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Security Integration

Integrating Security with Engineering Practices

Ryan D. Quint, PhD, PE
Director, Engineering and Security Integration
North American Electric Reliability Corporation
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RELIABILITY | RESILIENCE | SECURITY




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What is Security Integration?

Security Integration: *The integration of cyber and physical security aspects into conventional planning, design, and operations engineering practices.*

- Can we *plan* a grid more resilient to cyber and physical attack?
- Can we *design* a grid with security as a critical consideration up front rather than at the end?
- Can we *operate* the grid in a way that can easily identify, detect, and respond to security incidents?
- Can we *restore* the grid effectively following any compromise?
- No more “bolt on” security measures – integrate them up front

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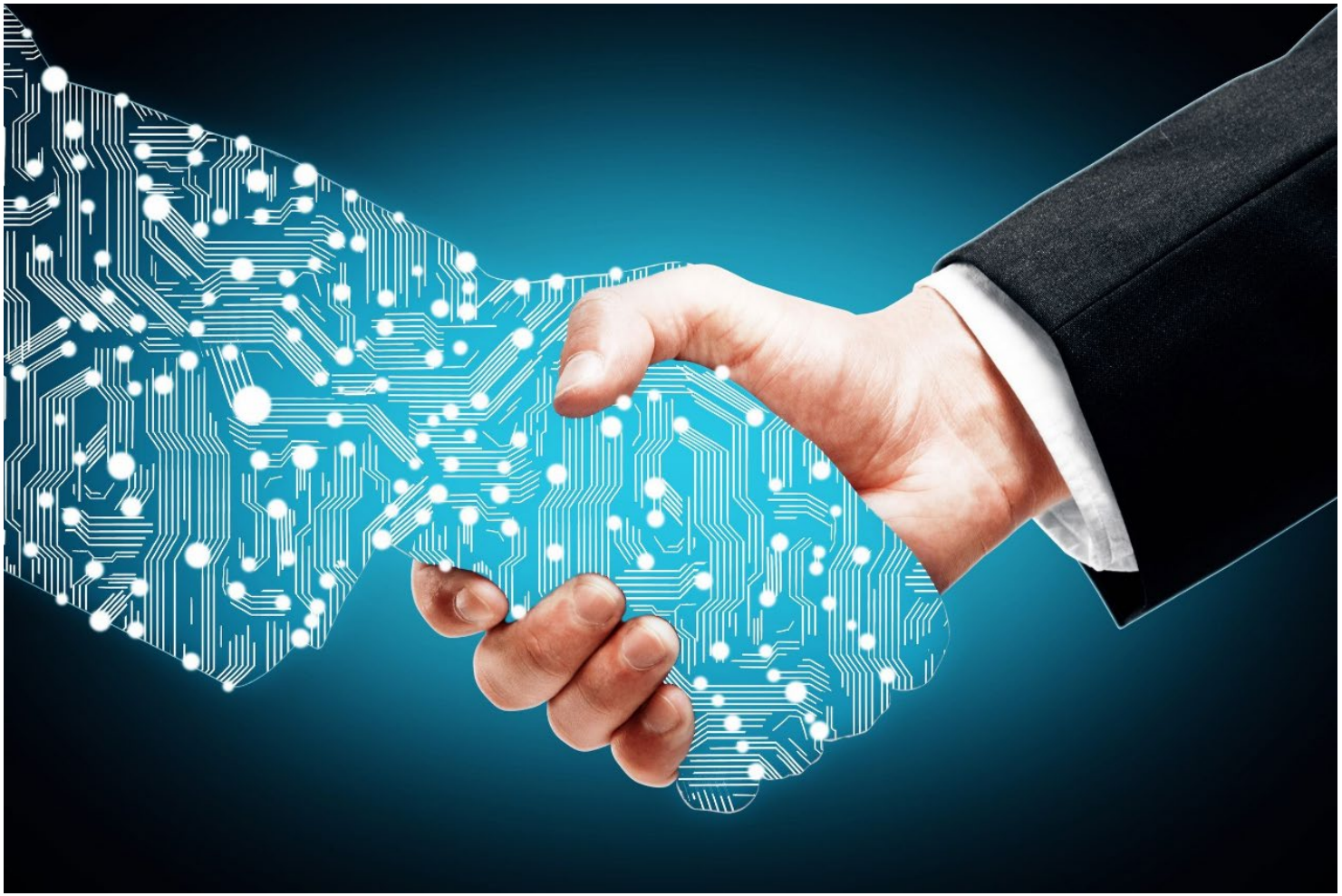
Historically…

