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Light Water Reactor Sustainability Program

Domestic Nuclear Power Plant Physical Security Reevaluation – High Level Project Plan

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ABSTRACT

The goal for this effort is a validated method which can be used to implement an updated physical security regime to optimize the physical security at domestic nuclear power plants. It is the intent for the evaluation recommendations to provide the technical basis for an optimized plant security posture, which could consider reduce conservatisms in that posture, and potentially reduce security costs for the nuclear industry while meeting all security requirements.

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ACRONYMS

BWR	Boiling Water Reactor
CRADA	Cooperative Research and Development Agreement
DBT	Design Basis Threat
DOE	U.S. Department of Energy
DOE-NE	U.S. Department of Energy's Office of Nuclear Energy
INL	Idaho National Laboratory
LWRS	Light Water Reactor Sustainability Program
MOU	Memorandum of Understanding
NDA	Nondisclosure Agreement
NEI	Nuclear Energy Institute
NRC	U.S. Nuclear Regulatory Commission
NPP	Nuclear Power Plant
OSTI	DOE's Office of Scientific and Technical Information
PWR	Pressurized Water Reactor
QA	Quality Assurance
R&D	Research and Development
SNL	Sandia National Laboratories
USG	U.S. Government
VA	Vulnerability Assessment
VAI	Vital Area Identification

Domestic Nuclear Power Plant Physical Security Reevaluation – High Level Project Plan

1. INTRODUCTION

This report documents the initial program plan for the US Department of Energy's Office of Nuclear Energy (DOE-NE) Light Water Reactor Sustainability (LWRS) Program's physical security evaluation for domestic nuclear power plants (NPPs) with a focus on sabotage and theft. This report provides the technically-based approach for the overall program's summary plan. LWRS physical security reevaluation project will include two phases:

1. Near-term activities (Section 2), and
2. Long-term activities (Section 3).

1.1 Program Goal

The ultimate deliverable for this effort is a validated method which can be used to implement an updated physical security regime to enhance the physical security at U.S. nuclear power plants. It is the intent for the LWRS evaluation to provide the technical basis for an optimized plant security posture, which could consider reducing conservatisms in that posture, and potentially reducing security costs for the nuclear industry while meeting all security requirements by focusing on important features of a nuclear power plant and leveraging technology to bolster the security regime for that facility.

1.2 Physical Security Evaluation Scope

The LWRS evaluation will analyze the existing physical security regime (regulations, personnel, technologies, etc.) with at least one pilot plant. Then, the LWRS evaluation will compare/contrast insights with alternative methods which leverage advanced modeling and simulation, modern technologies, and novel techniques to bolster physical security.

All activities in this work package will be performed in accordance with the LWRS Program quality assurance (QA) plan. Appropriate QA rigor will be taken for the intended us of the data.

All milestone deliverables in this work package will be processed in accordance with the laboratory records management plan. Appropriate export control and classification review will be performed to ensure the milestone deliverables are uploaded to DOE's Office of Scientific and Technical Information (OSTI).

1.3 Background

Domestic nuclear power generation faces increasing economic pressures, in part, by post-Fukushima regulatory requirements, an increase in subsidized renewable energy sources, and current low-cost natural gas. The requirements for U.S. nuclear power generation sites, post-9/11, to maintain a large on-site physical security force ranks high for related plant operational costs. U.S. nuclear power plants are seeking enhanced physical security methods and technologies to help deliver on the Nuclear Promise[a].

DOE National Laboratories have extensively studied various physical security configurations that couple detect, delay, and response attributes to regulatory required physical security postures. This DOE-NE LWRS effort seeks to assess benefits (e.g., reduced costs, regulator relaxation) from proposed enhancements, novel mitigation strategies, and potential changes to regulations, while confidentially reevaluating adequate physical security.

[a] https://www.nei.org/resources/delivering-the-nuclear-promise

2. NEAR-TERM ACTIVITIES (PHASE I)

The near-term project activities (Phase I) are to be completed within DOE FY18 and FY19.

Thrust description

Deliver an initial evaluation of the current domestic nuclear power plant physical security regime and identify technological gaps, regulatory issues, and collaborative partners for long-term activities.

The Phase I project plan activities include;

- Complete strategic planning and produce an overall project plan that includes;
  - Listing of initial participants from National Labs,
  - Roles and responsibilities of team members,
  - Basics of project administration, and
  - Milestone deliverable schedule.
- Conduct an initial review and summarize existing;
  - Analyses to include;
    - Physical Security Table Top
    - Force-on-Force
    - Facility & equipment damage
    - Safety & integrated safety-security
    - Economic & cost-benefit assessment
    - Integrated dynamic assessment
  - Evaluations to include;
    - Design Basis Threat (DBT) Methodology
    - Vital Area Identification (VAI) Methodology
    - Vulnerability Assessment (VA) Methodology
  - Reports to include;
    - Domestic regulations & technical basis
    - International guidance
    - Surety Risk Assessment Process & Physical Security Uncertainty Analyses.
- Conduct initial physical security data collection to include;
  - Review and evaluation of existing high-level physical security regime
  - Initial identification of potential physical security regime enhancements;
    - Concept of 'very' vital area identification
    - Review and evaluate existing technologies deployed for physical security
    - Identify potential areas for enhancements using technology
    - Identify potential near-term technology:
      - Wired or wireless sensors, and
      - Instrumentation.
  - Initial engagements with potential physical security vendor/utility/fleet partners;
    - Identifying contact personnel at physical security partner utility
    - Create CRADA/MOU/NDA/etc.

