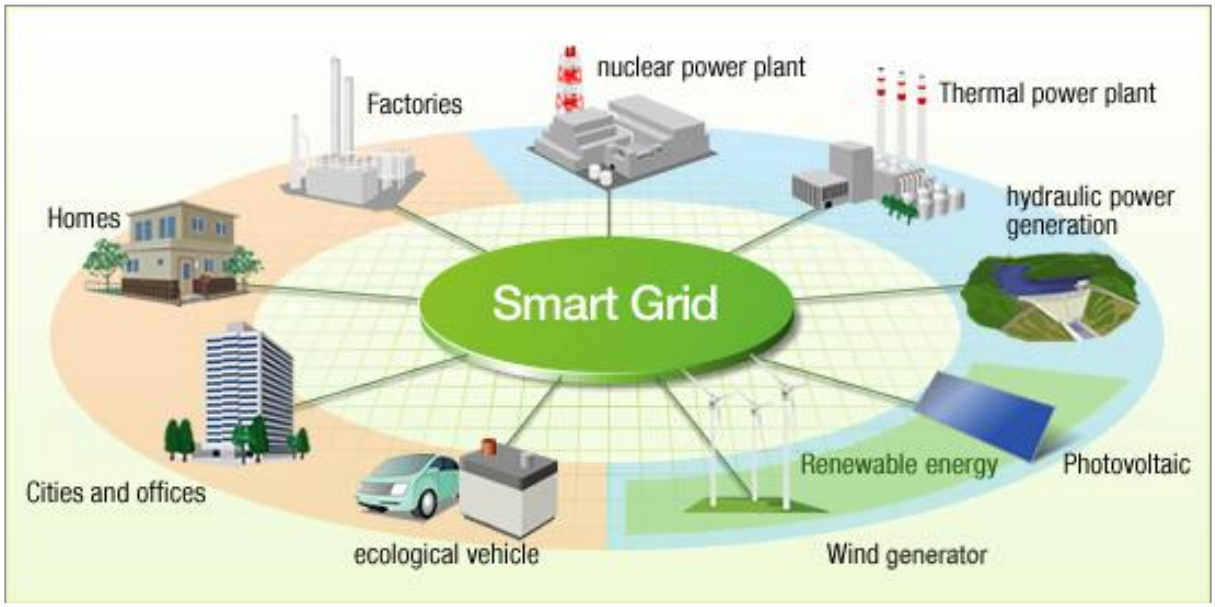
Recent Trends and Applications in SMART GRIDS and MICRO GRIDS

A Report on Short Course

10^{th} - 12^{th} July 2015



Organized By

Department of Electrical and Electronics Engineering

(Power System Research Group)

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(NAAC Accredited "A" Grade University)

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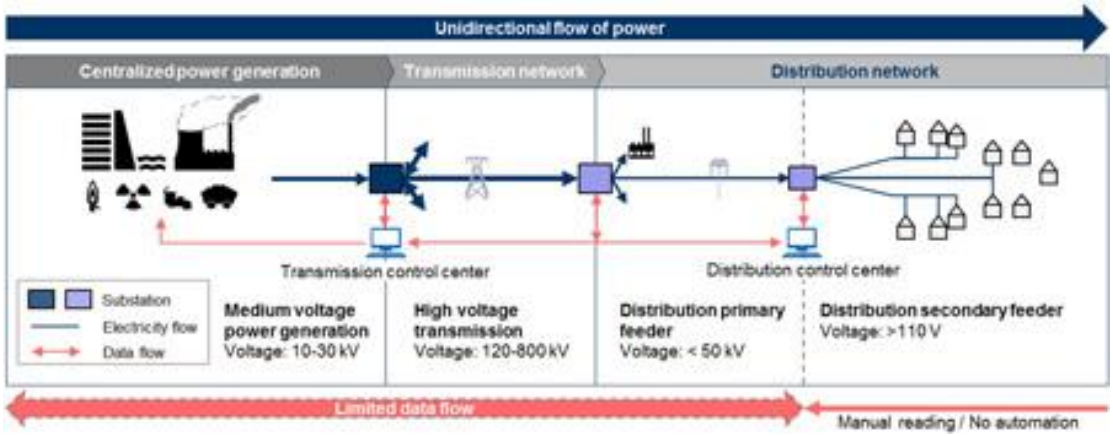
Introduction

