

*Economic Community  
Of West African States*



*Communauté Economique  
Des Etats de l'Afrique de l'Ouest*

**WEST AFRICAN POWER POOL**  
**SYSTEME D'ECHANGES D'ENERGIE ELECTRIQUE OUEST AFRICAIN**  
*General Secretariat / Secrétariat Général*

**TERMS OF REFERENCE**

**Provision of Consulting Services for the Development of a Training  
and Certification Programme in Solar Renewable Energy for the  
benefit of actors in the West African electricity sector**

**REF:BJ-WAPP-154248-CS-CQS**

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## TERMES DE REFERENCE

### A. BACKGROUND AND JUSTIFICATION

1. The West African Power Pool (WAPP) is a Specialized Institution of the Economic Community of West African States (ECOWAS) which encompasses thirty-six (36) public and private power generation, transmission, distribution and commercialization utilities in West Africa.
2. WAPP's vision is to ensure the integration of the operations of the power systems of its member utilities into a unified regional electricity market which, in the medium and long term, shall assure the citizens of the West African Member States a stable and reliable power supply at competitive costs.
3. The realization of this vision shall entail, among others, the elaboration of an appropriate institutional and regulatory framework, the development of power generation infrastructural facilities and interconnected power networks, including the establishment of a regional electricity market and building the capacities of WAPP stakeholders.
4. In pursuit of the achievement of these objectives, the WAPP Organization has benefited and continues to benefit from the technical and financial support of financial development institutions, which enabled it to launch the first phase of the regional electricity market in Cotonou in June 2018 and to envisage the total electrical interconnection of the 14 continental countries of the West African sub-region by the end of 2020.
5. This feat of the ECOWAS Member States should ultimately offer opportunities for power exchanges and the development of large-scale projects likely to reduce electricity costs by up to 50% in certain West African countries. Overall, the World Bank estimates that the regional energy market could generate annual savings in the range of \$5 billion to \$8 billion.
6. The integration of power networks in West Africa is expected to provide a more robust interconnected power system capable of absorbing more variable renewable energy (VRE) than if the national grids remained isolated. The WAPP Information and Coordination Centre (ICC), currently under construction, shall serve as the central accounting and monitoring hub for power trade within WAPP's electrical power space. The ICC will enable effective monitoring of VRE power generation and cross-border trade.
7. Furthermore, the WAPP Organization revised its ECOWAS Master Plan for the Development of Regional Power Generation and Transmission Infrastructure in 2018. This study made it possible to identify **75 (#) regional priority projects** for the period 2019-2033, with an estimated investment cost of US\$36.39 billion as broken down below:
  - **28 (#) high-voltage transmission line projects** of approximately 22,932 km, at an estimated cost of **US\$ 10.48 billion**; including lines which will interlink the regional

interconnected power system with North Africa, through Morocco, and to the Inga Dam, through the Central African Power Pool;

