect is that stakeholder engagement must start in the initiation phase of the project, because early engagement with the village community will contribute significantly to project success. The project team will carry out site visits to Nieuw Aurora on a regular basis to inform the community about the project and obtain their support. Especially the remote location of the village must be taken into consideration when planning the site visits. It will be the responsibility of the project manager to prepare presentations, hold regular meetings with all the stakeholders and manage stakeholder engagement.

Stakeholder Engagement Assessment

The Stakeholder Engagement Assessment matrix in chart 23, identifies gaps between the current (C) and desired (D) level of engagement of the stakeholders. The results of the analysis help to determine if additional communications measures are needed, and engagement gaps must be closed. The closing of the engagement gap between current and desired level of engagement will be of assistance to monitor stakeholder engagement.

The results from the Stakeholder Engagement Assessment matrix show that currently the contractors are unaware of the Aurora Project. The procurement department will collaborate with the project manager and engage with the contractors to bring awareness with respect to the project by means of emailing, telephone conversations, conference calls and presentations. This will be done in

order to get them to a leading level of engagement, which will contribute to project success.

The Stakeholder Engagement Matrix also shows that the desired level of engagement of EBS operations- and maintenance employees is currently neutral. It will be the responsibility of the project manager to engage with the employees and change their engagement level from neutral to leading in order to enhance project success.

The next step is the development of the Stakeholder Register. The Stakeholder Register for the Aurora Project together with the strategy that will be followed for engaging the stakeholders, can be seen below in chart 38.

Chart 38 Stakeholder Register (Source: R. Paal, Author of the FGP, Oct 2019)

n	Stakeholder	Main expectation(s)	Power / Interest	Strategy
1	The GoS	Aims to bring 24 hours per day electricity service to the community. and expects political gain after project success	H/H	This stakeholder will be engaged closely by formally communicating detailed project progress to this stakeholder at least twice a year
2	Funding institution (The European Union)	Wants the project to be completed successfully and in a timely fashion.in order to meet strategic objectives.	H/L	This stakeholder will be kept satisfied by executing the project according to the project plans and communicating the progress to the EU
3	IDB (overall project management)	Expects the project to be successfully completed in order to fulfill the management agreement.	H/H	Engage closely through meetings, telephone calls, conference calls, detail reports and site visits and provide project status and progress.
4	Sponsor	Expects the project to be successfully completed in order to obtain strategic goals for the company	H/H	Engage closely through one on one discussions, telephone calls, and high level reports and provide project status and progress.

n	Stakeholder	Main expectation(s)	Power / Interest	Strategy
5	Project manager	Expects the project to be successfully completed in order to build reputation for the company and or improve position or get a sense of accomplishment	H/H	Will be responsible for overall stakeholder engagement
6	Engineers, Procurement specialist, Financial Specialist, Administrative assistant	Expects the project to be successfully completed in order to build reputation and or improve position or get a sense of accomplishment	L/H	These stakeholders will be kept informed regarding project status, progress, activities and changes through meetings and reports
7	Contractors	Expects to get the contract awarded and thereafter execute the works in a successful manner in order to build business and receive financial gains.	L/H	These stakeholders will be kept informed regarding project status, progress and activities through meetings and reports They will be provided with the requirements of the services and/or products that must be delivered so they can deliver in a timely fashion.
8	EBS Operations and Maintenance team	Expects to receive proper training to support the project and operate it after completion of the project	L/H	These stakeholders will be kept informed regarding progress and activities through meetings. Prior to the test and commissioning of the project, the intensity of the engagement will be increased
9	Villagers	Expects to receive reliable 24 hours per day electricity service after project completion and expect the project to be delivered according to the project schedule	L/H	These stakeholders will be kept informed regarding project status, progress and activities through regular meetings in the village. The project manager must solicit for questions and concerns from the community so they can be answered or addressed.

4. Manage Stakeholder Engagement

Stakeholder management will be done according to the stakeholder engagement planning. Communication with all relevant stakeholders will be key when it comes to managing stakeholder engagement. The project manager will give presentations about the project and hold meetings on a regular basis with the different stakeholders. During the meetings, the stakeholders will be encouraged to forward the concerns they have regarding the project and the project manager will take the lead in addressing those concerns. Some of the site visits that will be carried out by members of the project team will also be used to manage the expectations from the villagers. During those visits, the project manager will provide updates regarding project objectives, status and progress to the community.