Electricity grids need to be modernized to meet growing demand and integrate new applications

Power grids, which bring electricity to 85% of the world's population, are arguably one of the most important engineering achievements of the 20th century. Today's grids, century-old by design, were built to accommodate centralized generators, unidirectional electricity transport through high-voltage transmission lines, dispatch to consumer via lower-voltage distribution lines, and centralized control centers collecting information from a limited number of network hubs called substations.



SIMPLIFIED VIEW OF THE TRADITIONAL GRID

The goal of a power grid is to optimize, for a given combination of generation capacity and demand patterns, the reliability of power supply (the frequency and extent of outages), the quality of power supplied (in terms of voltage signal shape, frequency and phase angle), and its affordability.

Today's grids are facing four principal problems and these are growing in severity. First, global electricity demand is rising faster than demand for any other final energy source; in addition, the electrification of the economy intensifies end-user demand around peak hours, stressing grids and making rapid expansion a necessity. Second, aging infrastructure tends to compromise reliability of power supply and exacerbate energy losses to the detriment of economies undergoing rapid electrification. Third, as the share of Variable Renewable Energy (VRE) in the energy mix grows, the power grid will need to become more flexible to match supply and demand in real time. Finally, as the penetration of Distributed Generation (DG) rises to very high levels in some areas, issues relating to power quality and bi-directional electricity flows arise that cannot be properly managed by traditional grids.

A smart grid refers to a modernized electricity network that monitors, protects, and optimizes the operation of its interconnected elements.

The notion of grid modernization grid differs from country to country, depending on the smartness of the existing system. However, not withstanding such differences, smart grids are generally characterized by the use of digital information and communications technologies to manage both the bi-directional flow of data between end-users and system operators, and the bi-directional flow of power between centralized and decentralized generation.

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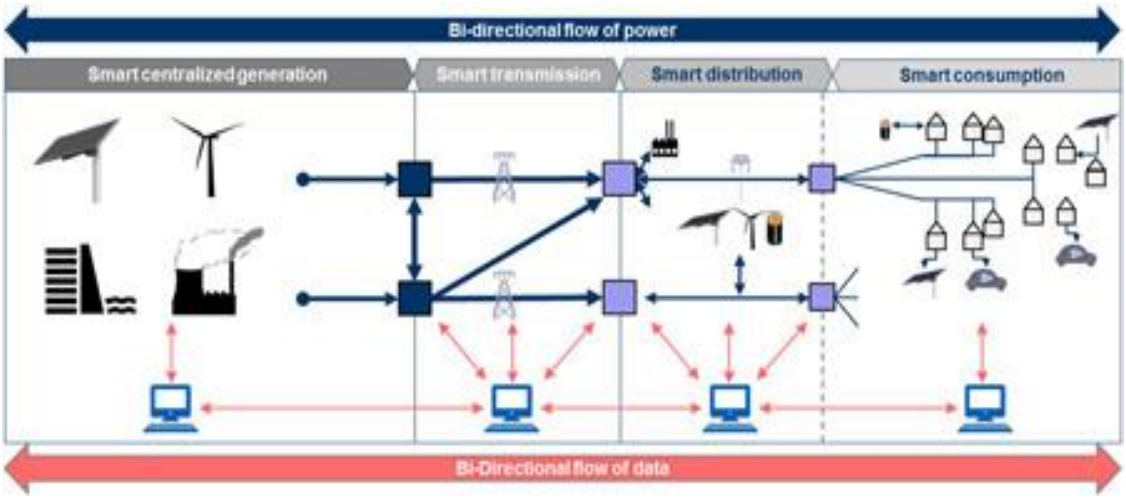