[Source: National Review]

Today…



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NERC Security Integration Strategy

Cyber-Informed Transmission Planning

- Cyber Contingency Mapping
- Cyber Informed Studies and Modeling
- Coordinating Risk Mitigation
- Adequate Level of Reliability and Security

Security Integrated Design and Operations

- Cyber Security Investments
- Technological Challenge Assessments
- Defense in Depth
- Securing Blackstart Plans

Grid Transformation

- Assessments of Aggregate Risks
- DER and DER Aggregator Cybersecurity
- Securing the Changing Resource Mix
- Infrastructure Interdependence and Fuel Supply

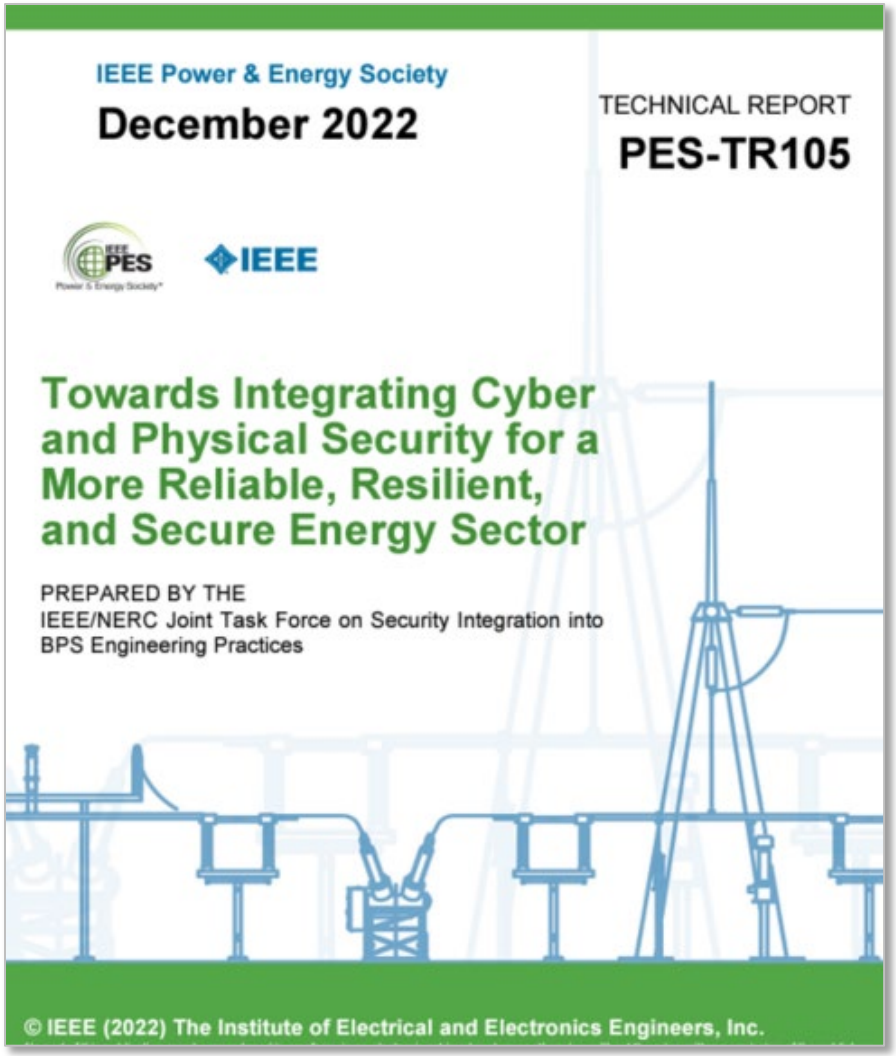
Emerging Technologies and Security Practices

- Identifying Emerging Technology Risk Areas
- Cloud Technology in OT Space
- Advanced Security Concepts

