Federal Utility Partnership Working Group
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Meeting Federal Energy Security Requirements

An Opportunity to Increase Federal-Utility Partnerships

Lawrence Markel
SRA International
Lawrence_Markel@sra.com

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Meeting Energy Security Requirements
An Opportunity to Increase the Scope of Federal-Utility Partnerships

Theme

Meeting energy security requirements in federal facilities provides opportunities for additional types of cooperation between utilities and the federal agencies.

However, there are significant barriers to pursuing these opportunities – constraints on utilities and on federal agencies, as well as sometimes-competing objectives.

What is Energy Security?

Energy security encompasses sufficiency, surety, and sustainability.

- Above all, energy security means having adequate power to conduct critical operations for the duration required (sufficiency).
- Secondarily, and leading to sufficiency, is ensuring resilient energy supplies that are accessible when needed (surety).
- Finally, the energy supplies must present the lowest life cycle cost, while considering all statutory requirements, as well as the impact to operations, community, and environment (sustainability)

What is Energy Security?

Requirements for Energy Security in Federal Facilities

- Maintain critical loads during grid disturbance/outage
- Mission assurance during extended grid outage
- Reduce reliance on vulnerable energy supply infrastructure and on foreign energy sources

Federal component and also a U.S. national interest component

- Contribute to national energy policy objectives
- Have federal facilities available to assist during extraordinary situations (DHS/FEMA, DOD, etc.)

Energy security should be integrated with physical security, cyber security, intrusion detection & situational awareness, etc. – silo'ed scopes are not efficient

CONOPS – Concept of Operations

Setting Your Security Objectives

RED: Extended outage or widespread threat (natural disaster or attack)

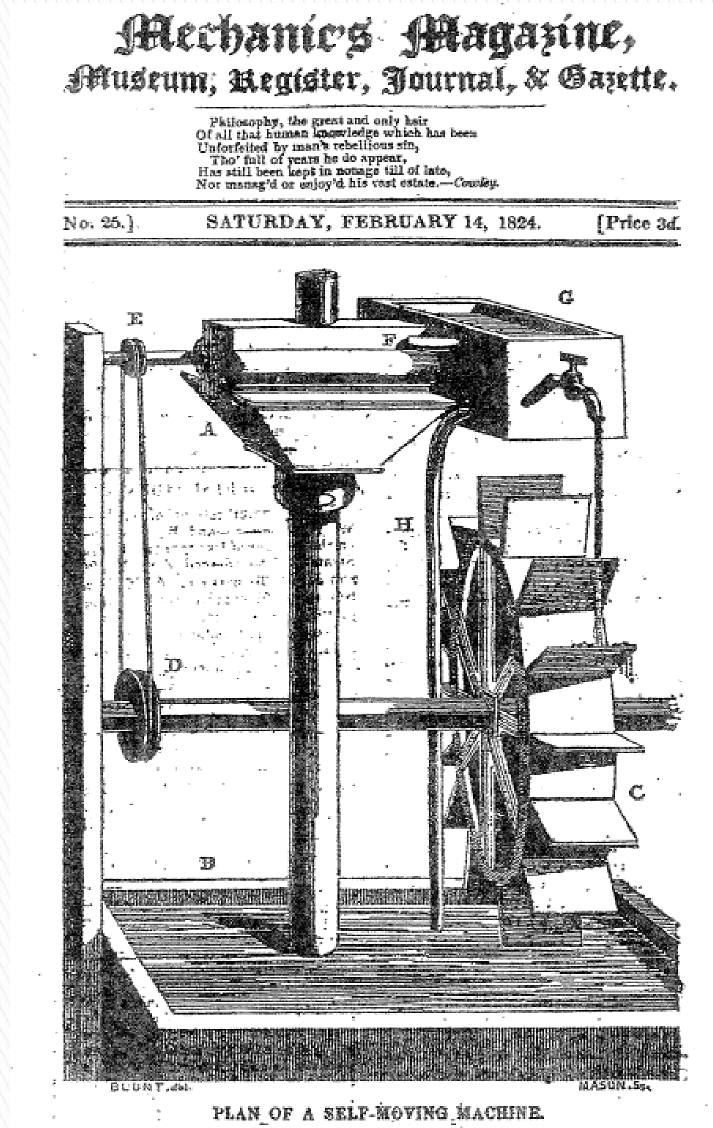
YELLOW: Grid is “shaky,” possible short duration outages or load shedding

GREEN: Normal operations. Meeting Federal energy efficiency, greenhouse gas emission, and fossil fuel use requirements. This is the space in which most UESCs operate.

Note that “Net Zero” as conventionally defined doesn’t necessarily address energy security for **YELLOW** or **RED** CONOPS

"Net Zero" is not a new concept

- It *is* being defined a little differently at present
- Net Zero on an annual basis doesn't provide for operational energy security if the grid is down
- In an emergency, non-critical loads should be curtailed. This is often not an element in Net Zero design calculations.
- Need to recognize the utilities' role – and costs – as half the Net Zero partnership. (e.g., mortgages could be Net Zero to the bank, but they still charge you interest)
- Army task force to re-define Net Zero in terms of mission


Mechanic's Magazine,
Museum; Register, Journal, & Gazette.

