



**EES-UETP**

**Electric Energy Systems University Enterprise Training Partnership**

**Course on:  
Protection of Future Networks with Distributed  
Generation**

**Course organiser: School of Electrical & Electronic  
Engineering of University of Manchester on behalf of Network  
of European Distributed Energy Recourses laboratories  
(DERlab) and Pre- Standardisation**

**Course Leader Prof. V. Terzija**

**8-10 March 2011**



**MANCHESTER**  
1824

The University  
of Manchester



# Content

1. Course outline.....	3
2. Scope and objectives.....	3
3. Who should attend.....	3
4. Course duration.....	4
5. Course venue.....	4
6. Course programme.....	4
7. Course presenters.....	5
8. Travel information.....	7
8.1 How to get to the University of Manchester.....	7
9. Accommodation.....	8
10. Organisation and contacts.....	9
10.1 Course fees.....	9
10.2 Payment details.....	10
10.3 Dinner.....	10
10.4 Contacts.....	11
11. Registration form.....	12

# 1. Course outline

- Introduction to Distribution network protection
- Advanced protection systems
- Impact of ICT on protective devices and principles
- Protection of future Smart Grids with high penetration of DG sources
- Laboratory demonstration modelling simulation of relays

# 2. Scope and objectives

The course is designed to give both industrial practitioners (technicians, engineers and managers) and young academics and researchers a solid understanding of Electricity Network Protection and Advanced Protection of Future Networks with high penetration of Distributed Generation (DG) Sources.

## **Course objectives:**

- to introduce the classical and advanced operating principles and main features of protection schemes, and various types of relays.
- to introduce the main principles for the protection of systems with high penetrations of DG Sources.
- to introduce the advances gained from the use of novel Information and Communication Technologies, satellite synchronisation and communication, advanced Digital Signal Processing Techniques, robust Control algorithms and those protection principles which will be utilised for the protection of future Smart Grids.
- to provide the attendees with the knowledge and practical skills necessary to apply these relays and schemes to the protection of plant and systems, including transmission, distribution and industrial networks and rotating machines

# 3. Who should attend

This course is intended for all technical staff, engineers and managers from electrical power utilities, independent generating companies, electricity regulators, industry, manufacturing and consulting companies and educational and research institutions who deal with Electricity Networks Protection issues and Distributed Generation.

## 4. Course duration

Three-day course, from Tuesday 8<sup>th</sup> to Thursday 10<sup>th</sup> of March 2011.

## 5. Course venue

The University of Manchester,  
School of Electrical & Electronic Engineering  
Ferranti Building, Room C 18.  
Manchester, M13 9PL  
United Kingdom

## 6. Course program

### Day 1 Tuesday 8<sup>th</sup> March 2011

10:00 -10:30	Registration
10:30 -11:10	Welcome and Introduction. Course overview. ( <i>V. Terzija</i> )
11:10 -12:00	Impact of the ICT Protective devices and principles ( <i>V. Terzija</i> )
12:10- 13:10	Lunch
13:10 -14:00	Impact of the ICT Protective devices and principles ( <i>V. Terzija</i> )
14:10 -15:00	Innovations in the field of protection in other countries ( <i>P. Vaessen</i> )
15:00 -15:20	Coffee break
15:20 -16:10	Innovations in the field of protection in other countries ( <i>P. Vaessen</i> )
16:20 -17:10	Laboratory demonstration modelling simulation of Relays ( <i>V. Terzija</i> )
17:10 -18:00	Laboratory demonstration modelling simulation of Relays ( <i>V. Terzija</i> )

