DESIGN, CONSTRUCTION, COMMISSIONING AND QUALITY CONTROL OF GRID CONNECTED PV PLANTS

Gain first-hand comprehensive discussion of the most relevant topics of different stages across the value chain of a grid-connected solar PV project

24 – 28 APRIL 2017, SINGAPORE

HALF DAY SITE VISIT TO SOLAR ROOFTOP WITH LIVE TESTING @ CLEANTECH ONE
Details in Brochure

Testimonials
“Very educational and timely knowledge sharing. Trainer is very experienced in the PV plants technology design construction and commissioning.” Senior Manager, Single Buyer Department (Technical Advisory), Tenaga Nasional Berhad.

Expert Course Faculty Leader

Asier Ukar
Senior Technical Manager Business Unit Photovoltaic Systems
PI-Photovoltaik Institut Berlin AG

Qualified for 30 PDUs by PEB
DESIGN, CONSTRUCTION, COMMISSIONING AND QUALITY CONTROL OF GRID CONNECTED PV PLANTS 24 – 28 APRIL 2017, SINGAPORE

About This Training Course

This course will provide a first-hand comprehensive discussion of the most relevant topics of different stages across the value chain of a grid-connected solar PV project. Issues like technical design, best practices of installation, energy yield prediction, commissioning, O&M, EPC contract, quality assurance or Technical Due Diligence (TDD) will be highlighted focusing specifically on the challenges and best practices in order to ensure a clear understanding of what leads to a good or a poor result.

The content of the course not only focuses on technical aspects, it illustrates also the interface between technical results and commercial or financial interpretations bringing LTA and investors to a common ground allowing an interdisciplinary and more accurate evaluation of technical outcomes with financial impact.

This course contains the knowhow of PV expertise acquired over almost one decade of intensive activities in mature and nascent markets in the Americas, Asia and Europe.

Learning Outcomes

This course will be valuable to participants involved in any of the different stages of the value chain providing a global understanding of the deployment of PV projects. Beginning with introductory aspects, the instructor will lead the participant through the natural course of PV projects including references to real projects in the past keeping a balanced mix between PV theory, hands-on practices, legal, commercial and academic topics. Through this multi-perspective approach the participant will gain a better understanding of the interface between different stakeholders.

- How to assess an investor from the technical perspective
- Identifying risks in each project stage
- How to estimate the yield losses due to shading
- How to evaluate and validate the accuracy of meteorological data
- How to estimate the profitability of a PV system
- How to differentiate between suitable and unsuitable sites for a plant location
- How to structure and improve an O&M program
- How to design an optimal PV plant from the technical perspective?
- How to conduct a TDD
- How to detect and interpret module failures in the field
- Best practices to be applied during installation
- Which guidelines must be applied to properly certify a PV plant
- How to select an optimal DC/AC ratio of an inverter
- Witnessing and evaluation of the correctness of commissioning protocols
- How to identify potential risks of EPC contracts
- Basics of IV curve tracing, electroluminescence and infrared technology

Who Should Attend

There are no prerequisites to attend this course but a basic knowledge of PV technology and PV systems will help to increase the understanding of the content shared during the 5 days of instruction.

- Lenders
- Project developers
- Investors
- EPCs
- Project managers
- Installers
- Designers
- Government policy makers
- Module manufacturers

www.poweredgeasia.com
HALF DAY SITE VISIT TO SOLAR ROOFTOP WITH LIVE TESTING @ CLEANTECH ONE

LIVE TESTING WILL BE PERFORMED ON

Electroluminescence
We will run the tests on several modules ideally affected by cracks, µ-cracks, finger interruptions, contact interruptions or any other failures identifiable with EL.

IV curve tracing outdoor
We will Show accurate and the inaccurate way of conducting this measurement. Focus will be on measurement process and the various steps to achieve high precision measurements.

