



TECHNICAL SPECIFICATION OF ONLINE PARTIAL DISCHARGE MONITORING SYSTEM FOR HIGH- VOLTAGE CABLES

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1. INTRODUCTION

High-voltage cables are an important part of the power system. During the operation of the cables, local electric field stress concentration caused by internal impurities, semiconductor protrusions, and accumulation of space charges under the action of voltage can lead to partial discharge, affecting the operation of the cables. Therefore, by monitoring the partial discharge of the cables online, it is possible to effectively determine the aging condition of the cable insulation, which is of great significance for the long-term stable operation of power cable lines. CEM are now seeking proposals for the installation of on-line Partial Discharge Monitoring System (PDMS) for high-voltage cables. We are looking for experienced contractor who specializes in on-line PDMS installations. The selected contractor will be responsible for implementing the on-line PDMS, including the installation of necessary hardware, configuration of monitoring software, and integration with the existing infrastructure. It encouraged interested parties to submit their proposals, outlining their expertise, past experience with on-line PDMS installations, and a detailed plan for the installation process. This is an exciting opportunity to contribute to our ongoing efforts in enhancing monitoring capabilities and ensuring the reliable and efficient operation of our infrastructure.

2. DEFINITION

- 2.1 SS – High Voltage Substation
- 2.2 PDMS - Partial Discharge Monitoring System
- 2.3 Equipment - The hardware of PDMS system
- 2.4 Sites - The SS location or HV cable joint location (common tunnel, bridge, etc.) to install the Equipment.
- 2.5 Works - The supply and installation service of Equipment and implementation of system provided by Contractor
- 2.6 CEM Engineer - The engineer who in charge of this project.

3. TENDER SCOPE

This is a 3-Years contract. Contractor shall provide the required service with the price quoted in BoQ. The scope of the Tender includes but not limited to the following:

- i. To propose a schedule of this project including system design and material supply which duration is preferable not longer than **2 months**.
- ii. To propose the installation and commissioning schedule, which should cooperate with cable isolation or modification work, if any.
- iii. To propose and provide the installation plan of all the necessary equipment, devices and sensors according to each SS floor plan or HV cable joint location. The three phases of HV cable termination and joints need to be monitored. These plans should be submitted to CEM for approval before any installations.
- iv. Collaborate with our team to finalize the PDMS system design, considering specific monitoring requirements and objectives.

- v. Determine the optimal placement of PD sensors, on-line PD acquisition, transmission equipment and cable routing.
- vi. Design an integrated software solution for data acquisition, processing, visualization, and reporting.
- vii. Supply and install the necessary hardware components for the PDMS system, including PD sensors, on-line PD acquisition, transmission equipment, fiber optic cables, connectors, and related equipment.
- viii. Develop a customized software solution tailored to CEM's monitoring needs, including data acquisition, real-time analysis, alarm generation, and reporting functionalities.
- ix. Configure the software to integrate seamlessly with the PDMS system and existing infrastructure, i.e. dedicated server.
- x. Implement user-friendly interfaces for data visualization and easy access to system controls.
- xi. Conduct thorough testing to ensure data accuracy, system compatibility, and reliable communication between components.
- xii. Verify the effectiveness of the software solution and its ability to process and interpret PDMS data accurately.
- xiii. All the installed equipment and software should be license free and without any limitations.
- xiv. Provide detailed documentation of the PDMS system installation, including system diagrams, cable routing plans, hardware specifications, and software configurations.
- xv. Conduct comprehensive training sessions for CEM staff to ensure proficient operation, re-configuration, maintenance, and troubleshooting of the PDMS system and associated software.
- xvi. To provide warranty period of **three (3) years** for the above works.
- xvii. Contractor must also specify their maintenance and user support services after the warranty period. A proposed list of spare parts and their price shall also be included in Contractor's Response.
- xviii. During the warranty or maintenance period, CEM could request Contractor to enhance the software or modify the configuration.