5. Monitor Stakeholder Engagement

Monitor Stakeholder Engagement will help to increase the efficiency and effectiveness of the stakeholder engagement strategies. Throughout the project, the project manager will be responsible for monitoring the relationships between the several stakeholders and modifying the stakeholder engagement strategies where needed. Work performance data including project status will help to determine if stakeholders are sufficiently engaged in the project and if there is sufficient support for it. The project manager will conduct regular meetings with the project team, the villagers and other stakeholders in order to monitor and assess the stakeholders' level of engagement and support for the project. If it appears that stakeholders are insufficiently engaged and if there is not sufficient support for the project, the project manager will submit a change request to the project sponsor with corrective actions to improve the level of stakeholder engagement. If and as soon as the change request is approved, the project manager will inform the project team. The Project Management Plan and related components and documents will be updated accordingly, followed by implementation of the change.

5. CONCLUSIONS

For the FGP, a Project Management Plan consisting of several subsidiary plans was developed for the Nieuw Aurora Project. The project is for designing, procuring, installation and testing of a solar power plant that will be used to provide the Nieuw Aurora Village in Suriname with 24 hours per day electricity service. The general conclusion for the development of the project management plan is that the plan provides the project team with a useful document to manage the Nieuw Aurora Project and improves as well as safeguards the project's chances of success. The plan consists of a Scope Management Plan, a Schedule Management Plan, a Cost Management Plan, a Quality Management Plan, a Resource Management Plan, a Communications Management Plan, a Risk Management Plan, a Procurement Management Plan and a Stakeholder Engagement plan. The Project Charter together with the PMBOK Guide 6th edition, and documentation obtained from digital documents and internet research have been used to develop the project management plan. Qualitative, quantitative and analytical research methods were employed together with templates and software programs such as MS Project and MS Excel. Due to the fact that the project is still in the planning phase, the emphasis of the Project Management Plan is on the initiation and the planning phases of the project. The development of the Project Management Plan provided the author of the FGP with a better understanding of the several project management knowledge areas that must be taken into consideration during project execution. The conclusions regarding the specific objections of the FGP are:

1. Specific objective number one was regarding the development of the Project Charter. The Project Charter is an important document that authorizes the existence of the project and authorizes the project manager to apply resources to the project activities. It is used as input document to develop the project

management plan and the other subsidiary plans, because it provides basic information regarding the project objectives, deliverables, the assumptions and constraints, the project schedule, the preliminary project budget and the preliminary list of project stakeholders.

2. Specific objective number two was regarding the development of the Scope Management Plan. This plan details how the “24 hours Solar Power for Nieuw Aurora” Project scope will be defined, developed, and verified, and acts as a guide for managing and controlling the project scope. In order to define the scope baseline for this project, the Scope Statement, Work Breakdown Structure (WBS) and WBS Dictionary were developed. The objective of this project is to install a solar photovoltaic system at Nieuw Aurora in order to provide the community with 24 hours per day electricity service.

3. The development of the Schedule Management Plan is also one of the specific objectives of the FGP. The Schedule Management Plan is required to manage the timely completion of the project. MS Project software was a useful tool to define the activities, sequence the activities, estimate the activity durations and develop the project schedule. The start date of the project is June 5th 2019 and the finish date is May 11th, 2022.

4 The Cost Management Plan is the fourth specific objectives of the FGP. It establishes how the project costs will be planned, structured, and controlled. The Cost Management Plan can be used to complete the project within the approved budget. The cost information for this project will be entered in a software program called Quickbooks. Microsoft Excel will also be used to develop templates for progress reporting on schedule activities and related costs. The project is financed by the European Union and the cost baseline amounts USD 1,339,000 with a

contingency reserve of USD 309,000. The project budget amounts USD 1,472,900 with a management reserve of USD 133,900.

5 The Quality Management Plan details in which manner and to which degree quality will be incorporated in the Aurora Project and how planning, managing and controlling of project and product quality requirements will take place. The plan is concerned with the quality that the project work and the deliverables need to have. Included in the Quality Management Plan are the key factors related to quality, the quality metrics, and the quality activities matrix. The main quality objectives regard the delivery of a 180 kW peak solar system that is according to standard and customers' expectation and capable of delivering 24 hours electricity service to the Nieuw Aurora community.

6 Specific objective number six regards the completion of the Resource Management Plan for the Nieuw Aurora project. The Resource Management Plan defines how to identify, acquire, and manage the resources needed for the successful completion of the project. The plan includes the organizational structure of the project, the RACI chart of the stakeholders, and the resource histogram. The project team consists of the project manager, three engineers, one financial specialist, one procurement specialist, an administrative assistant and an EBS operations and maintenance team. Separate contracts will be signed with contractors or companies for removal of vegetation from the project site and the turnkey delivery of the solar plant.