### Day 2 Wednesday 9<sup>th</sup> March 2011

10:00 -10:50	European Distributed Energy Resources Laboratories (DERlab)- The Network of Excellence ( <i>P. Vaessen</i> )
10:50 -11:10	Coffee break
11:10 -12:00	Impacts of DER on Distribution System Protection ( <i>N. Schaefer</i> )
12:10 -13:00	ICT implementation aspects for Smart grid protection ( <i>F. Garrone</i> )
13:00 - 14:00	Lunch
14:00 - 15:30	Review of Conventional Distribution System Protection ( <i>C. Booth</i> )
15:30 -16:00	Coffee break
16:00 -17:30	Impact of connecting distributed generation ( <i>C. Booth</i> )
19:30	Course dinner

## Day 3 Thursday 10<sup>th</sup> March 2011

10:00 -10:50	Impact of connecting distributed generation ( <i>C. Booth</i> )
10:50 -11:10	Coffee break
11:10 -12:00	Loss of mains protection ( <i>C. Booth</i> )
12:10 -13:00	Advanced protection systems ( <i>P. Crossley</i> )
13:00 - 14:00	Lunch
14:00 - 14:50	Advanced protection systems ( <i>P. Crossley</i> )
15:00 - 15:30	Panel discussion
15:30 - 16:00	Closing remarks ( <i>V.Terzija</i> )

## 7. Course presenters

**Prof. Vladimir Terzija** is the EPSRC Chair Professor in Power System Engineering in the School of Electrical and Electronic Engineering, The University of Manchester, where he has been since 2006. From 1997 to 1999, he was an Assistant Professor at the University of Belgrade. In 1999, he was Humboldt Research Fellow at Saarland University in Germany. From 2000 to 2006, he was with ABB AG, Germany, as an expert for switchgear and distribution automation. His main research interests are switchgear, DSP applications in power systems, and application of intelligent methods to power system monitoring, control, and protection. He is a senior member of IEEE and member of IET. In the past, he published over 150 papers and four text books.

**Prof. Peter Crossley** joined the Department of Electrical & Electronic Engineering at the University of Manchester Institute of Science & Technology in 1991 as a Lecturer and was later promoted to Senior Lecturer and Reader. In 2002, he moved to Queen's University of Belfast where he was Professor of Electrical Engineering and Director of the Power & Energy Research Cluster. In 2006, he returned to The University of Manchester as Professor of Power Systems in the EEE School and in 2008 became Director of the Joule Centre. Before moving to academia he was a Senior Technical Engineer and Manager of the Research & Long Term Development Group at GEC Measurements (now Areva T&D). His industrial and academic career has mainly involved education, research, design and development in electrical power engineering and renewable energy systems.

**Campbell D. Booth** received the B.Eng. and Ph.D. degrees in electrical and electronic engineering from the University of Strathclyde, Glasgow, U.K. He is currently a Senior Lecturer with the Institute for Energy and Environment, Department of Electronic and Electrical Engineering, University of Strathclyde. His research interests include power system protection; plant condition monitoring and intelligent asset management; applications of intelligent system techniques to power system monitoring, protection, and control; knowledge management; and decision support.

**Nils Schaefer** is a research assistant at the Fraunhofer Institute for Wind Energy and Energy System Technology (Fraunhofer IWES, formerly ISET

e.V.) in Kassel, Germany. He studied Energy Engineering at the University of Magdeburg, Germany, and received his Dipl.-Ing. Degree in 2006. From 2006/11 to 2007/06 he was a research assistant at the chair of Electrical Power Systems at the University of Erlangen-Nuremberg, Germany; during these eight months he was working externally at EDF R&D in Clamart, France, where he dealt with short-circuit performance of power transformers. Since August 2007 Mr Schaefer is with Fraunhofer IWES in Kassel, where his main field of research is power system protection and distributed generation.