- **47 (#) generation projects** with a total capacity of approximately 15.49 GW at an estimated cost of **US\$ 25.91 billion**; comprising 31.1% of thermal power plants mainly fuelled by natural gas, **69% of renewable energy projects** (consisting of hydro, solar & wind energy), **representing 15.27 GW**. Variable renewable energy projects constitute 20.33% of the total planned generation, accounting for 3.6 GW.
8. It is within this context that the World Bank has, within the framework of its Sub-Saharan Africa Solar Development Project - Phase 1 (SAHEL), decided to support WAPP member utilities in their efforts for skills development and qualifications of their human resources, notably in the fields of solar renewable energy resources.
  9. The Sub-Saharan Africa Solar Development Project - Phase 1 (**SAHEL**), aims to support among others:
    - ✓ a harmonized and systematic regional approach to intensifying competitive and large-scale solar energy generation, relying on private capital, with a view to lowering the cost of electricity, improving the capacities of VRE integration, and increasing the share of solar power in the energy mix.
    - ✓ A regional approach to capacity building drawing heavily on the framework of actions envisaged by the World Bank-International Council on Large Electric Systems (CIGRE) Partnership (WBCIP), and that will be complementary to the latter.
    - ✓ The development of Regional Solar Parks to satisfy the ambitions of the countries with regard to (a) increasing national generation of electricity vital for ensuring energy security; (b) significantly reducing the average cost of electricity; and (c) providing the countries, over time, with the opportunity of developing exports of solar power through regional interconnections.
  10. The objectives of the Sub-Saharan Africa Solar Development Project - Phase 1 (SAHEL), are as follows:
    - (i). promote the development of regional solar parks, through competitive bidding, in West Africa, and enable successful integration of variable solar energy.
    - (ii). strengthen regional technical capacity for the preparation of large-scale solar park projects and the integration of solar power into the networks.
  11. Toward this end, and in accordance with the abovementioned objectives, the strengthening of the capacities of the WAPP member utilities, through this project, must guarantee sustainability of regional efforts deployed to develop solar energy in large scale. Its viability shall be shaped and supported by the establishment of a working group on renewable energy whose mission will be to acquire, develop and maintain long-term know-how in the field of VRE integration within WAPP member utilities.
  12. With the assistance of the World Bank - CIGRE Partnership (WBCIP), the work programme of the renewable energy working group shall be structured so as to incorporate cutting-edge knowledge and lessons learned in a sustainable manner, with a view to

ensuring the raison d'être of the working group beyond the lifespan of the series of projects, while promoting private sector involvement and environmental sustainability.

13. In view of the gender disparities in employment within the energy sector and the need to enhance gender equity within national power utilities, efforts will be made to ensure that capacity building activities target women with a minimum required participation rate of 20%, particularly among staff members to be certified in the fields of planning, operation and maintenance of solar energy projects.

## **B. OVERALL AND SPECIFIC OBJECTIVES OF THE SOLAR ENERGY TRAINING AND CERTIFICATION PROGRAMME**

14. The overall objective of this Training and Certification Programme for Experts in Solar Renewable Energy is to promote the development of large-scale solar park projects with a view to bridging the electricity generation deficit in West African countries, notably by increasing the share of renewable energy resources in the energy mix and stimulating the socio-economic development of the region, while safeguarding the environment.

15. More specifically, the Training and Certification Programme for Solar Renewable Energy Experts shall ensure:

- (i). “**certified**” training courses in planning, implementation, operation and maintenance of solar energy generation facilities for the benefit of **at least 100 employees** from the Energy Ministries of ECOWAS Member States and WAPP member power utilities, including **at least 20% women participation**,
- (ii). availability of a pool of experts habilitated in the preparation, implementation, operation and maintenance of solar power generation projects in ECOWAS Member States, and
- (iii). increased and sustainable provision of training in solar renewable energy, through WAPP Regional Training Centres (RTCs).

## **C. SCOPE OF THE MISSION AND EXPECTED RESULTS OF THE CONSULTANTS/TRAINERS**

### **C.1. RESPONSIBILITIES OF THE CONSULTANTS**

16. Under the coordination of the WAPP Secretariat, the main responsibilities of the Consultants shall be to (i) identify and develop training content for a certification programme corresponding to the needs of WAPP, (ii) provide facilitation/training for WAPP participants and other actors in the West African electricity sector and (iii) provide tools for monitoring and evaluating the impacts of the certification programme on beneficiary entities and persons.

17. The proposed structuring of the certification programmes is indicated in **Annex A**.

### **C.2. TASKS OF THE CONSULTANTS**

***C.2.1. Evaluation / inventory of projects and operation of solar renewable energy generation facilities within the ECOWAS Member States***

18. As a first step, the Consultants shall prepare a data collection sheet on the status of public and private solar projects under preparation or implementation or operation in countries of the West African sub-region. Said sheets shall be completed by each participant for presentation in the course of the first training session. Furthermore, based on the personal documentary survey and files collected from participants, the Consultants shall prepare a summary document (inventory, success story, challenges, outlook, recommendations, etc.) on solar power generation projects and facilities within the West African sub-region.
19. In addition, the Consultants shall prepare an information sheet to be completed online by the participants (example on Survey Monkey) for gathering of information on their level of knowledge on the topics / themes to be addressed during the training sessions. Based on these surveys, the Consultants shall in a position to adequately adapt the training content and determine the topics / themes on which emphasis should be placed for more efficiency.