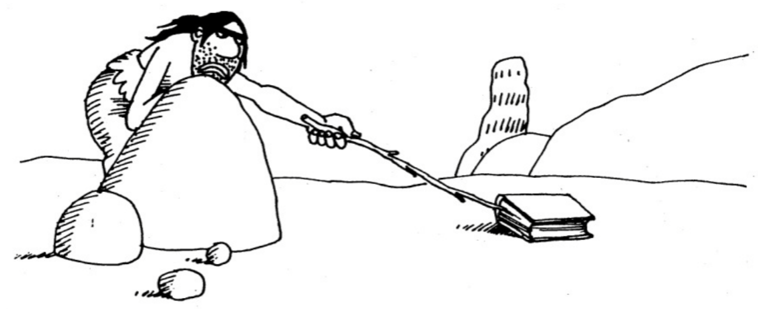
Philosophy, the great and only heir
Of all that human knowledge which has been
Unforfeited by man's rebellious sin,
Tho' full of years he do appear,
Has still been kept in nonage till of late,
Nor manag'd or enjoy'd his vast estate.—*Cowley.*

No. 25.] SATURDAY, FEBRUARY 14, 1824. [Price 3d.

PLAN OF A SELF-MOVING MACHINE.

Energy Security Technologies Being Introduced at Federal Sites

- Renewable energy – mostly as-available
  - Solar – PV and thermal
  - Wind
  - Biomass
- Microgrid
- Energy Storage
  - Batteries
  - Flywheels
  - Thermal storage
  - UPS
- Advanced controls and sensors
  - Advanced meters
  - Energy management systems
  - Progressive autonomy
  - Improved situational awareness



Opportunities for Increased Cooperation

- Load relief, reserve support: distributed generation, storage, controls (e.g., demand response)
- Reactive power management (VAr supply from DG, renewable energy, inverters, energy storage)
- Buffer variability from as-available energy sources (dispatch of energy storage)
- Help utilities determine the present amount of RE on the system to better determine operating reserve requirements (metering and advanced sensors)
- Facility or Energy Services Provider (ESCO) can participate in electricity and ancillary services markets (microgrid dispatch) – additional value proposition for performance contracting?

Load Relief / Reserve Support

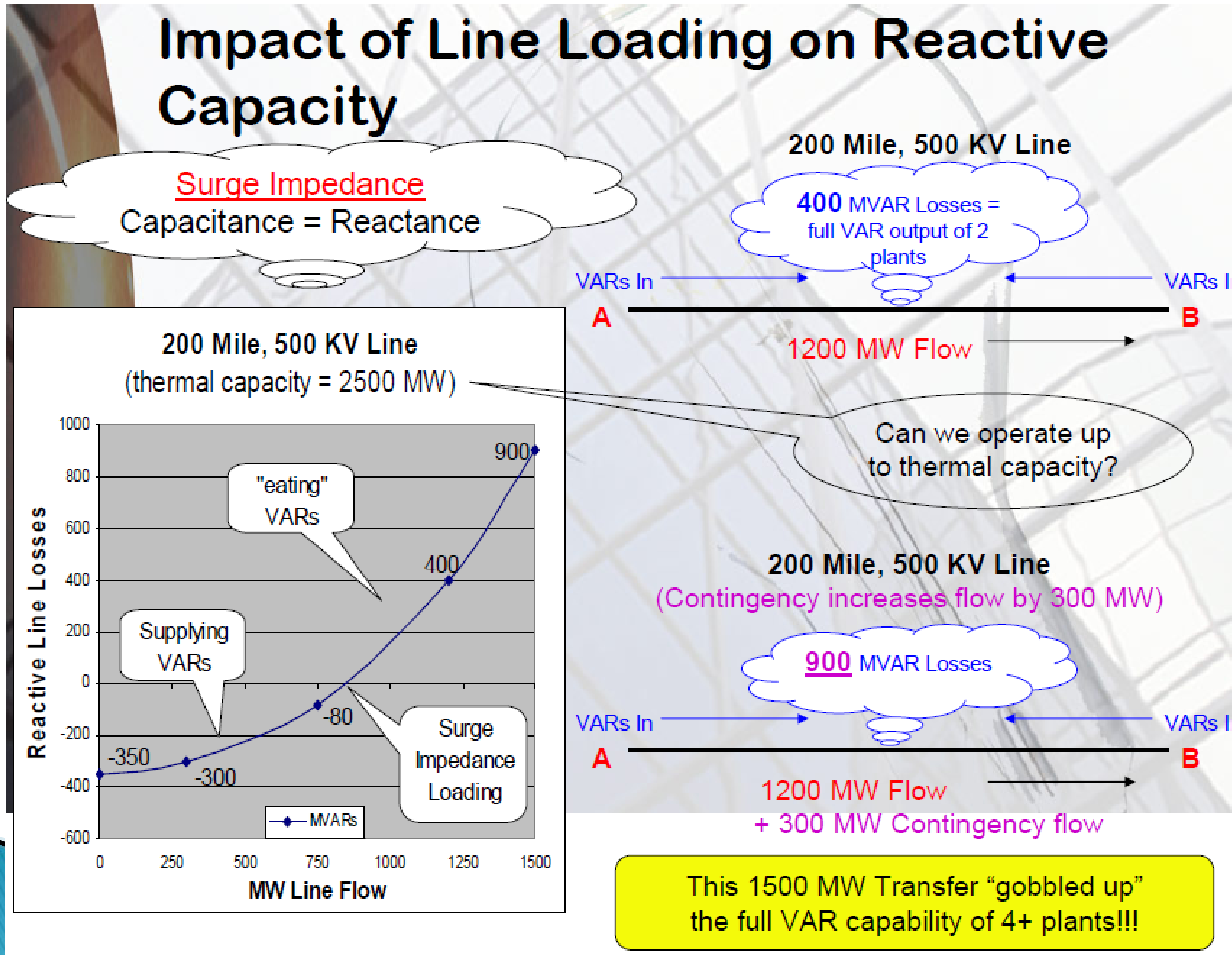
DG, Energy Storage, Controls/Demand Response