  - Engage utility's physical security partners
  - Summarize past/present/future efforts at physical security partner utility.
- Initially engagements with potential university partners for;
  - Identify contact personnel at university
  - Identify potential students
  - Create MOU/NDA/etc.
  - Engage university partners on R&D Phase II activities
  - Summarize future activities with university partner.

- Implement the proposed optimizations in physical security at a pilot system of a commercial utility
  - Create dynamic model of the existing pilot system to identify potential areas of optimization
    - Identify efficient and effective security posture through redeployment of personnel and technology
    - Identify areas of deploying potential technology in the pilot system
    - Identify potential technology to enhance the pilot system.
  - Deploy the proposed technology on the pilot system
  - Create dynamic model of enhanced system and measure improvements in the enhanced system
  - Perform economic and cost-benefit analysis of the enhanced physical security.
- Create end-of-FY Progress and Activity Report

3. LONG-TERM ACTIVITIES (PHASE II)

The long-term project activities (Phase II) are to start within DOE FY19 with expectations to be completed in FY22 or FY23.

Thrust description

Deliver a framework for a reevaluation of the current domestic nuclear power plant physical security regime, address technological gaps, and inform changes to the regulatory requirements by leveraging collaborative partners and engaging the NRC.

The Phase II project plan activities include;

- Update and finalize the overall project plan based on Phase I activities to include;
  - Roles and Responsibilities
  - Identify 'Off Ramps' for efforts, and
  - Activity and Milestone deliverable schedule.
- Thoroughly engage physical security partners in the domestic fleet to gather appropriate physical security data and document findings to include;
  - Conducting onsite discussions to review their plant security plan, plant security budgeting, and determine why each security plan activity is done
  - Identifying initial, high-level pros/cons of generic features for physical security regime.
- Thoroughly engage industry-wide partners such as the Nuclear Energy Institute (NEI) to gather appropriate physical security data and document findings to include;
  - Conducting onsite discussions to review the NEI industry-wide physical security program and activities
  - Conducting onsite discussions to review other industry-wide partner activities for physical security.
- Thoroughly engage physical security vendor partners to gather appropriate physical security data and document findings to include;
  - Conducting onsite discussions to review physical security activities
- Thoroughly engage university partners to gather appropriate physical security research, policy analysis, data, and document findings.
- Conduct assessments evaluating current challenges and constraints associated with generic, PWR-specific, and BWR-specific recommendations on areas for improvements to reduce cost while implementing an effective physical security program
- Conduct assessments evaluating current challenges and constraints associated with the integration of cyber security with physical security to include;
  - Tradeoffs which are leveraged by cyber security because of the current physical security posture
- Conduct assessments and evaluations of potential physical security enhancements to include;
  - Identify applicable modeling and simulations available such as;
    - Dynamic assessment methods linking physical security modeling with system response modeling, and
    - 3D visualization of force-on-force tabletops with the integration of plant operator response
  - Identify physical security scenario as an exemplar such as;

  - Lone Pine nuclear power plant facility
- Identify applicable technologies which could be deployed such as;
  - Security-by-design,
  - Target set identification,
  - Remote Operated Weapons System,
  - FLEX material use, and
  - Vital Area identification/reduction
    - Integration of 'very' vita area identification
    - DBT concept of 'defend' vs 'defeat'
    - Prevention analysis (which parts of the plant can guarantee no core damage if they are functional)
- Identify possible optimization strategies to consider;
  - Technology-based enhancements and improvements, or
  - More efficient and effective security posture through redeployment of personnel and technology
- Identify personnel within the 'system' which have the possibility of collusion
  - Concept of 'ultimate' insider
  - Personnel which should have a higher rigor or review at facility
  - Personnel which should have a lower rigor of review at facility
- Summarize of the potential physical security enhancements and methodologies

- Conduct assessments and evaluations of potential physical security enhancement cost savings to include;
  - Projections of X% of cost savings by incorporating novel solutions
  - Areas of R&D that would be beneficial in helping U.S. industry see cost reductions
  - What NRC regulations could be changed for economic relief such as;
    - Reconsidering the concept of 'vital areas',
    - Reconsidering the concept of 'perimeter intrusion detection system',
    - Considering use of available modern technology,
    - Considering co-operative grid security,
    - Reconsidering DBTs for 'defend' vs. 'defeat,' and
    - Considering 'beyond the horizon' DBTs
      - unmanned aerial vehicles/drones or
      - integrated cyber-physical attack vectors
  - Summarize proposed rethinking of physical security goals, functions, & needs based on the physical security exemplar

- Updated reevaluation physical security analysis report recommending methods which can be used to implement an updated physical security regime to optimize the physical security at U.S. nuclear power plants (existing and future) to include;
  - Create end-of-FY Project and Activity Report
  - Create final report proposing enhancements for an optimized physical security methodology.
    - Obtain feedback from industry partners

- Obtain feedback from NRC review
- Obtain DOE-NE approval of report.