***C.2.2. Preparation of the scientific components of the training modules***

20. The Consultants shall provide a feedback in his own terms of his detailed understanding of the training mandate. The Consultants shall prepare, in collaboration with the representatives of the WAPP Regional Training Centres (RTCs), a presentation note on the training sessions. This should indicate an explicit plan on the methodology that would allow the participants to acquire the targeted skills. The presentation note on the training sessions must include, among others, the training session schedule, the educational objectives of each theme and module, the content and duration of each module as well as the training methodology and tools. If necessary, the Consultants shall propose software / tools useful for the training.
21. The broad outlines of the training modules are attached for information in **Annex B**.
22. The Consultants shall also be expected to prepare training kits for participants including, among others, the hard and electronic copies of the entire training programme in both languages (English and French) as well as the requisite teaching tools.
23. The designed training kits as well as all relevant training materials must be readily available for other training courses in the WAPP Regional Training Centres. If necessary, training for trainers of the Regional Training Centres shall be organized to ensure the sustainability of these training courses within the region.
24. The Consultants must ensure the coordination and facilitation of the various training sessions. To this end, the Consultant shall determine the number of participants per session and the requisite teaching tools and methods to be implemented by the RTCs in order to ensure the smooth conduct of the training session.

25. The Consultants shall assist the WAPP General Secretariat in the preparation of training visibility documents for the benefit of the media, WAPP member utilities and WAPP Technical and Financial Partners.
26. The Consultant shall support the WAPP General Secretariat in the selection of the RTC (s) that shall host the Certification Programmes. To this end, the Consultant shall establish a technical evaluation grid for the RTCs for each of the certification programmes selected.
27. At the end of each training session, the Consultants shall, in collaboration with the trainers from the host Regional Training Centre, organize a debriefing day for the benefit of WAPP representatives, including stakeholders. representatives of the WAPP Organizational Committees, the World Bank and the authorities of the host utility. The purpose of said debriefing day shall be to report on the achievements and challenges of the training session, the participants' mastery of the content of the themes, the training process adopted, as well as to assess whether the training objectives have been achieved and what types of changes need to be made regarding the training content and/or methodology and teaching tools.
28. The Consultants shall organize a study tour on one or more internationally benchmarked solar power generation facilities (at least 3 sites). To this end, the Consultants shall prepare a presentation note on the sites to be visited and a complete travel agenda. The duration of each study tour shall not exceed five (5) working days. The study tour should enable the trainees to correlate with training dispensed and to build on the best practices and challenges.

### ***C.2.3. Evaluation of training sessions***

29. For the purposes of on-the-spot assessments, the Consultants shall in collaboration with the Regional Training Centres prepare three (3) participants' evaluation sheets:
  - (i). the first sheet shall be used by participants to assess all aspects of the training, in particular the training logistics, content, teaching method and tools, etc.
  - (ii). the second sheet (for the trainer) shall be used to assess the level of knowledge acquired by the participants and their ability to make use of said knowledge in their daily functions; and
  - (iii). the third sheet shall be used to assess the trainers on their knowledge of the modules taught, their competence in conducting the training and their skills in other subjects.
  - (iv). Each sheet shall bear evaluation rating scales.
30. In the event of deferred assessment, the Consultants shall in collaboration with the host Regional Training Centre propose a presentation note on an effective method for evaluating the performance achieved by the trainees and the impact of the training on the beneficiary utility.



#### ***C.2.4. Training Programme Report***

31. Upon completion of each training session, the Consultants shall submit a detailed report on the completion of the training course within a maximum of two (2) weeks, including all documentation, evaluation and attendance sheets, as well as recommendations for future training needs.

#### ***C.2.5. Monitoring & Evaluation of the impact of training sessions***

32. The Consultants shall propose a toolkit model for monitoring & evaluation of the impact of the training sessions within the beneficiary entities as well as on the trainees and the performance of the training centres in providing said training sessions.

