Local Area Monitoring System (LAMS) for Microgrid

March 6, 2012 update for
Korea Electrotechnology Research Institute

Illinois Institute of Technology,
Korea Electrotechnology Research Institute (KERI) and Procom
LAMS for Microgrid Vision

• Perfect Power microgrid with state-of-the-art data acquisition & analytics
• Proving ground for new technology
• High-resolution voltage & current phasor data for
  – Real-time situational awareness
  – Individual building load forecasting
  – Advanced security assessment
Hardware Scope

• 3 years
• Phasor Measurement Units (PMUs) in buildings: academic, residential, commercial
• PMUs in other critical locations
  – Substation
  – Distributed Energy Resources
    • Backup generators
    • Wind
    • PV
    • Battery Storage
    • Electric Vehicle Charging Stations
• PMU Data Concentrator (PDC)
• PMU Archival Database
IIT Campus

High Reliability Distribution System:
DIAGRAM: Drawing not to scale.
Task Update

• Tasks Completed
  – 12 PMU locations chosen
    • Complete coverage of Loop 3
    • Partial coverage of Loops 1 & 2
    • Plus coverage of significant existing DER
  – Additional $270,000 in equipment installation budget
  – First shipment of 8 PMUs (arrived 29th of September)
  – Second shipment of 4 PMUs (arrived 8th of December)

• Work In Progress
  – Electrical contractor installation
  – Database server and PMU Data Concentrator
  – PMU UPS
Known Implementation Issues (1)

- **IIT Tower**
  - Emergency generators would not participate in DR
- **LSR (Life Science Research)**
  - May be unable to shutdown for CT/PT installation
  - No nearby space for PMU cabinet (expensive installation)
- **Power Plant**
  - 4160 V shutdown delayed until end of heating season
- **Asbestos abatement**
  - Life Science Building requires specialized contractor
- **Battery storage module**
  - 250 kW/500 kWh flow battery installation delayed
- **GPS antenna relocation**
  - Mies van der Rohe building preservation
Known Implementation Issues (2)

- Database server compatibility
  - Procom needs to validate Windows Server 2008 R2 (64-bit)
- PMU UPS
  - Battery powered UPS required for each PMU
- PMU Data Concentrator
  - Spring 2012
- Procom commissioning of PMUs
  - Spring 2012
- Encrypted Communication Tunnel to KERI
  - IIT requires encrypted channel for real-time data
First Year Accomplishments

- Loop 3 PMU installation
  - Met end of November deadline
  - Achieved successful installation and complete coverage of Loop 3 (most important Loop)
  - Completed initial Procom PMU commissioning
  - Fixed minor phase reversals in Wishnick & Hermann Hall

- Additional installation funding
  - Secured $150,000 from IIT for Phase 2 installation
Second Year Accomplishments (as of 5-Mar-2012)

- Completed installation of Phase 2 PMUs
  - E1, Life Science (ethernet connection delayed due to asbestos), Stuart
- Secured $150,000 from MKE for Phase 3 installation
  - Gunsaulus Hall, MTCC, Power Plant, IIT Tower, LSR
- Began Phase 3 PMU installation
  - Gunsaulus Hall & MTCC PMUs have been installed
  - Ethernet cabling in progress for GH & MTCC
  - MTCC GPS antenna in progress (requires specialized roofer)
Year 2 and 3 Goals

- Commissioning of PMUs
- Collection of PMU data
- Collection of ancillary data for future load forecasting
- Development of building load demand models
- Filtering of PMU data for ease of analysis
- Capture of dynamic events
- Analysis of Distributed Energy Resources (DER): demand response DG, wind, PV, storage, EV
Siegel Hall PMU
LAMS: Critical Foundation for Smart Grid

- Smart Grid: electric energy delivery system using digital technology to save energy, reduce cost & environmental impact, while increasing reliability and transparency

- Five key technology areas:
  - Integrated communications: *real-time information* & control, cyber security
  - Sensing and measurement technologies: sensor networks, *phasor measurement units*
  - Advanced components: superconductivity, storage, power electronics
  - Advanced control methods: *rapid diagnosis*, decentralized control & automation
  - Improved interfaces and decision support: *situational awareness*
Short-term load modeling

• Traditional forecasting
  – Weather
  – Events and occupancy
  – Historical load patterns

• Future potential: dynamic load behavior
  – Transients following faults (may require modification of Procom PMU)
  – In-rush during load pick up (may require modification of Procom PMU)
  – Power Quality (may require modification of Procom PMU)
Long-term load modeling

- Traditional forecasting
  - Weather
  - Economy
  - Demographics
  - Buildings and facilities
  - Historical load patterns

- Future potential: market based load response
  - Demand response
  - Price sensitive load
Thank you!

MOU on Smart Grid between Korea–illinois (July, 2010)

International R&D Collaboration

R&D MOU

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Questions