TERMS OF REFERENCE – CONSULTANT/TRAINER

Ethiopia Electric Power (EEP) Electro Magnetic Transient Program (EMTP) Training.
Power Africa East Africa Energy Program

1. INTRODUCTION/BACKGROUND

Power Africa East Africa Energy Program aims to expand affordable and reliable electricity services in East Africa. The program’s goal is to support development priorities, including inclusive economic growth, security, and improved health and education outcomes. The program covers 10 countries: Burundi, the Democratic Republic of Congo, Djibouti, Eritrea, Ethiopia, Kenya, Rwanda, Somalia, Tanzania and Uganda. RTI and its partners Tetra Tech, Fieldstone Africa, Norton Rose Fulbright, the Center for Climate Strategies, and Khulisa will implement this program to address critical opportunities across the following four major objectives:

1. Optimized power supply
2. Increased grid-based power connections
3. Strengthened utilities and other power sector entities
4. Increased regional power trade

Overall objective of the assignment

RTI International, the lead implementing partner is seeking the services of a trainer/consultant to design and deliver a virtual training on Electro Magnetic Transient Program (EMTP) for the Ethiopian Electric Power(EEP) Transmission Planning Department. The consultant will work with the Power Africa East Africa Energy Program team to design a training syllabus/program, conduct joint training exercises, and administer the pre and post individual training assessment tools for each trainee.

Statement of Work

Power Africa is working with EEP to build the capacity of its Transmission Planning Department to meet the rapidly growing demand for electricity and the expanded system. This is aimed at ensuring the transmission sector is professionally, financially and technically viable and is aligned to the global requirements. It also aims to improve the knowledge and understanding of Ethiopian Electric Power’s transmission planning team and managers of Electromagnetic Transient Analysis. This will be done in the context of expected specific new developments on the Ethiopian power system listed below.

1) The HVDC transmission connection to Kenya which is at the construction stage; and
2) The Addis Abba light railway project, which is electrically driven and operational.
3) Addis Ababa to Djibouti railway traction stations which is electrically driven and operational
4) Awash to Woldia railway power supply project which is under construction

Additionally, the training is based on the usage of Alternative Transient Program-Electromagnetic Transient Program (ATP-EMTP) and ATP-Draw for demonstrating concepts and teaching through practical utility cases. The training should lead to internationally acknowledged accreditation on Electromagnetic Transient Analysis, or an alternative standard.

The software ATP-Draw will be used for demonstrating concepts and training through practical utility problem cases. This will be done through intensive hands-on training covering:

1. Insulation Coordination analysis with EMTP
2. Switching studies analysis with EMTP
3. Harmonics analysis both from High Voltage Direct Current (HVDC) and Railway traction;
4. Transformer energization studies with EMTP
5. Breaker Transient recovery voltage (TRV) studies
6. Very fast transients (VFT) studies
7. Capacitor bank design

The training targets 15-20 engineers from the following departments at EEP:

- Transmission Substation Strategy Office
- Power System Planning Department
- Transmission Substation Operation
- Transmission Substation Design Department

**Workshop objectives**

1. Insulation Coordination Analysis with EMTP. Participants familiarization with the usage of EMT-type software and study of power system transients.
2. Harmonics analysis both from High Voltage Direct Current (HVDC) and Railway Traction:
   - Familiarize with the different power quality issues and perspectives
   - Modelling of the electrical railway traction system including locomotives and HVDV system using EMTP software.
   - Identify different power quality problems and influence of electric traction system on power quality in the transmission system (simulation and power quality measurements) as well as recommend ways of addressing the challenges.
   - Understand the cause and effect of harmonics to electrical system
   - Identify the ways to mitigate the effects of harmonics.
3. Identify other priority capacity development needs for the power entities.
4. Introduce the individual training needs assessment tools for EEP’s Planning department application post-workshop.

2. PERIOD OF PERFORMANCE AND PLACE OF PERFORMANCE

Power Africa anticipates that the training will be conducted virtually. However, if travel restrictions are waived and group gatherings are again permitted, then Power Africa, EEP and the Consultant may decide to conduct in-person trainings. Bidders are encouraged to consider different modalities for deploying the training modules given the current and likely future work-from-home scenarios. The courses are to be spread out over a period of months to be determined competitively by bidders through application of their professional judgement. The consultant will discuss and develop the training program in consultation with Power Africa East Africa Energy Program and EEP. This is aimed at minimizing attendees’ time out of the office or away from their normal work obligations, as well as in consideration that this is potentially a virtual training, unless the prevailing circumstances during the training period permit otherwise.