### **D. EXPECTED RESULTS OF THE TRAINING WORKSHOP**

33. Depending on the certification programme, the trainee should – upon completion of the training course - be able to:

- ✓ master the basic concepts of solar power generation,
- ✓ develop the methodology for implementing solar power generation facilities,
- ✓ ascertain the different types of radiation and the physics of photovoltaic conversion,
- ✓ coordinate and assist in the formulation of policies, strategies and programmes aimed at accelerating the development of solar projects, notably within the framework of a Public Private Partnership (PPP) scheme in their respective countries,
- ✓ determine the potential benefits of solar generation facilities for the achievement of national, regional and institutional objectives.
- ✓ convince their decision-making bodies and other stakeholders involved in power sector policy dialogues and reforms on the benefits of increasing solar power generation in the national energy mix, including the related challenges and the likely differential impacts on men and women,
- ✓ clarify the allocation of roles and responsibilities to the various stakeholders in the preparation, implementation and operation of solar power generation facilities,
- ✓ prepare financing for solar power generation projects,
- ✓ dimension and design solar power generation facilities,
- ✓ understand simple economic calculations to determine the economic viability of solar power generation projects,
- ✓ monitor construction works on solar power generation facilities,
- ✓ comprehend the fundamental principles of integrating solar power generation in an autonomous or on-grid power system,
- ✓ operate and maintain solar power generation facilities,
- ✓ conduct power system connection studies: Static study & Dynamic study, using a software package,
- ✓ identify the specific risks of solar power generation facilities and determine the safety measures to be taken,
- ✓ independently plan and implement solar power generation projects,
- ✓ ensure the scheduling and implementation of solar power generation facility maintenance works and repairs,
- ✓ monitor and evaluate the technical, economic and safety performances of solar power



- generation facilities,
- ✓ make practical use of the knowledge acquired and serve as a relay for the training of other employees of the power utilities,
- ✓ promote the participation of women and youths in the preparation, implementation and operation of solar power generation facilities.

34. Upon completion of the training sessions, **participants should be able to ensure the promotion and development of regional solar parks**, through competitive tender calls launched in West Africa and to ensure the successful integration of variable solar power in the energy mix of the region.

35. In addition, the West African power sector stakeholders, notably WAPP member national utilities, shall be availed of pools of Experts capable of developing, implementing, operating and maintaining solar power generation facilities, with gained mastery of all requisite tools for PPP project analysis, planning and implementation.

#### **E. SCHEDULE AND VENUES FOR HOSTING OF THE CERTIFICATION PROGRAMMES**

36. The certification programmes shall be organized for the benefit of **separate groups of French-speaking and English-speaking participants** within the premises of WAPP Regional Training Centres. Each RTC shall produce a technical proposal detailing its capacities to implement the certification programmes.

37. The five (5) RTCs to be consulted are as follows:

- The *Centre de Formation et de Perfectionnement Professionnels (CFPP)* at Cap des Biches in Senegal belonging to Senelec,
- The *Centre de Formation Professionnelle et de Perfectionnement (CFPP)* at Calavi in Benin belonging to CEB,
- The *Centre des Métiers de l'Electricité (CME)* at Bingerville in Côte d'Ivoire belonging to CIE,
- The *NAPTIN Campuses* at Kainji in Nigeria, and
- The *VRA Academy* at Akuse in Ghana.

38. The exact dates and venues of the training sessions shall be determined upon assessment of the technical, human and logistical capacities of the five (5) centres identified to implement the training sessions.

**39. The provisional schedule of the training sessions is attached in Annex C.**

#### **F. PROFILE AND NUMBER OF PARTICIPANTS**

40. The profile of the participants shall be determined for each training session in accordance with the educational objectives and those targeted by the SAHEL 1 programme. To this end, the Consultants shall propose a standard profile for each certification programme.

41. All the same, the participants shall be senior executives and engineers in charge of renewable energy issues in their respective organizations and generally those originating from the Ministries in charge of Energy of ECOWAS Member States and WAPP member national utilities.
42. The estimated number of trainees to be trained is indicated in the table below and must comprise at least 15% female participation.