7 The Communication Management Plan was developed as part of specific objective number seven. The plan will serve as a guide for communications throughout the life cycle of the Aurora Project. It will ensure that the information needs of the project and its stakeholders are met, and that information is exchanged as required for the successful completion of the project. The plan

includes a Stakeholder Engagement Assessment Matrix and a Stakeholder Communications Matrix that maps the communication requirements of this project. Especially the communication with the village community will be very important for the successful completion of the project.

8 For specific objective number eight, a Risk Management Plan for the Nieuw Aurora Project was developed. The plan includes a qualitative and quantitative analysis of the project risks. Through those analyses, the plan determines the most significant risks of the project, develops responses to those risks and details how risks responses will be implemented. The plan includes a Risk Breakdown Structure and the Risk Matrix as well. The quantitative analysis shows that the amount of contingency reserve that must be available to cover the project risks amounts USD 143,970. In particular, the development of the quantitative risk analysis presents significant challenges because of the subjectivity of the probability factors and uncertainties in estimating the cost impacts and monetized schedule and quality impact of a potential risk.

9 The Procurement Management Plan was developed for specific objective number nine and includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team. The plan also details how the Aurora Project agreements will be developed and administered, and specifies the products and services that will be procured and the type of contracts that will be used to procure them. As for the Aurora Project, we can conclude that two main procurement processes will be conducted. The procurement of works for the site preparation through a National Competitive Bidding (NCB) process. This activity involves the removal of trees and vegetation from the site where the solar panels will be installed. The other procurement regards the turnkey delivery of the solar plant through an International Competitive Bidding (ICB) process.

10 The final specific objective of the FGP was the development of the Stakeholder Management Plan. The plan identifies the people, groups or organizations that could impact or be impacted by the Nieuw Aurora Project. It also defines the roles and responsibilities of the relevant stakeholders and determines their power and interest and develops strategies to engage them in project decisions and executions.

The Stakeholder Register and the Stakeholder Engagement Assessment Matrix are also included in the Project Management Plan. The results from the Stakeholder Engagement Assessment matrix show that the contractors are unaware of the Aurora Project and that the desired level of engagement of EBS operations and maintenance employees is currently neutral. It will be the responsibility of the project manager to change and improve those engagement levels to the desired levels.

6. RECOMMENDATIONS

For the FGP, the Project Management Plan was developed for the Nieuw Aurora Project. The recommendation is that the project team should use this plan to execute the project because this will significantly increase the chances of success of this project. Another recommendation is that the project management plan is a living document that must be reviewed on a regular basis and updated as required in order to adapt to possible changes that could impact the project. A mandatory requirement is that all changes must be processed through the Perform Integrated Change Control Process, and approved changes must be communicated to the project team and relevant stakeholders.

1. Specific objective number one was regarding to the development of the Project Charter. The Project Charter is an important document that authorizes the existence of the project and authorizes the project manager to apply resources to the project activities. Changes to the Project Charter should be carefully considered once this document has been approved by the project sponsor because this could significantly impact all the other subsidiary plans.

2. Specific objective number two regards the development of the Scope Management Plan. This plan details how the “24 hours Solar Power for Nieuw Aurora” Project scope will be defined, developed, and verified, and acts as a guide for managing and controlling the project scope. The project team should be aware and avoid occurrences of scope creep and gold plating.

3. The development of the Schedule Management Plan is also one of the specific objectives of the FGP. The Schedule Management Plan is required to manage the timely completion of the project. The project schedule must be used to communicate to stakeholders when certain activities are expected to take place in

order to make sure that they can anticipate and prepare in advance. Especially the village community must be informed about the completion date of the project. If schedule slip occurs, the project manager together with the project team has to look for options to get the project back on track.

4 The Cost Management Plan is the fourth specific objectives of the FGP. It establishes how the project costs will be planned, structured, and controlled.
The recommendation for this specific objective is that the estimate to complete the remaining project work forecast should be made at least once a month and if a cost overrun is forecasted this should be escalated to the project sponsor immediately. The contingency reserve must not be used for other purposes until after the bids from the contractor for the delivery of the solar plant has been received. After the bids have been received and evaluated, the project may be able and allowed to start using the contingency reserve for other purposes, with approval from the project sponsor.

5 The Quality Management Plan details in which manner and degree quality will be incorporated in the Aurora Project and how planning, managing and controlling of project and product quality requirements will take place. It will be of utmost importance for the project team to adhere to the Quaity Management Plan from the beginning of the project in order to deliver a succesfull project of good quality. It is therefore recommended that the project manager includes quality as a separate and specific topic to the agenda of the project team meetings.

6 Specific objective number six regards the completion of the Resource Management Plan for the Nieuw Aurora Project. The Resource Management Plan defines how to identify, acquire, and manage the resources needed for the successful completion of the project. Very often over allocation of human resources is an issue in the execution of projects within the company. It is therefore

recommended that the project manager gets a clear understanding of the availability of the project team and works with the project sponsor to ensure that the members of the project team are not over allocated.