4. GENERAL EQUIPMENT OF EQUIPMENT

4.1 STANDARD

- 4.1.1 GB/T 7354-2018
- 4.1.2 GB/T 17626
- 4.1.3 DL/T2271-2021
- 4.1.4 DL/T1506-2016

4.2 ENVIRONMENTAL CONDITION FOR EQUIPMENT

- 4.2.1 In substation, operating conditions of the PDMS equipment are shown as follows:

- Ambient Temperature 0°C to 40°C

- Relative Humidity ~85%
- Input Power Supply 230Vac

4.2.2 In HV cable joint location, operating conditions of the PDMS equipment are shown as follows:

- Ambient Temperature 0°C to 45°C
- Relative Humidity ~100%
- Input Power Supply 230Vac

4.3 **PDMS UNIT**

4.3.1 Inductive Power Supply

Item	Description	Requirement
1.	Mounting	Mounted on 110kV or 220kV power cable
2.	Minimum Current	≤ 50A
3.	Ferrite core	Split and shield

4.3.2 PD Sensor

Item	Description	Requirement
1.	Mounting	Mounted on coaxial bonding cable or mounted directly on HV cable, right at the interface with the joint
2.	Transfer function / Sensitivity	10pC
3.	Load impedance	50Ω
4.	Bandwidth at 3 dB	400 kHz to 80 MHz
5.	Ferrite core *	Split and shield
6.	Operating temperature	-10 °C to 70 °C
7.	Insulation	Electrically fully insulated and shall withstand at least 4-kV, 50 Hz, 1 minutes
8.	IP (Ingress Protection) ratings	IP68

* Ferrite core is non-essential item if a better solution can be provided.

4.3.3 PD Acquisition and Transmission Equipment

Item	Description	Requirement
1.	Operating environment	Outdoor, operating temperature from -10 °C to 90 °C
2.	Housing	Lockable IP68 weatherproof enclosure
3.	Input channel	At least three PD input channels and one synchronised channel
4.	Protection for input channel	$\geq 1\text{-V}_{\text{peak-peak}}$ overvoltage protection
5.	Sampling frequency	$\geq 200\text{M}$ samples/second for analysing down to 50pC PD signals captured by the PD sensor
6.	Bandwidth	1 MHz ~ 100 MHz
7.	Detection range	2pC ~ 10000pC
8.	Sensitivity	2pC
9.	Processing time	5 nanoseconds with real-time filtering and ultra-precise timestamp
10.	Interfaces	Ethernet or fiber optic or 4G

4.4 **PDMS SOFTWARE**

- PDMS software shall be a program that runs on Linux OS web based interface with menu driven capabilities as well as GUI for facilitating the measurement setup, i.e. The PD values, time, location and alarms of the HV cable termination / joint.
- The interface shall be user friendly and with a dashboard to show the overview of current monitoring situation.
- The generated data file structure format shall be compatible with Microsoft Excel.
- PDMS software shall offer periodic and automatic monitoring.
- The PD data shall be stored in Control PC. The data shall be viewed and controlled locally via a full color screen monitor. The basic functions are as follows:
 - a. Plotting a PD graph of the HV cable termination / joint for any given set of readings.
 - b. Set to provide two-level cable PD warning / alarm.
 - c. Pop-up window display for 1st level of warning and 2nd level for alarm at two pre-set PD levels.

5. DESIGN, PLANNING & MATERIAL SUPPLY

5.1 **DESIGN**

- 5.1.1 Contractor shall propose the installation location of PDMS Unit and Equipment inside SS and HV cable joint location which are selected and confirmed by CEM.
- 5.1.2 Contractor shall submit the proposal to CEM for approval.
- 5.1.3 Contractor shall revise the design, location of equipment according to the comments from CEM.

5.2 **SCHEDULE**

- 5.2.1 Contractor shall provide a full schedule of the Works including the equipment ordering & arrival time, the installation schedule of equipment, commissioning and the period to set up the PDMS software and user interface.

5.3 **SUPPLY OF EQUIPMENT**

- 5.3.1 Contractor shall supply the equipment according to the Bill of Quantities and submit in the Contractor's Response.
- 5.3.2 The specification of equipment shall be fulfill CEM's requirement.
- 5.3.3 The price shall include all the necessary accessories.
- 5.3.4 The price shall include all the delivery cost from manufacturer until to the Site.
- 5.3.5 Contractor shall deliver the equipment based on the agreed schedule with CEM.
- 5.3.6 Contractor shall provide a temporary storage of delivered equipment with their own cost.

5.4 **OPTIONAL SERVICES**

- 5.4.1 Contractor shall provide a portable PD device to measure the PD for joint or termination if requested by CEM.