No	Proposals for Certification Programme	Forecast of Participants per Training Sessions	Number of Training Sessions
1	Planning and implementation of renewable solar power generation facilities	66	3
2	Exploitation and integration of solar power generation into power grids	22	2
3	Maintenance and monitoring of the performance of solar power generation facilities	22	2
4	Study Tour	110	1
	<b><u>S/TOTAL</u></b>	<b><u>110</u></b>	<b><u>7</u></b>

#### **G. LOGISTICS FOR THE CERTIFICATION PROGRAMMES**

43. The WAPP Secretariat, in collaboration with the host RTCs, shall take charge of all logistical issues related to the training in respect of the participants and the trainer (s) (i.e. training room, coffee and lunch breaks, accommodation, local and international transport, etc.).
44. All the same, the Consultant (s) may separately include in their offers the costs relating to their costs of international transport, accommodation and stays (per diems).

#### **H. DELIVERABLES**

45. The Consultant shall prepare and submit all deliverables in accordance with international best practices, pursuant to the conditions and dates indicated in the table featured in **Annex C**.

#### **I. PROFILE OF THE CONSULTANT(S)**

46. The Consultant (s) shall comprise a maximum of two (2) Renewable Energy Experts specialized in issues pertaining to solar energy projects in partnership with the private sector and must have the following qualifications / competencies:
- holders of an engineering / master's degree in electrical engineering or an equivalent field of study.

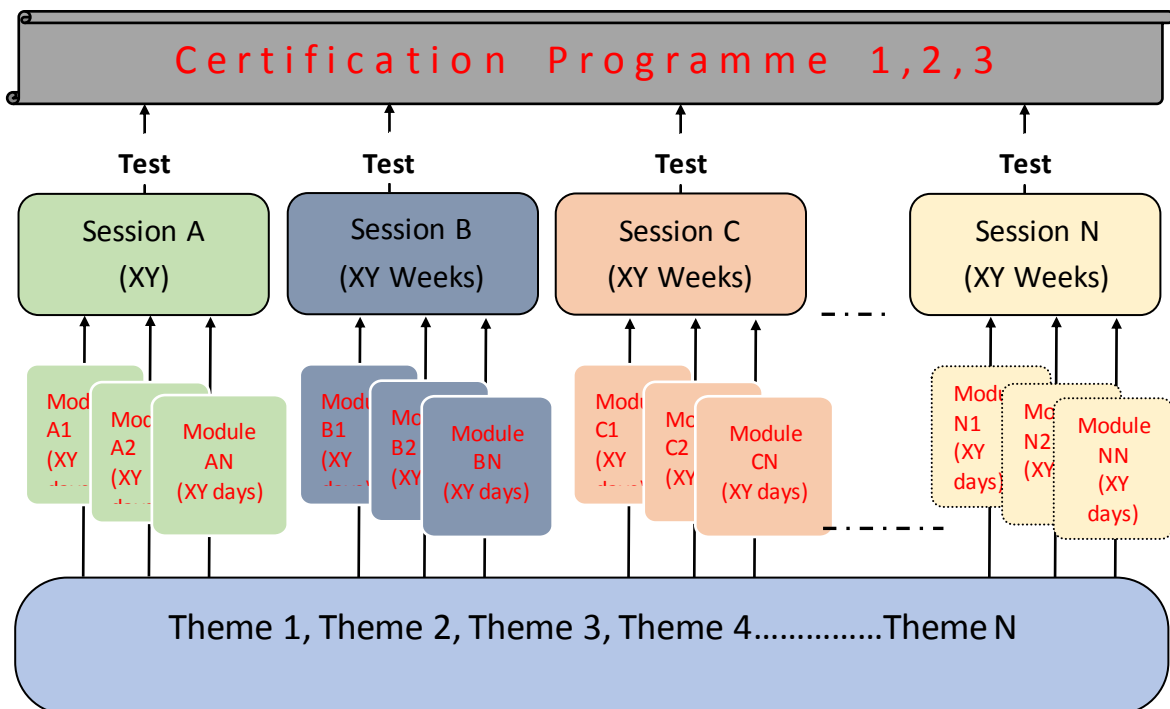
- holder of certificates with proven skills in the preparation of solar energy projects and / or in the operation and maintenance of solar power generation facilities,
- proven track record of at least 10 years of practical experience in renewable energy, notably in preparation of projects, operation and maintenance of solar power generation facilities.
- have at least 5 years of experience in training and capacity building for technicians, engineers, decision-makers and developers in the fields of renewable energy.
- demonstrate sound ability in the preparation of PPP renewable energy projects and / or the operation of power networks incorporating variable renewable energy resources.
- conduct of similar training assignments for the benefit of similar institutions would be considered an asset.
- a working knowledge of the West African region and familiarity with West African power networks would be considered an asset
- have an excellent knowledge of French or English and the ability to work in the other language.