7 The Communication Management Plan was developed as part of specific objective number seven. The plan will serve as a guide for communications throughout the life cycle of the Aurora Project. It will ensure that the information needs of the project and its stakeholders are met, and information is exchanged as needed for the successful completion of the project. Especially the communication with the village community will be very important in order to address their expectations and successfully complete the project. Due to the remote location of the village, it is recommended to obtain detail contact information from representatives of the village and establish proper communication methods and channels with them.
Especially in the beginning of the project, the project manager must hold meetings with the team to explain the roles and responsibilities of the team members in order to create a clear understanding of the reporting structure and the roles and responsibilities.

8 For specific objective number eight, a Risk Management Plan for the Nieuw Aurora Project was developed. The plan determines the most significant risks of the project, develops responses to those risks and details how risks responses will be implemented. The plan includes a qualitative and quantitative analysis of the project risks. Especially the development of the quantitative risk analysis presents significant challenges because of the subjectivity of the probability factors and uncertainties in estimating the cost impacts and monetized schedule and quality impact of a potential risk. It is recommended that this analysis is revisited on a monthly basis until the project manager feels comfortable with the amount that is determined by the analysis.

9 The Procurement Management Plan was developed for specific objective number nine and includes the processes necessary to purchase or acquire products, services, or results needed from outside the project team. The plan also details how the Aurora Project agreements will be developed and administered, and specifies the products and services that will be procured and the type of contracts that will be used to procure them. It is recommended that the project manager explains the procurement processes that will be followed, to the team and emphasizes that all procurement should go through the procurement department.

10 The final specific objective of the FGP was the development of the Stakeholder Management Plan. The plan identifies the people, groups or organizations that could impact or be impacted by the Nieuw Aurora Project. It also defines the roles and responsibilities of the stakeholders, and determines their power and interest and develops strategies to engage them in project decisions and executions. Stakeholder engagement and communication with the villagers will play an important role in the execution of the project. The project manager must take an active and leading role in communicating with all the project stakeholders.

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APPENDICES

Appendix 1: FGP Charter

PROJECT CHARTER Formalizes the project start and confers the project manager with the authority to assign company resources to the project activities. Benefits: it provides a clear start and well defined project boundaries.	
Date	**Project Name:**
May 19 2019	Project Management Plan for project "24 hours Solar Power for Aurora"
Knowledge Areas / Processes	**Application Area (Sector / Activity)**
Knowledge areas: Project Integration Management, Project Scope Management, Project Schedule Management, Project Cost Management, Project Quality Management, Project Resource Management, Project Communications Management, Project Risk Management, Project Procurement Management, Project stakeholder Management **Process groups:** Initiating Planning	Power sector Engineering Consultancy
Start date	**Finish date**
May 13, 2019	November 08, 2019
Project Objectives (general and specific)	
General objective: To create a Project Management Plan framed within the standards of the Project management Institute in order to manage the project "24 hours Solar Power for Nieuw Aurora". **Specific objectives:** 1 To develop a project charter in order to formally authorize the project and provide the project manager with the authority to apply organizational resources to the project 2 To develop a scope management plan to ensure that the project includes all the work required, and only the work required to successfully complete the project 3 To create a schedule management plan to manage the timely completion of the project 4 To create a cost management plan to define the processes for planning, estimating, budgeting, financing, funding, managing and controlling costs so that the project is completed within the approved budget 5 To develop a quality management plan to incorporate the organization's quality policy in order to meet stakeholders' objectives 6 To create a resource management plan to identify, acquire, and manage the resources needed for the successful completion of the project 7 To develop a communications management plan to ensure that the information needs of the project and its stakeholders are met 8 To create a risk management plan in order to optimize the chances of project success	

9 To create a procurement management plan to purchase products services or results needed from outside the project team
10 To create a stakeholder engagement plan to develop strategies to engage stakeholders in the work of the project

Project purpose or justification (merit and expected results)

The purpose of this project is to develop a project management plan for the project "24 hours Solar Power for Nieuw Aurora".
Nieuw Aurora is a village in the interior of Suriname, far away from the capital city. The village currently has only 4 hours electricity service per day, from 7:00 PM to 11:00 PM. This limited electricity supply is hampering the development of the village community and therefore the government of Suriname decided to implement a project in which Nieuw Aurora will receive 24 hours electricity service per day through the use of solar power.

