## Update on SGIP Technical Activities Susan Hoyler

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#### **SGIP Member Groups**







## SGIP Standing Member Committees

# SMART GRID ARCHITECTURE COMMITTEE



## Smart Grid Architecture Committee (SGAC)

- Responsible for creating and refining a conceptual reference model, which provides a high-level, overarching perspective of the characteristics, uses, interfaces, requirements and standards needed to enable the Smart Grid
- Addresses use cases that require interoperable communications as well as proper configuration and access through several ownership and management boundaries



## Smart Grid Architecture Committee (SGAC)

- Addressing several challenges
  - migrating the existing system-engineering actor/role model to services
  - developing a phased architectural approach that creates building blocks and identifies canonical data models for interaction
- Building industrial profile and process to address emerging Smart Grid/Grid Modernization challenges such as integrating electric cars, renewable energy, microgrids, and Transactive Energy



## Smart Grid Architecture Committee (SGAC)

- Transactive Energy Framework will be launched by GridWise Architecture Council (GWAC) in early November at SGIP Fall Conference
  - SGAC has started its own working party to examine the issues across all the domains
  - SGAC has contributed to the GWAC Framework, especially to the Architecture and Cyberphysical Systems of the paper
- Coordinating architectures with European Union
  - EU M490 Methodology & Interoperability Work Packages



# SMART GRID CYBERSECURITY COMMITTEE



- Create and maintain a logical reference model of the Smart Grid to enable the creation and maintenance of a logical Smart Grid system and security architecture.
- Identify and describe privacy risks and concerns with developed or emerging interoperability standards for the Smart Grid,
  - Help determine the most appropriate and feasible practices for mitigating the risks.
- Identify Smart Grid-specific cybersecurity specific Smart Grid gaps and challenges



- Develop an overall cyber security strategy for the Smart Grid that includes a risk mitigation strategy to ensure interoperability of solutions across different domains/components of the infrastructure.
- Create strategy to address prevention, detection, response, and recovery
- Define and implement overall cyber security risk assessment process for the Smart Grid



#### Subgroups

- SGCC Architecture
- SGCC Cloud Computing
- SGCC High Level Requirements
- SGCC NISTIR 7628 User's Guide
- SGCC Privacy
- SGCC Standards



- Completed Privacy Roadmap
- Completed Risk Management Case Study
- Completed mapping of Critical Infrastructure Protection (CIP) v5 to NIST IR 7628 (Guidelines to Smart Guide for Cybersecurity)
- Developed slides for "Train the Trainer" on Privacy in the Smart Grid

- Completed final draft of NISTIR 7628 Rev. 1 "Guidelines for Smart Grid Cyber Security" and will soon be available for public comment.
- Completed white paper "Cloud Computing Considerations in the Smart Grid — Assessing and Implementing Cloud Computing Initiatives that Potentially Impact the Smart Grid"



# SMART GRID IMPLEMENTATION METHODS COMMITTEE



## Smart Grid Implementation Methods Committee (SGIMC)

- Interoperability in Practice
  - Implementation of standards
    - Lessons learned and best practices
    - Business case
    - Barriers and challenges
  - Implementer Community
    - Forum for implementers to share experiences
  - Feedback loop
    - Pass along issues to DEWGS, Technical Committee, SDOs, User's Groups and Alliances



## Smart Grid Implementation Methods Committee (SGIMC)

- Working to develop a clearinghouse and forum for real world experiences in smart grid deployment, including IEC 61850 implementation
- Chosing standards or application areas for case studies for 2014:
  - Integration of distributed generation
  - IEC 61850
  - CIM (IEC 61970 / 61968)
  - Demand response
  - Electric transportation
  - Green Button
  - Smart Energy Profile 2.0
  - AMI
  - Distribution Automation



# SMART GRID TESTING AND CERTIFICATION COMMITTEE



#### Smart Grid Testing & Certification Committee (SGTCC)

- Testing and certification expected to play a key role in the coming years to help further Smart Grid interoperability
  - Accelerate the development and implementation of interoperable products throughout the smart grid domains
  - Identifying testing needs and priorities, particularly from the perspective of utilities
  - New test programs will ramp up to support the adoption and implementation of new technologies