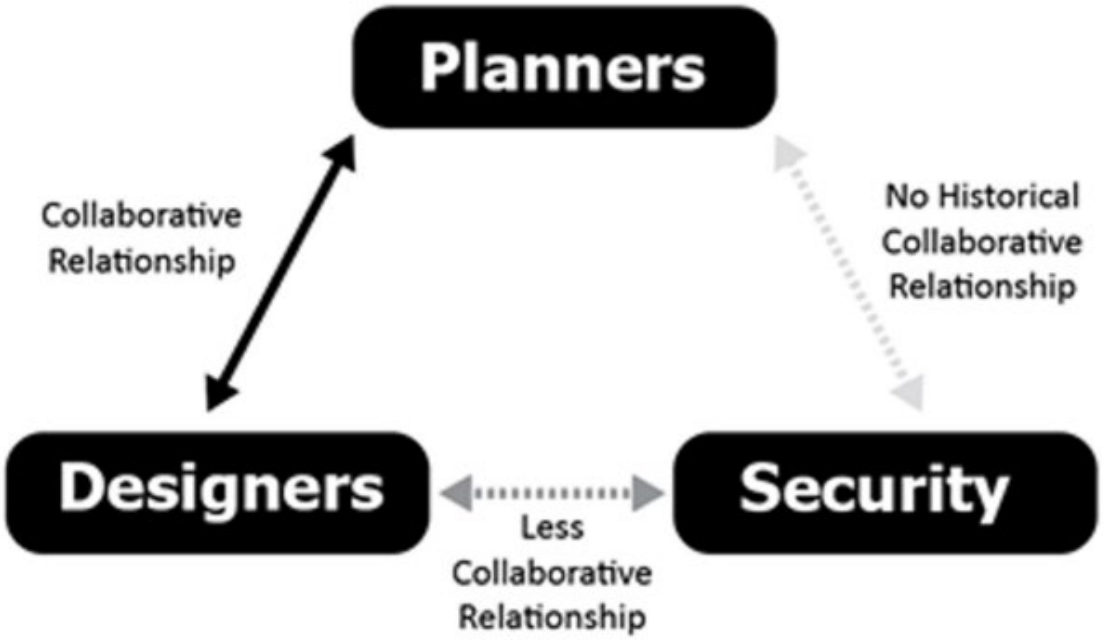
Guidance and Industry Support through Collaboration

Internal: E-ISAC / RSTC / Technical Sub-Groups
External: Industry Forums / Stakeholder Engagements / Federal and Private Partners

Foundational Documents of Security Integration



Historical Planning-Design-Security Relationship



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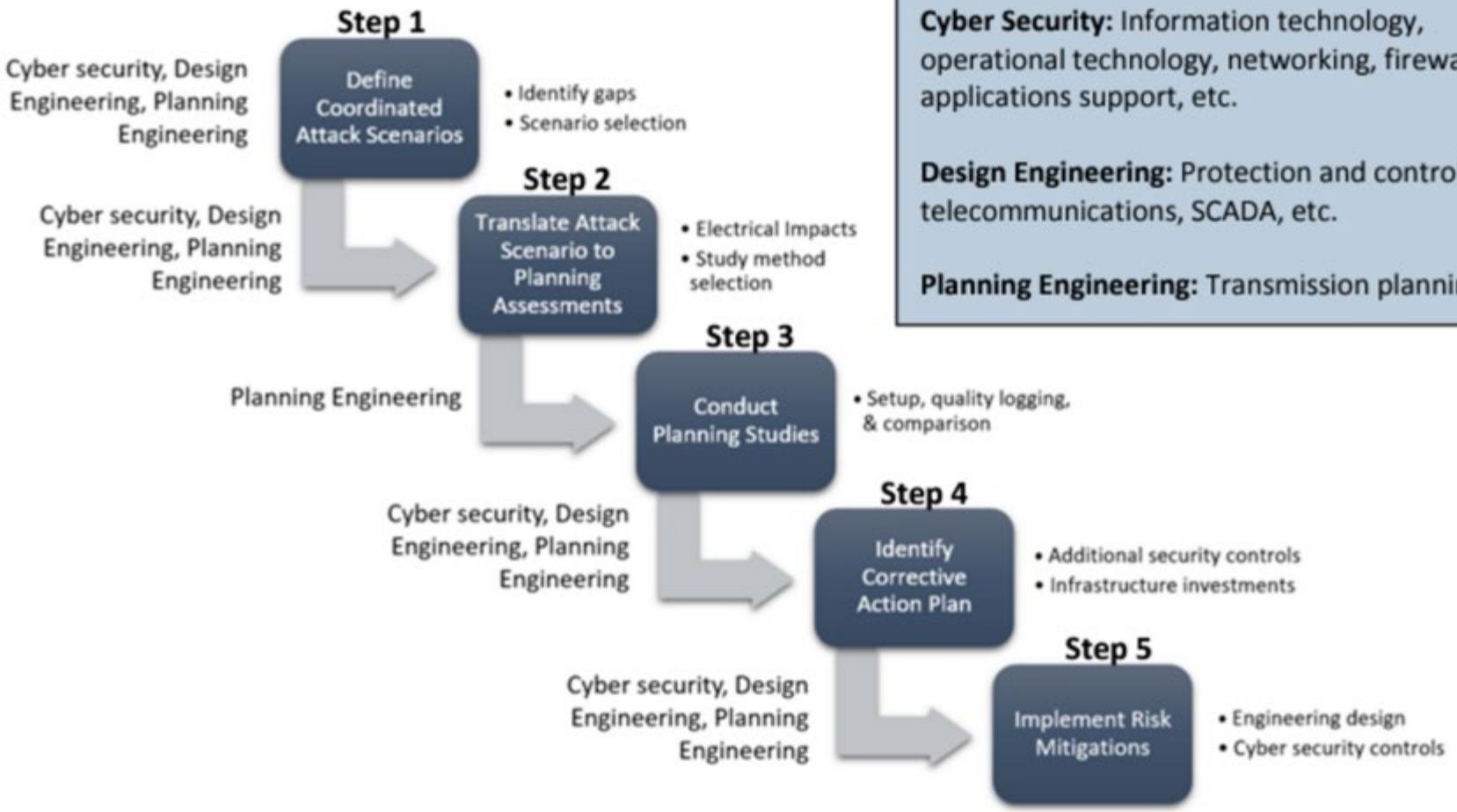
Cyber-Informed Transmission Planning Framework



