USAID
FROM THE AMERICAN PEOPLE

USAID ENERGY POLICY PROGRAM

POST-TRAINING EVALUATION

REAL-TIME POWER SYSTEM SIMULATOR TRAINING PROGRAM

OCTOBER 5-29, 2015

November 2015

This program is made possible by the support of the American people through the United States Agency for International Development (USAID)

USAID ENERGY POLICY PROGRAM

POST-TRAINING EVALUATION

REAL-TIME POWER SYSTEM SIMULATOR TRAINING PROGRAM

OCTOBER 5-29, 2015

Contract No: AID-EPP-I-00-03-00004
Order No: AID-391-TO-12-00002

©USAID Energy Policy Program
House 4, Street 88, Sector G-6/3
Ataturk Avenue, Islamabad, Pakistan
Tel: +92 (51) 835 7072, Fax: +92 (51) 835 7071
Email: tjaved@ep-ep.com.pk

DISCLAIMER

The contents of this document are the sole responsibility of Advanced Engineering Associates International Inc. (AEAI) and do not necessarily reflect the views of USAID or the United States Government.

Real-Time Power System Simulator Training Program
Training dates: October 5th-29th, 2015

Post-Training Evaluation Report

This assessment report summarizes and highlights the responses from Real-Time Power System Simulator (RTPSS) Training participants and trainers, collected during site visit conducted on October 27th and 28th, 2015. Based on the feedback, the assessment appreciated the time invested by EPP in the successful completion of the training. In this activity, Energy Policy Program (EPP) successfully delivered the Real-Time Power System Simulator Training with OPAL-RT technologies assistance; the training was given to participants belonging from Planning, Design, and System Protection and Technical Service Group (TSG) departments of NTDC.

Real-Time Power System Simulator (RTPSS) training program was designed to fill the capacity building gap of RTPSS expertise at NTDC. Through delivery of a successful training program, NTDC staff will be able to simulate operational models with DC transmission systems integrated into AC systems, and to incorporate renewable energy generation facilities into design. The trained staff will be able to improve AC systems operation, test system reliability, and improve system protection.

Number of Participants trained:

Department	Male	Female	Total
Planning	11	4	**15**
Design	1	2	**3**
System Protection	4	0	**4**
Technical Services and Group	2	0	**2**
Total	**18**	**6**	**24**

At the end of the training course, EPP conducted post-training evaluation sessions on October 27th and 28th, 2015 at NTDC with 16 participants. During the session, 16 out of 24 participants showed up hence the feedback will be based on the sample size of 16. The participants were given eight questions post-training evaluation feedback form to detail their valuable experience during the training. Following are the statistics and quotes from participants' responses.

Please tick in appropriate box: ***5 outstanding, 4 very good, 3 satisfactory, 2 needs improvement, 1 did not meet expectations***

Program Rating	*Did not meet expectations*	*Needs improvement*	*Satisfactory*	*Very good*	*Outstanding*
Relevance to your organization's work area			6		2
Structure of the training courses		1	4	8	3
Topics covered in the			4	9	3

courses					
Quality and appropriateness of course content and materials			5	8	3
Quality of Speakers/Trainers			3	6	7
Trainers/Speakers effectiveness			3	6	7

According to the rounded responses of all participants from the above stated table:

1. 50% of the participants rated "Relevance to your organization's work area" as very good, 37% rated it as satisfactory, and 12% rated it as outstanding.
2. 50% of the participants found "Structure of training courses" as very good, 18.5% participant rated it as outstanding and 25% of the participants rated it as satisfactory and 1 % felt the need for improvement.
3. 56% participants rated the "Topics covered in the courses" as very good, 25% of them found it satisfactory, 18% rated it as outstanding.
4. 50% rated "Quality and appropriateness of course content and materials" very good, 31% found it to be satisfactory, whereas 18% rated it as an outstanding content.
5. 37% of the participants felt the "Quality of Speakers/Trainers" was very good, 43% rated it as an outstanding effort by the trainers, and 18% rated it as satisfactory.
6. 37% participant's rated "Trainers/Speakers effectiveness" as very good and 43% found the effectiveness to be outstanding whereas 18% rated it as satisfactory.

Please share any observations or comments regarding the Real-Time Digital Simulator Training/trainer/t program/logistics:

Participants were asked to share their observations and comments regarding the trainer, training, and logistics. When asked about the trainer and logistic; almost all the participants found the training very beneficial for them w.r.t their organizational work, they elaborated:

"It was a very useful program organized by USAID for capacity building of NTDC employees."