## Smart Grid Testing & Certification Committee (SGTCC)

#### **Key Documents**

- IPRM Interoperability Process Reference Manual (IPRM) Version 2
- IPRM FAQs

- Interoperability Testing and Certification Authorities (ITCA) <u>Development Guide</u> and FAQs
- White Paper on Importance and Value of Testing and Certification for the Smart Grid
- Testing and Certification Landscape Report
- Testing and Certification Framework Development



## DOMAIN EXPERT WORKING GROUPS (DEWGs)



#### **SGIP Member Groups**





#### **Domain Expert Working Groups**

Building to Grid (B2G)	Industry to Grid (I2G)
Home to Grid (H2G)	Vehicle to Grid (V2G)
Business and Policy (BnP)	Transmission and Distribution (TnD)
Distributed Renewables, Generation & Storage (DRGS)	

## **Domain Expert Working Groups**

- Provide the strategic domain perspective on the NIST Smart Grid Interoperability Framework
- Prepare White Papers, Use Case Scenarios to identify issues and gaps in standards, guidelines and testing
- Propose Priority Action Plans to address gaps & issues



#### **Building to Grid (B2G) DEWG**





## **Building to Grid (B2G) DEWG**

- Scope: Commercial building interaction with the electric grid, including the energy service provider as well as other grid-side service partners.
- Vision: Enable commercial buildings to participate in energy markets and perform effective energy conservation and management. More broadly, to identify and enable every role that the commercial building can play in the future smart grid to better the energy future of the US.



## **Building to Grid (B2G) DEWG**

#### **Deliverables/Work**

Works closely with Industry to Grid (I2G) in Joint Work Group on several topics

- Preparing Electrical Storage vs. Thermo Storage white paper –expected completion early 2014
- Preparing white paper-expected completion early 2014 "Transactive Energy Retail Applications"
- Plans to develop Energy Ecologies Microgrid White Paper



### Industry to Grid (I2G) DEWG





## Industry to Grid (I2G) DEWG

- Scope: Interoperability and interaction between the electric grid and industrial facilities, including electric power generation
- Vision: Energy transfer occurs between industrial facilities and the electric grid, in various manifestations, to meet fluctuating demand at predictable quality and price, while acknowledging variable supplier delivery capability and regulatory requirements, and facilitating optimized energy conservation.
- Mission: Identify the I2G business and policy objectives and requisite interactions. Identify the standard services and interfaces needed for interoperability (e.g., syntax and semantics of information transfer, service interface protocols).





- Identify and define standards and interoperability issues and gaps related to Smart Grid integration of distributed renewable/clean energy generators and electric storage
- Enable high penetrations of distributed renewable/clean generator and storage devices while also enhancing rather than degrading grid stability, resiliency, power quality, and safety



- Initial sets of gaps and issues addressed
  - Information exchange requirements for operation of <u>DRGS</u> devices within week grids and microgrids.
  - Information exchange requirements for operation of <u>DRGS</u> devices within DC microgrids and DC circuits.
  - Information exchange requirements for interoperation of high-bandwidth inverter-based devices (such as photovoltaic generators and battery storage) with devices having high intrinsic inertia (such as rotating machines generators).
  - Information exchange requirements for interoperation of high-bandwidth inverter-based devices with distribution automation devices having discrete states (switched capacitors and switched tap transformers) - coordinate with <u>TnD</u> DEWG.
  - Information exchange requirements for coordination of <u>DRGS</u> devices with automated circuit protection devices (such as transfer trip approach) and communication-based anti-islanding.



- Initial sets of gaps and issues addressed
  - information model parameters to enable prediction of aggregated response to Smart Grid functions.
  - Requirements for harmonizing and unifying information model standards and approaches for multi-purposed <u>DRGS</u> systems with different constraints such as combined heat and power units and bi-directional plug-in vehicle chargers to enable effective aggregation - coordination with <u>H2G</u>, <u>I2G</u>, and <u>V2G</u> <u>DEWGs</u>.
  - Requirements for harmonizing and unifying information model standards and approaches for <u>DRGS</u> across the T&D boundary to simplify aggregation and standards maintenance - coordinate with IEC Multi-TC Task force recently initiated to address this gap.
  - Requirements for International duel-logo IEC/IEEE Distributed Resource Interconnection Standard based on IEEE 1547 and recently instituted PAS process.
  - Strategy for test and certification of large multi-MW to high-MW inverter-based <u>DRGS</u> plants comprised of multiple <u>DRGS</u> units with distributed power collection systems.