Cyber Security: Information technology, operational technology, networking, firewalls, applications support, etc.

Design Engineering: Protection and controls, telecommunications, SCADA, etc.

Planning Engineering: Transmission planning

Concept of Eliminating "Critical" Facilities

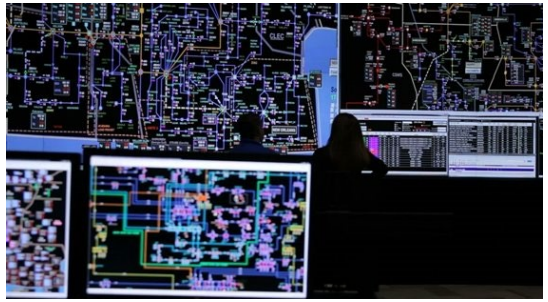
- Leverage multi-value projects that help reduce the number *critical* facilities on the grid
  - Critical = those facilities that could result in instability, uncontrolled separation, or cascading outages
  - Challenges with confidentiality across regulatory spectrum
- Combination of protecting the "crown jewels" and eliminating their criticality in the first place
- Requires concerted "cyber-informed planning" rather than focusing solely on environmental contingencies in the planning horizon

Security Considerations for Inverter-Based Resources

- Scaling of attack surface
  - More distributed assets on bulk power grid
  - Internet-connected assets on the distribution system
- Decentralized control
  - Remotely accessibility and controlled, unmanned facilities – by operator, contractors, equipment manufacturers, etc.
- Predominately power electronic-based response (room for risk)
- Need coordinated effort to secure resources from cyber attack
  - Equipment standards (IEEE, IEC, etc.) and operational security standards

[Source: SMA]

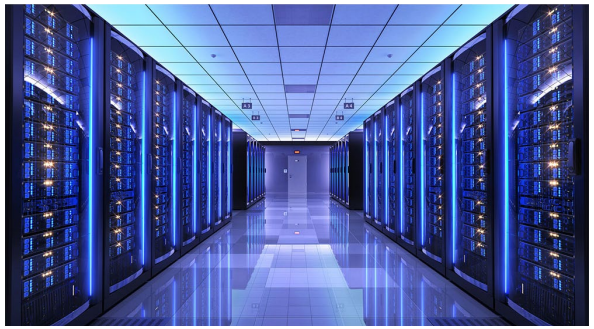
[Source: GE]

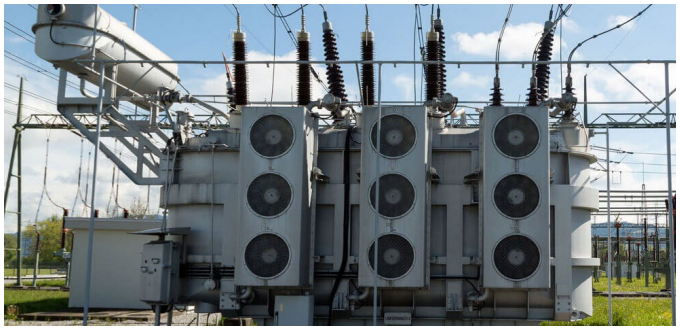


[Source: MISO]