Additional discussions will be held with the successful bidder to explore options of possible workshop in Addis Ababa if the prevailing circumstances will permit at the specific time of delivering the course, this could be for specific modules that will not have been covered virtually, or for a final face-face interaction with the trainees. The program will cover all travel, accommodation and meals for the consultants if there will be any face-face meeting in the coming months. Therefore, bidders should not include any logistical or travel costs in the bid, other than those related to provision of virtual training such as costs of virtual platforms - which should be indicated in a separate budget line. Kindly refer to the RFP for additional details specifically the deliverables, performance duration and costing template.

3. WORK REQUIREMENTS

The Consultant will conduct virtual trainings either independently or by partnering with an experienced virtual training firm.

Virtual Learning Requirements:

- **a. Session delivery methods** – should be audio-visual and interactive through lectureettes interspersed with practical online exercises and quizzes.
- **b. Learning resources** – the learning resources for each session in the training should be accessible by the participants in-session with an option to download handouts for personal revisions offline.
c. Training session delivery needs to be self-paced for each participant or group of participants over a pre-determined duration prescribed in the training schedule developed by the Consultant.

d. Formal assessments- For certification purposes, learning assessments to be provided separately for online self-paced administration by each participant within a pre-determined period after the training course.

The Consultant will propose the preferred modality for participants to access the virtual training meeting requirements (a)-(d) above.

The Consultant must recognize that the participants will be in East African Time Zone, specifically Ethiopia. Any live interaction must be done during normal business hours. All deadlines and dates must put into consideration the time zones.

The EEP Electro Magnetic Transient Program (EMTP) Virtual Training has four parts namely:

3.1 Inception

This phase will cover formal familiarization and orientation with Power Africa and EEP. The session will also include development of the training program. Consultant will perform the following activities under this phase:

- Participation in a virtual assignment kick-off orientation session with Power Africa and EEP during which all the key trainers must participate. This will be spread over a couple of days with an agreed number of hours per day. Discussion on the number of days and hours for the virtual orientation session will be determined following discussions with the selected consultant
- Preparation of notes from kick-off orientation session with Power Africa including detailed and agreed training methodology
- Delegates/ participants profiling
- Training readiness- an overview of the context of expected specific new developments on the Ethiopian power system
- Corroborate a clear pathway to an internationally accredited certification, no obstacles/delays expected. Detail all procedures including actions required to award the participants
- Confirmation of all provisions in relation to the required software
- Final preparations to deliver the training virtually
- Testing the virtual training platform three working days in advance
- Approved training design syllabus/course program with timelines
- All the above and additional matters that will come up summarised in an inception report.

3.2 Pre-Training

Activities under this phase include:

- Preparation of pre and post training assessment tools
• Development of training modules and submission for feedback and finalized for approval
• Design of participants feedback questionnaires to be administered and analysed for each training day
• Preparation of all the training material and tools including Monitoring and Evaluation (M&E) forms, ready for printing or administration to participants
• Participants invitations and participation follow-up
• Testing of the virtual training platform a day in advance
• The consultant will not be required to provide logistics (transport, hotel, etc) for any participants
• The consultant will avail the final training tools and deliverables for review and approval five working days in advance of the training to Power Africa

3.3 Training

This phase includes conducting of the training/workshop, and development/consensus on post individual training assessment for various planning engineer staff. Activities under this phase include:

• Conduct participant training in line with the approved training program including provision of rapporteur services
• The consultant will work with the Power Africa East Africa Energy Program team to ensure that requisite M&E forms and corresponding data, including daily participant sign-in forms are duly completed
• The bidder will not be required to support training logistics (i.e. identification and procurement of meeting space, refreshments, equipment rental, printing, photocopying, miscellaneous supplies, or communications)
• The trainer will prepare and submit daily training notes and a brief post-training report for the workshop, outlining where they perceived strengths and weaknesses of participants in terms of knowledge and understanding of the technical training, combined with participant feedback
• Submit daily participant sign-in register duly completed/ signed, and shared at the end of each training day
• Administer, analyse, and submit participants feedback questionnaires at the end of each training day to evaluation participants level of satisfaction with the training
• The trainer must receive a satisfactory result on the training, as analysed from the feedback questionnaires completed by attendees for each training day, before conducting additional trainings
• Pre-training and post-training assessment reports are administered, completed, analysed, and submitted, to evaluate level of knowledge change on the participants.