#### Subgroups

- Subgroup A: Standards Roadmap
- Subgroup B: Use Cases, Information Exchange, and Object Models
- Subgroup C: Microgrids, Hierarchical Distributed Control
- Subgroup D: Conformity and Interoperability Test and Certification
- Subgroup E: Regulatory and Market Issues
- <u>Subgroup F: Distributed Energy Resources, Interconnection</u> <u>Standards (DER-IS)</u>



#### **Deliverables/Current Work:**

- DRGS Subgroup B: White Paper: "Resiliency and Security Recommendations for Distributed Energy Resources (DER) Cyber-Physical Systems" is being reviewed
- DRGS Subgroup B: White Paper "Distributed Energy Resources (DER): Hierarchical Classification of Use Cases and the Process for Developing Information Exchange Requirements and Object Models" near completion



- DRGS-Subgroup C: Coordinating with DOE, DOD
  - Define use cases based on Microgrid demonstration projects
  - Developing architectures and models for information exchange
- DRGS-Subgroup D: Coordinating development of test procedures and test plans for grid interactive Smart Inverter functions
- DRGS-Subgroup E: White Paper on DER Regulatory and Market issues



#### Home-to-Grid (H2G) DEWG




## Home-to-Grid (H2G) DEWG

#### Scope

Applications and communications linking energy service providers (utilities and other third-party providers) with customer equipment in residential buildings via the electric grid and associated networks.

Customer equipment may include home appliances, consumer electronics, plug-in electric vehicles (PEVs), plug-in hybrid electric vehicles (PHEVs), and local power sources (such as photovoltaics).



#### Home-to-Grid (H2G) DEWG

- H2G is investigating communications between utilities and home devices to facilitate demand response programs that implement energy management.
  - Adapting home appliances for Load Following and Frequency Regulation (tools for Grid stability)
  - Investigating impact of micro inverters on Residential Power Systems
- Investigating the impact of Transactive Energy on residential devices and findings may result in white paper or use case scenarios



#### Home-to-Grid (H2G) DEWG

- Developing white paper: "Economic Value of Demand Response in the Electric Energy Market"
  - Expected completion: end of 2013
- Investigating broadcast communication of Demand Response prices and events to appliances/products



#### **Transmission & Distribution (TnD) DEWG**





#### **Transmission & Distribution (TnD) DEWG**

#### Scope

 Utility transmission and distribution operations as well as interactions with other producer/users on the grid.

#### Vision

 Create unprecedented robustness and resilience to grid instabilities and disturbances for improved reliability. Improve power quality to meet customer needs and enable ready access for distributed generators to the grid



#### **Transmission & Distribution (TnD) DEWG**

- Ongoing development of Transmission Bus Load Model
  - A model for an interface between transmission and distribution systems
  - Facilitates communications between the transmission Energy Management System (EMS) and the Distribution Management System (DMS)
  - Scenario 14 abnormal states of TBLM following Very Large Scale Events (like Superstorm Sandy)



#### Vehicle as Grid (V2G) DEWG







## Vehicle as Grid (V2G) DEWG

#### Scope

 Plug-in electric vehicle (PEV) interaction with the electric grid, including discharging as well as charging and customer-utility interactions

#### Vision

- Create the infrastructure to make plugin vehicles a reality, including ability to charge at different locations and billing one account, using the PEV as an energy storage device for DR
- Provide support for customer-utility interactions for account setup, diagnostics and report generation



## Vehicle as Grid (V2G) DEWG

#### Mission

- Clarify PEV business objectives and prioritize corresponding PEV-grid interactions.
- Identify the service interfaces and standards needed (syntax and semantics of information transfer, service interface protocols, cross-cutting issues, business and policy level)



#### **Business & Policy (BnP) DEWG**



# Business & Policy (BnP) DEWG

- BnP assists business decision-makers and legislative/regulatory policy-makers in implementing smart grid policies sensitive to interoperability.
  - Green Button initiative
- Engaged discussions with National Association of Regulatory Utility Commissioners (NARUC)
  - Distributed Generation and Utilities Business Model
  - Differing State renewable portfolio standards
- Formed adhoc group to explore:
  - Framework for data sharing
  - Usage agreements between interacting parties (utilities, aggregators, etc.)



