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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

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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

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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

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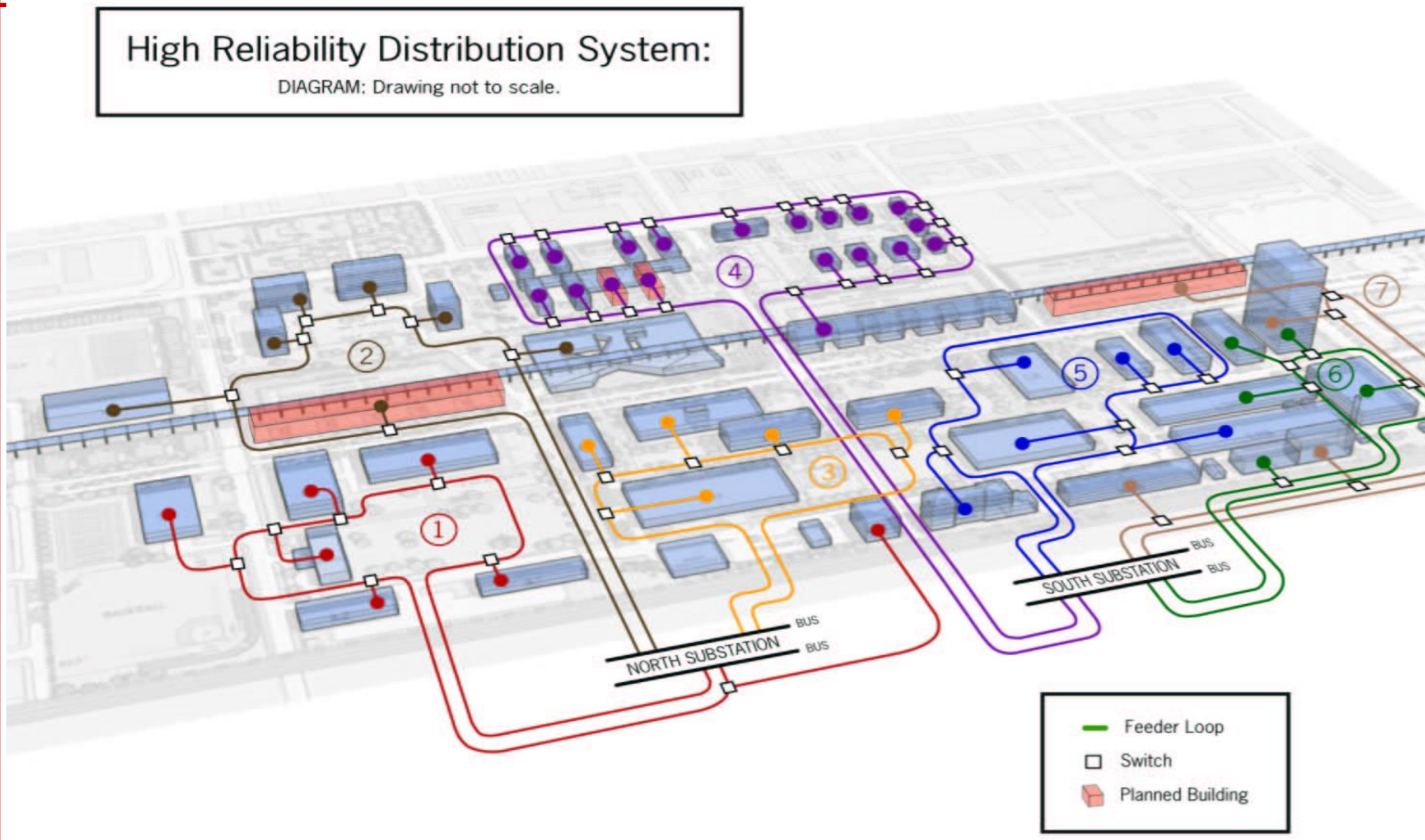
IIT Campus



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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

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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

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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

