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LETTER REPORT

NRC Research and Technical  
Assistance Report

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PHYSICAL PROTECTION OF NUCLEAR FACILITIES

Progress Report  
November 1980

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# PHYSICAL PROTECTION OF NUCLEAR FACILITIES

## Progress Report

### SUMMARY

Vital area analyses were performed on two pressurized water reactor (PWR) facilities and three boiling water reactor (BWR) facilities during November. Modifications to existing facility data were received for three facilities and used to specify data for additional units within each facility or to form different versions of the facility fault trees. This work continues.

Studies were initiated to determine both reactor component task times necessary for sabotage and the dynamic dependence of reactor systems on component availability. Work also continued on the problem of identifying the relative importance of reactor components for the rank ordering of vital areas within a facility.

A preliminary investigation of methods which can be used to define optimal guard response strategies was also initiated. A linear programming approach was used to obtain a deterministic optimal guard deployment strategy. Future efforts may include the application of parametric integer linear programming techniques to this problem.

### FACILITY CHARACTERIZATION

#### In-House Activities

##### Vital Area Analyses

The vital area analyses of operating reactor facilities, which are being performed jointly by the Los Alamos National Scientific Laboratory (LANSL) and Sandia National Laboratories, Albuquerque (SNLA) for the U.S. Nuclear Regulatory Commission, Office of Nuclear Material

Safety and Safeguards (NRC/NMSS), continued during November. Activities during November included:

1. Cards were received and an analysis run for PWR No. 25,
2. Fault tree and location changes were received for PWR Nos. 23 and 25, and analyses were rerun for these facilities,
3. Changes were received to convert BWR No. 8-1, Unit 1 data into Unit 2 data and the conversion was completed,
4. Analyses were run and then corrections were received and analyses were rerun for BWR No. 8-2-A,
5. A subtree was added to BWR No. 8-2-A to form version B (BWR No. 8-2-B); the analysis of this facility is in progress, and
6. Modifications were received for locations from BWR No. 8-3, Unit 2; these location changes were made to BWR No. 8-3, Unit 3 and the analyses were begun.

#### Rank Ordering of Vital Areas

The problem of identifying the relative importance of reactor components was addressed during November. Considerations in component ranking evaluations include sabotage times, recovery times, occurrence in minimal cut sets derived from fault trees, and overall impact on facility safeguards. These component studies will be used as essential input to area rankings.

#### Sabotage Task Times

Development was initiated during November for the determination of reactor component task times necessary for sabotage. Preliminary work in this area, which was performed by Science Applications, Inc. (SAI), is being reviewed. The results of this review will be used in a more comprehensive study of task times for sabotage.

#### Maintainability Analysis of Reactors

An investigation has been initiated into the dynamic dependence of reactor systems on component availability. Discrete and continuous methods are being studied to facilitate a combined time-dependent/

event space approach. The SLAM simulation language will be used for this study.

## EVALUATION METHODOLOGY

### In-House Activities

#### Optimization of Guard Response

A preliminary investigation and feasibility assessment was initiated in the area of optimal guard response strategies. Initial examination of a simplified test problem used linear programming to obtain a deterministic optimal guard deployment strategy. Extension to a parametric case, where the number of available guards was increased, yielded an alternate deployment strategy. Preliminary weights and importance factors to be incorporated into the optimization objective function have been considered.

There is a need to extend the method to larger test problems in order to evaluate its feasibility for application to real-world cases. In addition, a more extensive literature search needs to be conducted. Extension of the technique by the use of parametric integer linear programming would yield integer guard allocations and indicate alternate deployment strategies.

#### Computer Code Modifications

The Brief Adversary Threat Loss Estimator (BATLE) code has been run through the TIDY computer code in order to improve the readability of BATLE. A final draft of the user's guide for BATLE has been completed and is currently being reviewed.

### Contractual Support

#### Insider Reactor Sabotage Analysis

SAI has completed a draft report which discusses the insider reactor sabotage problem. Copies of this draft are currently being made, and delivery of the report to SNLA will be in early December.