**Fabrizio Garrone** graduated in Electronic Engineering from Polytechnic of Milan (Italy) in 1984. He joined ISMES (Istituto Sperimentale Modelli e Strutture) in Bergamo, a Research Centre of ENEL. He held positions of coordinator of design and implementation of data acquisition systems for telemetry, private communication network management systems, remote control of wind and photovoltaic power plants. He has been involved in a MIUR (Ministero della Istruzione, Università e Ricerca of the Italian government) national project for water resource management and integrated information systems design and development for utilities. In 2006 he joined CESI RICERCA (now RSE) as ICT specialist where he has been involved in the CRUTIAL European Project (CRITICAL UTILITY InfrastructurAL resilience - STREP Project FP6-2004-IST-4-027513), addressing the security and resilience of new networked ICT systems for the management of the electric power grid, in DERri European Project (Distributed Energy Resources Research Infrastructure - FP7-INFRASTRUCTURES-2008-1 GA228449), and in the Italian Research Program on Electric Power System Governance including studies on Power and ICT interdependencies, risk assessment and test bed deployment. Related to these projects, he is a co-author of publications in international scientific conference.

**Peter Vaessen** received his M.Sc. degree in electrical engineering from the Eindhoven University of Technology, The Netherlands in 1985. In the same year he joined KEMA and he held several research positions in the field of large power transformers and high voltage measurements. From 1991 to 1996 he managed several realization projects, among them construction of Dutch 400kV substations. As a principal consultant he has experience in (U)HVDC technology and quality assurance, as well as in future SmartGrids development with integration of RES and DG. For the European Union and the Dutch Ministry of Economic affairs he participated in the set up of several research programmes and performed studies into the future of electricity supply and the reliability of the electricity network. He is actively involved in the technology strategy of KEMA for the research and laboratory developments. He is member of the working group grid infrastructure for the Dutch Ministry of Economic Affairs and member of the Cigré working group B4-52 DC grid feasibility study and the GENELEC working group on the development of SmartGrids standards. He is an experienced lecturer on modern control systems and high voltage technology at the Arnhem Polytech. He successfully chaired and participated at international panel sessions and conferences, delivered numerous presentations, published some 30 papers and coached some 60 undergraduate students (university and polytech)

during their practical work at KEMA. He is co-author of the book “rapid current, the next revolution in electricity”.

## 8. Travel information

### *8.1 How to get to the University of Manchester*

The University of Manchester ([www.manchester.ac.uk](http://www.manchester.ac.uk)) is located close to both Piccadilly main line station (about two and a half hours from London) and Oxford Road train station, with Victoria train station a little further away.

For details of timetables, tickets and other rail information, please ring National Rail Enquiries on +44 (0)20 7278 5240 from overseas.