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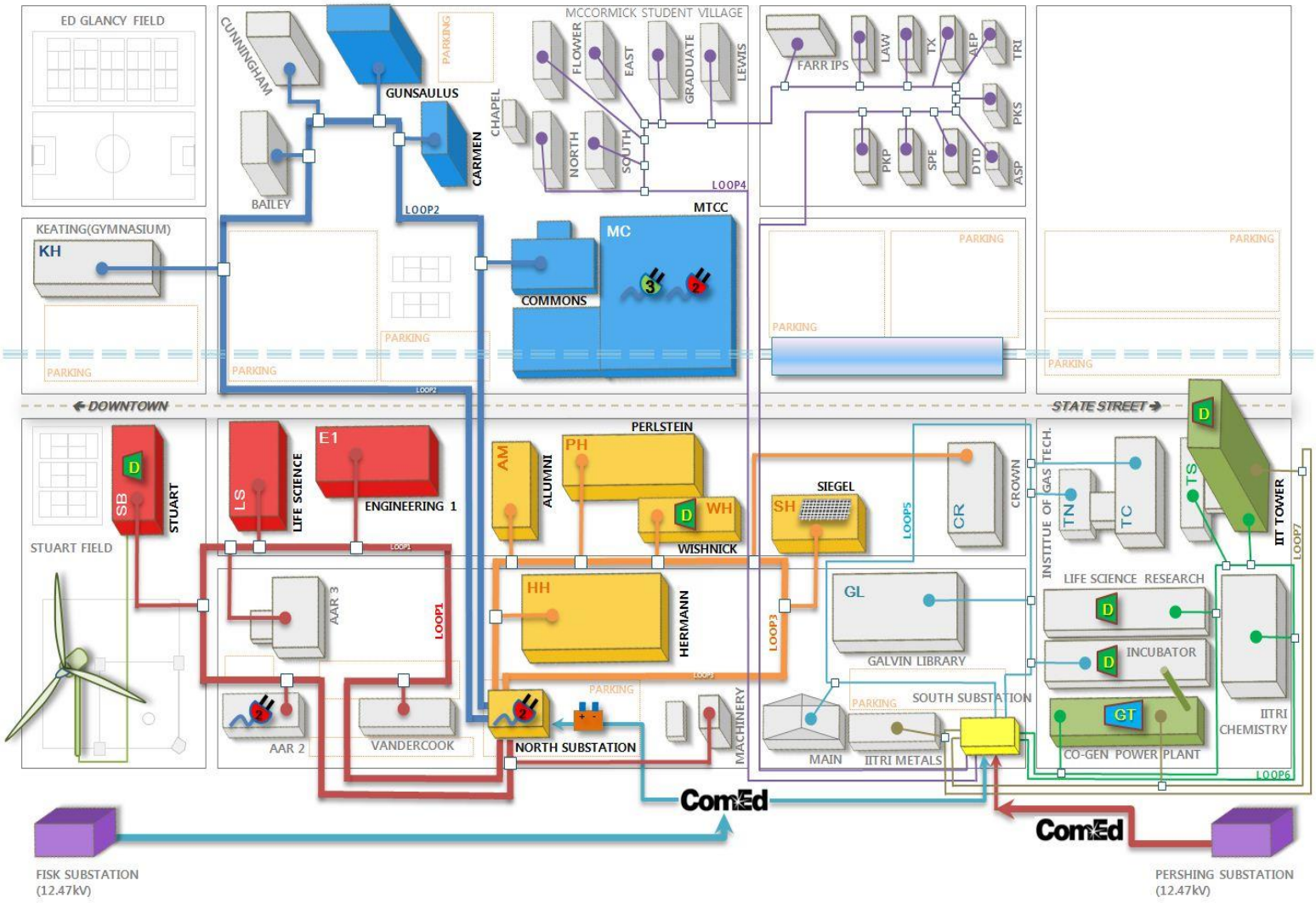
MICROGRID OF IIT CAMPUS



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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

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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)

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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

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Siegel Hall PMU

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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***