- Utility needs immediate, assured, and confirmed response from facility
- Facilities must be wired with separate circuits and controls   to be able to shed non-critical loads
- Value of reserve support to utility must be weighed against obligation and cost to serve the facility.
  - Performance-based rates (e.g., reliability metric)?
  - Must look at structure of electricity market/ISO

Reactive Power / VAr Support

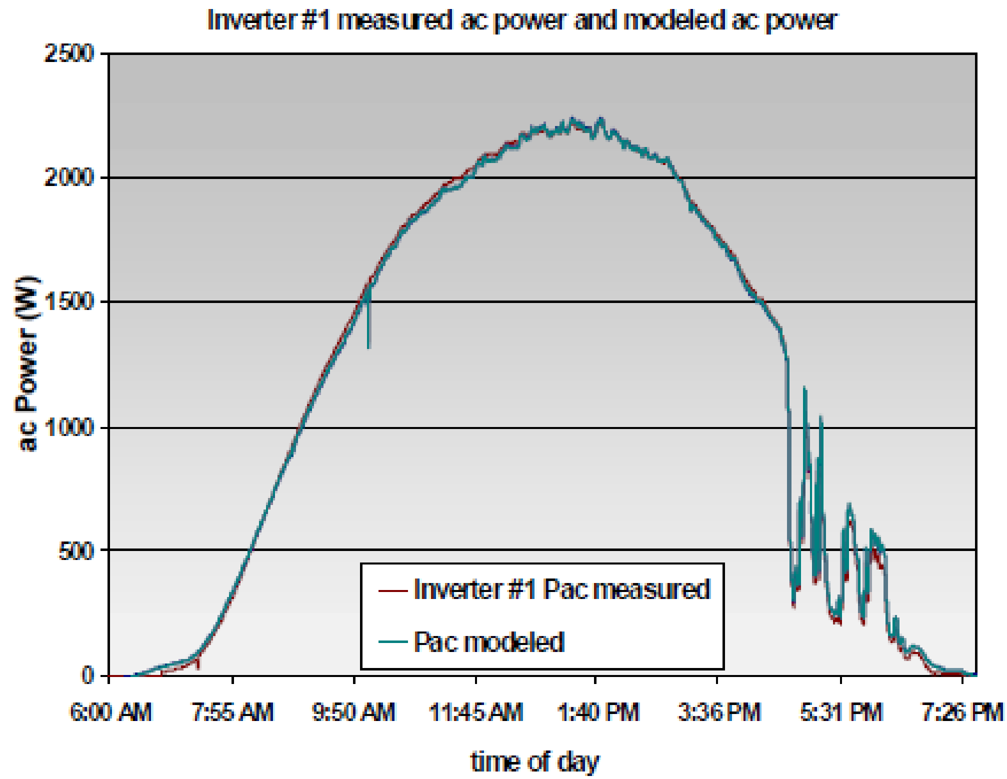
- Explaining $\sqrt{-1}$
- Sometimes a VAr is worth more than a kW
  - Constrains kW production
  - Constrains kW delivery
  - Slower ramp up rate to supply VArs
- Volt-VAr control needed for islanded microgrids
  - Capacitors and compensators
  - Inverter power factor control
- What is the value to the utility of the facility's being able to supply VArs (or reduce demand for VArs)?

From Joe Schatz, Southern Company



Help Utility Manage As-Available Generation

- Buffer variability (e.g., energy storage)
- Monitor amount of PV (or other as-available resources) actually on the power system
- Better estimate operating reserve requirements, manage unit commitment



Participate in Energy Services Markets

- Facility or Energy Services provider (ESCo) might be able to participate
- States franchise utilities: Who is a utility?
- Does behind the meter generation and/or dispatch control make the ESCo and/or the facility a utility requiring state franchise?
- Energy Lawyers and Contracting Officers Working Group (Julia Kelley, ORNL & Linda Collins, GSA) has developed draft templates for URESC agreements. Can these principles be applied to ancillary services and arbitrage?

Barriers / Challenges - 1

Can we quantify value propositions and identify new revenue streams to help pay for energy security in a budget-constrained period?