#### **From Manchester Piccadilly railway station (Main station in Manchester)**

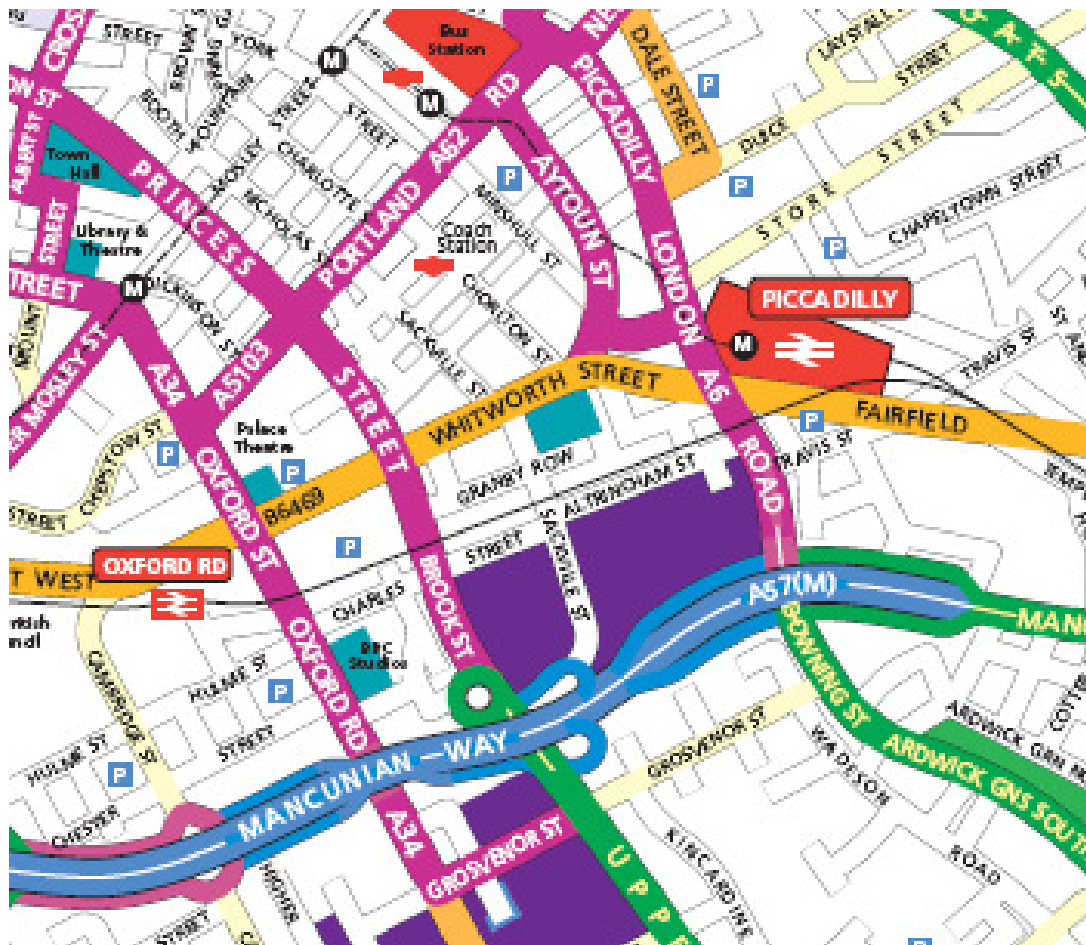
The Sackville Street area of the campus is within 5 minutes' walk of Piccadilly Station. (See Sackville Street area map below)

#### **From Manchester airport:**

Manchester Airport is one of the largest and busiest in the country. It is located about 10 miles (16km) south of the city centre, about 30 minutes from the university.

The airport has a number of transport links to the city:

- Train - The airport's two terminals are linked directly to the city centre by a fast, frequent 24 hour train link to both Piccadilly and Oxford Road stations.
- Taxi - A taxi from the airport to the University will cost approximately £15.
- Bus - Local buses also run to the Oxford Road and Sackville Street areas of the campus.



Sackville Street area map

For more maps see <http://www.manchester.ac.uk/visitors/travel/maps/> and the pdf campus map

## 8.2 How to get to the course location

**Ferranti Building** is number 20 on campus map:

[https://webmail.manchester.ac.uk/horde/imp/view.php?popup\\_view=1&mailbox=INBOX&index=3243&actionID=view\\_attach&id=3&mimecache=d19c7f6766214047f3e6467983243154](https://webmail.manchester.ac.uk/horde/imp/view.php?popup_view=1&mailbox=INBOX&index=3243&actionID=view_attach&id=3&mimecache=d19c7f6766214047f3e6467983243154)

Room C18 is on the C floor.

## 9. Accommodation

### Recommended Hotels

#### Days Hotel Manchester City (Highly recommended)

Weston Bldg, Sackville Street  
Sackville St, City Centre

Manchester, M13BB UK

### **Maps & Directions**

<[http://www.daysinn.com/DaysInn/control/Booking/check\\_avail?variant=&id=15068&propBrandId=DI&force\\_nostay=false&tab=tab4](http://www.daysinn.com/DaysInn/control/Booking/check_avail?variant=&id=15068&propBrandId=DI&force_nostay=false&tab=tab4)>