6. INSTALLATION SERVICE AND ITS EQUIPMENT

6.1 **GENERAL REQUIREMENT**

- 6.1.1 Contractor shall arrange visit to individual site before start of the Works and make themselves thoroughly acquainted with the location, general site conditions, accessibility, storage space, restrictions for loading and off-loading materials, etc. No claim will be allowed on the grounds of ignorance of the conditions.
- 6.1.2 Contractor shall provide all necessary temporary supplies of lighting, electrical power and water and shall arrange sanitary and washing facilities for his employees.
- 6.1.3 The Site and the various parts of the Works are to be kept clean, hygienic, safe and orderly at all times and Contractor shall remove, at his expense, all rubbish and waste materials accumulated from the Sites at regular interval.
- 6.1.4 Contractor must not permit any duplicate to be made of any key.
- 6.1.5 Contractor shall make available first aid boxes and portable fire extinguishers on site for the duration of the work, if necessary.
- 6.1.6 Contractor shall comply with the requirements of the Construction Site (Safety) Regulations and all other related regulations.
- 6.1.7 Contractor shall not allow any workman to live on the Site at any time.
- 6.1.8 Contractor shall not allow any unauthorized visitors to enter the Site.

- 6.1.9 All Contractor's employees should wear their company identity cards and uniform at all times while performing the Works.
- 6.1.10 Smoking and drinking are strictly prohibited inside SS or near the SS door and the HV cable joint location.

6.2 **WORKING LOCATION**

- 6.2.1 The erection works are to be carried out at various existing CEM SS, bridges, common service tunnel, roads in Macau S.A.R..
- 6.2.2 All these various locations shall be individually and collectively designated as the "Site".
- 6.2.3 For the Works to be carried out in an existing SS and the HV cable joint location, contractor shall note that the existing SS and the HV cable joint location contain dangerous and/or sensitive equipment which is energized and in operation.
- 6.2.4 Contractor shall note that the Works are carried out in a live electrical SS and shall take all safety precautions in carrying out the Works. Cables in the vicinity are live and shall be protected up to the satisfactory of site engineer and at no cost to CEM. No water hose whatsoever shall run within the inside of SS or any high-voltage area.
- 6.2.5 Contractor shall ensure that the existing SS and the HV cable joint will not be damaged, and the operation of SS not be interfered with.
- 6.2.6 Nobody shall be allowed to work in SS alone.

6.3 **WORKING HOURS**

- 6.3.1 Comply with any current legislation or regulations regarding working conditions, working hours, rates of payment and compensation to employees and accept the risk of any impending legislation or other conditions, which alters any obligations or imposes new obligations.
- 6.3.2 The normal working hours are from 08:00 to 18:00, excluding public holidays and CEM Company holidays, throughout the year.
- 6.3.3 If Work is required to be carried out during weekends or at night due to the limitation of government licenses, the Contractor shall perform such work within the approved working hours and shall not be entitled to any additional compensation.

6.4 **WORKMANSHIP**

- 6.4.1 Contractor shall only employ experienced workmen having the appropriate skills to carry out the works. The name list of the workmen shall be submitted to CEM in Contractor's Response.
- 6.4.2 Contractor shall appoint a full-time, competent and experienced project engineer. The engineer shall be responsible for receiving instructions from the CEM's engineer.
- 6.4.3 Contractor shall station a foreman/supervisor on site supervising the quality and progress of the works.
- 6.4.4 The foreman/supervisor shall be a full-time employee of Contractor and he/she shall be responsible for ensuring compliance with all requirements of the Contract and with instructions issued by CEM.
- 6.4.5 For compliance with the Electricity Ordinance, Contractor shall arrange registered electrical worker to be in charge at each site of work. Non-registered workers may only work under the charge of a registered electrical worker.

- 6.4.6 CEM shall have the right to require Contractor to remove any person employed on Site, who in the opinion of CEM is not suitably skilled and experienced or is in any other respect unsuitable. Any costs incurred by Contractor in complying with the provisions of this clause shall not be reimbursable by CEM.

6.5 **DELIVERY OF MATERIAL**

- 6.5.1 Contractor will be responsible for provision of suitable vehicle, mobile crane, lifting and pulling equipment and manpower for transporting the equipment supplied to Site.
- 6.5.2 A copy of the current test certificates for lifting equipment, wire rope and etc. should be kept on the vehicle and is available for inspection by CEM staff.