- Energy-centric rates, performance metrics, service contracts : Need to recognize – and pay for – the value of reactive power & the time-varying value to the utility of energy
- Large government facilities may have already negotiated low electricity rates that don't provide for VAr and kW support, and renegotiating part of the tariff may open up all
- Utility needs quick, assured, verified response – who has priority control of facility's DER?
- Remember how you measure energy use:

a)

b)

c)

Barriers / Challenges – 2

Contracting / FAR & Franchise Issues

- UESC funded from performance improvements, but Energy Security may be justified for mission assurance and funded with appropriations (capital budget): Need to blend operational/performance and appropriated funds (Energy Lawyers and Contracting Officers can discuss that this afternoon.)
- State Regulations: no common requirements or approach

Note: Authorization for 3rd-party solar PV PPAs usually lies in the definition of a "utility" in state statutes, regulations or case law; in state regulatory commission decisions or orders; and/or in rules and guidelines for state incentive programs. This information is provided as a public service and does not constitute legal advice. Seek qualified legal expertise before making binding financial decisions related to a 3rd-party PPA.

These slides will be updated quarterly. Please send comments to Amanda Vanega at amanda_vanega@ncsu.edu.

- Arizona: ACC Decision 71795, Docket E-20690A-09-0346
- California: Cal. Pub. Util. Code § 218, § 2868
- Colorado: S.B. 09-051; PUC Decision C09-0990
- Connecticut: Connecticut Clean Energy Fund
- Delaware: S.B. 266 and S.B. 267 (2010)
- Hawaii: PUC Order 20633
- Illinois: 220 ILCS 5/16-102; 83 Ill. Adm. Code, Part 465
- Massachusetts: 220 CMR 18.00
- Maryland: H.B. 1057 (2009)
- Michigan: 2008 Public Act 286; PSC Order Docket U-15787
- New Jersey: N.J. Stat. 48:3-51; N.J.A.C. §14:8-4.1 et seq.
- New Mexico: H.B. 181 and S.B. 190 (2010) *(effective 1/1/2011)*
- Nevada: S.B. 395 (2009); PUC Orders 07-06024 and 07-06027
- New York: NYCLS 2.13
- Ohio: PUC Order 06-653-EL-ORD
- Oregon: PUC Order, Docket 08-388
- Pennsylvania: PUC Order, Docket M-00051865
- Puerto Rico: No policy reference available; based on news reports and articles
- Utah: H.B. 0145 (2010) *(effective 3/31/2010, and limited to installations at public buildings, schools or 501(c)(3) non-profits)*
- Virginia: VA Code § 56-232 and 20VAC5-315-20