"Trainer was very professional. He was very co-operative. Advance training program should be conducted in detail."

"The training program was basically designed for planning engineers, whereas the program gave basic introduction to the protection guys as well. Overall it was ok from protection requirements point of view."

"RTPSS, as I observed is a very useful tool for system designing and analysis the behavior of system components under different scenarios by replicating and stimulating the real life issues and faults to better understand and design reliable system. Training program was effective as it took from basic to advanced level in smooth way."

"This is very good training. Completing the simulation in specific time is very useful."

"Communication skills of trainers were good. Hardware interfering with RTPSS was the most interesting part of the training."

"RTPSS training was very comprehensive but practical interfering Modules were not provided to learn more. Each power system components is given software (hyperism) requires more advance training to have grip on given software."

"Both trainers are very cooperative and helpful. They gave us hands on training which was very helpful in understanding RTPSS."

"Trainers expertise was relevant in this area but due to no background knowledge and pre-requisite data couldn't get much out of it as expected, trainers were very dedicated, and practice weeks were very fruitful"

"Trainers were very good they provided their best knowledge regarding the program but hands on experience is lacking behind due to less practice therefore trainers assistance should be continued in future if needed."

Before you received this training, how would you describe your technical knowledge of RTPSS?
Keeping in view all the responses it shows that before this training most of the participants had very limited technical knowledge regarding RTPSS The trainees feel positive about the future use of technical knowledge, as they quoted:

"Before this training I didn't know much about RTPSS. Technical knowledge before this training was limited."

"Before commencement of this training program, I merely had an idea regarding RTPSS .In other words the knowledge was very basic."

"Before this training I had very basic knowledge of RTPSS for instance that this simulator may be helpful in doing loop in hardware testing and in real time domain."

"Before this training I had little or no knowledge of RTPSS. I only had a sleek idea, as is obvious from the name too, that it is a simulator that it is a simulator which can model power systems and perform simulation and analysis without having an actual idea of its capabilities and scope.'

What specific skills did you gain as a result of your exposure to the training being provided allowing NTDC staff, to connect graphical interface and interactions while analyzing load flows, schematics, simulation modes, results and outcomes?
Participants were asked to address specific skills that they have gained during this training w.r.t their work domain; and they mentioned:

"I have learned how to make a system in hyperism, perform load flow to a system, and see the output on scopes."

"For all of the concerned activities, basic to medium level skill has been acquired so far as a result of the training. It is because such kind of training has been conducted first time in NTDC and it includes complex and wide range of equipment modelling. After this training NTDC will keep on practicing on RTPSS to improve their skills and model/study for various kind of projects in NTDC network."

"I learned how to develop graphical models on Hyperism for simple power system and analyzing the results of various simulations like transient analysis, load flow etc. for these systems."

"The training enabled us to model our system in the simulator interface software and play with the system parameter during different conditions and is helpful during the pre-designing stage of the power system components."

"The training helped me to understand modelling of power systems and analysis its behavior under different scenarios by observing the results. Being a transmission line engineers, the RTPSS however has wide scope and application in grid systems, protections schemes load flow and other planning studies them in the transmission line designing. However, load flows analysis is a useful task for transmission line design engineers too."

"By attending this training, I am now able to differentiate offline and real time simulations. I can now use hyperism to draw network systems, can stop, start, and control the simulations. I also learnt to manage sensors. The hyper view cope view is test view being the graphical interface enabled me to plot, visualize and manage the graphs as when and desired."

"By doing group projects and activities, expertise in the area of I/0, simulations and load flows improved but hands on experience despite the whole two weeks dedicated for this purpose was not sufficient due to office constraints."

"Connecting graphical interfaces, modifying their parameter, Digital Analog loopback, Analyzing load flow, simulation results and outcomes."

"I have learnt about RTPSS. Its modules, interface tools but still lacking behind due to less practice although I know about the software how to use it but to incorporate our power system models in it still needs assistance/practice."

How will you use your enhanced abilities to stimulate operational models with DC transmission systems integrated into AC transmission systems, and to incorporate renewable energy generation facilities into its planning and design?

The training strategy was based on enhancing individual's ability to stimulate operational models with DC transmission systems integrated into AC transmission systems, and to incorporate renewable energy generation facilities into its planning and design. Participants were asked to express how they will use their enhanced abilities to perform better, they shared:

"The skills developed during this training can be utilized in future by applying them to our NTDC network issues e.g. SSR, HVDC, FACT devices converter stations etc., how to incorporate them into our system avoiding the challenges."