## **Business & Policy (BnP) DEWG**

#### **Subgroup on Systems and Devices**

 Examine business and policy issues for rapid integration of appliances into Smart Grid (Home Area Networking related)





## **WORKING GROUPS**



#### ElectroMagnetic Interoperability Issues Working Group (EIIWG)

- Examine how to enhance the immunity of Smart Grid devices and systems to the detrimental effects of natural and man-made electromagnetic interference, both radiated and conducted
- Address these electromagnetic compatibility (EMC) issues and to develop recommendations for the application of standards and testing criteria to ensure EMC for the Smart Grid



#### Gas Technologies Working Group (GTWG)

- Evaluates the intersection of gas and electric system interoperability standards
- Gas industry seeking to develop and deploy technologies that effectively use two-way communications and control, remote sensors, and other intelligent field devices to:
  - Enhance safety and efficiency of the gas delivery network
  - Facilitate the migration to natural gas as a primary fuel for electric generation
  - Address the interactions between the gas and electric grids
  - Accommodate natural gas-powered vehicles
  - Integrate the gas delivery grid with electric, water, telecom, and heating grids



#### Gas Technologies Working Group (GTWG)

- Proposed project in development for pressure enabled sensors for gas meters
- Two Pronged Approach
  - Focus on the distribution automation use case of pressure monitoring



 Emphasize cyber-security in the development of this application



## **PRIORITY ACTION PLANS**



#### **SGIP Member Groups**





## **Priority Action Plans**

- PAPs arise from the analysis of the applicability of standards to the Use Cases of the Smart Grid
- PAPs include identified experts from related Standard Development Organizations (SDOs)
- Currently there are 13 active PAPs and 6-8 topics in the pipeline for creation
- Each PAP is at different point in the review cycle



#### Priority Action Plan (PAP) Project Lifecycle (2013-07-31)



## **PAP-02: Wireless Communications**

- Finalizing publication of NIST IR 7761 v2 Guidelines and examples for wireless communication for Smart Grid applications
- Provides assessment of the many types of wire technologies used in different power grid environments
- Identifies the suitable capabilities and weaknesses for plausible conditions of operations for wireless technologies operating in both licensed and unlicensed bands



#### PAP-07: DER/Electric Storage Interconnection & Object Model Standard

- Developed requirements resulting in new documents:
  - IEEE 1547.8 Recommended practice for grid-interactive DER
  - IEC 61850-90-7: Information Model for Advanced DER inverter functions
  - UL 1741 Certification Requirement Decision: Certification tests for Grid Interactive DER and Special Purpose DER
- With DRGS DEWG, provided baseline work to IEEE
  - Draft of IEEE 1547a

- New PAR P1547.1a, Voltage Reg, Voltage/Freq. ridethrough
- FERC & California PUC initiate new rulemaking process to consider requiring inclusion of new functions



## PAP-09: Standard DR and DER Signals

- Develop a common semantic model for standard Demand Response signals to make the information conveyed more consistent as a signal flows from grid management through aggregators to customers and within premises networks
- Define framework and common terminology for price, grid safety or integrity signals, DER support, etc.
- Cooperate with IEC TC57, OASIS, NAESB and AMI-ENT



# PAP-12: Mapping IEEE 1815 (DNP3) to IEC 61850

- 300 comments received on first IEEE 1815.1 ballot
  - Almost all comments have been addressed
  - Balloting is targeted for September 2013
- Excellent example of SGIP collaboration and acceleration of global harmonization with IEEE and IEC
- Anticipated output is IEC will approved a dual logo standard (IEC TC 10, Fluids for Electrotechnical Applications, and IEEE 1815.1)



## **PAP-15: Power Line Communications**

- Developing an interoperable profile containing common features for home appliance application
- Provides guidelines for the implementation of coexistence for low frequency narrowband power line communication standards and broadband power line in the Smart Grid
- Being worked in collaboration with ITU-T and IEEE to with respect to security issues and guidelines for implementation and companion NIST IR 7943, Guideline for the Implementation of Coexistence for Low Frequency Narrowband Power Line Communication



