Building Nuclear-Specific Cybersecurity Expertise in Higher Education

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The New World of Nuclear

- Significant transformation
  - Modernization of legacy nuclear power plants
  - Increased momentum behind Advanced/Small Modular Reactors (A/SMRs)
  - AI-fueled energy demand, with corporate investment from leaders like Microsoft and Amazon
  - Stakes in nuclear operations are uniquely high
- Unique compliance and governance obligations
- Digitalization introduces new cyber risks

Why Specialization is Needed

- General cybersecurity education is insufficient
- Stakes in nuclear operations are uniquely high
- Nuclear facilities operate in a multi-layered regulatory ecosystem
- Cybersecurity professionals' competencies must extend beyond traditional information technology (IT) and operational technology (OT)
- Urgency heightened by workforce challenges and evolving cybersecurity practices

What Nuclear Cybersecurity Specialists Need to Learn

- Cybersecurity foundations
- Nuclear engineering context
- Regulatory and governance literacy
- OT/ICS security in the nuclear context
- Insider threat mitigation
- Incident response and recovery
- Applied integration and capstone simulation

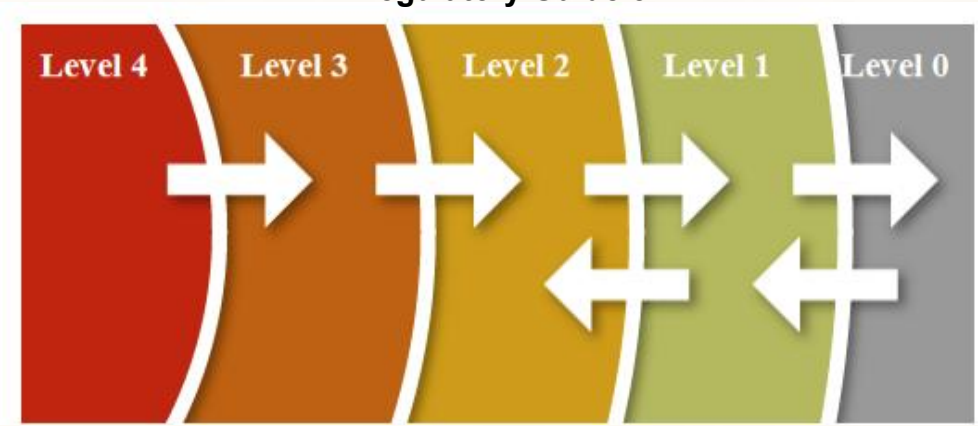
Educational Framework Recommendations

- National Institute of Standards and Technology's Cybersecurity Framework (NIST CSF)
- Nuclear Regulatory Commission (NRC)
  - 10 Code of Federal Regulations (CFR) 73.54
  - Regulatory Guide (RG) 5.71
- Nuclear Energy Institute (NEI) 08-09
- Training on OT components
- MITRE ATT&CK for ICS
- Consequence-driven, Cyber-informed Engineering (CCE)
- Immersive simulations
- Credentialing pathways
- Institutional partnerships

Sample Curriculum

- Weeks 1 & 2 — Foundations & Governance
- Weeks 3-5 — Identify
- Weeks 6-8 — Protect

NRC Regulatory Guide 5.71



Introduction to the regulatory landscape
Asset identification & classification
Threat vectors & attack paths
Consequence & risk assessment
Design access control matrices
Implement network segmentation strategies
Establish secure baselines for control systems
Process simulated change requests
Implement controls for portable media & mobile devices

Sample Curriculum

• Weeks 9-12	Detect & Respond	Configure Security Information & Event Management tools Analyze simulated logs Develop incident response playbooks
• Weeks 13 & 14	Recover	Restore compromised digital assets from backups Validate system integrity Draft corrective action plans Conduct post-incident reviews
• Week 15	Capstone Simulation	Red Team/Blue Team exercise simulating a multi-vector attack on a fictional nuclear power plant

Conclusion

- Planned nuclear expansion
- Aging workforce: retirement outpacing replacement
- Limited undergraduate exposure to nuclear cybersecurity
- Nuclear engineering graduates
  - Solid understanding of nuclear power plant operations
  - Limited/No cybersecurity expertise
- Cybersecurity graduates
  - Strong technical skills
  - Require several months of retraining to acquire nuclear context
- Opportunity for universities to develop programs to meet the workforce demands of planned nuclear expansion

Thank You

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