

Technical Tender Specifications for Bartica 1.5MWp Solar PV Farm 13.8kV Interconnecting Line

September 9, 2021

Project: Renewable Energy Solution for the Hinterland - Bartica
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Site: Bartica, Essequibo River, Guyana

This document provides the technical specifications for the Supply and Installation of a 2.8 km, 13.8kV three (3) wire transmission line and a fiber optic communication link for the interconnection of the proposed 1.5 MW Bartica Solar Farm to GPL's existing power plant. This document is an Annex of the Bidding package prepared by Guyana Energy Agency with IDB procurement templates.

Revision log:

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Acronyms:

EA	Executing Agency
DG	Distributed Generation
DOD	Depth of Discharge
EPA	Environmental Protection Agency
ESAR	Environmental and Social Analyst Report
ESMP	Environmental and Social Management Plan
ESRA	Electricity Sector Reform Act 1999
GEA	Guyana Energy Agency
GEI	Government Electrical Inspectorate
GoG	Government of Guyana
GPL	Guyana Power & Light
GYD	Guyana Dollar
H&S	Health and Safety
HECI	Hinterland Electrification Company Inc.
IDB	Inter-American Development Bank
kWh	Kilo Watt Hour
kWp	Kilo Watt Peak
LCOE	Levelized Cost of Energy
LFO	Light Fuel Oil
MoPI	Ministry of Public Infrastructure
MWp	Mega Watt Peak
O&M	Operation and Maintenance
PCU	Project Coordinating Unit
PUC	Public Utilities Commission
RE	Renewable Energy
RET	Renewable Energy Technology
T&D	Transmission and Distribution
USD	United States Dollar

1 Introduction

1.1 Hinterland Electrification Programme

- 1.1.1 Guyana is 98% dependent on imported fossil fuel for its energy needs. The cost and reliability of electricity are also recognized by the Government as a major factor for profitability and efficiency in business operations, especially in energy-intensive industries such as manufacturing.
- 1.1.2 To counter this vulnerability, Guyana, in its revised National Energy Policy and Green State Development Strategy, has re-committed itself to the development of its indigenous renewable energy resources and to pursue 100% renewable energy in electricity generation.
- 1.1.3 The project is being facilitated by the Ministry of Public Infrastructure (MoPI) of the Government of Guyana (GoG) as part of the national development priority to transition to renewable energy sources and to ensure stable, reliable and economic energy supply for all in Guyana. The Guyana Energy Agency (GEA) has been identified as the Executing Agency (EA) and a Project Coordinating Unit (PCU) dedicated to the project has been established. The main objectives of the project are to reduce fossil fuel consumption for electricity generation, increase energy security particularly for hinterland utilities and support of Government's drive for a greener economy.

1.2 Bartica

- 1.2.1 Bartica, located in Administrative Region 7 (Cuyuni-Mazaruni), is considered the gateway to the interior locations and has been designated to be Guyana's first Green Town. The 'Green Bartica Plan' is a Government of Guyana initiative that involves a holistic approach to sustainable economic growth in the township. The main objectives of the plan are to create a climate resilient economy and to establish a green pathway for the foundation of a new Guyana, which will result in reducing the overall carbon footprint in electricity, agriculture, fisheries, water, forestry, waste, manufacturing, transport, construction, tourism and other sectors.
- 1.2.2 The town has a population of about fifteen thousand (15,000) whose main economic activities stem from the extractive industries such as logging and mining as well as commerce. The town has four (4) nursery schools, five (5) primary schools and two (2) secondary schools. Several government entities including the Town Council and the Regional Democratic Council are in Bartica. The town also has a Regional Hospital, a Community Centre, Police and Fire Stations, and several Commercial Banks and Hotels.

1.3 Electrical demand

- 1.3.1 Electricity is provided on a 24-hour basis from an island diesel grid with an installed capacity of 3.36 MW that is operated by the Guyana Power and Light Inc. (GPL). Consumers currently pay GY\$39.1-43.08 per kWh (<http://gplinc.net/bill/rates-and-tariffs/>). Fuel accounts for about 70% of operational costs and the current peak load are about 1.6 MW. However, the peak demand grew up to over 3 MW during the period of high gold price in 2009-2010.

1.4 Diesel Power Generation

- 1.4.1 The distribution grid and the power plant are managed by GPL.
- 1.4.2 The electrical demand of Bartica is provided by a new diesel generation plant, which was commissioned in December, 2019.
- 1.4.3 The installed generation capacity at the diesel power station is 3.36 MW. There are three (3) C1250 D6 Model Cummins Diesel Generator Sets with Power Command 3.3 Control System with each having the capacity of 1.12 MW prime-rated and 0.8 MW continuous rating. The nominal terminal voltage of the generator set and bus voltage at the power station is 13.8 Kilovolts, however, during operation, this bus voltage can range between 1.0 pu – 1.05 pu.
- 1.4.4 The power plant floor plan and site plan are presented in Annex 1.1 and Annex 1.2 respectively.
- 1.4.5 Annex 1.3 provide a single line interconnection diagram for the Bartica power Plant.

1.5 Bartica solar PV Farm

- 1.5.1 The proposed site for the 1.5 MWp solar PV farm is located at latitude 6.365779° and longitude - 58.626475°. The site is approximately 10 acres and is located 5 km from central Bartica by a combination of road and existing footpaths, and 2.2 km away by road and existing footpath from GPL's 3.36MW diesel power generation station.