## ANNEX A: Organisation of Certification Programmes

The certification programme shall be structured around the three (3) main areas of competence as referred to in item point F above and shall be carried out in accordance with a specific educational programme which comprises the stages described in Table A below. Each candidate for the certification programme must be able to validate the tests/examinations of the stages described below.

- ✓ The certification programme consists of **1 to 3 training sessions, the durations of which shall be valued in weekdays**. Participation in the certification programme shall be capped with the award of a "diploma" attesting to the successful completion of the various theoretical and practical tests/examinations relating to this programme.
- ✓ The **training session shall comprise at least 2 training modules**, the durations of which shall be valued **in number of days**.
- ✓ The **training modules shall comprise complementary training themes**, the durations of which shall be valued **in number of hours**. Each module may comprise a theoretical part and a practical part.

*Table 1: Synopsis of the Certification Programme*



The training modules shall be structured in such a manner that will allow candidates for the certification programme to firstly immerse themselves in the fundamentals of solar power generation to give them a solid grounding, followed by an in-depth knowledge of specific themes and/or issues, the content of which shall consist of a theoretical background and some simulation exercises.

Furthermore, **each training module should be developed** in line with the following points:

- the expectations of the training module or the educational objective which defines the performance to be achieved by the trainees upon completion of the training activity. It must meet certain criteria and permit to deduce the conditions for its evaluation.
- the duration of the training (hours or days),
- the requisite profile of the trainees,
- the minimum and maximum number of participants per module,
- the educational tools required,
- the required training mode (presentation, lecture or practical) as well as the briefing materials: datasheets,
- the training period,
- the linkage with other training modules,
- references to educational training books,
- the knowledge assessment tools including paper-based or equipment-based educational practical tests, oral questions in the course of training, online quizzes on desktop computer or pc, assessments, etc.
- the test / examination questionnaire exclusively designed for the training session,
- trainers' references,
- etc.

The certification programmes shall be developed in collaboration with the following institutions:

- ✓ The **WAPP Regional Centres of Excellence** with the requisite technical capacities and educational tools may carry out the training sessions.
- ✓ **Higher and professional training institutes specialized in electrical engineering** may provide support to the RTCs in the preparation of educational contents, the determination of educational tools and the development and correction of certification tests/exams. As such, they may give insert their brand name on the training certificates.
- ✓ **CIGRE may assist in the provision of expertise and reference works** as well as in **the preparation of study tours** in which participants, if required, shall take part in the course of the certification programme.

## ANNEX B: Outline of the Training Modules

The broad lines (non-restrictive) of the “certified” training contents are grouped into three (3) areas of expertise:

(i). *Certification programme I: Planning and implementation of renewable solar power generation facilities*