The first Solar project of this kind in Suriname was commissioned last year February 2018 and this Project served as a pilot to provide an isolated village in the interior of Suriname with 24 hours electricity service by means of renewable energy technologies. After this project was successfully completed, the Government of Suriname started with a countrywide initiative to provide all the villages (131 in total) in the interior of Suriname with 24 hours electricity service by using the same model.

A project team from the engineering department from the Suriname National Electricity company, has been assigned to execute the "24 hours Solar Power for Nieuw Aurora" project. In order to properly manage the project and perform Project Integration Management, a Project Management Plan will be developed through the use of the Project Management Institute standards.
This Project Management Plan will provide the project team with a document that can be used as input for the various project management processes. This will help the team to execute the project within the project constraints and improve project success.

Description of Product or Service to be generated by the Project – Project final deliverables

The following deliverables are part of this project:

1. An approved project Charter
2. The Project Management Plan for the 24 hours Solar Power for Aurora project, including subsidiary documents that are part of the Project Management Plan

Assumptions

1. All the information required to develop the Project Management Plan for this project will be available or be made available in a timely fashion
2. There will be sufficient resources (tutor and reviewers) available to allow the development of the Project Management Plan within a maximum of 3 months
3. The requirements to start with the Final Graduation Project (e.g. successful completion all of the previous courses in the program, payment and registration) will have been fulfilled by July 28 2019
4. The tutor's approval of the final version of the FGP document profile will be obtained ultimately June 23, 2019

Constraints

1. The FGP must be developed on a tight and stringent schedule and must be completed by November 2019
2. The Project Management Plan must be developed according to PMI standards and UCI guidelines
3. The FGP has limited execution times – three months or less – there most probably will be no time to include the elements related to the control, implementation or closure elements of the project or of its

phases

Preliminary risks

1. Solar power projects are new to Suriname and if the required knowledge, skills and expertise to develop the subsidiary project management documents is missing this might negatively impact the project schedule

Budget

USD 300

Milestones and activity dates

Milestone/activity	Start date	End date
Final graduation Project	May 13, 2019	Nov 8, 2019
Final graduation Project start	May 13, 2019	May 13, 2019
Project Charter	May 13, 2019	May 17, 2019
FGP Work Breakdown Structure (FGP WBS)	May 13, 2019	May 17, 2019
Introduction Chapter	May 20, 2019	May 24, 2019
FGP Schedule	May 20, 2019	May 24, 2019
Theoretical Framework chapter	May 27, 2019	May31, 2019
Methodological Framework chapter	Jun 03, 2019	Jun 07, 2019
Executive Summary	Jun 10, 2019	Jun 16, 2019
Bibliography, Indexes	Jun 03, 2019	Jun 07, 2019
Signed Charter -Approval	Jun 10, 2019	Jun 14, 2019
FGP Charter approved	Jun 14, 2019	Jun 14, 2019
Final graduation Project planning phase start	Jul 29, 2019	Jul 29, 2019
Tutoring process	Jun 17, 2019	Sep 13, 2019
Reading by Reviewers	Sep 16, 2019	Oct 04, 2019
Adjustments	Oct 07, 2019	Nov 01, 2019
Presentation to board of examiners	Nov 04, 2019	Nov 08, 2019
Final graduation Project Approved	Nov 08, 2019	Nov 08, 2019

Relevant historical information

Normally a project of this nature is managed inside the company by using an operations manual developed especially for the project.
This is the first time that a Project Management Plan using PMI standards and UCI guidelines will be developed for a solar power plant project within the company.

Stakeholders

Direct stakeholders:

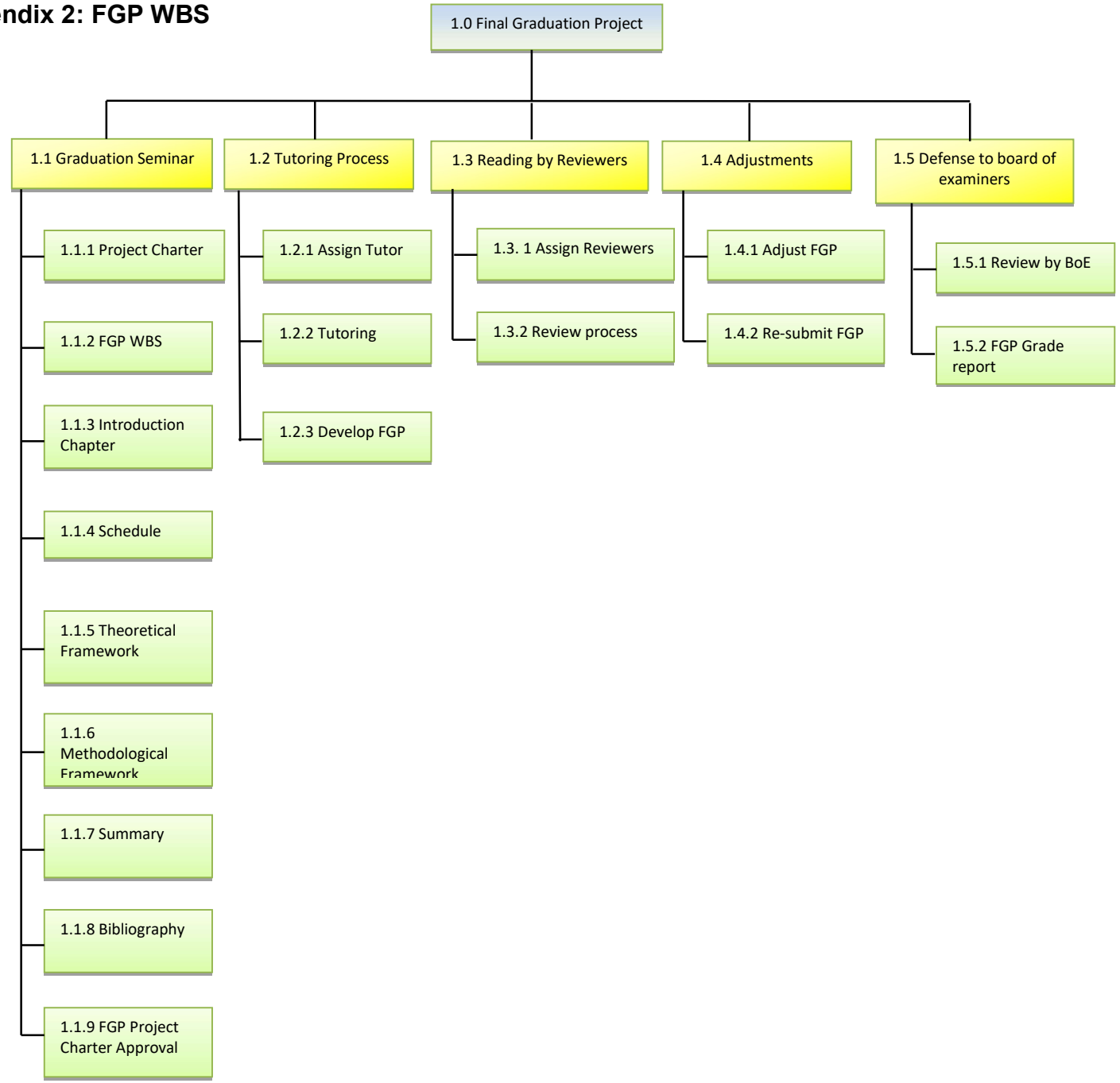
1. FGP Seminar Lecturer – Mr. Carlos Brenes
2. FGP Tutor
3. FGP Reviewers
4. FGP Project Manager – Richard PaaL
5. FGP Company Sponsor

Indirect stakeholders:

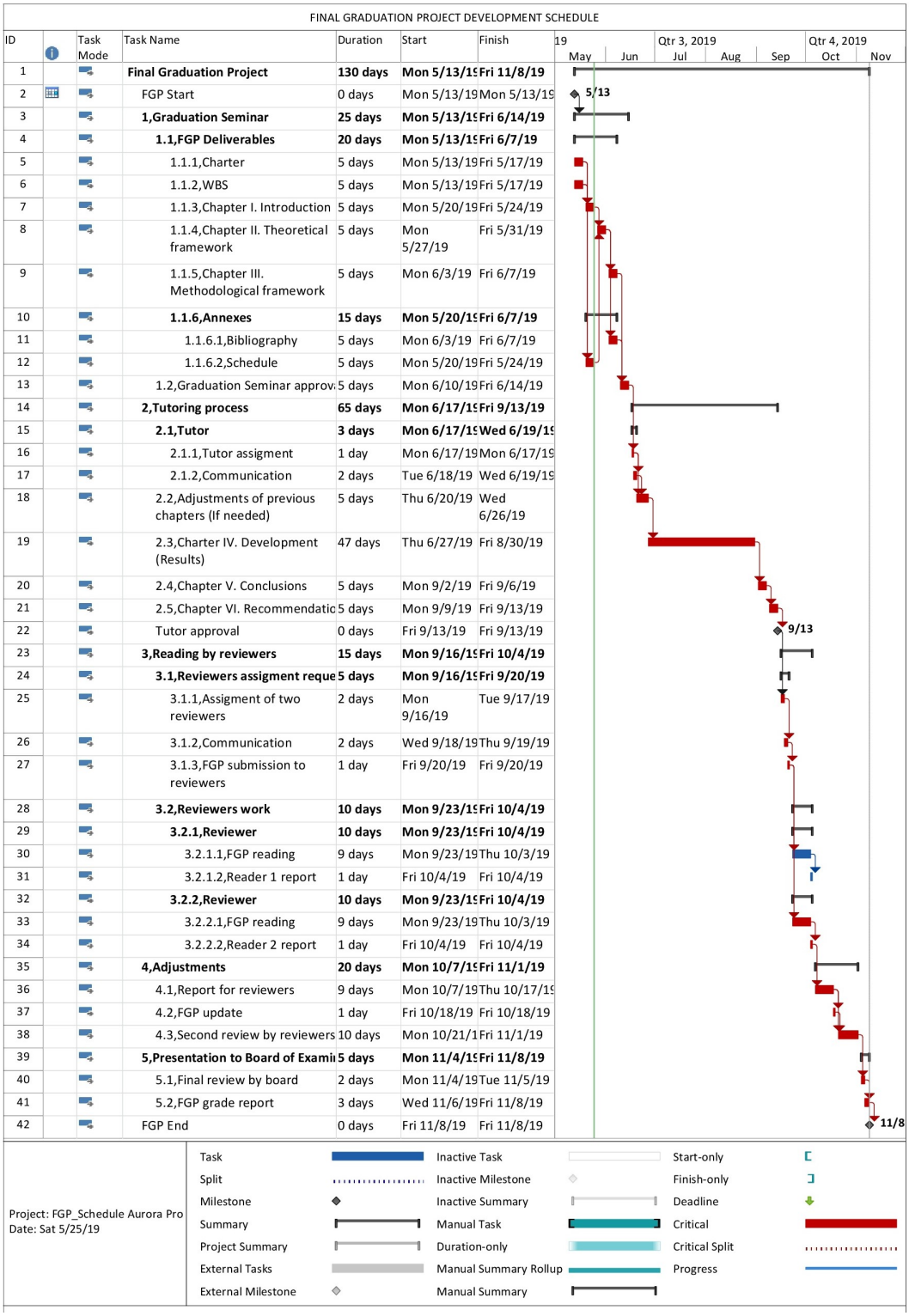
1. Academic Assistant- Gabriela Zúñiga
2. Subject Matter experts in the field of Solar Power Plants

Project Manager: Richard Ceasar Paal	**Signature:** 
Authorized by: Carlos Brenes	**Signature:**

Appendix 2: FGP WBS



Appendix 3: FGP Schedule



Appendix 4: Nieuw Aurora Project Charter

PROJECT CHARTER Formalizes the project start and confers the project manager with the authority to assign company resources to the project activities. Benefits: it provides a clear start and well defined project boundaries.	
Date	**Project Name:**
Aug 18, 2019	24 hours Solar Power for Nieuw Aurora
Project benefits	
This project will ensure that every household and customer of the Nieuw Aurora village has access to reliable energy 24 hours per day. The access to electricity 24 hours per day will positively affect the community and household practices, social relations and the local economy. This project will also increase eco-tourism and will bring positive business and developmental impacts in the community. Because the existing diesel generator sets will be replaced by a solar pv system, the negative environmental impacts such as carbon emissions and diesel oil spills will be significantly reduced.	
Start date	**Finish date**
Jun 05, 2019	May 11, 2022
Project Objectives (general and specific)	
General objective: To install a Renewable Energy Technologies (RET) system at Nieuw Aurora in order to provide reliable electricity access to the village. **Specific objectives:** 1 To install a solar photovoltaic (PV) system in Nieuw Aurora in order to provide the village with 24 hours electricity service 2 To install a battery backup system in order to ensure the provision of electricity when there is a lack of solar power 3 To connect the solar power plant to the existing electricity network from Aurora in order to distribute the power to the customers	
Project purpose or justification (merit and expected results)	
The purpose of this project is to provide 24 hours Solar Power to Nieuw Aurora through the use of solar energy. Nieuw Aurora is a village in the interior of Suriname, 220 km away from the capital city Paramaribo. The village currently has only 4 hours electricity service per day, from 7:00 PM to 11:00 PM. This limited electricity supply is hampering the development of the village community and therefore the government of Suriname decided to implement a project in which Nieuw Aurora will receive 24 hours electricity service per day through the use of solar power. The first solar project of this kind in Suriname was commissioned in February 2018 and this project served as a pilot to provide an isolated village in the interior of Suriname with 24 hours electricity service by means of renewable energy technologies. After this project was successfully completed, the Government of Suriname started with a countrywide initiative to provide all the villages (131 in total) in the hinterland of Suriname with 24 hours electricity service by using the same model. A project team from the national electricity company EBS has been assigned to execute the “24 hours Solar Power for Nieuw Aurora” project.	
Description of Product or Service to be generated by the Project – Project final deliverables	
The following deliverables are part of this project: 1. A solar plant complete with battery back-up system	

