

Frances M. Cleveland**President & Principal Consultant, Xanthus Consulting International****Key Qualifications:**

Ms. Cleveland has managed and consulted on Smart Grid information and control system projects in the electric power industry for over 35 years. Her expertise has focused primarily on ***Smart Grid information interoperability standards, cybersecurity standards and best practices, grid codes and market-based functionalities for utility-scale Inverter-based Resources (IBR) and Distributed Energy Resources (DER), and the integration of systems***, including SCADA systems, plug-in electric vehicles (PEV), Advanced Metering Infrastructures (AMI), Distribution Automation (DA), substation automation, and energy market operations. Recent work includes consulting on the following projects:

Distributed Energy Resources (DER) Projects

- **MESA:** Lead of the Modular Energy System Architecture (MESA) Technical Working Group to develop the MESA-DER “de facto” communications requirements, including a focus on energy storage and on PV plus storage, for meeting the California Rule 21 and IEEE 1547-2018 DER interoperability requirements and market-based functions. Through a joint MESA-EPRI project, developed the MESA-DER Specification mappings from the IEC 61850-7-420 semantic data model to IEEE 1815 (DNP3) as a profile for utility management of renewable energy resources (DER and IBR). Currently developing MESA-DER Use Cases for Energy Arbitrage, Scheduling of Active Power Limiting, Scheduling of Energy Storage Functions, Microgrid Management, and other business requirements to support the implementations of the MESA-DER Specification. Also developing the testing and certification process for meeting the MESA-DER Specification.
- **IEC 61850-7-420 semantic data model standard:** Model manager and editor for the IEC 61850-7-420 information model standard for DER (released Q2 2021), including communication requirements for photovoltaic systems, energy storage systems, combined heat and power, electric vehicles, and other energy resources. The supported functions include the new North American DER interconnection requirements (IEEE 1547) and the European DER grid codes, such as voltage and frequency ride-through, volt-var function, frequency-watt function (frequency droop/ frequency sensitivity), volt-watt, etc.
- **IEC 61850-7-520 Use Cases for IEC 61850-7-420:** Developing use cases for IEEE 1547 functions using IEC 61850-7-420, as well as use cases for microgrid islanding and operations management, for utility-scale energy storage as Inverter-Based Resource (IBR), and for different DER architectures such as campuses, shopping centers, buildings, off-grid, etc.
- **CEATI Infrastructure Protection & Security Interest Group:** Developed report for Consolidated Edison and NRECA on “*Managing Cyber Security Risk and a Review of Protocols Used in Distributed Energy Resources (DER)*”, covering existing and potential future DER architectures, requirements for meeting IEEE 1547 interoperability requirements, communication requirements, data model standards, and DER-focused protocols, as well as the cybersecurity recommendations for protecting DER installations and interactions with utilities.
- **IEC TC69/TC57 JWG11:** Developed document on “*Electric Vehicles (EV) as Distributed Energy Resources (DER)*”, with the purpose of developing IEC standards that support not only the charging of EVs from the grid, but also support EVs as providing V1G and V2G grid services (grid support and/or market-driven).
- **California Energy Commission (CEC) and California Public Utilities Commission (CPUC):** Led the Smart Inverter Working Group (SIWG) which has developed the Phase 1 recommendations to the CPUC on key autonomous DER smart inverter functions for California utilities in order to update the California DER Interconnection Rule 21. Led the SIWG Phase 2 effort in developing the communications and cyber security recommendations for these DER smart inverters for inclusion in Rule 21 with the default IEEE 2030.5 protocol. Led the discussions on

the Phase 3 additional smart inverter functions using communications. The CPUC has made the Phase 1 functions mandatory, and has approved the inclusion of the Phase 2 and Phase 3 recommendations.