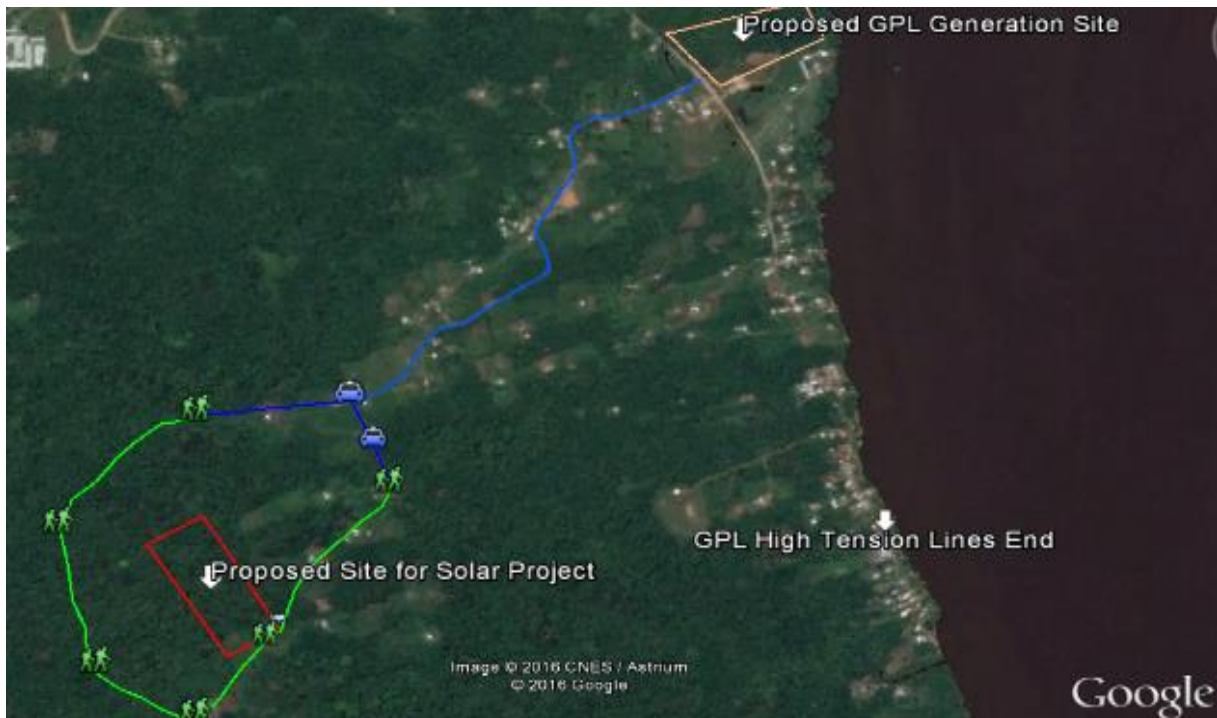


Figure 1: Solar PV farm and GPL power plant location

1.5.2

1.5.3 *Figure 1* provides a google earth image of the proposed location of the solar PV farm and GPL's new power plant location. Annex 1.4 provides more information on the location of the solar farm and the GPL power plant. As requested by this tender, the new 2.8 km long, 13.8 kV, three wire (3W), three phase, bare conductor overhead transmission line shall be built to interconnect the solar PV plant to the existing 13.8kV busbar in the GPL's power plant.

1.5.4 The supply and installation of a fiber optic communication link between GPL's diesel power plant and the new solar PV power plant is also included in the scope of this tender.

1.6 Stakeholders

1.6.1 The Inter-American Development Bank (IDB) is the funding agency for the Turnkey Delivery of the solar PV plant as well as the supply and installation of the proposed transmission line (see the scope of work list in *Item 2.1*). Procurement and contracting will follow the IDB's standard procedures and templates.

1.6.2 The Guyana Energy Agency (GEA) is the executing agency. GEA has established a Project Coordinating Unit (PCU) for this project.

1.6.3 Guyana Power and Light Inc. is the operator of Bartica Power Plant and Bartica Transmission and Distribution Grid.

1.6.4 The PCU will be responsible for the administrative, technical and operational management of the project during tendering, contracting and implementation phase. The PCU will act as a liaison between the Contractor and all stakeholders which include but are not limited to GEA, GPL and IDB.

2 Scope of Work

2.1 This scope of work describes the requirements for the Bartica 1.5MW Solar PV Farm 13.8kV Interconnecting Line as follows:

2.1.1 Lot 1

- Supply all materials, specialized equipment and construct a 2.8 km long, 13.8 kV, three wire (3W), three phase, bare conductor, overhead interconnecting line between Bartica 1.5 MWp Solar PV Farm and GPL's 3.3 MW Power Plant at Dagg Point Bartica.

2.1.2 The transmission line to be built will serve as an 'express' line and will only be utilized to transport power from the 1.5 MWp solar PV Farm to GPL's 3.3 MW Power Plant at Daag Point.

2.1.3 The design, supply and construction of the Transmission Line must comply with the **National Grid Code** which can be found in Annex 3.

2.1.4 The following civil works must be provided by the Contractor: Site Clearance and Land Preparation, and Foundations as required:

2.1.4.1 Survey right of way of line, identify pole locations and mark pole position in accordance with line design drawing provided in Annex 1.5 Bartica Proposed Transmission Line Design-Route;

2.1.4.2 Trim trees and clear vegetation that are within the right-of-way of the interconnecting line and work area that will be used to construct said line;

2.1.5 The Contractor shall provide a Quality Control Plan, a Health and Safety Plan and Environmental and Social Management Plan and follow the procedure for the Fauna Rescue and Redistribution Plan as proposed in the Environmental and Social Analysis Report (ESAR). All works must comply with the mentioned plans.

2.1.6 Special attention must be paid to the tropical, high humidity environment with regard to the selection of the materials to be used and supporting structures.

2.2 This scope of work describes the requirements for the Bartica 1.5MW Solar PV Farm Optical Ground Wire communication link and lightning protection:

2.2.1 Supply all materials, specialized equipment and install 3,500 metres long Optical Ground Wire (OPGW), and associated line support hardware, at the top of all poles of the 13.8kV transmission line described in section 2.1. The OPGW shall provide the function of communication and lightning protection of the interconnecting line between GPL's diesel power plant and the new solar PV power plant.

2.2.2 The OPGW to be installed shall be capable of withstanding the rigors of outdoor installation for a lifetime of up to 20 years.

2.2.3 The cable must have a wide operating-temperature range, be resistant to sunlight and moisture, and have sufficient tensile strength for long pull distances.

2.2.4 The cable structure must isolate the fiber optic cable from the mechanical stresses that can be induced throughout the cable's service life.

3 Technical Specifications – General

3.1 Introduction

3.1.1 Overhead transmission line:

All designs, materials, installations and services under this tender shall comply with the following:

- Relevant standards and publications of the International Electrotechnical Commission (IEC) for electrical equipment.
- NESC and confirm to standard overhead line construction guidelines and practices;
- Sag and Tension of Tulip (AAC) conductor must confirm to standard overhead line construction guidelines and practices;
- All poles must be treated Wallaba type;
- All crossarms must be treated Purpleheart type;
- All medium voltage power cable must be copper conductor;
- All works will be subjected to inspections by GPL's Authorized Personnel; and
- GPL's National Grid Code¹
- EPA's Permitting Requirements for transmission line (if applicable).
- Approved Contractor must have previous experience in construction of Overhead Distribution Lines.