SIMPLIFIED VIEW OF THE SMART GRID

The goal of such a modernized network is to address grid challenges at a minimal cost. It should be able to accommodate all generation and storage options, optimize energy efficiency and asset utilization, improve power quality for end-user devices, self-heal, resist physical and cyber attacks, and enable new business solutions in a more open-access electricity market, such as demand-response programs and virtual power plants.

Beyond incremental changes in traditional grids, smart grids facilitate the expansion of independent micro-grids that are capable of "islanding" themselves from the main grid during power-system disruptions and blackouts. The modular nature of micro-grids may allow for their independence, interconnection and, ultimately, the construction of a new type of super-reliable grid infrastructure.

Background and Objective

To strengthen Andhra Pradesh's position on the global investment map, Chief Minister Sri N. Chandra Babu Naidu visited Japan from July 6-9th to finalize investment proposals of Japanese companies/investors .

The Chief Minister, during his Japan visit in November 2014, invited Fuji Electric to do a feasibility report for a smart grid project. During the meeting, Fuji Electric's Representative Director Mr. Yoshio Okuno informed the Chief Minister that they have identified a site in Vijayawada for the smart grid project. The project in Vijayawada will be taken up on pilot basis. In order to make Andhra Pradesh's smart grid project the best in the country, Fuji Electric representatives presented a research report after analyzing weather, wind direction and correlation between weather and power demand.

Today, academic research and industrial applications in the area of Smart Cities seek to optimize existing city infrastructure, networks, and urban behavior through the deployment and utilization of digital networks.

While teaching and research are the top priority, KL University considers equal importance to the stream of activities that contribute to society by transferring its technological know-how. Through these stream of activities, KL University is able to match society's expectations as engine of innovative growth along with its main mission of educating and research.

Objectives of the short course

KL University's Electrical and Electronics Engineering department in association with KL University IEEE student chapter inaugurated a three day short course on Recent Trends and Applications in Smart and Micro Grids.

The specific objectives of the course were to bring up professional deliberation on micro and smart grid technologies for explaining the innovative trends of power system operation and control both for educators and practicing engineers. Few of the specific objectives of the short course are given below:

- Understand the background for Smart Grid, and the differences between the future Smart Grid and today's power system, as well as have knowledge about important terminology.
- Have knowledge about challenges faced by the Indian energy sector in the years ahead, such as challenges regarding the deployment of smart meters.
- Know the electric power engineering basis for Smart Grid.
- Have knowledge about technology for micro grids and the integration of renewable energy such as wind power, solar power, including the characteristics of these sources, in the power system, and technology related to charging of electric vehicles.
- Resilient Energy Systems – Microgrids and locally-produced renewables create agile, adaptable, efficient energy networks
- Responsive Technologies – Innovative systems enable powerful new applications that improve the life of each resident in areas of health, energy conservation, mobility, and communications
- Trust Networks – Privacy is assured for otherwise invasive systems that make use of highly personal data such as mobility patterns and resource consumption (food, water, energy, and individual health profiles)

Inauguration of Short Course

The programme was inaugurated by the chief guest K. Raja Bapaiah ,FIE Chief Engineer (APSPDCL,Vijayawada), Chancellor Dr. M Ramamoorthy, Principal Dr. Anand Kumar and RPAC chairman of EEE department Dr G Kesava Rao. In the opening remarks Dr M Ramamoorthy addressed the gathering and suggested the need for applying latest trends in Smart Grids to

existing age old power networks. The Chief Guest for the occasion K. Raja Bapiah thrown light on the need of developing and implementing smart metering systems even for LT customers, these benefits which are now only limited for HT customers. He also mentioned that developments in the area of Power Systems leapfrogged in the last two decades and yet there is still scope of improvement in developing systems with end user in consideration.