Infrared
Focus on failures such as Hotspots, PID, cell mismatch, disconnected cell strings, damaged JB
5 Day Course Outline

Day 1

Introduction
- What will you learn?
- Structure of the capacity building program
- Description of the teaching methodology

Overview of project phases from feasibility study to O&M
- Project Organigram of a SPV project
- Overview of project phases
- Risks and key aspects in each project phase

Solar PV technology
- Applications of SPV to grid-connected centralized PV plants
- Overview of a ground-mounted SPV system
- Solar PV modules (technologies and applications)
- Fixed mounting structures vs. tracking systems (pros and cons)
- String inverters vs. central inverters (pros and cons)
- Quantifying the system performance. Representative values

Day 2

The solar resource
- Main variables (irradiation and temperature)
- Satellite vs. land-based stations
- Available meteorological sources in the market, main features
- Important aspects when selecting irradiation data sets

Site selection - not all are suitable for PV projects
- Key aspects to be inspected, site-specific risks
- Exclusion criteria

Energy yield prediction
- Importance of hourly values of the irradiation and temperature
- Calculation of the irradiation on a tilted plane
- Available simulation programs in the market
- Input values for the simulation programs
- Overview of the system losses between module and grid connection points
- Module degradation and system availability
- P50 and P90 calculation

PV plant design
- System components selection
- Layout and shading of large-scale PV plants
- Electrical design (DC/AC ratio, DC and AC protection, overvoltage, grounding)
- What does an ideal plant look like?
- Design documentation requirements

Day 3

Installation standards
- Construction planning
- Site preparation
- PV modules
- Mounting structure
- DC cable routing
- Combiner boxes and distributors
- AC cable routing
- Grounding and equipotential bonding

Commissioning
- Provisional acceptance commissioning (PAC), commissioning sequence and protocols
- Final acceptance commissioning (FAC), commissioning sequence and protocols

Operation and maintenance
- Aims of an O&M plan
- General requirements for a proper O&M service
- Schedule and unscheduled maintenance
- Performance Ratio control
- Module cleaning in the field
- Typical failure distribution in operating plants

Day 4

Essential electrical devices used for failure detection in the field
- Drones vs. handheld cameras (pros and cons)
- Electroluminescence analysis, best practices and applications for certain module failures
- IV tracing, best practices and applications for certain module failures

Selection of relevant norms and standards for grid-connected large-scale PV systems

Contracts and permits
- Overview of relevant permits during the development phase
- EPC contract
- O&M contract

Quality assurance of PV plants - interface between LTA and investor
- Milestones for quality inspection
- Impact of quality lacks on the financial revenue
- Investment risks and countermeasures
- Types of Technical Due Diligence (TDD)
- Structure of TDD
- Commercial interpretation of the technical results. How much do you want to know?

HALF DAY SITE VISIT
DAY 5

Technical challenges of SPV nowadays

- Extreme climate conditions in new markets, expected performance and reliability of the system components
- Cost reduction of BOS components
- Performance simulation
- Fast and high quality installation in new markets

Case studies

- Commercially relevant design and installation failures - Photographic documentation
- 5MWp Italy - Module claim - 100% Electroluminescence - micro cracks
- 40MWp Israel - 100% Infrared - Hot Spot analysis, soiling
- 4 MWp Germany - Technical Design - roof top, shading analysis
- 64 MWp Bulgaria - Module claim - Potential Induced Degradation analysis
- 130 MWp Chile - Technical design c-Si fixed tilted - desert area
- 9 MWp India - Technical design (c-Si fixed tilted and tracking, thin film fixed tilted)
- 140 MWp Philippines - Design review