- **UL CRDs:** Worked on the UL CRD to update to UL 1741-SB to include scheduling of active power limiting.
- **IEEE 1547-2018 standard:** Facilitator for the revision of the IEEE 1547-2018 standard to update the DER grid code interconnection requirements, expanding on the California Rule 21 DER requirements and focusing on interoperability and communications for these DER grid code functions.
- **San Diego Gas & Electric (SDG&E):** Developed a Request for Proposal (RFP) for *“IEC 61850 Standard for Substation Automation”*. The project will demonstrate power system infrastructure modernization solutions, focusing on the use of the international standard, IEC 61850, for substation automation. Investigating the application and usefulness of IEC 61850 will bring SDG&E up to speed on the technology involved and will permit SDG&E to assess the benefits and challenges of implementing this standard in new substations. This demonstration will also address the problem of interoperability, allowing SDG&E to verify that multiple vendor products can correctly interact with each other. The RFP included cyber security requirements for substation automation with IEC 61850.
- **EPRI/DOE National Energy Sector Cybersecurity Organization Research (NESCOR):** Team lead for developing cybersecurity requirements and failure scenarios for DER systems, covered in the document *“Cyber Security for DER Systems based on the NISTIR 7628”*.
- **National Institute of Standards and Technology (NIST):** Technical Champion for the SGIP Priority Action Plan (PAP) 7 and working group on Distributed Renewables, Generation, & Storage (DRGS), including participation as lead Subgroup on DER Use Cases and Information Standards. Developed the *“SGIP DRGS Subgroup B White Paper: Categorizing Use Cases in Hierarchical DER Systems”* and *“IEC 61850 Information Model Concepts and Updates for Distributed Energy Resources (DER) Use Cases and Functions”*.
- **EPRI:** *“Standard Communication Interface and Certification Test Program for Smart Inverters”* to develop a smart inverter communications and cyber security test program for meeting California’s proposed smart inverter functions. This test program will include the test procedures, software, and facilities needed to validate inverter functional, communications, and cyber security capabilities, based on the IEC 61850 communications standard information model, mappings to different communications protocols, and cyber security.
- **Western Interstate Energy Board (WIEB):** Developed a report and web site on *“Emerging Changes in Electric Distribution Systems in Western States and Provinces”* that provides WIEB stakeholders, particularly regulators and utilities, with the current status and emerging issues of distribution systems. It focuses on the regulatory and utility challenges of integrating high penetrations of Distributed Energy Resources (DER) systems, as well as the opportunities posed by the smart inverter functions.
- **Electric Power Research Institute (EPRI):** *“Advanced DER Inverter Functions”* to develop the functional requirements for volt/var, frequency/watt, high/low voltage ride-through, and other inverter functions, including the development of the IEC 61850 object models for these functions, which are now IEC standards: IEC/TR 61850-90-7 and IEC 61850-7-420. These formed the basis of the smart inverter functions recommended by California’s SIWG to the CPUC for Rule 21 updates.
- **San Diego Gas & Electric (SDG&E):** Developed *“Scoping Study on SDG&E Application Experiments and Demonstrations (Pilot Projects) for Integration of Customer Distributed Energy Resources (DER) with Smart Distribution System Operations”*. Assisting SDG&E to prioritize the pilot projects and develop their specifications, including for California's smart inverter requirements.

Cybersecurity Projects

- **Convenor of IEC TC57 WG15 for IEC 62351 Cybersecurity Standards for Power System Operations**, which is responsible for developing international standards for power system information exchanges. Its scope is: *“Undertake the development of standards for security of the communication protocols defined by the IEC TC 57,*

specifically the IEC 60870-5 series, the IEC 60870-6 series, the IEC 61850 series, the IEC 61970 series, and the IEC 61968 series. Undertake the development of standards and/or technical reports on end-to-end security issues.” These standards also include Role-Based Access Control (RBAC), Network and System Management (using SNMP), Cryptographic Key Management, Security Logging, and Resiliency for Power Systems with DERs.