3.1.2 OPGW – Lightning Protection and Communication link.

All designs, materials, installations and services under this tender shall comply with the following:

- Relevant standards and publications of the International Electrotechnical Commission (IEC) for optical telecommunication cables, commonly with single-mode fibres used primarily in overhead power lines applications electrical equipment (IEC 60794-4-20:2018)
- ANSI/ICEA S-87-640 - Optical Fiber Outside Plant Communications Cable
- Approved Contractor must have previous experience in the installation of the required OPGW cables.

3.1.3 The monthly average temperature, cloud cover, precipitation, rainfall, sunshine, wind speed and wind direction are shown below. It should be noted that these are indicative conditions and therefore it is strongly recommended that the Contractor conduct his/her own assessment at the site.

¹ http://gplinc.net/sites/default/files/renewable_energy/GPL%20National%20Grid%20Code%20Final_0.pdf

Temperature

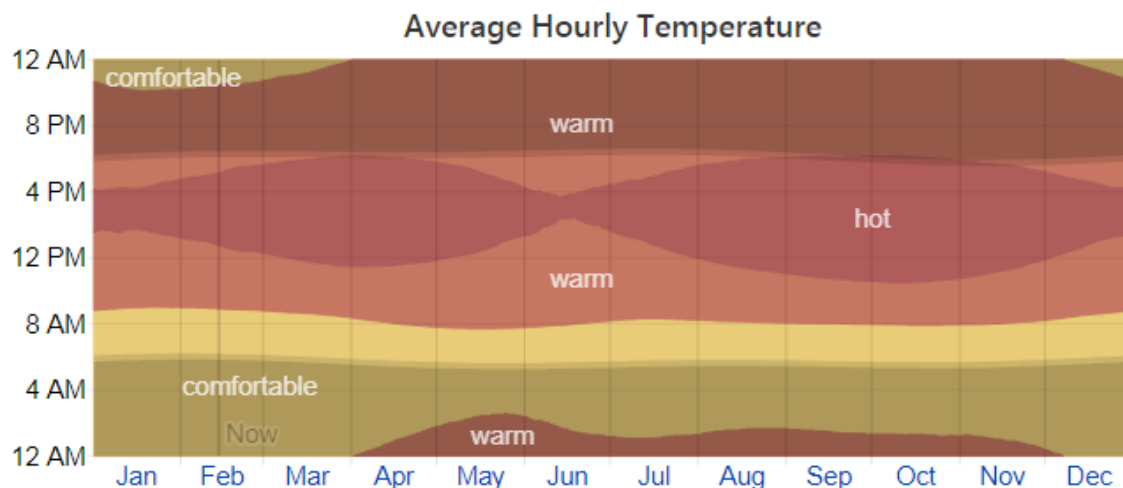


Figure 1: Average hourly temperature, color coded into bands. The shaded overlays indicate night and civil twilight.

Figure 2 gives a compact characterization of the entire year of hourly average temperatures. The horizontal axis is the day of the year, the vertical axis is the hour of the day, and the colour is the average temperature for that hour and day.

Cloud Cover

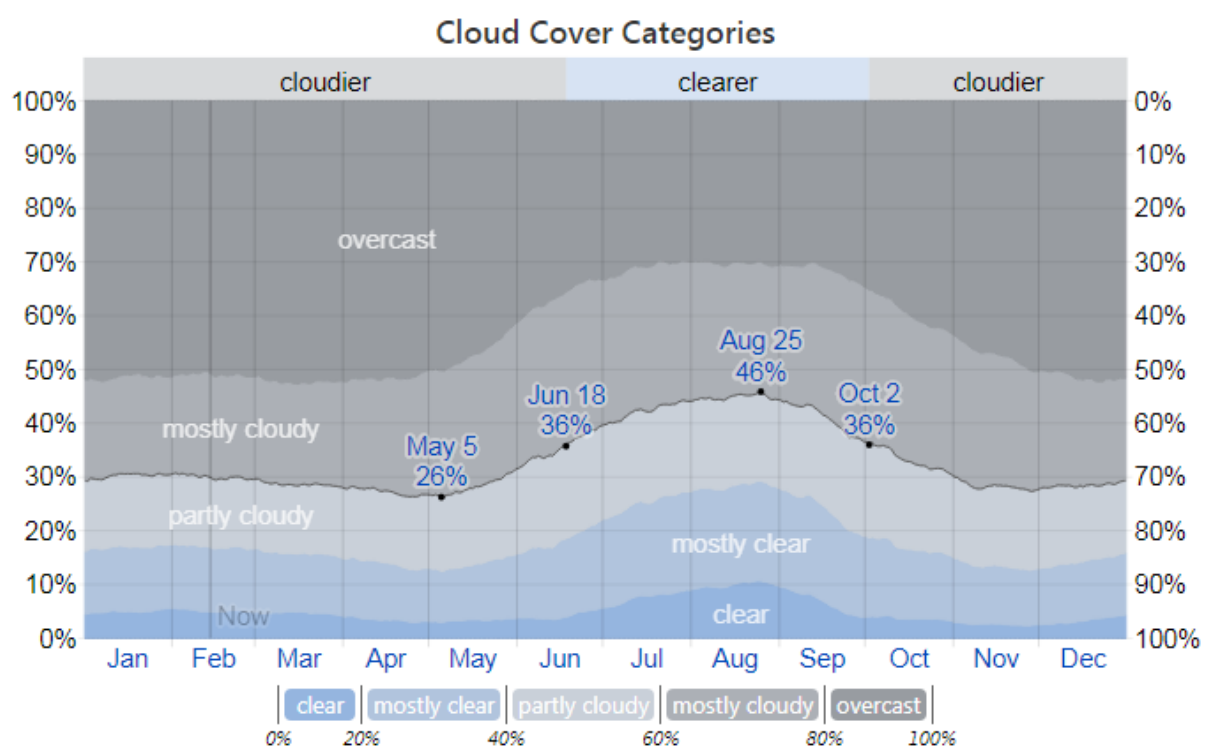


Figure 2: Percentage of time spent in each cloud cover band, categorized by the percentage of the sky covered by clouds.