Expert Course Faculty Leader

Asier Ukar is Senior Technical Manager of the Business Unit PV Systems at the PI-Photovoltaik Institut Berlin AG based in Berlin, Germany. He has 10 years of experience in deployment of multi-MW grid-connected PV systems with physical presence in Germany, Spain, Italy, Bulgaria, the UK, Czech Republic, Chile, Brazil, Israel, Turkey, Japan, the Philippines, Singapore, Malaysia, Morocco, Nigeria and India, being active in the Asian market since 2010. Asier Ukar has years of experience in the creation of feasibility studies, design of multi-MW PV plants, installation supervision, commissioning, energy yield assessment, tender process support, contract assessment and comprehensive quality assurance of large-scale grid-connected PV plants. The installed capacity of the power plants for which he has acted as a consultant range from 1MWp and 560MWp. He is in charge of supervising the technical activities of the Business Unit PV Systems, developing tailor-made design and inspection packages, site-specific inspection concepts acting as on-site specialized supervisor with presence at key phases of projects. The Business unit PV Systems has been actively involved in the design, supervision, operation and refinancing of approximately 2.5 GWp of installed capacity since 2007 in Europe, Asia, Africa and the Americas. Asier Ukar acts as consultant for several banks, lenders, governmental authorities, EPCs and module manufacturers since 2008 and is responsible for the capacity building programs in PI Berlin AG since 2014. Asier Ukar regularly collaborates in scientific publications and is invited as a speaker at international conferences around the world. He is listed as an international expert in various organizations, including "Asian Development Bank" (ADB), the German "Physikalisch-Technische Bundesanstalt" (PTB), "Deutsche Gesellschaft für Internationale Zusammenarbeit" (GIZ) and the organ Deutsche Kommission Elektrotechnik Elektronik Informationstechnik "(DKE), which belongs to the German Institute Standards (DIN) and "Verband der Elektrotechnik, Elektronik und Informationstechnik" (VDE). Asier Ukar holds a diploma in mechanical engineering from the University Karlsruhe, Germany (TU Karlsruhe) and speaks five languages.
### Other Available Courses

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<td>Making IPP &amp; Renewable Energy Projects Contract Frameworks Bankable</td>
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<td>Advanced Project Finance for Power</td>
<td>Managing Complex Projects for Power and Utilities Professionals</td>
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<td>Advanced Technical Report Writing &amp; Presentation Skills</td>
<td>Medium Voltage &amp; High Voltage Switchgear</td>
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<td>Advanced Turnaround Shutdown &amp; Outage Management</td>
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<td>Ancillary Services in Competitive Electricity</td>
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<td>Coal Contracts</td>
<td>Offshore Platforms Electrical Systems Design &amp; Illustrations</td>
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<td>Combined Cycle Power Plants Operation</td>
<td>Operations of Coal Fired Power Plants</td>
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<td>Combined Heat &amp; Power (CHP) and Co-Generation Plant Operations</td>
<td>Power Generation Commissioning, Operations &amp; Maintenance</td>
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<td>Competency Management System for the Power Industry</td>
<td>Power Generation Operation, Protection &amp; Excitation Control</td>
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<td>Design &amp; Operations of Circulating Fluidized Bed Boiler</td>
<td>Power Plant Chemistry for Chemist &amp; Chemical Engineers</td>
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<td>Developing &amp; Structuring Public-Private Partnership (PPP) for Infrastructure</td>
<td>Power Purchase Agreements</td>
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<td>Effective Tender Process Management for Power &amp; Utilities</td>
<td>Process Control Methods</td>
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<td>Electrical Hazop (eHazop) Studies for the Power Industry</td>
<td>Programmatic CDM</td>
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<td>Electricity Demand-Side Management</td>
<td>Project Management for Power and Utilities</td>
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<td>Electricity Industry Design</td>
<td>Relay Protection in Power Systems</td>
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<td>Electricity Network Planning</td>
<td>Reliability Centered Maintenance Masterclass</td>
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<td>Electricity Retail Contracts</td>
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<td>Electricity Theft</td>
<td>Renewable Energy Development &amp; Investment</td>
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<td>EPC Contract Management for Power &amp; Utilities</td>
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<td>Essentials of Coal Markets and Trading</td>
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<td>Excitation Systems</td>
<td>SCADA &amp; Power Systems</td>
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<td>Feed-In Tariffs for PV Systems</td>
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<td>Financial Modelling for Project Finance in Power &amp; Utilities</td>
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<td>Fitness-For-Service AP1 579 &amp; High Energy Piping Life Management</td>
<td>Supercritical and Ultra-Supercritical Coal-Fired Power Plant</td>
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<tr>
<td>Fundamentals of Power Generation</td>
<td>Ultra Low NOx Gas Turbine Combustion</td>
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<td>Gas &amp; LNG Contract Negotiation</td>
<td>Uninterruptible Power Supply</td>
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<tr>
<td>Gas Turbine Generator Selection, Operation &amp; Maintenance</td>
<td>Vibration Analysis &amp; Condition Monitoring</td>
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<td>Gas Turbine Hot Gas Paths, Rotors &amp; Failure Analysis</td>
<td>Waste to Energy Plant Operations</td>
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<tr>
<td>Gas Turbine Major Inspection &amp; Overhaul</td>
<td>Water Treatment and Corrosion Control for Steam</td>
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<td>GE Gas Turbine Operations Simulation Based</td>
<td>Generation and Power Production</td>
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<tr>
<td>HRSG Design, Operations &amp; Understanding, Controlling of HRSG Damage</td>
<td>Writing Effective Standard Operating Procedures (SOP) for Power &amp; Utilities Professionals</td>
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<td>Mechanisms</td>
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<td>HV Substation Design &amp; Construction</td>
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<td>IEC for Utilities</td>
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<td>Integration of Distributed Generation</td>
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<td>Introduction to Carbon Capture &amp; Storage</td>
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<td>Introduction to Clean Coal Technology</td>
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<td>Keeping Electrical Switchgear Safe</td>
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<td>Leadership &amp; Team Dynamics for Power &amp; Utilities</td>
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<td>LNG Fundamentals</td>
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<td>Maintenance Planning &amp; Scheduling</td>
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<td>Other Available Courses</td>
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### Frequently Asked Questions (FAQs)