Hotel's Sunburst Rating

<javascript:popup=window.open('http://www.daysinn.com/DaysInn/control/Booking/sunb\_popup','brand\_logo\_DI',%20'height=300,width=550,resizable=yes,scrollbars=yes');popup.focus();>

Phone: 44-161-9558400

Fax: 44-161-9558050

E-Mail: [reservations@days-mcc.co.uk](mailto:reservations@days-mcc.co.uk)

### **McDonald Hotel, Manchester**

Hotel & Spa, London Road, Manchester, M1 2PG

Tel: (+44) 0844 879 9088

<http://www.macdonaldhotels.co.uk/manchester/index.htm>

Rooms approx £98

### **Ibis, Charles Street, Manchester**

Charles Street, Manchester M1 7DG

Tel : (+44) 161 2725000

<http://www.ibishotel.com/gb/hotel-3143-ibis-manchester-charles-street/index.shtml>

Rooms approx £60

### **Novotel China Town, Manchester**

21 Dickinson Street, Manchester M1 4LX

Tel (+44)161/2352200

<http://www.accorhotels.com/gb/hotel-3145-novotel-manchester-centre/index.shtml>

Rooms approx £75

**Please make sure to book your rooms in due time.**

## 10. Organisation and contacts

### *10.1 Course fees*

Fees for three-day course:

- 367.5 Euro for attendees from member universities of EES-UETP
- 900 Euro for attendees from non-member universities of the EES-UETP
- 1500 Euro for attendees from non-member industrial enterprises of the EES-UETP

Course fees for the UK attendees from:

- EES-UETP member universities

- non-members universities of the EES-UETP
- non-member industrial enterprises of the EES-UETP

can also be accepted in British Pounds (as an equivalent sum calculated on the base of Euro/GBP exchange rate on the date of transaction). Exchange rate must be specified on the bank payment form.

Course fees include lectures, course aids (lectures on CDs, leaflets, brochures, etc.) coffee breaks, lunches and course dinner.

## *10.2 Payment details*

Attendees from the UK make their payments to:

Barclays Bank  
Account number: 60272663  
Sort Code: 20-55-34

Attendees from abroad make their payments to:

Account number: 60272663  
Sort Code: 20-55-34  
Swift N: BARCGB22  
IBAN N: GB05BARC20553460272663

### **Note**

- Please, state the number **RO13187** on the bank payment form
- Participants have to provide course organisers with the proof of course fees payment (i.e. invoice) by fax no later than 1 week before the course date

## *10.3 Dinner*

On the 9<sup>th</sup> of March 2011, a course dinner will be held at a restaurant in the city. Further information will be provided during the first morning session. Please inform Galina Romanovsky ([Galina.Romanovsky@manchester.ac.uk](mailto:Galina.Romanovsky@manchester.ac.uk)) if you will be attending.

## *10.4 Contacts*

**Course Leader: Prof. V. Terzija**

The University of Manchester, School of School of Electrical & Electronic Engineering  
Ferranti Building, C8  
Sackville Street, PO Box 88  
Manchester M13 9PL, UK

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Fax: + 44 161 306 4820

personal site:

<http://www.eee.manchester.ac.uk/research/groups/eeps/staff/show.html?ea=Vladimir.Tertzija>

**Contact: Dr. Galina Romanovsky,**

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Tel. (office): +44 (0)161 306 28 11

Tel. (mob.): +44(0) 77 946 33 225

## 11. Registration form

<b>Name</b>	
<b>Surname</b>	
<b>Attendee Position in the Company (University, etc)</b>	
<b>Attendee main activity</b>	
<b>Attendee Contact Address</b>	
<b>Attendee Contact Phone number(s)</b>	
<b>Fax</b>	
<b>Attendee E-mail</b>	
<b>Name, address and main activity of the Company (University, etc.)</b>	
<b>Is the Company a member of EES-UETP</b>	
<b>Is invoice required</b>	<b>YES</b> <b>NO</b>