In Bartica, the average percentage of the sky covered by clouds experiences mild seasonal variation over the course of the year.

The clearer part of the year in Bartica begins around June 18 and lasts for 3.5 months, ending around October 2. On August 25, the clearest day of the year, the sky is clear, mostly clear, or partly cloudy 46% of the time, and overcast or mostly cloudy 54% of the time.

The cloudier part of the year begins around October 2 and lasts for 8.5 months, ending around June 18. On May 5, the cloudiest day of the year, the sky is overcast or mostly cloudy 74% of the time, and clear, mostly clear, or partly cloudy 26% of the time.

Precipitation

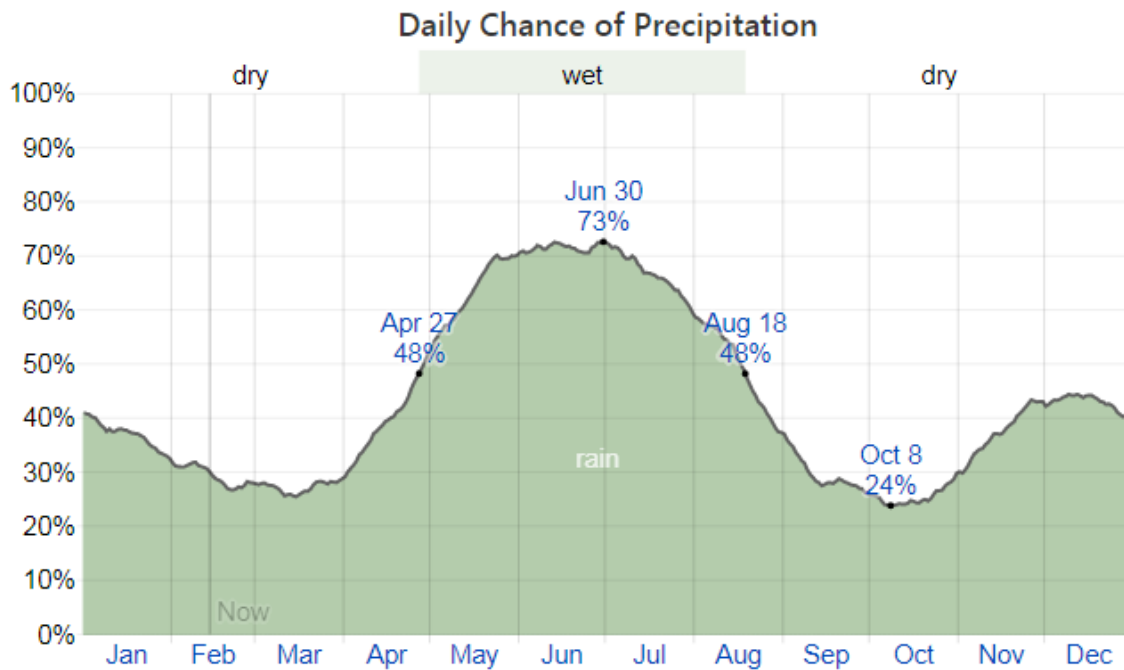


Figure 3: Percentage of days in which various types of precipitation are observed, excluding trace quantities: rain alone, snow alone, and mixed (both rain and snow fell in the same day).

A wet day is one with at least 0.04 inches of liquid or liquid-equivalent precipitation. The chance of wet days in Bartica varies significantly throughout the year.

The wetter season lasts 3.7 months, from April 27 to August 18, with a greater than 48% chance of a given day being a wet day. The chance of a wet day peaks at 73% on June 30.

The drier season lasts 8.3 months, from August 18 to April 27. The smallest chance of a wet day is 24% on October 8.

The most common form of precipitation throughout the year is rain alone, with a peak probability of 73% on June 30.

Rainfall

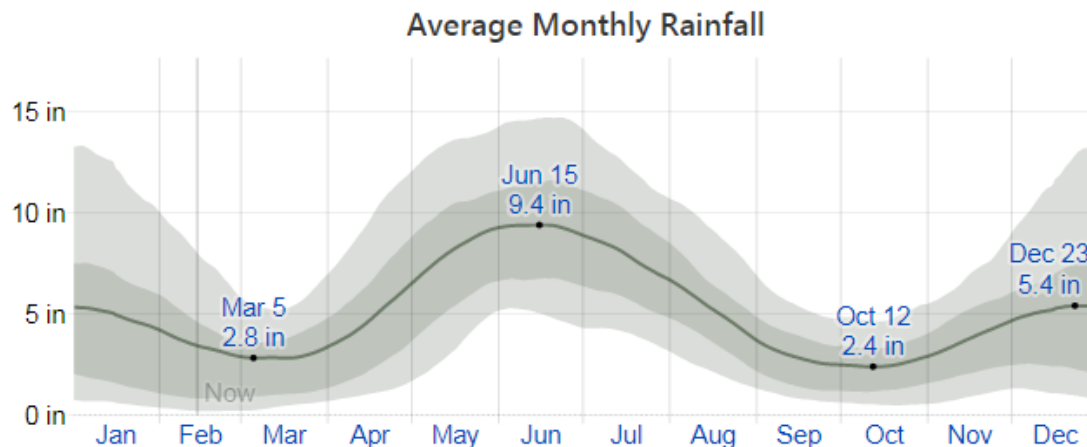


Figure 4: Average rainfall (solid line) accumulated over the course of a sliding 31-day period centered on the day in question, with 25th to 75th and 10th to 90th percentile bands.

To show variation within the months and not just the monthly totals, the rainfall accumulated over a sliding 31-day period centered around each day of the year. Bartica experiences extreme seasonal variation in monthly rainfall.

Rain falls throughout the year in Bartica. The most rain falls during the 31 days centered around June 15, with an average total accumulation of 9.4 inches.

The least rain falls around October 12, with an average total accumulation of 2.4 inches.