Barriers / Challenges – 3

Technical

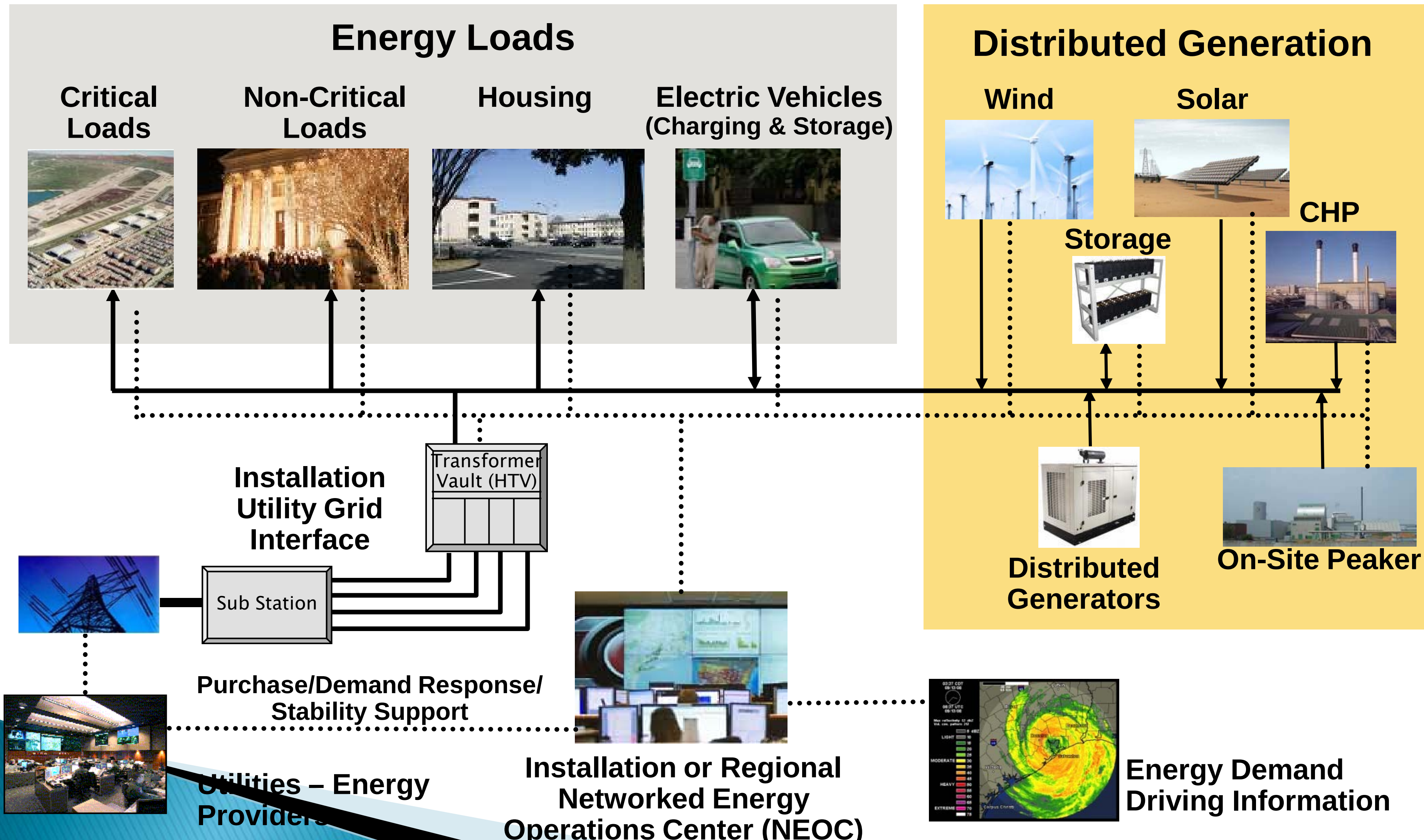
- **Let's get the CONOPS right:**

  "If a raccoon can do it, a terrorist can." -ASA Hammack
- **Cyber security and comm link**: Utility-federal facility communications links (to monitor or to enable fast-response control) can introduce cyber vulnerability: Need to upgrade SCADA, agree on cyber security standards, tests, protocols
  - Biloxi AFB spends $500k with Mississippi Power to install "smart" meters it can't read because of non-conformance with DoD CS requirements
  - Stuxnet, Telvent
- **"Microgrid":** Microgrids with DG and storage are a "new" and very different entity on a utility system:
  - System study for interconnection and protection coordination can be very complex and one-off.
  - Is standardization of design and controls possible?