## **PAP-15: Power Line Communications**

- Addressed the issue from two perspectives:
  - Broadband–PLC
    - operates in the frequency bands over 1.8 MHz
  - Narrowband-PLC
    - operates in frequency bands below 500 kHz

Two NIST IRs issued to address the issues and the variances in standards



## **PAP-20: Green Button ESPI Evolution**

Consumers should have access to their own energy usage information in a downloadable, easy-to-use electronic format, offered by their utility or retail energy service provider





## **PAP-20: Green Button ESPI Evolution**





## **PAP-20: Green Button ESPI Evolution**

Green Button allows consumers to have easy access to their own energy usage

- NAESB completed and ratified REQ18/REQ19;
- UCAlug developed Green Button Test Plan
  New tool for testing "Green Button Download My Data"
- UCAlug to conduct live testing for Green Button Download My Data based on SGIP SGTCC's IPRM
- NAESB developing update to Green Button standard based on issues and lessons conveyed from UCAlug



#### PAP 21: Weather Information

- Identify Use Cases (UCs) that illustrate the benefits of bidirectional weather data exchange
- Coordinate development of UCs with inputs from a wide range of industries including Renewable/DER, distribution utilities, ISO/RTO markets, and forecasters
- Produce a set of information requirements designed to facilitate the harmonization of information models and exchange models to be used in Smart Grid applications.



## PAP-22: EV Fueling Submetering Requirements

- Separate metering of Personal EV loads
- Tracking of PEV electrical consumption for credits
- Utility need to monitor PEV loads for predictive analysis
- Requirements and standards needed to specify
  - Accuracy, performance, security,
  - Utility revenue grade billing data & 3<sup>rd</sup> party billing,
  - Data formats, and certification



#### Priority Action Plan (PAP) Project Lifecycle (2013-07-31)



## **PAPS Awaiting Standards Handback**

- PAP 08 CIM for Distribution Grid Management: PAP output into IEC 61968-3 through TC 57 WG14, Systems Interface for Distribution Management
- PAP 16-Wind Plant Communications: Requirements handed off to IEC TC 88, Wind Turbines
- PAP 17-Facility SG Information Standard: ASHRAE & NEMA developing standards to meet PAP requirements
- PAP 19-Wholesale Demand Response (DR): Output submitted to IEC TC 57, Power Systems Management, for evaluation and potential adoption



#### PAP 08 - CIM for Distribution Grid Management

- Enables the rapid integration of wind, solar, and other renewable resources,
- Focuses on the information support of Advanced Distribution Automation and back-office applications as well as on "application-to-application" information exchanges
- Focuses on interactions involving monitored and controlled devices serving as actuators and information sources for distribution automation functions, such as voltage and var controllers, remotely controlled switching devices, DER devices, and other field equipment, thus addressing models using IEC 61850



## **PAP 16-Wind Plant Communications**

- Most of the existing command and control infrastructure for wind power plants and site monitoring is based on proprietary technologies and products or at best old protocols that are not capable of being managed or secured
- IEC formed Joint Working Group between TC88, Wind Turbines, and TC57, Power Systems Management and Information Exchange, to handle changes proposed by PAP 16





#### PAP 17-Facility SG Information Standard

- Create core set of data requirements from the set of use cases that describe the facility side scenarios
- Extended data models developed to define a comprehensive set of data objects and actions that support a wide range of energy management applications and electrical service provider interactions
- ASHRAE/NEMA Standard 201P, Facility Smart Grid Information Model , currently in comment resolution


#### PAP 19-Wholesale Demand Response (DR)

- Build an information model for wholesale demand response communications based on the IEC Common Information Model (CIM), profiles from which may be mapped to other relevant profiles such as <u>OpenADR</u> 2.0b and <u>MultiSpeak</u>
- Developed Wholesale Demand Response Communication Protocol (WDRCP) extensions for consideration by IEC TC57, Power Systems, for inclusion in CIM



## **SGIP Catalog of Standards**

- Compendium of standards, practices, guidelines and other technical documents considered relevant for the development and deployment of a robust and interoperable Smart Grid
- Serves as a reference to the Smart Grid community with the intent of serving as a useful resource for utilities, manufacturers, regulators, consumers, and other Smart Grid stakeholders
- SGIP industry experts conduct a rigorous multi-part technical review using objective criteria by industry experts in the SGIP process to assist in evaluating interoperability concerns in Smart Grid projects