1. **Does PowerEdge have other programmes than those listed?**
   We have more than 200 programmes that we are capable of running. All we need is for you to contact us and request for the preferred programme and we will be able to develop it.

2. **Where is PowerEdge based?**
   PowerEdge is headquartered in Singapore but we run our training programmes in different venues around Asia.

3. **What does PowerEdge do?**
   We are a Power & Utilities Training Specialist.

4. **Can this course be done in our city?**
   It absolutely can. Get in touch with us to request for a training programme to be carried out in your city.

5. **Can you reduce the price of our preferred course?**
   While our price has been reduced before it is even launched, we are always happy to help you negotiate a better rate with hotels.

6. **Can you change the dates of the course?**
   If you have a special requested date, let us know and we will arrange another session for you.

7. **Who are the companies that will be participating?**
   This varies from a diversity of Power Operators, Regulators, Financiers, to Vendors in the Power & Utilities Industry.

8. **Where is the venue for the course?**
   We usually engage a 4 to 5 star hotel meeting room to ensure the comfort of our participants.

9. **How many delegates should we expect for each course?**
   This varies from 15 to 20 participants. Class sizes are kept small to allow trainers to focus better on each participant.

10. **What are the different payment modes?**
    We accept Visa/MasterCard, cheques, bank transfers and cash on site.

11. **Is accommodation included when I sign up for a course?**
    Accommodation is not included in the course fee but we are always happy to advise on available accommodations.

12. **Can I get a cheaper accommodation through PowerEdge?**
    We will be pleased to help you negotiate a better rate with hotels.

13. **Is lunch provided during the course?**
    We provide lunch and 2 tea breaks every day during our training programmes.

14. **Are the training materials included once I have signed up for a course?**
    Yes, training and course materials are included in the course fee.

15. **Will there be a certificate for the course?**
    Yes, there will be a certificate of participation upon completion of a course.

16. **Who are PowerEdge trainers?**
    They are expert consultants and practitioners with many years of experience in the subject matter that they deliver on.

17. **Are PowerEdge trainers competent?**
    We have received numerous favourable feedbacks on our trainers from past participants.

18. **Can PowerEdge assist with Visa travel applications?**
    We can assist in advising you on the relevant procedure(s) and embassies/consulates that provide Visa for travel purposes.