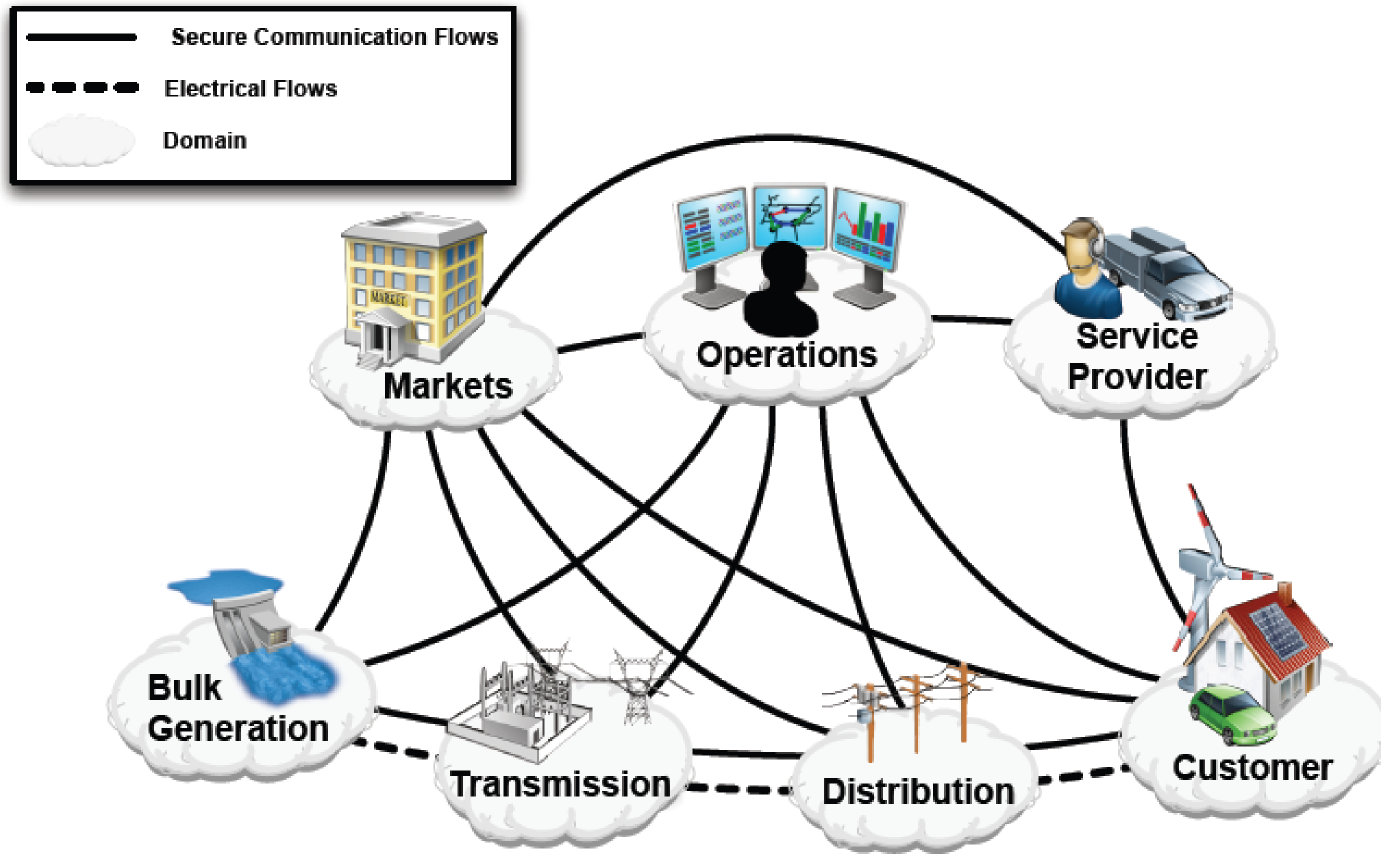
Evolution of Backup Power

- Stage 1 – No back up power like most homes and businesses
- Stage 2 – Generator and/or UPS dedicated to individual building or device
- Stage 3 – Connect buildings/devices along distribution feeder: share generators and have more than 1 generator available to power critical loads – the microgrid is born !
- Stage 4 – A more advanced microgrid makes it feasible to use additional distributed energy resources to conserve fossil fuel:
  - Renewable energy – wind, solar thermal & PV, landfill gas, biofuel
  - Energy Storage (thermal and electrical)
  - Demand response to reduce load served while islanded (separate critical and non-critical loads)
  - Energy efficiency to reduce load served while islanded
- The microgrid actively controls the network for better reliability, especially when physical or communication systems are damaged or attacked