Sunshine

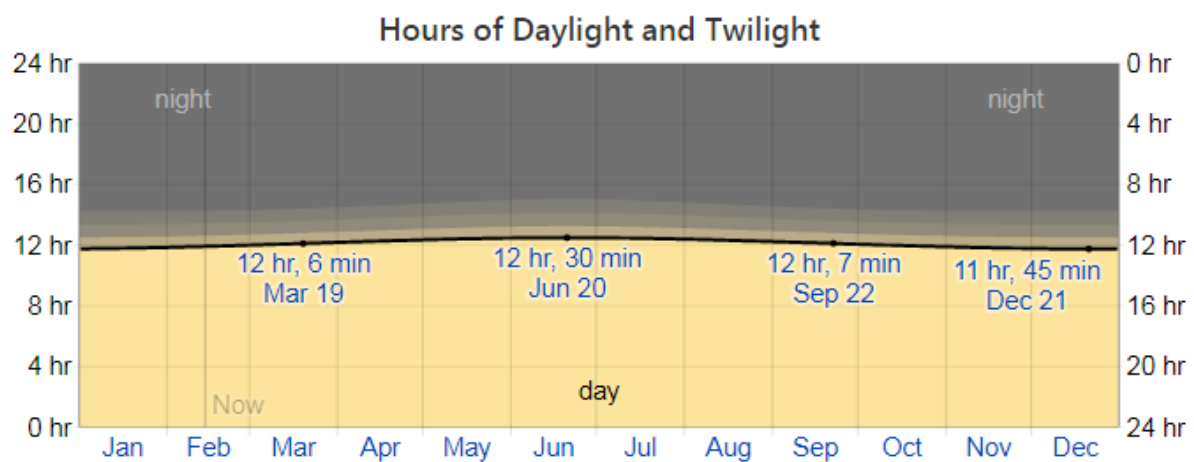


Figure 5: The number of hours during which the Sun is visible (black line). From bottom (most yellow) to top (most gray), the color bands indicate full daylight, twilight (civil, nautical, and astronomical), and full night.

The length of the day in Bartica does not vary substantially over the course of the year, staying within 29 minutes of 12 hours throughout. In 2020, the shortest day is December 21, with 11 hours, 45 minutes of daylight; the longest day is June 20, with 12 hours, 30 minutes of daylight.

Wind Speed

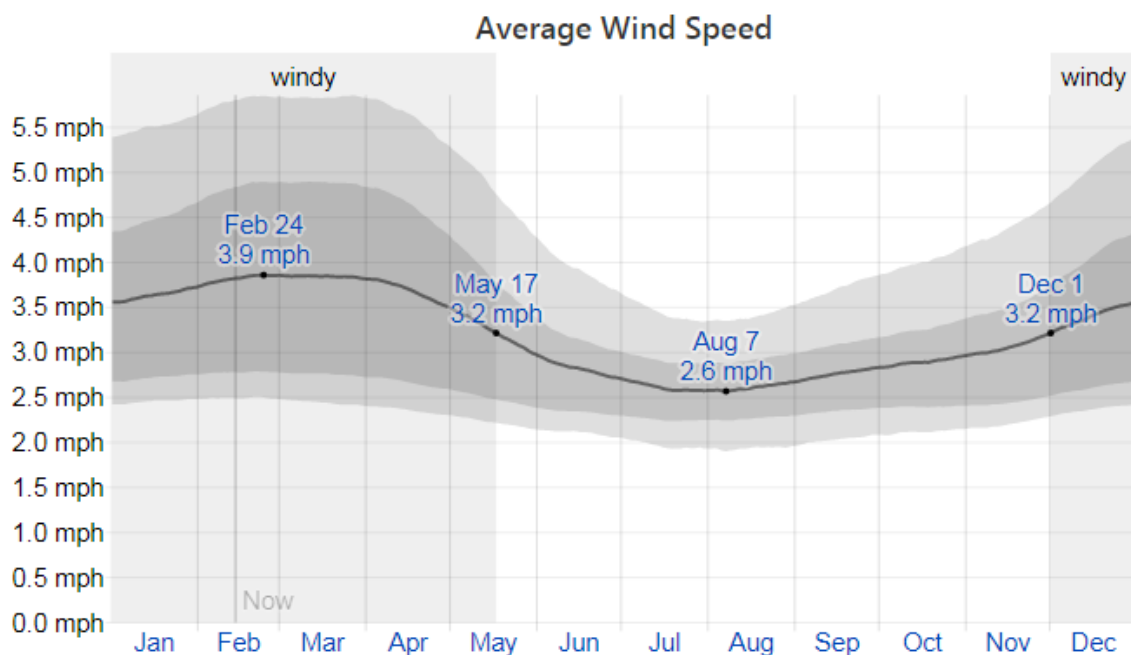


Figure 6: Average of mean hourly wind speeds (dark gray line), with 25th to 75th and 10th to 90th percentile bands.

This section discusses the wide-area hourly average wind vector (speed and direction) at 10 meters above the ground. The wind experienced at any given location is highly dependent on local topography and other factors, and instantaneous wind speed and direction vary more widely than hourly averages.

The average hourly wind speed in Bartica experiences mild seasonal variation over the course of the year.

The windier part of the year lasts for 5.5 months, from December 1 to May 17, with average wind speeds of more than 3.2 miles per hour. The windiest day of the year is February 24, with an average hourly wind speed of 3.9 miles per hour.

The calmer time of year lasts for 6.5 months, from May 17 to December 1. The calmest day of the year is August 7, with an average hourly wind speed of 2.6 miles per hour.

Wind Direction

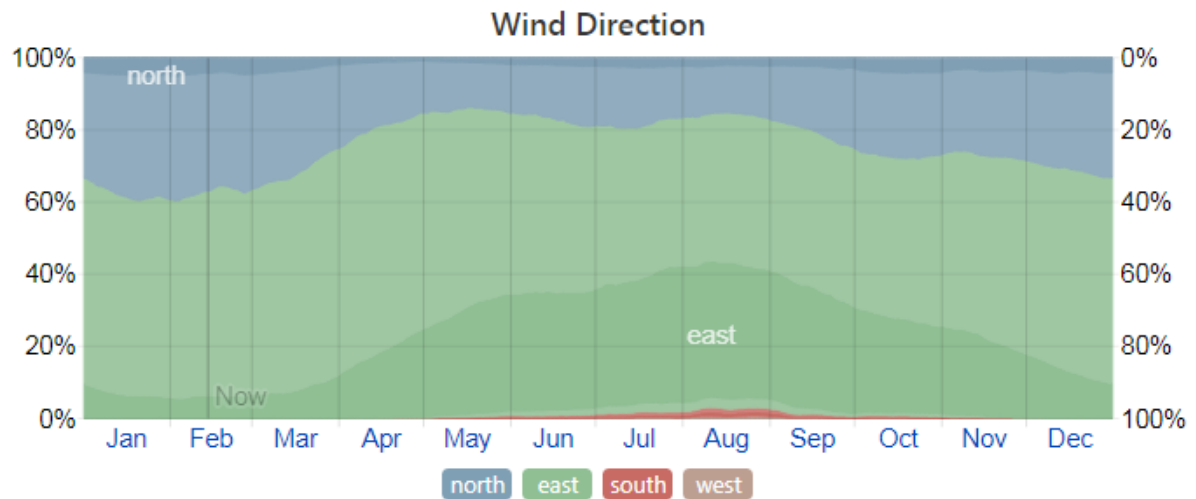


Figure 7: Percentage of hours in which the mean wind direction is from each of the four cardinal wind directions, excluding hours in which the mean wind speed is less than 1.0 mph

The predominant average hourly wind direction in Bartica is from the east throughout the year.