3.4 Post Training

This is the final phase for this assignment which entail submission of the workshop report
And issuance of accreditation certificates to the participants. The certification process will be done in consultation with Power Africa and EEP.

The final report should include but not limited to:

- Final evaluations
- General observations
- Areas for future consideration
- Possible improvement to the curriculum for future possible training
- Projected possible developments on the Ethiopian power system in relation to Electromagnetic Transient Analysis.

The Preliminary Training Requirement

**Theme One: Insulation Coordination Studies (Basic)**

- General Introduction to ATP-Draw and Type of Field application
- Presentation of User Interface
- How to create a simple circuit
- Introduction to Scopview and MPLOT
- Practical exercises- Modelling an overhead line for lightening studies.
- Sub-circuit creation and hierarchical designs
- Rotation exercises: Synchronous generator, Exciter, governor modelling
- Practical exercises using the EEP network and parameters.

**Theme Two: Insulation Coordination Studies (Switching Transient)**

- Transformer Energization
- Line and cable modelling
- Modelling of Transformers
- Switching transients: Line Energization Analysis
- Switching transients: Transient Recovery Voltage Analysis
- Switching transients: Selection of BSL/BIL based on IEC 60071-1

**Theme Three: Insulation Coordination Studies (Lightening Transients)**

- Lighting Transients (Introduction)
- Lighting Transients (System modelling for lightning analysis)
- Lighting Transients (Study of back flash over analysis)
- Study of Shielding failure analysis
- Selection of BIL based on IEC 60071-1

**Theme Four: HVDC System**

- The Basic of HVDC link
- Introduction to Voltage Source Converters (VSC) HVDC systems and controls.
- Steady state operations
- Modular Multi Converter (MMC)-HVDC transmission, description of components
- AC fault behavior of MMC-HVDC systems, system impacts

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• DC fault behavior of MMC-HVDC systems, impact on DC cable
• Interaction studies

Theme Five: Power Quality Problems

• Overvoltage
• Undervoltage
• Sustained Power Interruption
• Short Duration Power Interruption
• Voltage Sag
• Voltage Swell
• Voltage Fluctuation
• Voltage Distortion
• Voltage Variation Computation
• Voltage Unbalance Computation

Theme Six: Power System Harmonics

• Fundamentals of Harmonics
• Sources of Harmonic and Effect of Harmonics
• Relationship between Harmonics and Transients
• Harmonic Sources from nonlinear loads, switched converters, etc.
• Sect Mitigation of Harmonics
• Analysis Method: Measure of Distortion
• Design of Harmonic Filters and Harmonic Filtering
• Voltage/current distortion: distortion limits and guidelines.
• Harmonic effects upon capacitor bank, transformers, motors, etc.
• Power failure due to Harmonics
• “Traditional” harmonic problems in transformer and other devices.
• Review of applicable standards
• Introduction to Computer simulation technique (EMTDC)

Theme Seven: Harmonics from Railway Traction

• Introduction to Railway Traction load characteristics
• Harmonic Model of Railway Traction Transformer
• Harmonic Model of Railway Traction Network
• Measurement at traction transformer substations
• Modelling of Reactive power compensation for railway traction systems.
• Simulation model of electrified railway connected to power grid with EMTDC.

4. EXPERIENCE AND QUALIFICATIONS

The service provider may be a consulting firm or individual consultants with teaming agreements, if they meet all the eligibility requirements stated in the RFP.

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The lead trainer will be in charge of the assignment and engagement with Power Africa including successful delivery of the assignment. He/she will be the focal point expert for all aspects of the assignment to achieve all the required deliverables. The individual will coordinate the team members to develop a detailed implementation schedule for the assignment. The lead trainer will ensure deliverables are designed and produced in a participatory manner and will be responsible for progress updates and emerging concerns in the delivery of the assignment.

The lead consultant should have:

1. A master’s degree in Electrical Engineering with specialization in Power Systems.
2. A minimum of 15 years of progressive work experience.
3. More than seven years’ experience in providing sector or organizational development (four) Must demonstrate previous utility or consultancy experience using ATP-EMTDC and ATP-Draw.
4. Must have at least two relevant energy sector work experience or engagements in a field related to the intervention area selected.
5. Must have practical experience in the sector or organizational development.
6. Must have vast experience in engagement with public officers in Ethiopia or equivalent developing country.

Support Trainer: Working closely with the lead consultant, s/he will prepare the deliverables and represent the team in day to day engagement with Power Africa and EEP for successful delivery of the assignment. The individual will be in charge of gathering data, information and background records including conducting in-depth desk reviews and preparation of related reports. The support trainer will also act as a rapporteur in all events related to the assignment.