Microgrid Architectural Elements

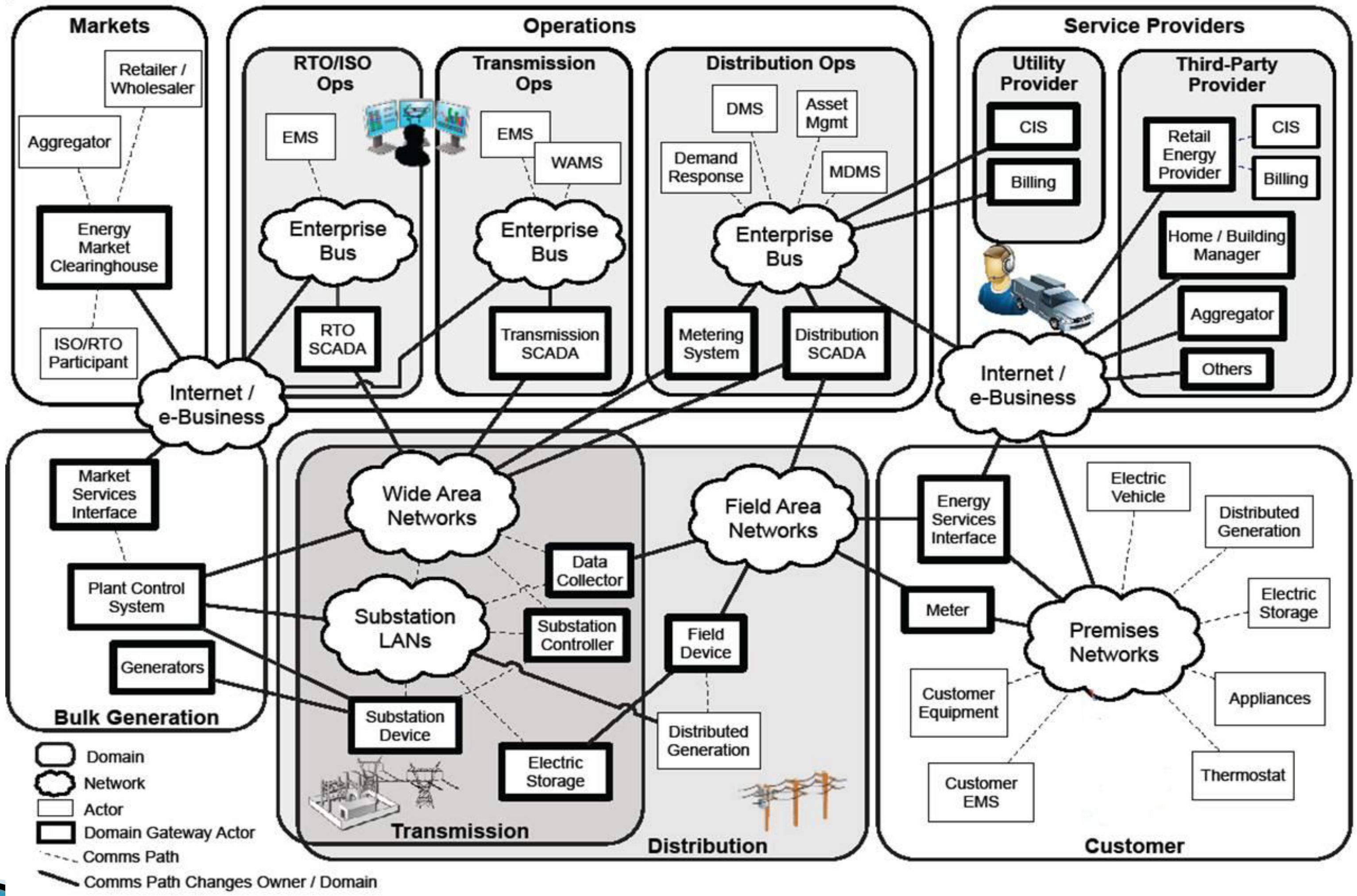


NISTIR 7628- Smart Grid Framework

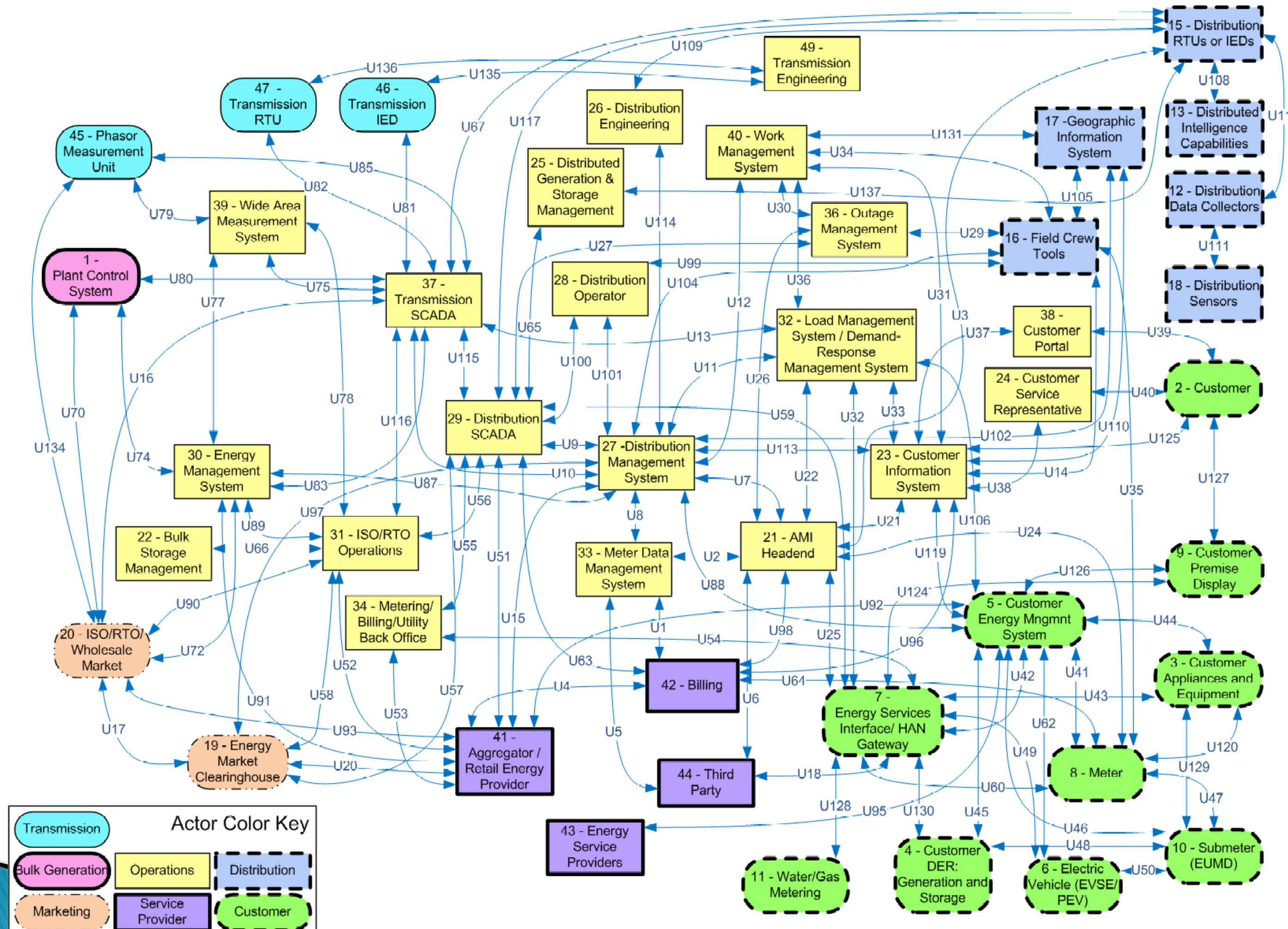


NIST Smart Grid Framework 1.0 January 2010

Continued Complication



NISTIR 7628– Logical Reference Model



Leading to the need for yet *another* Standard

ASA
K100.1-1966

American Standard

Safety Code and Requirements for Dry Martinis

Sponsor
Water Conservation League

Approved August 31, 1966
AMERICAN STANDARDS ASSOCIATION

Table 2
Proportions

Gin Proof	Minimum Parts Gin	Maximum Parts Vermouth	Nominal Drink Size
86	20	1	Double
90	17	1	Double or Large
94	17	1	Large or Regular
96	17	1	Regular
100	16	1	Regular

items that may be required in the preparation of a dry martini. Their necessity will be determined by the mixing method to be employed.

5.2 Methods. Dry martinis may be mixed in any one of the following manners:

5.2.1 *Stirring Over Rocks.* In this method, proper proportions of the stipulated ingredients are poured into a container over solid pieces of ice. Crushed or cracked ice shall not be used, and at least 90 percent of the ice employed shall be in pieces at least 1 cubic inch in size. Following an interval of not less than 30 seconds and not more than 1 minute, the ingredients shall be stirred by one of the methods indicated in Figure 1. Stirring shall be vigorous enough to encourage a blending of the gin and vermouth, but gentle enough to insure the slightest amount of melted ice.

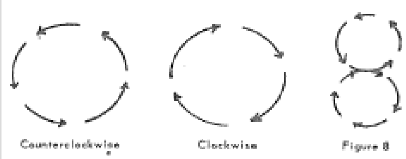


Fig. 1
Stirring Patterns

5.2.2 *Blending of Refrigerated Ingredients.* In this method, both the gin and vermouth are refrigerated to a temperature no higher than 32°Farenheit and then mixed without the addition of ice. Care shall be taken to refrigerate the mixing container as well as the ingredients.