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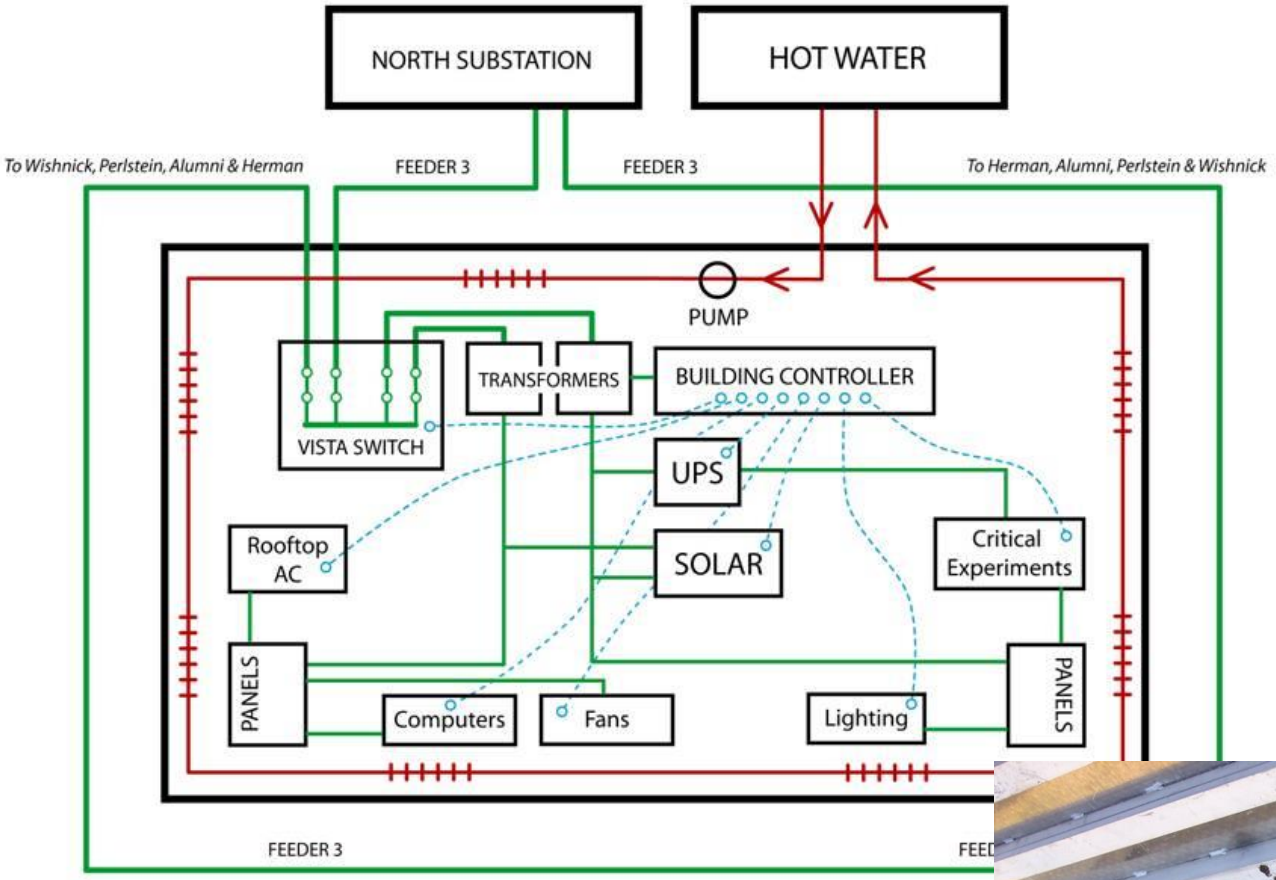

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Short-term load modeling

- 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)

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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

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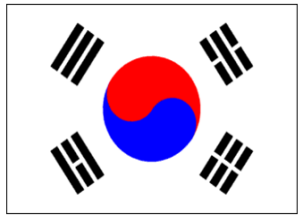
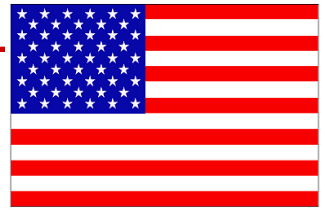
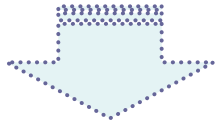
Thank you!



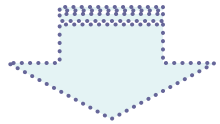
MOU on Smart Grid between Korea-illinois (July,2010)



International R&D Collaboration



R&D MOU



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Questions