- ✓ Governance and sectoral policy on renewable solar energy,
- ✓ Assessment of existing legislative, regulatory and institutional frameworks in West Africa,
- ✓ Pricing of solar energy,
- ✓ Support mechanism, Auctions, Carbon Credit, etc.
- ✓ Assessment of solar resources and their yield,
- ✓ Assessment of demand forecast, solar irradiation,
- ✓ Spatial analysis of a territory (GIS) and site selection,
- ✓ Dimension of solar power generation facilities (modules, inverters, cables, transformers, protections, telecommunications, civil engineering, security, surveillance...),
- ✓ Identification of the components of a solar power facility, Concept and Structure of a PV power plant,
- ✓ Differentiation of types of solar power plants (modules, fixing, transformers, etc.)
- ✓ Design of solar power plants (basic design), if possible, with a software,
- ✓ Analysis of the operational data of a solar power system
- ✓ Assessment of the main activities of the PV systems’ value chain,
- ✓ Assessment of the main developmental and implementation stages of solar power plant projects,
- ✓ Permits, Licenses and Environmental Considerations,
- ✓ Network connection agreements,
- ✓ Preparation of terms of reference for preparatory studies on solar power plant projects (feasibility, ESIA, RAP, etc.)
- ✓ Identification of the key stakeholders and project structures,
- ✓ Risk analysis, how to mitigate them, do's and don'ts,
- ✓ Determination of performance indicators for PV project calculation,
- ✓ Principal Costs Study (CAPEX and OPEX) and other relevant figures for an economic analysis,
- ✓ Sensitivity analysis.
- ✓ Identification of projects leverage effect,
- ✓ Evaluation of a project with a corresponding economic efficiency calculation tool,
- ✓ Time scheduling of project investments and portfolios,
- ✓ Monitoring and coordination of the implementation of solar power generation facilities,
- ✓ Identification and analysis of the structuring of solar energy projects and their financial solvency,

- ✓ Supervision of construction contracts for solar power generation facilities (EPC...),
- ✓ Explanation of the Green Funds financing mechanisms,
- ✓ Forms of financing,
- ✓ Project development cycle,
- ✓ Public-Private Partnership in solar energy projects,
- ✓ Solar power purchase agreements and negotiation,
- ✓ Frequent construction errors,
- ✓ Role of electrical power storage (battery, hydro pumping, etc.) as well as the integration of solar power into networks,
- ✓ Supervision and acceptance of works on solar power plants,
- ✓ Etc.

**(ii). *Certification programme II: Operations and integration of solar power generation into power grids***

**Understanding solar power generation**

- ✓ Notions and concept of solar irradiation, uncontrollable variability, partial unpredictability, geographic dependence,
- ✓ Variable Renewable Energy Sources,
- ✓ Configuration of PV generation systems
- ✓ Concept and Structure of a PV power plant,
- ✓ Physics of the PV technology,
- ✓ Optimal operating point of a PV module,
- ✓ Types and evolution of photovoltaic cells,
- ✓ PV technologies and performance
- ✓ Norms (Standards) for PV modules

**Inverter**

- ✓ DC-AC conversion,
- ✓ Standards for inverters,
- ✓ Capacities of the different types of inverters,
- ✓ Sizing and selection of inverters,

**Power System**

- ✓ Structure, Components, characteristics, operation,
- ✓ Role and responsibility of the operator,
- ✓ Power concept (Active and reactive power),
- ✓ Power transmission: transmission technologies
- ✓ Synchronous interconnections,
- ✓ Power system planning and operation: timeline, security principles
  - Load dispatch centre control room
  - SCADA – EMS



**Power System Control**

- ✓ Control structure
- ✓ Frequency and voltage control and management
  - Objectives
  - Voltage control levels
  - Voltage stability
- ✓ Control Structure
- ✓ Frequency and load balance management
- ✓ Power generation profile
- ✓ Types of reserves
- ✓ Load-frequency control
- ✓ Principles of operational security
- ✓ Application of the N-1 security criterion
- ✓ Network planning timeframe

**Integration of renewable energy (RE) into the power grid**

- ✓ Principles of integrating RE into the grid at all voltage levels
- ✓ Challenges in integration of variable renewable energy
  - Bearing in the event of low voltage
  - Compensation of variability
- ✓ Projection and dispatching of variable renewable energy generation from large-scale renewable energy power plants
- ✓ Challenges in integration of variable renewable energy into the power grid and possible solutions

□

**Network Codes**

- ✓ Roles of network codes, network connection rules and network connection agreements.