## **SGIP Standards Review Criteria**

Criteria for a standard being considered:

- Relevant to advancing interoperability of Smart Grid devices and systems
- Accepted by the community
- Suitable for deployment
- Focused on the interface to facilitate integration and promote implementation flexibility
- Documented and maintained by a standards setting organization or a multi-member organization



## **SGIP Standards Review Criteria**

Catalog characterizes Smart Grid standards according to a set of attributes including:

- Description of the development organization and its process
- Support, conformance, certification, and testing
- Application domains targeted by the standard (Generation, Markets, Transmission, Distribution, Operations, System Operator, Customer)
- Interoperability categories covered by the standard (organizational, informational, technical layers)
- Cybersecurity and privacy aspects



## **SGIP Catalog of Standards**

- Hundreds of standards considered for inclusion
- Presently 56 entries in the Catalog of Standards
- Anticipate many more to be added this year
- Over 50 standards at the top of the queue
- Prioritizing on standards emerging from SGIP Priority Action Plans or connected to the NIST Framework
- Additional 160 standards in the queue

http://sgip.org/catalog-of-standards/



# EMERGING TOPICS And CALL FOR PARTICIPANTS



## **Call for Participation**

- Outline of Requirements for AMI Key Management
- Cybersecurity Risk Management: Case Study and Training Class
- Transactive Energy Retail Applications
- Sensors for Transmission and Distribution Networks
- Data Sharing and Usage Agreements
- Microgrid Information Architectures



### Outline of Requirements for AMI Key Management

- SGIP members will develop requirements document
- Relates to ANSI C12.19 and C 12.22 standards & cybersecurity requirements
- Results could be incorporated into one or more of:
  - ANSI Technical Report
  - Existing or new ANSI C12.xx Standard
  - NEMA Report
- Could lead to new SGIP Priority Action Plan
- Contact: <u>victoria.yan@nist.gov</u>



### Cybersecurity Risk Management: Case Study and Training Class

- Building on the Department of Energy document, "Electricity Subsector Cybersecurity Risk Management"
- Project will investigate:
  - Implementation of Smart Grid cybersecurity interoperability standards
  - How an organization chooses which standards to implement based on their risk profile
- Seminar provided on:
  - Understand keys of cybersecurity risk management program
  - How to implement the processes within your organization
- Contact: <u>victoria.yan@nist.gov</u>



### **Transactive Energy Retail Applications**

- Business and technical implementation of transactive energy
  - Interoperable retail cost-of-service and competitive tariffs within current regulatory policy
  - Residential, commercial, industrial, DG and storage
  - Energy commodity and distribution services
  - Based on existing or to-be-developed standards
- Contacts:
  - David Holmberg, <u>david.holmberg@nist.gov</u>
  - Ram Sastry, <u>c.sastry@sta.samsung.com</u>
  - Edward Cazalet, <u>ed@temix.com</u>



#### Sensors for Transmission and Distribution Networks

- Increasing variability of electrical generation & load
- More Smart Grid sensors provide more information
- Enable operators to respond rapidly
- Lack of standards limits sensor deployment
- SGIP Members to develop requirements
  - for any new standards or extensions to existing standards
  - to improve the resiliency and reliability of the power grid
- Contact: <u>gerald.fitzpatrick@nist.gov</u>



#### **Data Sharing and Usage Agreements**

- SGIP Distributed Renewables, Generation and Storage Working Group is:
  - Collecting and developing use cases for microgrid projects
  - Defining architectures and models for info exchange to support operations and markets in microgrid scenarios
- International in scope
- Coordinate with U.S. Dept of Energy & Dept of Defense
- Contact: <u>Allen.Hefner@nist.gov</u>



# **Microgrid Information Standards**

- Smart grid capabilities depend upon information exchanges between cooperative organizations
- Need profiles for access and usage agreements including stewardship of exchanged data
- Work emerging from Federal Smart Grid Task Force, privacy efforts in Cybersecurity Committee and interest voiced in BnP DEWG
- SGIP members to coordinate requirements (within an agreement framework) for data sharing and usage
- Develop a roadmap for trial and implementation
- Contact: <u>Steve.Widergren@pnnl.gov</u> and <u>Ward.Camp@landisgyr.com</u>



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