5.2.3 *Radiation.* This method produces martinis of the proper degree of dryness with an accuracy not even approached by the preceding methods. It also makes it possible to produce and store proper martini cocktails by the bottlefull. As indicated in Figure 2, a 60 watt incandescent lamp is placed on a flat surface exactly 9 inches from a sealed bottle of vermouth. A sealed bottle of gin is placed on the other side of the bottle of vermouth at a distance of 23 inches. Care shall be taken to aline the bottles so that the rays of the lamp pass through the vermouth bottle directly into the gin bottle. Labels shall be so orientated that they do not hinder such passage of light. With the lamp and bottles suitably arranged, the lamp may be illuminated for an interval of 7 to 16 seconds. The duration of exposure is governed by the color of the bottles. Clear bottles require the shortest exposure; dark green bottles demand the longest exposure.*

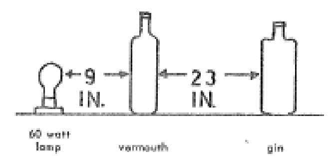


Fig. 2
Radiation Mixing Method

6. Test Methods

The testing of the American Standard dry martini requires a high degree of skill, experience, and selfless dedication. No known scientific apparatus has yet been developed that can match the sensitivity of the palate of a qualified American Standard dry martini taster. In testing, the taster shall watch for lightness of color, absence of sediment, a delicate aroma that effectively combines the scent of the juniper with the herbal infusion in the vermouth, a taste that is both sharp and clean with a faint body, and a light delicate aftertaste.

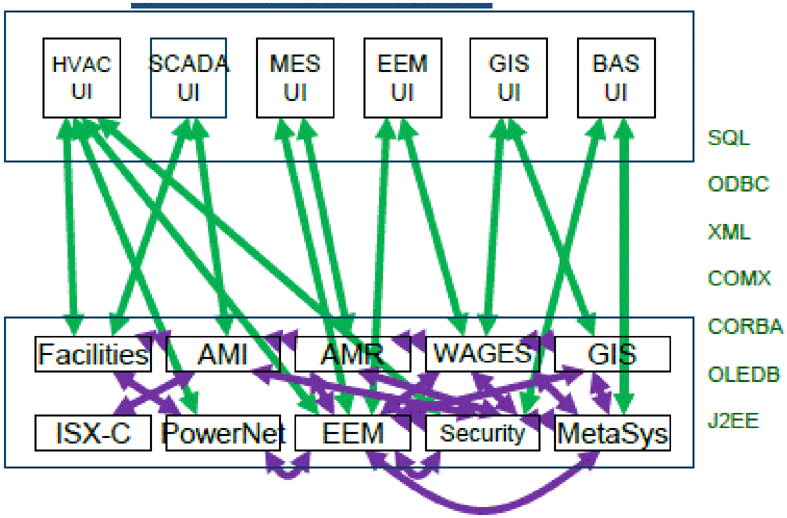
*Subcommittee 20-1 is presently engaged in the development of standards for uniform optical density of gin and vermouth bottles.

Middleware-based Microgrid Architecture

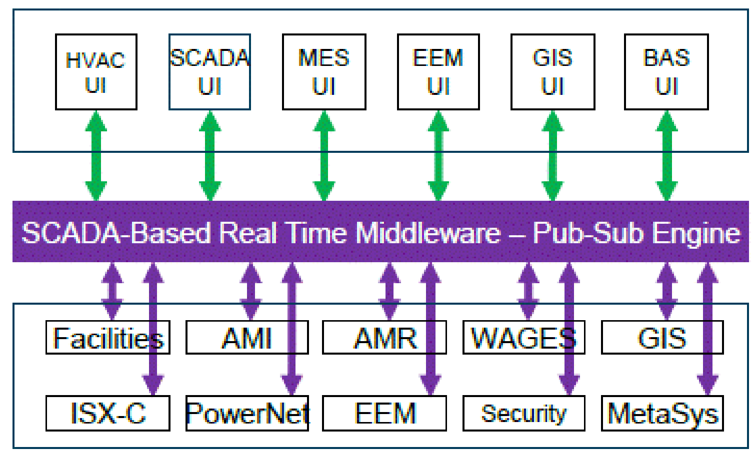
Potential Problems

Clients

Servers



Desired State



Dedicated connectors required to pass data between applications

All clients and applications have single connection to middleware

Energy Security Opportunities

Technologies

- Distributed generation
- Energy storage
- Renewable energy
- Controls, sensors, communication
- Microgrids

Additional Cooperation

- Load relief, reserve support
- Reactive power management
- Improve utility's situational awareness
- Energy and ancillary services markets

Challenges/Barriers

- Design - address CONOPS
- Tariff alignment – earn value for legitimate value propositions
- Communications link introduces CS threats
- Blending operational and appropriated funding under FAR
- State utility franchise requirements
- Non-standard, one-off system architectures do not adequately provide for legacy equipment, common operating platform, known interconnection requirements

Questions?

Larry Markel
SRA International
Lawrence_Markel@sra.com
865-671-5650 x104

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