3.2 Quality Assurance

- 3.2.1 To ensure that the Works are in accordance with the outlined specification, regulations and authorised international standards, the Contractor shall have in place suitable Quality Assurance Programs and Procedures.
- 3.2.2 The Contractor must submit a Provisional Quality Assurance Plan in the Bid. The final Quality Assurance plan shall be approved by the Contracting Agency before signing of Contract.
- 3.2.3 The Contracting Agency is entitled to supervise or to have supervised the Quality Assurance Plan of the Contractor with respect to the Works in all phases of the project (design, engineering, material handling, manufacturing, testing, inspecting, constructing and erecting, commissioning). When required by the Contracting Agency, the Contractor must facilitate all requested tests, inspections and sample submissions.
- 3.2.4 The Quality Assurance Plan must contain the procedure, schedule and considerations for the realization, review and approval of the design. The considerations must comply with the requirements of the Contract. Considerations may include calculations, tests or certificates. The Quality Assurance Plan must outline the relevant considerations.
- 3.2.5 In cases where test results or other characteristics of similar components or parts deviate significantly from each other, the Contracting Agency is entitled to reject them.

3.3 Health and Safety Plan

- 3.3.1 The Contractor shall comply with the Occupational Safety and Health Act of the Contracting Agency and Guyana. The OSHA of Guyana can be found in Annex 4: Occupational Safety and Health Act of Guyana.
- 3.3.2 The Contractor shall submit their own Health and Safety (H&S) Plan with mitigation measures in the Bid. During the design stage, the final H&S plan shall be shared with the Contracting Agency together with the final design of the system.
- 3.3.3 All contractors, staff and third party shall be well informed and trained on all H&S issues at the site. All facilities shall be designed to enhance safety planning. All activities shall be executed within the confines of the relevant legislation as well as stakeholders' interests. All project activities shall be properly managed through careful planning and the application of relevant safety policies such as:
 - Environmental Protection Agency (EPA) Environmental Operation Permit
 - H&S meetings before embarking on a job
 - Use of appropriate personal protective equipment (PPE)
 - Prohibition of alcohol in the project area
 - Proper journey management
 - Regular emergency drills
 - Use of appropriate caution signs
 - Control of atmospheric Emissions

3.4 Environmental and Social Management Plan (ESMP)

- 3.4.1 The Contractor shall comply with the Environmental and Social Analysis Report prepared for Solar PV Farms in Mahdia, Lethem and Bartica. The report can be found on the IDB's website (<http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=EZSHARE-1460553615-30>) as well as in Annex 5: Environmental and Social Analysis Report.
- 3.4.2 The Contractor shall be responsible for ensuring that all areas of the site are left in the same conditions as prior to the commencement of the works.
- 3.4.3 All site clearance works shall be carried out within defined perimeters and only when necessary. The maximum permissible time lapse between site clearing and initiation of construction operations shall be reduced to the bare minimum. Clearing of vegetation shall be kept to the barest minimum necessary to permit safe operations. Trees felled from the project site shall be made available to the host communities for re-use prior to decision on the disposal of the materials at the authorized landfill.
- 3.4.4 Dirt roads and exposed construction areas shall be moisturized during the dry season to prevent and minimize dust emissions. Construction equipment shall be well maintained to minimize exhaust emissions into the atmosphere.
- 3.4.5 Noise levels shall comply with relevant regulations. The personnel, as well as the environment that shall be affected by any established noise source, shall be provided or equipped with an appropriate protective or corrective device to ameliorate noise effect.
- 3.4.6 Adequate waste management shall be integrated during implementation and construction. The principle of waste reduction, recycling, recovery and re-using shall be practised whenever possible. All waste, which cannot be reused, will be managed and disposed of in accordance with the regulatory standards. Some of the waste management options and waste disposal systems that will be considered for this project are:
- Segregate components such as wood, plastic and paper shall be recycled or reused whenever possible, with preference for reusing and recycling given to interested stakeholder(s), principally the local community for their benefit.
 - Reduce packaging waste such as paper and plastic using bulk handling systems
 - Dispose of all wastes at approved municipal dumps
 - Refilling and reusing of containers
 - Appropriate mobile septic tanks/sanitary facilities shall be provided during installation/pre-construction and construction phases.
- 3.4.7 Hazardous waste can be generated during construction due to accidental spills of fuel for the operation of construction equipment. It is recommended that waste from any fuel clean-up activities be stored on site in closed and clearly labelled containers and disposed of through an EPA approved Contractor.
- 3.4.8 All debris, spoilt materials, rubbish and other waste, shall be cleared from the site during construction and disposed of accordingly at the Government's designated dump/landfill sites for such wastes. The burning of any type of waste shall be strictly prohibited. Waste disposal records shall be kept and include as a minimum, the following information:
- Date of dispatched
 - Description of waste
 - Waste quantity/container type

- Designated disposal site and method
- Consignee /driver name and means of transportation
- Confirmation of actual disposal (time and date)

3.4.9 The Environmental and Social Analysis Report mentioned in *Item 3.4.1*, provides recommended mitigation measures to comply with the environmental and social specifications. The Contractor shall provide his/her own measures and its breakdown cost in the submission of this Bid.

3.5 Site Visit

3.5.1 The Contractor is advised to visit and examine the route where the transmission line is to be installed/constructed, its surroundings and the road/path access and obtain for itself on its own responsibility all information that may be necessary for preparing the Bid. The cost of visiting the site shall be at the Contractor's expense.