"Study switches characteristics and impact on system, SVC and SVG studies on particular system"

"Being the protection engineer, this is out of our scope for analysis, however this training gave us an overview of the modeling of PC system and how to analyze its effects on the existing national grid."

"We shall use enhanced abilities to stimulate operational models while designing & planning future models of DC transmission along with AC transmission."

"The working on demo models of HVDC, renewable energy among others has definitely increased the knowledge and has opened paths for further working by taking NTDC's ongoing similar projects and modelling and simulating them in RTPSS to better analyze the systems, controllers and protection schemes for these projects."

"Hyperism provided by Opal-RT through USAID provides a variety of power systems to stimulate interaction of MC & VC and models having integration of renewables can be built and simulated, for planning purposes and power quality studies."

"Renewable (solar and wind) can be modeled in RTPSS and their harmonic analysis may be done along with checking system stability requirements and integration capacity."

"At this point, I can try to simulate small system but can't study whole system on my own without trainer supervision."

"If I find HVDC controller (Real), I would like to Interface it with Hyperism and try to modify its parameters and set them according to our field requirement. Further, you can do transient analysis for hybrid energy system."

"The skills learned in this training, will be enhanced further by carrying out studies specific to our problems e.g. SVC, HVDC, control Power Quality Analysis, SSR analysis, Copy of actual controllers can be asked to be provided by vendor to analyze its input on system."

"I am not able to design the DC transmission system integrated into AC system efficiently because, I still have very basic knowledge regarding incorporating renewable energy generation facilities and DC to AC system integration modules."

"Before utilizing our ability it is required more advance training from the trainer who is highly skilled person of Hyperism software and RT lab software."

How will your organization benefit from the training's objective of "strengthening the NTDC design, planning and system protection departments to enhance, and improve AC systems operations ,test system reliability, and improve system protection in a timely manner' w.r.t Real Time inputs/outputs in both short-term and long-term?

When asked about how the training will help achieve the training objective, participants mentioned:

"Interfacing of the physical relay with RTPSS and confirmation of their performance parameters as well as their setting for improvement of system performance and modelling and study as well as optimization of parameters of HVDC converters, renewable energy generation, SVC, PSS, and series compensation for improvement of grid system. Study of AC and DC system in an integrated system to achieve optimum performance."

"We are basically from protection department; we will test our protective relays in real environment. Transient behavior of protective relays can be checked by suing RTPSS."

"After having complete knowledge about the RTPSS we can model our own system in it and can check the transient stability and harmonic analysis from it which we can't check through. Our existing facilities we can configure the equipment behaviors before placing them on ground which will let us know about the real on ground conditions to improve our system."

"Advance studies (EMT) can be carried out in house. The lab can be further developed into research center where industry and academia will work together to create new knowledge."

"NTDC can now have its own capacity to build and stimulate, analyze the advance parameters of AC power system"

"Being part of planning department, the effectiveness of the training mainly lies on the practice definitely it would be beneficial if this lab/faculty remains accessible and updated continuous projects should be built on this software the PSS/E"

"The stimulator can model sensitive power system elements like static van compensators reactors e.t.c with an extensive range of parameters. Harmonic analysis of system and corresponding dynamic stability analysis may be done."

"With Hyperism RTPSS, we may have stability studies, transient studies. Both of these are helpful for planning purpose we may have simulation, fact analysis, relay testing, control system equipment testing and these are quite beneficial for design, protection, and planning purposes."

"In short-term, the knowledge gained through this training will help NTDC design department (Transmission line) like the proposed HVDC lines, before construction and make improvements by using the results to achieve better reliability. The continued hands-on practice on RTPSS will benefit in long-term by enhancing the skills and gaining expertise by encountering and solving real life problems that may arrive in future."

"With real-time inputs/outputs, we are able to analyze and test relays and other hardware models as well as prototypes through amplifier units."

"The digital simulator shall be really helpful for analyzing the effects of SVC, DC network, renewable energy resources that are to be introduced in our system and hence enable us to decide different parameters that are to be set for protection relay settings and other protection relay component."

"NTDC planning can use this tool for EMT transient analysis which is more powerful tool than PSSE currently being used. Design can utilize the information gained by the simulation and incorporate into our system design, update system specification etc."

"We can test the relays by connecting them in the hyperism model and this tripping can be observed."

What was missing from the training? Please be specific and site examples.