6.6 **INSTALLATION OF EQUIPMENT**

- 6.6.1 Contractor shall install the supplied equipment according to the submitted design and its planning.
- 6.6.2 Contractor shall install the PDMS Unit and Equipment according to the submitted and approved design.
- 6.6.3 The installation price should include all the necessary civil work in SS and HV cable joint location.
- 6.6.4 All the equipment is required to link with PDMS Unit physically or by wireless connection.
- 6.6.5 Contractor shall install all the Sensors and Equipment, which location is approved by CEM.
- 6.6.6 Contractor shall supply and install all the necessary wiring, termination boxes and accessories.
- 6.6.7 Contractor shall perform the termination work of O.F. cables, which installed by CEM for PD data transmission or communication used.
- 6.6.8 Contractor shall provide 3-years mobile data card and pay the monthly service cost.
- 6.6.9 The PDMS system should connect to the destination appointed by CEM Engineer. The PDMS system panel shall connect to SDH Rack or OTN Rack located at communication/control room by CAT6 ethernet cables and PDMS system panel has to equip layer 2 switch/router with port at least 100Mb interface with full duplex mode.
- 6.6.10 If any equipment is necessary to install on a live HV Cable, Contractor is required to submit an installation method statement for CEM's approval.
- 6.6.11 All the equipment should be tested and comply with the requirement of CEM.

6.7 **SITE CLEARANCE/REINSTATEMENT**

- 6.7.1 Contractor shall reinstate the Site upon completion of the Works and leave the premises clean and fit for handing over to CEM.
- 6.7.2 Contractor shall remove all temporary installations and make good all works disturbed on completion of the Works.
- 6.7.3 Upon completion of the Services, Contractor shall remove all his plant, equipment, belongings, surplus building materials and any other materials arising from the Works, all at Contractor's expense.
- 6.7.4 Contractor shall comply with any orders from CEM in connection with the removal of rubbish or clearing of the Site.

6.8 **WORK SAFETY REQUIREMENT**

- 6.8.1 Contractor shall submit the Standard Operating Procedures (SOPs) and Job Hazard Analyses (JHAs) for CEM approval before any Works.
- 6.8.2 Contractor shall comply with all statutory requirements together with CEM's Safety Regulations and with any other requirements stipulated in the Contract.
- 6.8.3 Contractor shall also comply with all Macau SAR Government Regulations relating to Safety on construction sites.
- 6.8.4 CEM requires that the maintenance of a safe and healthy environment be regarded as a major objective by Contractor and Sub-Contractor, working on CEM construction / work sites. Contractor's, his sub-Contractor, and their employees, shall conform to all Laws and Regulations in force in Macau pertaining to the safe execution of works and shall be governed by, but not limited to, the relevant current editions of following documents:
- The CEM Loss Prevention Guidelines
 - The CEM Safety Codes of Practice
 - The CEM Safety Data Sheets
 - The CEM Safety Rules
 - The CEM Employee Safety Handbook
 - The CEM Corporate Environment Management System Manual
 - Electricity Supply Ordinance
 - Factories & Industrial Undertakings Ordinance
 - Gas Ordinance
 - All Government Ordinances and Regulations
 - Plus other documents which, from time to time, might be released by official entities CEM.
- 6.8.5 Above-mentioned CEM internal documents are available to Contractor upon request. Contractor shall make all documents available to Contractor's employees.
- 6.8.6 In the even CEM defines any area where Contractor or its Sub-Contractor are not complying fully with the safety requirement as stipulated in the Contract, then CEM or its representative may at its sole discretion suspend the Services until such default is rectified.
- 6.8.7 Any such suspension shall not under any circumstances entitle Contractor to any additional costs or extension of time.
- 6.8.8 In the event of Contractor not complying with any instructions issued by CEM relating to safety matters, CEM may employ and pay other persons to supply safety items and/or carry out work so as to ensure safety on Site. All expenses properly incurred by CEM in so doing shall be recoverable from Contractor by CEM.
- 6.8.9 Contractor shall ensure that all tools, equipment and temporary facilities plus other items used in carrying out the Work, whether purchased, rented or otherwise provided by Contractor or his sub-Contractor or provided by CEM for use by Contractor or his sub-Contractor are in safe, sound and good condition and are capable of performing the functions for which they are intended.
- 6.8.10 Without prejudice to Contractor's responsibilities under the Contract, Contractor shall ensure that his own employees and employees of all his sub-Contractor of every tier shall, when necessary or when so instructed by the CEM Engineer, use safety equipment including safety helmets, safety footwear, safety belt, falling arrestor, protective clothing, masks, eye protector,

eye shields, gloves, harnesses and other like items which shall be provided by and at the expense of Contractor and/or his sub-Contractor.