3.6 Civil works

3.6.1 The Contractor shall design and provide the following civil works:

- All site clearance and land preparatory works shall be carried out within defined perimeters and only when necessary. The maximum permissible time lapse between site clearing and initiation of construction operations shall be reduced to the bare minimum. Clearing of vegetation shall be kept to the barest minimum necessary to permit safe operations.
- Lines passing through the village shall not disrupt any existing drainage system. A suitable drainage system shall be constructed and connected to the existing drainage for route cleared to accommodate the transmission lines.
- Removal of temporary construction facilities and completion of restoration works.

3.6.2 The Contractor shall include in the civil works the necessary works to prepare the road/footpath for delivery of the equipment.

3.6.3 The Contractor shall prepare the land, including but not limited to cutting and disposal of the trees in a designated area by the Contracting Agency within Bartica.

3.7 Security

3.7.1 The Contractor shall be responsible for the security of the all material delivered and installed before official handover.

3.8 Taxes

3.8.1 The Contractor shall pay all applicable taxes as it relates to the equipment and services accordingly to the current Laws of Guyana.

3.9 Transport

3.9.1 This Project includes all transportation and installation/construction of the 2.8 km transmission line and fiber optic communication link in Bartica (located approx. 120 km from Georgetown).

- 3.9.2 All transportation up to the construction site shall be included in the Contractor's scope of supply, including, but not limited to, insurance, storage, demurrage, handling and fork-lift truck.
- 3.9.3 Road alone or road and river transport from Georgetown are to be considered. The Contractor should also take into account the transport routes of heavy equipment to the site, which can/will take place on sand roads or paved roads with a limited axle load capacity.
- 3.9.4 The Contractor is fully responsible for organizing and guaranteeing timely delivery and transport of the equipment and material to the site.

3.10 Identification

- 3.10.1 All supporting structures for the transmission line shall be provided with unique codes. The Contractor shall determine the assignment of codes in consultation with GPL/GEA.
- 3.10.2 All labelling should be weather resistant.
- 3.10.3 Labels must be attached permanently on a clearly visible spot of the supporting structure.

3.11 Documentation

- 3.11.1 All engineering documents, specification and drawings shall be sent to GPL/GEA for review, prior to the construction of the transmission line.
- 3.11.2 During the design and engineering phase, the Contractor shall submit a draft Operation and Maintenance Manual.
- 3.11.3 After the completion of the installation, the Contractor shall submit the AS-BUILT drawings and any other document that has changed from the design phase.
- 3.11.4 The manual must contain at least the following information:
 - Description of the installation
 - Construction and assembly instructions
 - Design considerations
 - Operational procedures for all possible normal and abnormal conditions, including failure assessment and fault identification/interpretation
 - Maintenance schemes and instructions
 - Data sheet and specifications
 - Test certificates
 - Design drawings
 - Manufacturer, type, rating, serial number and test reports of each part of the installation
 - Complete commissioning manual
 - Parts manual
 - Address of components deliverers or manufacturers
 - Startup and commissioning spares, critical and operational spares.
- 3.11.5 All requested information must be in **English**. All manuals and diagrams must also be supplied in digital form in CAD or other standard software formats (Microsoft Project, Microsoft Excel and Microsoft Word), in addition to all documents in PDF.

4 Technical Specifications – Particular

4.1 Overhead 13.8 kV, three wire (3W) transmission line

- 4.1.1 This tender document is for the supply of all materials, specialized equipment and construction of a 2.8 km, 13.8 kV, three wire (3W), three phase, bare conductor, overhead transmission line between Bartica 1.5 MWp Solar PV Farm at Dagg Point and GPL's 3.3 MW Power Plant at Dagg Point.
- 4.1.2 Supply and erect fifty-nine (59) - 14 metre Wallaba poles and two (2) - 15 metre Wallaba poles as per line design drawing provided in Annex 1.5;
- 4.1.3 Supply and build pole structures by installing Purpleheart type 2.44m (8' x 4-1/2" x 3 1/2") crossarms, insulators, machine bolts, brace and other necessary line hardware for the following:
 - Forty-nine (49) 3 Wire Intermediate/Light Angle Structure;
 - Ten (10) 3 Wire Double End Pole Structure; and
 - Two (2) 3 Wire End Pole Structure.
- 4.1.4 Supply and install a total length of 8,895 metres of codename Tulip (AAC) or equivalent size 336.4 MCM of bare conductor (2,965 meters per phase). The three wire (3W) interconnecting line will take a horizontal orientation on the cross-arm with two (2) phases on one side and one phase on the other side of the cross-arm. The centre phase should be alternated at every pole so that the centre phase will be left on one pole and then right on the next pole to counteract the weight and tension on the structure, and also assist with the line symmetry.
- 4.1.5 Supply and install 400 metres of three core 35 mm square, 15 kV Class, 133% insulation level, Copper conductor with Cross-linked Polyethylene (XLPE) type insulation, Medium Voltage Power armoured cable between GPL's 3.3 MW power plant and take-off structure. All associated civil works to install cables must be included. All ends of cables shall be properly terminated, insulated and installed using cable termination kits, stand-off insulator kits and other relevant materials;
- 4.1.6 Supply and install 100 metres of three core 35 mm square, 15 kV Class, 133% insulation level, Copper conductor with Cross-linked Polyethylene (XLPE) type insulation, Medium Voltage power cable between 1.5MW Solar PV Plant and take-off structure. All associated civil works to install cables must be included. All ends of cables shall be properly terminated, insulated and installed using cable termination kits, stand-off insulator kits and other relevant materials;
- 4.1.7 All buried cabling must comply with GPL's '**Technical Guidelines for Installing Directly Buried 13.8kV Cable**' provided in Annex 1.6.
- 4.1.8 Supply and install 45 (15 sets) 15 kV rated voltage, 12.7 kV Maximum Continuous Operating Voltage (MCOV), 10 kA discharge current, distribution class lightning arresters at locations highlighted in the line design to protect the interconnecting line against lightning strikes.
- 4.1.9 Supply and install 6 Single Pole Disconnects (SPD), 3 each on the two (2) take-off structures (at both ends of the interconnecting line);
- 4.1.10 Supply and install 23 complete Guy Sets including guy wire, guy strain insulator, anchor rod and other associated materials on pole structures that require guying;
- 4.1.11 Supply and install five (5) complete Overhead Guy Sets including 9m Wallaba pole, guy wire, guy strain insulator, anchor rod and other associated materials on pole structures that require overhead guying.