19. **Can we purchase training materials without attending a course?**
    Unfortunately this option is not available as training materials are specially developed for courses.

20. **Can course content be tweaked to cater to our needs?**
    Of course! Just let us know your request and we will get the trainer to assist in carrying it out.
**CANCELLATIONS & SUBSTITUTIONS**

In the event that PowerEdge PTE LTD postpones an event, delegate payments at the postponement date will be credited towards the rescheduled date. For cancellations received in writing more than seven (7) days prior to the training course you will receive a 100% credit to be used at another POWEREDGE PTE LTD training course for up to one year from the date of issuance. For cancellations received seven (7) days or less prior to the event, no credits will be issued. In the event that POWEREDGE PTE LTD cancels an event, delegate payments at the date of cancellation will be credited to a future POWEREDGE PTE LTD event. This credit will be available for up to one year from the date of issuance. In the event that POWEREDGE PTE LTD postpones an event, delegate payments at the postponement date will be credited towards the rescheduled date. If the delegate is unable to attend the rescheduled event, the delegate will receive a 100% credit.

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**PAYMENT METHODS**

By Cheque/Bank Draft: Make Payable to PowerEdge Pte Ltd.

By Telegraphic Transfer: Please quote AE1 with the remittance advise

Account Name: PowerEdge Pte. Ltd.


Bank Address: 65 Chulia Street OCBC Centre, Singapore 049513

All bank charges and payment in Singapore dollars (SGD) to be borne by payer. Please ensure that PowerEdge Pte Ltd receive the full invoiced amount.

**PAYMENT TERMS**

Payment is due in full at the time of registration. Full payment is mandatory for event attendance. I agree to PowerEdge Pte Ltd. payment terms.

* GST: Exclusive price is only applicable for overseas corporate customers subject to qualifying conditions.

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**COMPANY DETAILS**

Organisation name ................................................................. Industry .................................................................

Address .................................................................................................................................

Postcode ................................................................................................................................. Country .................................................................

Tel ................................................................................................................................. Fax .................................................................................................................................

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**PER PARTICIPANT**

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<tr>
<th>Programme</th>
<th>5 Day</th>
<th>2 PARTICIPANTS OR MORE</th>
<th>IN-HOUSE TRAINING</th>
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<td>SGD 4,000 Per Participant</td>
<td>SGD 3,400 Per Participant</td>
<td>Guaranteed Minimum 40% Off Normal Price</td>
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<td>*SGD 4,280 Per Participant (GST Inclusive)</td>
<td>*SGD 3,638 Per Participant (GST Inclusive)</td>
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**4 ways to Register**

- [Online Web Registration](mailto:info@poweredgeasia.com)
- [(65) 6741 9927](tel:(65) 6741 9927)

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**ATTENDEE DETAILS**

Name ................................................................................................. Job title .................................................................

Tel ................................................................. Department ................................................................. Email .................................................................

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**ON SITE TRAINING**

- Keeping Electrical Switchgear Safe
- Introduction to Power Systems
- Excitation Systems
- Fundamentals of Power Generation

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**ONLINE TRAINING**

Can’t make it for the Course? We’ll make the course come to you!!

Simply let us know your preferred time and dates and we will meet you at your schedule and venue.

With a host of highly trained experts, we will be happy to customize your programme with your needs 100% fulfilled.

Contact us today

[info@poweredgeasia.com](mailto:info@poweredgeasia.com)

[(65) 6741 9927](tel:(65) 6741 9927)

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**4 related trainings**

- Fundamentals of Power Generation
- Keeping Electrical Switchgear Safe
- Excitation Systems
- Introduction to Power Systems

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**How to Register**

- Online Web Registration
- [(65) 6741 9927](tel:(65) 6741 9927)
- [(65) 6747 8737](tel:(65) 6747 8737)
- [(65) 6747 9277](tel:(65) 6747 9277)
- [(65) 6747 9277](tel:(65) 6747 9277)

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