- 6.8.11 Contractor shall notify the CEM Engineer, either directly or by telephone, immediately upon becoming aware of any accident, minor or serious, or likely to result or actually resulting in the death or hospitalization of one or more of his own employees or of an employee or employees of sub-Contractor of any tier.
- 6.8.12 Contractor shall promptly furnish the CEM Engineer with full written reports of any accidents that may occur to any of Contractor's employee of any tier whilst on the Site.
- 6.8.13 Contractor shall take all possible precautions against fire hazards and provide all necessary portable fire-fighting equipment and trained personnel in the use of such to the complete satisfaction of the Site environment.
- 6.8.14 Except stated in the Specification, all metal works shall be bonded to the SS's or HV cable joint location earthing terminal with copper conductor.

7. SYSTEM REQUIREMENT

- 7.1 The PDMS Software and its user interface should be free of charge and without any limitations.

7.2 INTEGRATION REQUIREMENTS

- 7.2.1 The backend servers should be placed into CEM server farm, which is running VMware server virtualization technology with the latest versions for high resilient purpose.
- 7.2.2 Contractor is required to propose a high availability architecture with redundancy arrangement, like more than dual nodes on DB servers. In addition, it is necessary to specify the details of every components of system landscape in the proposal, for instance, what's kind of OS and software to be installed into each of backend servers. CEM may not accept any des-support versions of the software components in the system landscape.
- 7.2.3 Server OS preferable to be run on Window Server or RedHat Linux with the latest version.
- 7.2.4 System database is required to be adopted by open source DB like MySQL, PostgreSQL without sacrificing the PDMS systems performance or MS SQL Server, etc.
- 7.2.5 Contractor needs to comply Macau Cyber Security Law and CEM related cyber security policy.
- 7.2.6 Contractor needs to comply with the deliverables of PDMS system, provide the Virtual Machine requirement and firewall rules for CEM approval during implementation stage.
- 7.2.7 Contractor is required to fully specify their proposed integration protocol in technical terms; such includes architecture; use of standards; operation logic; message structure; functions defined and roadmap, if applicable; functions implemented; testing and implementation tools.
- 7.2.8 PDMS system could be Integrated with GIS & SCADA, if required.

7.3 USER INTERFACE REQUIREMENTS

- 7.3.1 Contractor should provide a web-based user interface to CEM.
- 7.3.2 The user interface should show the status of installed PDMS system in each SS and HV cable joint location.
- 7.3.3 The user interface should show the status of geographical information of each monitored HV cable termination or joint.

- 7.3.4 The user interface could obtain the real time status of the installed Equipment over a certain time interval which could be set by user, or user could obtain the instant status by clicking a "refresh" button or alternative solution to obtain the instant status.
- 7.3.5 The user interface should have an item to show and export the alarm signals of monitored HV cable termination or joint.
- 7.3.6 The user interface should have an item to notify the alarm signals of each monitored HV cable termination or joint and PDMS systems by email or SMS or WeCOM.

8. TRAINING

8.1 TRAINING MATERIAL

- 8.1.1 Contractor shall prepare all the training material and submit it to CEM.
- 8.1.2 The training material shall include all the Equipment and system provided and installed by Contractor.

8.2 TRAINING SESSION

- 8.2.1 Contractor shall provide training sessions to CEM staff on the operation, re-configuration, maintenance, and troubleshooting of the PDMS system and associated software.
- 8.2.2 The training schedule will be confirmed by CEM.

9. WARRANTY PERIOD AND TECHNICAL SUPPORT

9.1 WARRANTY SUPPORT

- 9.1.1 After formally taking over by CEM, there shall be three (3) years of warranty period for the overall hardware and software.
- 9.1.2 During the warranty period, Contractor shall be responsible to rectify any defects in the work due to faulty workmanship or due to use of substandard materials in the work.
- 9.1.3 Any defects in the work during the warranty period shall therefore, be rectified by the Contractor without any extra cost to CEM within a reasonable time.
- 9.1.4 Contractor shall report the root causes of the defects within 1 week after received the notification from CEM.
- 9.1.5 CEM could require Contractor to enhance the user interface and its functions during warranty period, without any additional cost.
- 9.1.6 CEM could require Contractor to modify the connectivity of installed PD sensors during warranty period, without any additional cost.