- 4.1.12 Supply and install 80 complete Earth Sets including copper conductor, ground rod, ground wire connector and other associated materials on line equipment that require earthing. OPGW wire should be earthed at every pole. Lightning Arresters should also be solidly grounded as well.
- 4.1.13 Test and commission completed 13.8 kV interconnecting line after construction.
- 4.1.14 All materials, equipment, and hardware proposed must be accompanied by a detail manufacturer specification/data sheet
- 4.1.15 The specification/data sheet must indicate the country of origin for all materials, equipment and hardware proposed and shall comply with Section III 'Eligible Countries' of the Standard Bidding Document.

4.2 Interconnection

- 4.2.1 The interconnection of the transmission lines will be done in close coordination with GPL, the contractor responsible for the solar PV farm and the transmission line contractor.
- 4.2.2 The transmission line contractor is required to be on site during the interconnection and testing of the lines.

4.3 Commissioning

- 4.3.1 Commissioning refers to inspection and testing the transmission line after installation and certifying that it operates as expected and is installed in accordance to the engineering and design plans and complies with all the regulations and standards specified.
- 4.3.2 The Contractor shall submit to the Contracting Agency the test procedures and protocols four (4) weeks before testing.
- 4.3.3 The commissioning shall include at a minimum:
 - Complete integrity test
 - Test and commissioning of line, according to IEC standards
 - Electrical protection system commissioning, according to IEC standards
 - Perform thermal hotspot check with infrared images

4.4 Overhead OPGW Communication Link and Lightning Protection

- 4.4.1 This tender document is also for the Supply of all materials, specialized equipment and install 3,500 metres long Optical Grown Wire (OPGW), and associated line support hardware, at the top of all poles of the 13.8kV transmission line. The OPGW shall provide the function of communication and lightning protection of the interconnecting line between GPL's diesel power plant and the new solar PV power plant.
- 4.4.2 The OPGW cable must be selected to effectively provide communication and lightning protection of the interconnecting line between GPL's diesel power plant and the new solar PV power plant and must comply with the following specifications:

OPGW Cable Type	OPGW-12B1-60
No. of Fiber Strands	12 (6 Pairs)
Sectional Area	61.1 mm ²
Diameter	10.8 mm
Weight	430.9 kg/km
Rated Tensile Strength	73.7 kN
DC Resistance (20 °C)	1.389 Ω/km
Short-circuit Capacity	18.3 kA ² .s (40°C -200°C, 1s)
Elasticity Modulus	162 kN/mm ²
Thermal Expansion Coefficient	13 x 10 ⁻⁶ (1/°C)
Minimum Bending Radius	216 mm
Minimum Bending Radius (Run)	162 mm
Fiber No.	12B1
Fiber Type	G.652 Single-mode fiber

- 4.4.3 The fiber optic cable shall be of single mode 12 strand type.
- 4.4.4 The cable structure must isolate the fiber optic cable from the mechanical stresses that can be induced throughout the cable's service life, also the cable shall be installed utilizing only approved/certified hardware.
- 4.4.5 The cable shall be a single run, with special attention to maximum allowable bend radius for cable type.
- 4.4.6 Cable shall be installed with adequate sag to allow for thermal expansion and contraction, and not to exceed the mechanical properties of the cable
- 4.4.7 Cable should have a minimum height of 1.2 metres to a maximum 1.8 metres above the current carrying conductor.
- 4.4.8 Preformed armoured rod (Plats) must be used for cable attachment and suspension along the cable route. Cable should be supported with the appropriate suspension kit for intermediate structures; appropriate tension kit for the angle structures; and appropriate remaining cable shelf and joint boxes, where splicing of the cable is required. Each support kit shall include pole band attachment, clevis, grounding cable, lag screws, clamps, clips, bolt and nuts etc.
- 4.4.9 Cable route must be anchored where cable direction changes and with the absence of same on the existing route.
- 4.4.10 Supply and install two (2) 4U wall mount rack enclosures, one at the Bartica diesel power plant and one at the solar PV plant. Specific locations shall be decided upon in consultation with the contractor responsible for the solar PV plant, GPL and the employer (GEA).
- 4.4.11 Supply and install two (2) rack mounted 12-port (SC UPC) 1U optical distribution frame (ODF) patch panel, one at the Bartica diesel power plant and one at the solar PV plant in the enclosures mentioned in section 4.2.5. The contractor shall be responsible for the termination/splicing of the fiber optic cable to each ODF installed.
- 4.4.12 Full tube fusion splicing to be completed at both ends of the fiber cable (all strands). Contractor is responsible for providing all materials and equipment for this activity.
- 4.4.13 Supply and install two (2) ethernet router / switch (full duplex) with at least two (2) SC ports (1000 Base-X) and at least 4 1000 Base-T ports at both sites. The router / switch must be capable of routing or switching at least 1Gbps of traffic.
- 4.4.14 The installation of the OPGW cable must be done at the top of all poles of the 13.8kV transmission line.
- 4.4.15 All materials, equipment, and hardware proposed must be accompanied by a detail manufacturer specification/data sheet
- 4.4.16 The specification/data sheet must indicate the country of origin for all materials, equipment and hardware proposed and shall comply with Section III 'Eligible Countries' of the Standard Bidding Document.
- 4.4.17 Testing
 - All testing must be performed in the presence of the employer.
 - The test plan must include tests for continuity, length, anomalies, and attenuation on all strands of fibre that are planned to be used.

- After all splices have been completed, a single-direction OTDR test at 1310 nm and 1550nm, of all spliced fibers in all buffer tubes and recorded.
- End-to-end testing using a laser source and power meter must be done. Measurements of loss and power level at 1310 nm and 1550nm, must be recorded.

4.4.18 Maximum acceptable loss criteria

- Attenuation:
 - o @ 1310nm = 0.50 dB/km
 - o @ 1550nm = 0.40 dB/km
- Anomalies: no event shall exceed 0.30 dB
- Splice Loss reading from OTDR test: 0.30 dB
- Connector Loss: 0.60dB

The total optical fiber loss must not exceed the summation of all the above stated criteria for the given segment distance.

4.5 Economic evaluation of Bid submission

- 4.5.1 The Bidder is required to submit a detailed bill of quantities indicating costs for materials/hardware, services and transportation.
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