Resource person Dr M.K.S.Sastry (University of West Indies) on the first day of the course started with an introduction to Micro Grids, different forms of fuel that enable power generation at micro level. By the end of the days session delegates were able to thoroughly understand design methods and analysis of Micro Grids through various simulation tools.

Structure of the workshop

This was a three day short course. The course was divided into day wise sessions, there were 6 sessions altogether, 4 sessions handled by the international resource person; Dr. M.K.S Sastry, of university of West Indies Trinidad and Tobago and 2 sessions were handled by the national expert Dr N. Murugesan, Former Director General Central Power Research Institute. By the end of each day participants had rigorous case study exercises.
Day wise distribution and delivery of the presentations were as under:

First day of the course covered the presentation of Dr. M.K.S Sastry outlining the over view of

- Smart grid –Architecture and Models
- Grid integration of renewable energy sources
- Cyber , physical and system security of smart grid
- Data communication for the smart grid
- Power trading , market regulation and policies
- Case studies

Second day of the course covered the presentation of Dr. M.K.S Sastry in the areas of

- Basic distribution load flow
- Design of a micro grid based on -load curve [sizing of conductors, transformers, and feeder layout]
- Reactive compensation using capacitor banks – utility side and customer side
- Energy pricing – using normal tariffs and TOU tariffs – costs of active and reactive powers/ energy units
- Case studies

Final day covered by the presentation of Dr N. Murugesan

- Pressing DERs into micro grid – PV cells – load curves with and without DERs, savings for the customer, savings for the utility
- Impact of location and size of DERs on losses and voltage profile
- Customer decision support for TOU tariffs & utility decision support.
- Case studies

The presentations and interactive discussions during the course were designed to give thorough understanding on the foundational concepts involving Micro Grids and Smart Grids.

Closing address by Mrs. S.V.N.L LALITHA

Associate professor, KLU; Mrs. S.V.N.L LALITHA in her closing address, appreciated the efforts of EEE department at KLU along with IEEE student chapter in organizing very useful and much needed short course. She was of the view that this course had presented many examples of how Smart Grids and Micro Grids are going to play a key role in intelligent management of Power. She also added that many of the concepts presented in this short course were new. This course presented numerous examples of progress and illuminates potential opportunities.

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Vote of thanks by Mr. D Narasimha Rao

Mr. D Narasimha Rao, Associate Professor, EEE, KLU thanked the extended support of resource persons, officials and all other involved in the successful organization of this short course. He also extended his gratitude to the course participants for their sincere efforts, attention and fruitful interactive sessions that contributed greatly towards the success of the short course.

Certificate distribution to training participants

Certificate distribution ceremony to the successful participants of the short course Dr N. Murugesan, Former Director General, Central Power Research Institute.; Dr. M.K.S Sastry, of university of West Indies Trinidad and Tobago and Dr. M Ramamoorty, Chancellor, KLU presented the certificates to the successful participants.