9.2 ADDITIONAL TECHNICAL SUPPORT AFTER WARRANTY PERIOD

- 9.2.1 Contractor shall provide technical support for 5 years after the 3 years warranty period as an optional item. Yearly breakdown quotation for this support should be covered in the proposal.
- 9.2.2 During this period, Contractor shall support to maintain all hardware and software in good conditions.
- 9.2.3 CEM may make changes to improve the system and Contractor shall support.

- 9.2.4 CEM could require Contractor to enhance the user interface and its functions during this additional period, without any additional cost.
- 9.2.5 CEM could require Contractor to modify the connectivity of installed PD sensors during this additional period, without any additional cost.
- 9.2.6 Contractor shall provide the mobile data card and pay the monthly service cost.

10. PENALTY

10.1 GENERAL TERMS

- 10.1.1 For non-compliance of any contractual clause, CEM will notify Contractor with a warning in written. For the accumulation of three warning, a penalty of 10% of the price of the three warned jobs will be applied on the month where the third warning occurred.
- 10.1.2 Any penalty applied to Contractor by CEM will be communicated to Contractor in writing, with acknowledgment of receipt.
- 10.1.3 When situations occur where Contractor considers he has the right to disagree, he must request to inspection a record of the facts and their consequences, which are necessary for future valuation. The disagreement must be presented in writing, within a period of five days from the related situation in question, duly based on the records referred to in the above.

10.2 DELAY OF WORK SCHEDULE

- 10.2.1 Contractor should follow the schedule submitted in this Tender. If any delays of work without a strongly reason, a penalty will be applied.
- 10.2.2 For non-compliance, CEM will notify Contractor with a warning in written, a penalty of 1% of the contract price will be applied on the end of month, until the penalty amount reaches the maximum of **10%** (ten percent) of the total value of the contract.

10.3 QUALITY OF INSTALLATION

- 10.3.1 To ensure the installation quality of Equipment and back-end system, it is required to achieve 80% monthly online rate of total installed equipment, starting from the month after commissioning and site acceptance by CEM Engineer.
- 10.3.2 The monthly online rate should be calculated by the following formula:

$$\text{Monthly Online Rate} = 1 - \frac{\sum \text{Failure Duration (by hours)}}{\text{Total Number of Equipment} \times \text{Number of days in month} \times 24 \text{ hours}}$$

- 10.3.3 For non-compliance, CEM will notify Contractor with a warning in written, a penalty of 0.5% of the contract price will be applied on the end of month, until the penalty amount reaches the maximum of **5%** (five percent) of the total value of the contract.

10.4 SAFETY AND ENVIRONMENTAL NON-COMPLIANCE

- 10.4.1 Contractor in control of the site is responsible for presiding and maintaining safe working and environmental conditions for staffs and visitors.
- 10.4.2 In the event of breaching Safety, Health and Environmental obligations, Contractor shall pay to CEM the fines/penalties according to the latest version of "SHE Non-Compliance in Contracts

Managed by CEM”, and without prejudice to the right of CEM to claim Contractor for indemnification due to such non-compliance.

10.5 **DAMAGED CEM FACILITIES**

10.5.1 If the Contractor damages CEM facilities, regardless of whether the works are for CEM or for other entities, the following penalties, together with the maintenance fee in additional to that, shall be applied:

a)	High Voltage Network or Facilities	MOP 500,000.00
b)	Medium Voltage Network or Facilities	MOP 300,000.00
c)	Communication Network or Facilities	MOP 200,000.00
d)	Low Voltage Network or Facilities	MOP 50,000.00
e)	Public Lighting Network or Facilities	MOP 10,000.00

10.5.2 Besides the abovementioned compensation amount, Contractor shall be responsible for the replacement/repair cost of such loss/damage. In case that CEM equipment is being damaged, Contractor shall be charged of the cost of the equipment as well.