***(iii). Certification Programme III: Maintenance and monitoring of the performance of solar power generation facilities.***

**Repairs and Maintenance**

- ✓ Soiling of the module,
- ✓ Availability of water,
- ✓ E&M contract (role, fundamentals, structure and content, Guarantee...),
- ✓ Determination of maintenance costs,
- ✓ Preventive / scheduled maintenance
- ✓ Unscheduled maintenance
- ✓ Inspection & verification
  - Hot spots
- ✓ Structural integrity
- ✓ Equipment servicing (modules, inverters, trackers, auxiliary, etc.)

- ✓ Vegetation,
- ✓ Spare parts
- ✓ Restrictions, network downtime and network maintenance
- ✓ Scheduled and unscheduled outages
- ✓ Insurance

**Performance monitoring**

- ✓ Technique performance
  - Monitoring system
- ✓ Quantification of the yields of solar power generation facilities.
  - performance coefficient
  - specific yield
  - capacity factor
- ✓ Commercial Performance
- ✓ Financial performance
- ✓ Technical and financial audits.
- ✓ Solar energy certifications and standards.

**It should be noted that the contents of the training modules shall be finalized by the Consultant responsible for the Training of Trainers and Experts from the Training Institutes and Regional Training Centres**

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## ANNEX C: Tentative Implementation Schedule for the Certification Programmes

No	Activities / Deliverables	Description	Timeframe	H/J	Duty Station
1	Signing of Contract	Signing of Contract	W0		on site
2	Preparation of the kick-off meeting	Preparation of the kick-off meeting	W0+1	2	Office
3	Mission kick-off meeting	Detailed description of the Consultant's methodology, the mission implementation schedule, data collection sheets, inconsistencies in the TOR	W0+2	2	On site
4	Report on the Mission kick-off meeting	Report on the results and conclusions of the kick-off meeting	W0+3	3	Office
5	Fact sheet on the level of knowledge of the trainees	The Consultant shall prepare a fact sheet which shall be completed online by the participants (example on Survey Monkey) for data collect on their level of knowledge about the topics / themes to be addressed during the training sessions.	W0+3	1	Office
6	Mission Interim report	Results of surveys and data collections notably			
		<i>Data collection in the 4 RTCs</i>	W0+2	10	on site
		<i>Level of knowledge of Trainees designated by power sector stakeholders</i>	W0+4	3	Office
		<i>Presentation note on the certification programme providing details of the training sessions, including contents of the training modules</i>	W0+4	5	Office
		<i>Presentation note on the study tour organized for the trainees</i>	W0+4	3	Office
		<i>The evaluation grid of the RTCs</i>	W0+4	1	Office
		<i>Document buttressing the visibility of the Certification Programmes</i>	W0+4	1	Office
		<i>Training session kit</i>	W0+4	2	Office
<i>Training session evaluation sheets (On-the-spot and deferred assessments)</i>	W0+4	2	Office		
7	Interim report validation meeting by stakeholders (WAPP, World Bank, RTC,	Consideration and validation of Consultant's proposals on the certification process.	W0+4	2	On site

No	Activities / Deliverables	Description	Timeframe	H/J	Duty Station
	Other partners)				
8	Launching of the Certification Programmes	Official launching ceremony	W0+5	1	on site
9	Delivery of the Certification Programme I	<i>Session I of the Certification Programme I</i>	W0+6	10	on site
		<i>Session II of the Certification Programme I</i>	W0+9	10	on site
		<i>Session III of the Certification Programme I</i>	W0+12	10	on site
10	Official award of Programme Certificates I		W0+13		
11	Training Programme Report I		W0+14	3	office
12	Delivery of the Certification Programme II	<i>Session I of the Certification Programme II</i>	W0+15	10	on site
		<i>Session II of the Certification Programme II</i>	W0+18	10	on site
13	Official award of Programme Certificates II		W0+19		on site
14	Training Programme Report II		W0+20	2	office
15	Delivery of the Certification Programme III	<i>Session I of the Certification Programme III</i>	W0+21	10	on site
		<i>Session II of the Certification Programme III</i>	W0+24	10	on site
16	Official award of Programme Certificates III		W0+26	1	on site
17	Training Programme Report III		W0+28	2	office
18	Study Tour	Study Tour	W0+30	10	on site