- **Secretary of IEEE 1547.3: Guide for Cybersecurity of Distributed Energy Resources Interconnected with Electric Power Systems**, which will address the cybersecurity recommendations for many of the various DER stakeholders as they interact with DER, including utilities, aggregators, DER facilities, DER vendors and implementors, etc.
- **CEATI infrastructure protection & security interest group**: Developed report for Consolidated Edison and NRECA on “*Managing Cyber Security Risk and a Review of Protocols Used in Distributed Energy Resources (DER)*”, covering existing and potential future DER architectures, requirements for meeting IEEE 1547 interoperability requirements, communication requirements, data model standards, and DER-focused protocols, as well as the cybersecurity recommendations for protecting DER installations and interactions with utilities.
- **EnerNex**: Developed report on cybersecurity for Distributed Wind (wind turbines as DER), covering different architectures of distributed wind, the relevant semantic data model standards, and recommendations on cybersecurity by leveraging the IEEE 1547.3 recommendations to focus on specific issues with distributed wind.
- **IEC SyC Lead for Cyber Security and Resilience Guidelines** - US Technical Expert to the IEC System Committee – Smart Energy (SyC-SE) and lead for the cyber security and resilience guidelines for the power industry, an IEC report released in 2019 on <https://syc-se.iec.ch/deliveries/cybersecurity-guidelines/>. Using the NIST Cyber Security Framework as the organizational structure, assessing the different requirements from international cyber security standards, and working extensively with ENEL, EdF, and utility product vendors.
- **US Technical Advisor** to the IEC ACSEC (Cyber Security), which covers security not only the energy sector, but also other industrial sectors.
- **National Institute of Standards and Technology (NIST)**: Architecture and cyber security requirements for the cyber-physical systems of the power industry, to evaluate the representative architectures, highlight the drivers, functions, business requirements, technical needs, and value propositions and to determine their cyber security requirements, including risk management, best practices, and standards.
- **National Institute of Standards and Technology (NIST)**: Cyber security and resilience for Smart Cities, by assessing the cyber security and resilience strategies used in one city for “smart capabilities”, and extracting the lessons learned to develop guidelines for other Smart Cities.
- **NIST and the Smart Grid Interoperability Panel (SGIP)**: Major participant in the development of the NISTIR 7628 “*Guidelines for Smart Grid Cyber Security*”. Lead of the NIST Smart Grid Cyber Security Working Group (SGCC) Standards Subgroup to evaluate cyber security in standards used in the power industry. In conjunction with the SGIP DRGS, developed the “*Resiliency and Security Recommendations for Power Systems with Distributed Energy Resources (DER) Cyber-Physical Systems*”, which is now IEC/TR 62351-12.
- **Taiwan Power Company (TPC)**: Held a two-day workshop on cybersecurity and developed the cybersecurity requirements for their Central Dispatch Control Center specifications.
- **Hydro-Québec**: Developing the requirements for cybersecurity in substation automation and a new SCADA system, including bid assessments and cyber security electric domain architecture for the latter. Also supporting the development of DER management system (DERMS) requirements.
- **Electricité de France (EdF)**: Assessed the NERC CIPs with respect to large DER power plants and developed a report on the “*Impact of NERC CIPs on EdF SCADA for “Edge Services”*”, which described the NERC CIP requirements that could affect EdF’s large DER power plants in the United States which bid into the bulk energy

market to provide energy and ancillary services. Although these DER power plants connect at the distribution level, they could fall under the NERC CIP requirements in some circumstances.

Professional Memberships:

In the International Electrotechnical Commission (IEC), she is:

- **Convenor** of IEC TC57 WG15 for IEC 62351 cybersecurity standards for power system operations
- **Editor** for IEC TC57 WG17 for IEC 61850-7-420 and IEC 61850-90-7 information standards for DER systems, electric vehicles, and distribution automation
- **Technical Expert** to the IEC TC 57 for WG17 (Distributed Resources), WG14 (CIM for Distribution and AMI Integration), WG 03 (RTU telecontrol), WG07 (ICCP), WG15 (Information Security), WG16 (Market Operations), WG19 (Harmonization of TC57 standards), and JWG11 (Information Standards for Electric Vehicles)
- **Technical Expert** to the IEC System Committee - Smart Energy (SyC-SE), WGs 2, 3, 5, and 6. **Lead** for Cybersecurity Guidelines Task Force under WG3
- **USNC Representative** to the IEC ACSEC (Cyber Security)

In the IEEE, she is a **IEEE Life Member**:

- Secretary of IEEE 1547.3: Guide on Cybersecurity for DER
- Member of SC21 for IEEE 1547 DER interconnection standards
- Past Chair of the IEEE PES PSCC and the Security Subcommittee

Professional Background:

- **Xanthus Consulting International**, President & Principal Consultant, WBE, Sept 2005 to present
- **Utility Consulting International**, Vice President & Principal Consultant, Sept 1992 to Sept 2005
- **ECC** (now Kema/DNV), Lead Consultant – Jan 1984 to Sept 1992
- **Systems Control** (now ABB), Senior Consultant – 1975 to Dec 1983

Education:

- **MBA**, San Jose State University (1987),
- **M.S.** in Electrical Engineering and Computer Science, University of California at Berkeley (1975),
- **B.A.** in Electrical Engineering and Applied Physics, Harvard University (1969)

Presentations

- **Cybersecurity: OT versus IT:** <https://youtu.be/OYI6SaMai5k>
- **IEC 62351 Cybersecurity standards series:** [IEEE 1547.3 Cybersecurity Guidelines for DER](#)
- **IEC 62351 for IEC 61850:** [IEC 62351 Cybersecurity Standards for IEC 61850](#)