11. **CONTRACTOR’S RESPONSE**

11.1 **DOCUMENT TO BE SUBMITTED**

11.1.1 When replying to Tender, Contractor is required to submit information of different nature and under several formats, as stated in the “Instructions to Contractor and Related Documents” document.

11.1.2 The following documents to be included in the Contractor’s Response to the Tender:

- Technical Proposal
- O-chart of Project Team
- Response to CEM Requirements
- PDMS Working Experience in previous 15 years
- Data Schedule / Specification of Equipment
- Type Test Report of Proposed Equipment
- Bill of Quantities

11.1.3 The Response to CEM Requirements document shall be an appendix to the Technical Proposal. The Bill of Quantities shall be part of the Commercial Proposal together with all other documents required by CEM. The Technical Proposal and the Commercial Proposal must be *separate* documents.

11.1.4 The Technical Proposal must be submitted as a Microsoft Word document. The Response to CEM Requirements may be submitted in Word or in Microsoft Excel. The Bill of Quantities shall be submitted in Excel (a printed copy with authorized signature and company stamp should also be included in the proposal).

11.1.5 Submissions of information should be clear, direct, concise and complete. Some items require that the Contractor confirms a stated requirement; others require a description or proposal. Detailed supporting materials such as standard technical, proof of complaint or marketing literature should be included as appendix of your submittals.

11.1.6 Contractor is kindly reminded to strictly follow the requirements regarding the submission of information: the quality of the proposals shall be part of the final evaluation mark attributed to each Contractor's response.

11.1.7 The *Technical Proposal* shall follow the outline below:

11.1.7.1 Executive Summary

- The Executive Summary should provide a brief summary (two pages, maximum) of your available and proposed solutions and products. The summary should be directly relevant to CEM's requirements, and include a high-level description of the Stations proposed with system integration diagrams as applicable. The Executive Summary shall also state the entities involved in the proposal: a main Contractor and possibly other companies involved, with all roles in the implementation clearly specified.

11.1.7.2 Introduction

- This section shall provide an overview of Contractor's proposal.

11.1.7.3 Company and Team Qualification

- Tenderer shall complete not less than 5 PDMS projects, each project should have been put in service for a minimum of three (3) years.
- This section shall include the areas of expertise, size, location, and years in the industry of all partners involved. The description shall address the partners' experience in Cable Monitoring System development and its system deployment.
- The section shall include the project team organization which shall have at least one Project Manager and two Key Team Members for back-end system and site installation respectively. Short resumes of them shall be included as attachment.
- Working experience of PDMS in past 15 years, it is required to fill up all the information as the attached form.

11.1.7.4 Understanding the Project

- This section shall summarize your understanding of the objectives and scope of the project. It should also identify technical challenges, risks, and success factors; and the partners' strengths in delivering the system.

11.1.7.5 Proposed Solution

- This section shall describe your solution that addresses all issues in the scope, including the specific products to be delivered, which shall comply with the requirements mentioned in previous section.
- It shall include the technical specification and parameter of the Equipment and PDMS system.

- It shall describe how the proposed Equipment and PDMS system monitor the HV cables.
- Any additional functions is welcome to propose.

11.1.7.6 Scheduling

- Contractor should provide an overall working schedule of this project, including every milestone like material ordering and delivery to Macau, submission of the proposed installation plan, individual installation of each SS and HV cable joint location, back-end system setup, etc.
- The schedule should be submitted as a Microsoft Project document or equivalent.

11.1.7.7 Responses to CEM requirements

- This separate document should describe the Contractor's response to all CEM requirements.
- When organizing the response, the Contractor should set out the overall framework, indicating the requirements for each subsystem in order, and respond to them.
- The response to each requirement must be clear and unambiguous. The Contractor should state whether their solution meets the requirement and provides any available evidence. If a requirement is not met, the Contractor may propose an alternative and/or state whether the functionality is available in their solution.
- Contractor should also indicate all instances where their product capabilities exceed the CEM requirements.
- Optional features that are broader than the CEM requirements are accepted and may be included in the bill of quantities. However, optional features may only be accepted if the CEM requirements are already met by the features included in the Contractor's base proposal.

11.1.7.8 Supplementary Technical Information

- Include leaflets, catalogs, press releases, technical papers and testing reports from international laboratory for the standard etc. as attachments.
- The Bill of Quantities shall specify the costs to CEM of all the equipment and services necessary to implement the solution, including support and maintenance after system go-live.