Detailed Agenda of the Short Course

Inaugural Function	
10:00 AM to 10:05 AM	Inviting Dignitaries on to the Dais.
10:05 AM to 10:08 AM	Jyothi Prajwalana.
10:08 AM to 10:11 AM	Prayer Song.
10:11 AM to 10:14 AM	Welcome note by Dr. G. Kesava Rao, RPAC Chairman.
10:14 Am to 10:17 AM	Message by Dr. O. Chandra Sekhar, Dept., HoD.
10:17 AM to 10:27 AM	Message by Dr. M. Ramamoorthy, Hon'ble Chancellor.
10:27 AM to 10:30 AM	Message by Dr. A. Anand Kumar, Principal College of Engg.
10:30 AM to 10:32 AM	Introduction of Resource Person Dr. M.K.S. Sastry
10:32 AM to 10:35 AM	Message by Dr. M.K.S. Sastry
10:33 AM to 10:55 AM	Message by Chief Guest Er. K. Raja Bapaiah, FIE Chief Engineer, Central Zone, APSPDCL, Vijayawada.
10:55 AM to 11:00 AM	Vote of Thanks
Day 1: July 10, 2015 (Friday) Resource Person: Dr. M.K.S. Sastry, Professor, University of West Indies	
09:00 AM to 10:00 AM	Registrations.
10:00 AM to 11:00 AM	Inaugural Function.
11:00 AM to 11:10 AM	Tea Break.
11:10 AM to 12:40 PM	Introduction to Microgrids.
12:40 PM to 01:15 PM	Lunch Break.
01:15 PM to 02:45 PM	Design, Analysis of Microgrids and Simulation Tools.
02:45 PM to 03:00 PM	Tea Break.
03:00 PM to 05:00 PM	Hands on Training.
Day 2: July 11, 2015 (Saturday) Resource Person: Dr. M.K.S. Sastry, Professor, University of West Indies	
09:00 AM to 10:30 AM	Operational Issues and Islanding of Microgrids.
10:30 AM to 10:45 AM	Tea Break.
10:45 AM to 11:45 PM	International Trends and Case Studies.
11:45 PM to 12:45 PM	Current Standards and Future directions.
01:15 PM to 02:00 PM	Lunch Break.
02:00 PM to 03:30 PM	Hands on Training.
03:30 PM to 03:40 PM	Tea Break.
03:40 PM to 05:00 PM	Hands on Training (Continuation).
Day 3: July 12, 2015 (Sunday) Resource Person: Dr. N. Murugesan, Former Director General CPRI	
09:00 AM to 09:05 AM	Speaker Introduction.
09:05 AM to 10:30 AM	Introduction to Smart Gird (SG) and Overviews.
10:30 AM to 10:45 AM	Tea Break.
10:45 AM to 12:30 PM	Metering Automation, Substation & Distribution Automation.
12:30 PM to 01:15 PM	Lunch Break.
01:15 PM to 03:00 PM	SCADA/DMS System design issues and Communication Technologies for Smart Grid Systems.
03:00 PM to 03:15 PM	Tea Break.
03:15 PM to 04:00 PM	Analysis of Smart Grid standardization activities.
04:30 PM to 04:45 PM	Vote of Thanks

List of Workshop Participants

SNo	Name	Organisation	Designation
1	m.b. murali krishna	k.l.u	student
2	deepak kumar	k.l.u	student
3	t.gopi krishna	k.l.u	student
4	m.saipramod kumar	k.l.u	student
5	p.poojitha	k.l.u	student
6	b.venkateswarlu	k.l.u	student
7	k.vijay kumar	k.l.u	student
8	g.divyasri	k.l.u	student
9	u.chenchu lakshmi	k.l.u	student
10	n.bala bhaskar	k.l.u	student
11	k.chandana	k.l.u	student
12	v.divya	k.l.u	student
13	s.p.lahari	k.l.u	student
14	k.seshasai	k.l.u	student
15	ch.hemanth	k.l.u	student
16	j.hemanth kumar	k.l.u	student
17	ch.prathibha	k.l.u	student
18	a.vijaya bharathi	k.l.u	student
19	k.vikram	k.l.u	student
20	v.sai prasanna	k.l.u	student
21	ch.manishadevi	k.l.u	student
22	a.sahithi	k.l.u	student
23	g.padmasri	k.l.u	student
24	g.krishna priya	k.l.u	student
25	sk.b.karishma	k.l.u	student
26	g.v.s.sai manikanta	k.l.u	student
27	i.surendra varma	k.l.u	student
28	k.saida rao	k.l.u	student
29	kushagra mathur	k.l.u	student
30	v.vijay kumar reddy	k.l.u	student
31	d.sudheer babu	k.l.u	student
32	p.sandeep	k.l.u	student
33	n.kiranbabu	rvr and jc	student(M-tech)
34	a.pradeepthi pavani	st.ann's	asst.prof
35	syed.abdul mujeer	rvr and jc	student(m-tech)
36	n.anjani pavani	rvr and jc	student(m.tech
37	r.nadini	rvr and jc	student(M-tech)
38	p.alexanda	rvr and jc	student(M-tech)
39	j.sujeet kumar	sits pune	research scholar
40	mahadev.ch	sits pune	research scholar
41	sharad s patil	sits pune	research scholar