She/ he must have:

1. An advanced degree that is relevant for the assignment
2. At least 12 years of progressive work experience
3. Demonstrate knowledge and experience in energy sector or public sector in general.
4. Must have undertaken consultancies for large organizations or the public sector.
5. Must have practical experience that is relevant for the assignment.

5. SCHEDULE

The below list consists of the initial schedule identified for the technical training. This schedule will be part of the engagement contract and shall be completed upon establishment of the timelines as proposed and negotiated with the winning bidder:

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6. MILESTONES/DELIVERABLES

This activity has three phases that correspond with milestone payments. The following table outlines the milestones and payments associated with each.

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<th>Deliverables</th>
<th>Tasks</th>
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| 1 Inception Report | • Participate in kick-off meetings/calls.  
• Notes from kick-off orientation session with EAEP including detailed and agreed training approach methodology  
• Delegates/ participants profiling  
• Training readiness- an overview of the context of expected specific new developments on the Ethiopian power system.  
• Pathway to an internationally accredited certification or an alternative standard confirmed – no obstacles / delays expected. All procedures detailed including actions required to participants awarding.  
• Confirmation of all arrangements in relation to the required software  
• Conclusion of preparations to deliver the training virtually  
• Testing of the virtual training platform 3 working days in advance  
• Approved training design syllabus / course program with timelines |
### 2. Pre-Training Report
- Pre and Post training assessment tools
- Training Modules drafted, submitted for feedback, and finalized
- Design of Participants Feedback Questionnaires to be administered and analysed for each training day.
- All the training material and tools including M&E forms, ready for printing or administration to participants.
- Testing of the virtual training platform a day in advance
- Participants invitations and participation follow-up.

### 3. Training report
- Daily participant sign-in register duly completed/ signed, scanned, and shared at the end of each training day
- Conduct training as per approved training program
- Administer, analyse, and submit participants feedback questionnaires at the end of each training day
- The trainer must receive a satisfactory result on the training, as analysed from the feedback questionnaires completed by attendees for each training day, before conducting additional trainings.
- Rapporteur services
- Pre- training and Post-training assessment reports are administered, completed, analysed, and submitted
- Workshop report submitted for the full training.
- Completed M&E forms.

### 4. Post- training
Consultant to issue accreditation certificates to delegates who qualify.

Final report for the whole assignment to include but not limited to;
- Final evaluations,
- General observations,
- Areas for future consideration,
- Possible improvement to the curriculum for future possible training,
- Projected possible developments on the Ethiopian power system in relation to Electromagnetic Transient Analysis.

### 7. REQUEST FOR BUDGET AND NARRATIVE
RTI requests a quote with an accompanied budget narrative that responds to the Terms of Reference and work requirements. Budget Line items will include:

- Labour as applicable, harmonised with expertise requirements section
- Any other direct costs must be justified.
- Indirect costs
o All indirect costs must be substantiated by audited financial statements or an approved Negotiated Indirect Cost Rate Agreement (NICRA).

8. OTHER REQUIREMENTS

Bidders are expected to provide the most realistic and favorable performance duration for each deliverable. This is specifically important because the total performance duration for completion of the assignment is one of the selection factors and basis for competition among bidders. Kindly refer to the RFP for additional details specifically the deliverables, performance duration and cost template.

During the pre-planning session the consultant will be required to attend a virtual briefing session with the pertinent Power Africa technical and cross cutting teams.

Bidders are reminded to review all the LPO terms as detailed in the attachments (links) to this RFP such as, but not limited to required insurances, indemnity clauses and Intellectual Properties. RTI’s subcontract terms and conditions can be found here: https://www.rti.org/sites/default/files/msa_template_v1_13_2016.pdf

9. GENDER COMPONENT

In delivering support, Power Africa will consider how gender equality and female empowerment can be advanced or achieved, and how participation by both female and male stakeholders will be facilitated in project activity. The consultant should indicate how they will align their project approach with this requirement.

10. ACCEPTANCE CRITERIA

Acceptance of all deliverables will reside with Power Africa East Africa Energy Program Deputy Chief of Party – Project Management Unit, who will work with the Senior Power Pool Advisor and in consultation with the relevant EEP Technical representatives to ensure the completeness of each stage of the project and that the scope of work has been met. Once a project phase is completed and the Consultant provides the deliverables for review and approval, Deputy Chief of Party – Project Management Unit will reply to the Consultant, in writing and may advise pending tasks.

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