

## **PTE 519: Integrated Cyber-Physical Security for Oil and Gas Operations**

**Wednesdays: 12:30 to 3:10pm OHE 136 Instructor: Prof. Donald Paul**

**REQUIREMENTS:** Undergraduate or graduate degree in any engineering discipline, computer science, science, or mathematics. Graduate students in business or public policy with technical backgrounds and an interest in the security of critical energy infrastructures are also welcome.

The course develops the multi-dimensional aspects of cyber-physical security in the context of the exponential growth in cyber-originated attacks which threaten the operational performance, safety, and environmental integrity of critical oil and gas assets. The full spectrum of oil and gas assets and businesses are discussed, from upstream exploration and production, through midstream infrastructure, to refining and petro-chemical facilities. The course follows an integrated systems approach to understanding the evolving nature of the threats, designing defenses, and the management of an effective and secure oil and gas business. The system dimensions of technology, business, policy, and human behavior are woven into individual subject lessons, case studies, and assignments. The course does not require an existing knowledge of network and control systems and will not involve programming or software development assignments.

### **LEARNING OPPORTUNITIES:**

- Developing a systems view of the entire oil and gas supply chain from exploration and production through refining, petro-chemical and product distribution systems, including the identification both information technology dependencies and cyber-physical security exposures and liabilities.
- Understanding how the continuing advancement and growth in the application of “smart oil field”, “smart infrastructure”, and “smart refinery” technologies creates a corresponding rise in security threats with potentially severe operational, safety, and environmental outcomes.
- Understanding the design and function of modern Operations Technology (OT) systems and their components, such as SCADA and process control networks.
- Understanding how the interaction of the OT systems with the overall information technology and network systems impacts the total performance and risk profile for oil and gas operations and infrastructure.
- Understanding the critical role played by “human factors” in security, including the impacts of organizational culture, security policies, and individual behaviors.
- Learn how to put all the pieces together: a) how to interpret case studies of cyber-attacks and incidents, b) how to understand the linkage of cyber-initiated attacks to physical outcomes and risks, c) how to assess the effectiveness of a defense and response system, and d) to design an effective cyber-physical security system, define practices, and specify policies to create a secure operating oil and gas infrastructure.

**ANTICIPATED LECTURE SCHEDULE (subject to change during the semester):**

Aug 24	Lecture #1	Prof. Paul	"Course Introduction, Framework, and Expectations"
Aug 31	Lecture #2	Prof. Paul	"The Oil and Gas Industry and Security"
Sep 07	Lecture #3	Prof. Paul	"Industrial Network Security Part I: Fundamentals"
Sep 14	Lecture #4	Prof. Paul	"Industrial Network Security Part II: Process Control Systems"
Sep 21	Lecture #5	Prof. Paul	"Industrial Network Security Part III: Security Architectures"
Sep 28	Lecture #6	Guest:	"Security Implications for Smart Oilfield Operations"
Oct 05	MID-TERM EXAM		
Oct 12	Lecture #7	Prof. Paul	"Security Risks: Technological Change"
Oct 19	Lecture #8	Guest:	"Security Risks: Human Behavior and Cultural Factors"
Oct 26	Lecture #9	Prof. Paul	"Security Risks: Suppliers and Supply Chain Management"
Nov 02	Lecture #10	Prof. Paul	TERM PROJECT SPECIFICATIONS
Nov 09	Lecture #11	Prof. Paul	"Security Regulation, Compliance, and Policies"
Nov 16	Lecture #12	Prof. Paul	"Integrated Cyber-Physical Security Design for Oil and Gas"
Nov 23	HOLIDAY		
Nov 30	Lecture #13	Prof. Paul	"Review of Course and Projects"
Dec 09	FINAL EXAM		

**GRADING SYSTEM: Mid-term = 30%; Final Exam = 40%; Individual Class Project = 30%**

**HOMEWORK:** Homework, including reading assignments, will generally be assigned every week. Students are expected complete assignments as specified. Although no formal grade will be assigned for homework, feedback on student progress will be provided. Completing homework will be very important in preparing for the Midterm and Final Exams, for delivering a successful Individual Class Project, and for maximizing your learning experience.

**CLASS ATTENDANCE:** **All students are expected to attend every scheduled class.** All students are expected to be prepared to engage in class discussions as appropriate. Although the class will be recorded and all slides uploaded, experience from the past classes in 2014 and 2015 clearly demonstrates that you will maximize your educational experience and increase the likelihood of improved performance on examinations and in the Individual Project by attending and participating in every class.