Assumptions

1. A plot of land will be made available by the village in order to install the solar panels
2. The growth of the number of households after project start will be according to a business as usual scenario
3. Transportation cost over the river will conform to the rates used by the local boat owners

Constraints

1. The project budget is set at USD 1.47 MM
2. The project must be completed ultimately June 9, 2022 (this is when the Implementing agreement expires)
3. Approximately 500 customers will be connected to the solar system

Preliminary risks

1. Solar power projects are new to Suriname and if the required knowledge, skills and expertise to execute the project is insufficient this will negatively impact the project progress.
2. Equipment or material damage during transport and handling, especially during transport over the rapids in the river.
3. The village can be flooded during the rainy season thus hampering project activities

Budget

USD 1.47 MM USD

Milestones and activity dates

Milestone/activity	Start date	End date
Nieuw Aurora Project	June 5, 2019	May 11, 2022
Project start	June 5, 2019	June 5, 2019
Mobilization	June 5, 2019	June 25, 2019
Site visits and data collection	June 26, 2019	Oct 15, 2019
Basic Engineering and Design	Aug 07, 2019	Dec 10, 2019
Procurement process for turnkey delivery of solar plant	Dec 11, 2019	June 10, 2020
Detail engineering	June 11, 2020	Oct 14, 2020
Fabrication of solar panels	Oct 15, 2020	Mar 31, 2021
Solar panels fabricated	Mar 31, 2021	Mar 31, 2021
Factory Acceptance Testing of solar system	Apr 01, 2021	Apr 07, 2021
Shipping of solar panels	Apr 08, 2021	May 19, 2021
Solar panels to site	May 20, 2021	June 02, 2021
Construction	June 03, 2021	Oct 06, 2021
Construction complete	Oct 06, 2021	Oct 06, 2021
Commissioning	Oct 07, 2021	Nov 03, 2021
Commissioning complete	Nov 03, 2021	Nov 03, 2021
Punch list Items	Nov 03, 2021	Dec 15, 2021
Contingency (Schedule)	Dec 16, 2021	Mar 30, 2022
Close out project and hand over to operations	Mar 31, 2022	May 11, 2022

Relevant historical information

EBS has installed only one PV solar power plant to date. The plant was installed in a village called Pokigron, has a capacity of 500 kW peak and was commissioned in February 2018. Because of this project, there is some expertise and historical data available relevant to the Aurora project.

Stakeholders

Project stakeholders:

1. The Government of Suriname
2. The Inter-American Development Bank (IDB)
3. The European Union (EU)

4. End users (villagers) 5. The project team 6. EBS internal stakeholders 7. The project sponsor (Chief Executive Officer) 8. Contractors	
Project Manager: Richard Ceasar Paal	**Signature:**
Authorized by:	**Signature:**

Appendix 5: Philologist Review Letter

October 20th, 2019

Mr.Ing. Osvaldo Martínez G. MAP, MSc.
ITILv3®, ITIL OSA®, CSSGB®,GPM-b®,PSM®, PMP® & DevOps® Certified.
UNIVERSITY FOR INTERNATIONAL COOPERATION

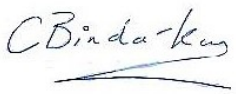
Re: Philologist Approval for Final Graduation Project Review and Correction

Dear Mr. Osvaldo Martínez,

I, Cynthia Binda-Karg with identity card number EI 005792, with an undergraduate degree in Teaching English as a Foreign Language from Instituut voor Opleiding van Leraren (Institute for Higher Vocational Education for Teachers in Suriname), graduated in 1990, and work experience as a full-time English proofreader and translator for the Brazilian Embassy in Suriname from 1990-1998, and full-time (junior) high school English teacher since 1998, declare that I, as a professional in the field of Philology, have reviewed and corrected the Final Graduation Project (FGP) of Mr. Richard Paal, entitled *'A Project Management Plan for Project 24 Hours Solar Power for Nieuw Aurora',* dated October 2019.

The FGP document now meets the proper philological quality in terms of proper writing, spelling and grammar, as stipulated by the University and is corresponding to a master's level work. It is a requirement of the University that the final version of the FGP document for a Master in Project Management, to be awarded by the University for International Cooperation, is reviewed and corrected by a professional in the field of philology.

Yours sincerely,



Cynthia Binda-Karg

Undergraduate degree in Teaching English as a Foreign Language from Instituut voor Opleiding van Leraren in Suriname (IOL)

Full time (junior) high school English teacher / English proofreader and translator