特別講演 JIPE-34-13

Power Electronics in Utility Application in Korea

忠北大学
Jaeho Choi

(Choi 先生には、平成 20 年 8 月 2 日、第 174 回定例研究会においてご講演頂きました)

Energy Management System (EMS) and Test Site for Microgrid

Prof. Jaeho Choi
Chungbuk National University

Aug. 2, 2008

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Outline of Presentation

1. Introduction of Chungbuk National University (CBNU)
2. Introduction of Power IT National Projects in Korea
3. Development of Energy Management System and Test Site for Microgrid
4. Conclusion

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CBNU

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Chungbuk National University

- 1951: Started originally from
Cheongju Junior Agricultural College
- 1977: Upgraded to
Chungbuk National University
– 18,000 students
– 644 faculty members
- 1975: Dept. of Electrical Eng.
- 1997: School of Electrical and Computer Eng.
- 2009: College of Electrical and Computer Eng.

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School of Electrical & Computer Engineering (ECE)

Division	No. of Students (Under)*	No. of Graduate Students*	No. of Faculties	Contract Based Faculties
Electrical Eng.	71	28	10	3
Electronics Eng.	105	63	19	
Information & Communication Eng.	117	88	17	16
Computer Eng.	109	68	17	
Total	402	247	64	19

* Registered Students

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Division of Power Engineering

- 10 Faculties
 1. Electrical Material Lab.
 2. Power Electronics Lab.
 3. Signal Processing Lab.
 4. Semiconductor Lab.
 5. Electrical Machine Lab.
 6. Electrical Power System Lab.
 7. Plasma Lab.
 8. Communication Lab.
 9. Embedded System Lab.
 10. Control Lab.

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Lab. of Energy and Power Electronics Application in CBNU

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- Students
 - Ph. D: 2+1(FT), 6(PT)
 - Master: 4(FT)
- Graduate Students
 - Ph. D: 15
 - Master: 46

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Current Research Activities of EPE Lab. in CBNU

1. CRA Based Design Controller for Power Converter
 - PWM Converter for Traction Drives
 - Inverter System for Renewable Energy Sources
2. Overmodulated PWM Technique for Three Level Inverter
 - Traction Drives Application
3. Energy Storage System for Supercapacitors
 - SM Flywheel System
4. Management and Control of Micro-Grid System
5. Power Quality Monitoring and Classification

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Center for Power IT National Program (CPIT)

Power IT ?

Implementation and integration of information and communication technology for power technology, power systems, and power

business
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History of Korean Power IT Program

- Dec. 2004: Power IT Steering Committee was created by the Ministry of Knowledge Economy (MKE)
- Sept. 2005: Nine Power IT projects were initiated
- Sept. 2006: Power IT Education project and Standardization project were initiated
- April 2007: Center for Power IT National Program (CPIT) was established
- Sept. 2007: The tenth Power IT project (Development of integrated EMS for the Microgrid and application technology to real site) was launched

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Organization of CPIT

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Vision, Goal, and Strategy

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Composition of Power IT Program

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Introduction of Major Power IT R&D Projects (1)

Project	Contractor	Participants	Period	Objectives
Korea Energy Management System (K-EMS)	Korea Power Exchange (KPX)	Univ/Inst: 7 Ind: 3	'05-'10 5yrs	-Development of Korea energy management system (KEMS) -Development of IT solutions for power system operations -Development of power system operations training simulator -Future application to Korean electric power system
IT-based Flexible AC Transmission System	KEPRI	Univ/Inst: 1 Ind: 1	'05-'10 5yrs	-Development of 100MVA STATCOM -Development of IT-based operations technology of STATCOM -Development of 20MVA BTB STATCOM

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Introduction of Major Power IT R&D Projects (2)

Project	Contractor	Participants	Period	Objectives
Intelligent Transmission Network Monitoring & Operation System	KEPRI	Univ/Inst: 3 Ind: 8	'05-'10 5yrs	-Development of real-time transmission network monitoring system management system -Development of Reactive power management system -Development of transmission risk management system based on GPS information
Advanced Substation Automation System Based on the Digital Control Technology	KEPRI	Univ/Inst: 4 Ind: 16	'05-'11 6yrs	-IED development based on the IEC 61850 protocol -Total operations management system development for digitalized substations -Test and demonstration of the substation automation system

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Introduction of Major Power IT R&D Projects (3)

Project	Contractor	Participants	Period	Objectives
Intelligent Distribution Management System	KEPRI	Univ/Inst: 6 Ind: 18	'05-'10 5yrs	-Development of distribution automation central control system -Development of intelligent distribution facilities and devices -Development of distributed generation interconnection technology
Active Telematics System for Power Facility Monitoring	KON	Univ/Inst: 8 Ind: 16	'05-'9 4yrs	-Development of sensors and sensor networks for transmission network monitoring -Development of data management system and user platform for transmission network monitoring

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Introduction of Major Power IT R&D Projects (4)

Project	Contractor	Participants	Period	Objectives
Consumer Portal System for IT-based Energy Service Business	KEPRI	Univ/Inst: 6 Ind: 18	'05-'10 5yrs	<ul style="list-style-type: none">•Development of distribution automation central control system•Development of intelligent distribution facilities and devices•Development of distributed generation interconnection technology
Broadband Power Line Communication	KEPRI KERI	Univ/Inst: 7 Ind: 11	'05-'11 6yrs	<ul style="list-style-type: none">•Development of broadband PLC modem and network system•Development of open architecture BPLC platform technology•Development of performance test system and advanced metering system of BPLC•Development of multi-business services using BPLC technology

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Introduction of Major Power IT R&D Projects (5)

Project	Contractor	Participants	Period	Objectives
Power Semiconductor for Distributed Generation and Industrial Inverter Application	Consortium for Semiconductor Advanced Research	Univ/Inst: 5 Ind: 5	'05-'10 5yrs	<ul style="list-style-type: none">•Development of 600V/1,200V IGBT and devices•Development of module integration and package technology•Development of power semiconductor performance test system
Energy Management System and Test Site for Microgrid	KEITRA	Univ/Inst: 3 Ind: 4	'07-'12 5yrs	<ul style="list-style-type: none">•Development of major devices and systems for Microgrid•Development of operation system of Microgrid•Development of performance test system and test plant for Microgrid

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Definition of Microgrid

- Electrical network system for special districts
e.g. industrial plant, power park, etc.
- Power supply system with controlling and operating function for various types of distributed generations, storage devices, and loads

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Concept of Microgrid

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Technology for Microgrid

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Technical Requirements for Microgrid

- **Supply/Demand Control**
 - Demand Forecast, Load Following, IT Technologies
- **Stabilizing Control for Generation Output**
 - Stabilization of Fluctuating Output for DER Using Power Output Forecast
- **Keeping Power Quality Level**
 - Voltage/Frequency Stabilization, Harmonics
- **Economics/Environment**
 - Optimal Generation Configuration, Optimal Operation

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Benefits of Microgrid

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Trend of Microgrid

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- ✓ Technology development for highly reliable/efficiency power grid
- ✓ Key device development, pilot plant for urban and rural system

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Data Model:
IEC 61850 Object Modeling

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Data Model:
IEC 61850 Object Modeling

Photovoltaics : DPVC(PV Array Controller) ; DTRC (Tracking Controller)

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Thank you for your attention !
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Resultant Global Inequity
Global Consumer Energy Density Map