SNo	Name	Organisation	Designation
42	kulkarni.n.a	zcoer pune	research scholar
43	shravan kumar.a		research scholar
44	ch.krishna prasad	kits khammam	faculty
45	p.sai niranjan	gnits hyd	faculty
46	sk.faiz mohammad	andhra layola	m-tech asst.prof
47	d.lakshman kumar	shri vishnu	asst.prof
48	g.bhrathi	shri vishnu	asst.prof
49	ch.amarendra	klu	research scholar
50	t.raghu	anurag eng.	assoc.prof
51	s.v.r.lakshmi kumari	vr siddartha	assoc.prof
52	b.ramesh	vr siddhartha	asst.prof
53	v.v.satyanarayana.r	sri sarathi inst.	assoc.prof
54	p.vaneela	nbn pune	asst.prof
55	l.v.suresh kumar	gmrit	asst.prof
56	vnsr murthy	k.l.u	asst.prof (phd sch)
57	o.ranjith kumar	klu	asst.prof (phd sch)
58	t.renukha	k.l.u	asst.prof (phd sch)
59	b.nagaraju	k.l.u	assoc.prof(phd sch)
60	b.venugopala reddy	k.l.u	assoc.prof(phd sch)
61	a.ramesh	k.l.u	assoc.prof(phd sch)
62	c.kumar	pvpsit	assoc.prof
63	m.seshu	pvpsit	asst.prof
64	b.mohan	pvpsit	asst.prof
65	m.ravi kumar	pvpsit	asst.prof
66	Dr.a.v.naresh babu	mic	professor
67	Dr.t.vamsee kiran	mic	professor
68	m.rama mohan rao	mic	asst.prof
69	k.vijay kumar	mic	assoc.prof
70	m.suresh	viit	asst.prof
71	k.k.deepika	k.l.u	phd sch
72	b.mabu shareif	k.l.u	phd sch
73	k.s.ravi kumar	k.l.u	phd sch
74	t.ravi kumar	k.l.u	phd sch
75	Dr.k.swarnasri	rvr and jc	professor
76	smt.k.radha rani	rvr and jc	assoc.prof
77	g.srinivasa rao	k.l.u	scholar
78	n.murali krishna	k.l.u	scholar
79	b.baddu naik	pvpsit	asst.prof
80	k.l.sireesha	k.l.u	scholar
81	n.lavanya	k.l.u	scholar
82	t.bharath kumar	k.l.u	scholar
83	r.sunitha	k.l.u	phd sch

SNo	Name	Organisation	Designation
84	d.ragaleela	pvpsit	asst.prof
85	g.madhavi	pvpsit	asst.prof
86	j.srinivasa rao	anurag eng.	assoc.prof
87	amritha	k.l.u	research scholar
88	k.neelima	k.l.u	research scholar
89	k.mahesh	k.l.u	m.tech(ped)
90	n.narendar reddy	s.v.eng.	asst.prof
91	m.venkateswarlu	k.l.u	research scholar
92	s.shanshul haq	k.l.u	research scholar
93	p.ravi	k.l.u	research scholar
94	v.kranthi kumar	k.l.u	research scholar
95	j.rajesh	k.l.u	research scholar
96	p.gopi	klu	research scholar
97	N.D.V. Prasad	ANU	M.tech

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