Most of the participants complained that the training covered only basic level of knowledge and they want more advanced training on the equipment. They stated;

"RTPSS training required more two advance trainings i-e RT-Lab/Matlab Simulation system"

"NTDC system network based models should be used for explaining the purpose of RTPSS instead of making it general for better understanding. We model our own system as projects but it should be part of training course content."

"Demos were not so helpful and accurate. Input data base is missing."

"Software is more complex. Basics are covered but more advanced training is missing."

"Trainers should have practiced the pre-requisite data list so that data could have been arranged before the start of this training. Relevant/related NTDC based examples were not covered which should have taken into account for better understanding as well as authentication of result."

"As the training was in NTDC office, therefore we couldn't concentrate full on the training because we were asked to do the office work as well."

"Hands on experience of integration of renewable with our system should be given. Venue of the training should not be NTDC premises, as full time involvement cannot be assured due to ongoing office affairs."

"Video simulator training of different models was missing."

"Participants were not given separate work stations."

"I think, almost all of us didn't have much idea about RTPSS before training so this training provided an overview of the latest trends in modern power system and quite adequate considering the level of expertise we had before."

Do you have any suggestions for how EPP could improve similar future trainings?

All the participants have different views about how to improve future trainings; some of the highlighted recommendations are:

"EPP can improve future trainings as; by arranging instate venue, by calling upon serious participants, participants should only be devoted for training purpose"

"The course outline of training should be provided before the start of training. The material of RTDS should be self-explanatory for better reference during and after training .Trainer should preferably be selected from English speaking background."

"Advance level training should be given in detail along with separate workstations for more understanding."

"This training program can be a bit more organized in terms of the sequence of deliverables to the trainees. However this depends upon the trainer management for the program. Overall it was ok."

"Refresher course should be arranged by EPP after some duration."

"Advanced level training on RTPSS on practical NTDC system models to be arranged with detailed equipment model, relay coordination studies, ferro-resonance analysis, more detailed model of HVDC system and renewable energy generation, simulation and analysis of blackouts."

"The training venue should not be in the office so that the participants get training uninterrupted and ,if that is not possible then the management of NTDC should not disturb participants during the training."

"EPP should ask the participants from relevant department to ensure full time availability by seeking relief from office duties."

"Training contents should be specific to the system examples (i.e. Model our own system so that we can learn more and incorporate that in our system"

TRAINER'S FEEDBACK

Trainers were also asked to give their feedback on different components of the training. Following were their responses

Program Rating	Trainer's Response	
	Weihua Wang	Fei Gao
Learning objectives were accomplished	Very Good	Very Good
Training materials(handouts, presentations, overheads) supported the overall training	Outstanding	Very Good
Participant group fully contributed in each module of RTPSS	Very Good	Very Good
Participant's interest in building running and assigning "AD", "DA", "DI" and "DO" to their First Hyperism Model	Outstanding	Very Good
Hands on: Use of breakers of 300km transmission line network by participants during the study of advance schematics	Outstanding	Outstanding

Trainers were of the view that no further training is needed on the subject provided the trainees will keep practicing the skills and techniques learned.

Trainers were asked to highlight the factors that had negative effect on this training and on accomplishing the learning objectives; they wrote

"The trainees had never communicated with the trainer before the lecture officially debut. A large group of trainees' more than a size of class that we normally maintain. In the second part of the training some trainees quit the training since the tool is not related to their work. However, the learning objectives have been better achieved. The training objectives should be communicated between the trainer and trainee before the training."

"If everybody could attend the training on time every day they would learn more, but they have their own office work to do."

The trainers discussed the factors which had positive effect on the training by saying;

"The trainees started showing more interest when they understood the background of RTPSS. It was a good idea to start with comprehensive introduction on background knowledge"

"Trainees have a lot of real experience about power system and everyone could play the simulator with their interested application."

Trainers described the specific issues and special situations that were raised by the participants based on their experiences during the course of training by stating

"I am very happy to see everybody is interested in Real-Time Simulation. Some of them worked very hard on studying it."

"The lecture schedule has been changed several times due to different requirement on transportation and a holiday which was not considered during the planning."

Trainers describe specific issues or special situations that were raised by the participants based on their experiences during the course of this training by saying;

"The lecture schedule has been changed several times due to different requirement on transportation and a holiday which was not considered during the planning"

"I am very happy to see that everybody is interested in Real-Time Simulation. Some of them worked very hard on studying it"

Confidential information redacted

[pages 11-94]

www.ep-ep.com.pk
info@ep-ep.com.pk