Complexity and Rigidity of Existing IT and OT Systems

- Differentiate security by design for new systems versus managing security risk for existing systems
  - Conflict of new security controls, tools, and practices versus complexity and rigidity of existing systems
- Inherent risks moving from serial-based systems on private networks to IP-based protocols with new technologies
  - Virtualization, cloud computing, IoT devices, emerging technologies
- Growing security vulnerabilities requires both IT and OT resources – from monitoring to mitigation





[Source: Omicron]

Notable Security Concerns from an Engineering Perspective

- Grid edge devices = Internet-connected
  - Internet of Things
  - Smart thermostats
  - Electric vehicles
  - Building management
  - Microgrids
  - Energy storage and DERs
- Virtual power plants and distributed energy resource (DER) aggregators
- Growth of large power consumption loads – both aggregate and individual
  - Aggregate impact of electric vehicles
  - Individual impact of data centers and crypto mining facilities
- Lack of standards (equipment or performance) across the board

[Source: Home Appliances World]

[Source: Electrive]

Securing the Energy Transition

- Rapidly increasing penetration of inverter-based resources
- Growth of distributed energy resources (DERs)
- Introduction of DER Aggregators and virtual power plants
- Large load interconnections – data centers, crypto mining, etc.
- Rise of electric vehicles
- Continued connectivity of end-use loads to Internet

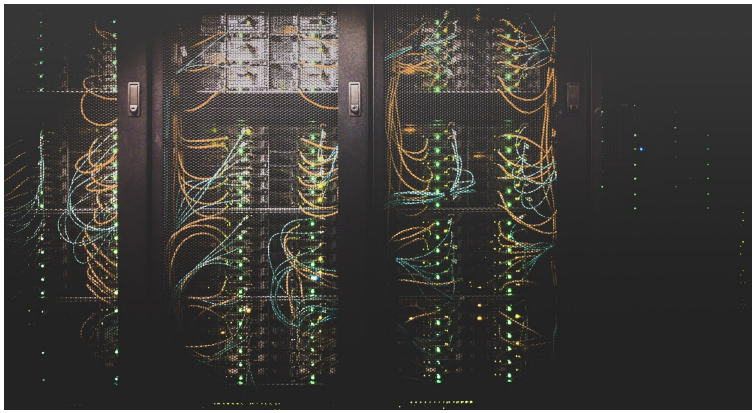
Securely Enabling Emerging Technologies

- Wide range of emerging technologies
  - Virtualization
  - Cloud computing
  - Zero trust network access
  - Artificial intelligence
  - Grid edge technology
  - 5G communications
  - Blockchain
  - Mobile resources
  - Virtual power plants
  - Quantum computing

[Source: QAD]

- Present boundary-spanning risks – span multiple organizations and segments of the energy sector
- Require coordinated efforts to fully leverage benefits yet mitigate risks
- Some we will have ability to “manage” the emergence; others we will be driven by external factors

Securely Leveraging Cloud Technology



- Operational benefits
  - Redundancy and reliability of data
  - Remote vendor support and services
  - Increased resilience and reduced costs
- Operational concerns
  - Availability and reliability
  - Communications links
- Potential risks and challenges
  - Compliance audits of cloud service providers
  - Layered complexity of cloud service offerings (understanding dependencies)
  - Roles and responsibilities of provider versus customer
  - Ensuring sufficient security controls in the overlay
- Great for offline applications and services (e.g., system studies)
- Technology readiness and maturity for real-time operational critical infrastructure

Existing and Future OT Security Workforce Development

- Need to upskill and train existing workforce
- Need blended security/engineering curricula in academia ("cyber engineering)
- Need workforce expertise in:
  - OT network security, not just IT expertise
  - Utility experience and understanding of engineering practices
  - Blended cybersecurity and engineering background
  - Protocols, network architectures, tools, engineering needs
- Covers the full spectrum – generation, transmission, distribution; system operators, utilities, regulators, policymakers, government agencies
- Need range of experience levels; build a strong bench

References

- NERC Security Integration Strategy
- ERO Enterprise Cyber-Informed Transmission Planning Paper
- IEEE Technical Report 105 on Security Integration
- INL Cyber-Informed Engineering (CIE)
- Consequence-Driven, Cyber-Informed Engineering
- ISA/IEC 62443 Series of Standards
- NIST SP 800-82 Rev. 3

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Questions and Answers

Ryan D. Quint, PhD, PE
Director, Engineering and Security Integration
ryan.quint@nerc.net