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INTERIM REPORT

NRC Research and Technical
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PHYSICAL PROTECTION OF NUCLEAR FACILITIES

Progress Report
April 1980

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PHYSICAL PROTECTION OF NUCLEAR FACILITIES

Progress Report

SUMMARY

In-house activities during April included (1) continuation of vital area analyses of operating reactor facilities, (2) development of an improved technique for complementing Boolean equations derived from fault trees, (3) application of the Safeguards Automated Facility Evaluation (SAFE) methodology to facilities associated with the Naval Weapons Support Center (NAVWSC) and Allied-General Nuclear Services (AGNS), and (4) development of a Brief Adversary Threat Loss Estimator (BATLE) Graphics code. Work also continued on the preparation of a SAFE Users Manual and instructional material related to the use of SAFE.

Contractual support continued to be provided by Science Application, Inc. (SAI), Pritsker & Associates, Inc., and Management Group, Inc. (MGI). SAI continued to provide assistance in the expansion and revision of generic sabotage fault trees developed by Sandia National Laboratories, Albuquerque (SNLA). These revisions will facilitate the use of the fault trees. Activities by Pritsker & Associates, Inc. concentrated on (1) incorporation of graphics capabilities into the Safeguards Network Analysis Procedure (SNAP) computer code, (2) development of a SAFE/SNAP interface, and (3) implementation of new BATLE statistical routines into SNAP. The insider reactor sabotage analysis work, which is also being performed by SAI, centered on modification of the baseline pressurized water reactor (PWR) and the boiling water reactor (BWR) facility data which was recently gathered.

MGI is presently developing modules of instruction for security officers who participate in the Multiple Integrated Laser Engagement System (MILES) exercises. Lesson outlines have been developed for the following: (1) Communications--Active/Passive, (2) Weapons Training, and (3) Response Tactics.

FACILITY CHARACTERIZATION

In-House Activities

Vital Area Analyses

The vital area analyses of operating reactor facilities, which are being performed jointly with the Los Alamos National Scientific Laboratory (LANSL) for the U.S. Nuclear Regulatory Commission, Office of Nuclear Material Safety and Safeguards (NRC/NMSS), continued during April. Two BWR and two PWR facilities were analyzed during the month. The current status of these analyses is as follows:

1. Cards were received and an analysis performed for PWR No. 18, and

2. Modifications were received and analyses rerun for PWR No. 4 and BWR Nos. 11 and 13.

An improved technique has been developed for complementing Boolean equations derived from fault trees. Using the Set Equation Transformation System (SETS), the new technique complements a set of equations in which selected intermediate events are treated as primary events rather than complementing the entire equation in one step. The new technique achieves considerable savings in computer time and storage requirements. This technique can be used as the final step of a vital area analysis to identify a minimum set of locations (minimum critical location sets).

Contractual Support

SAI continues to provide assistance in the expansion and revision of generic sabotage fault trees developed by Sandia National Laboratories. These revisions are being made in order to improve the utility of the trees and to reduce analyst time required for their application. A summary of the proposed loss-of-coolant accident (LOCA) transient changes will be completed and submitted for review during May.

COMPONENT FUNCTIONAL PERFORMANCE CHARACTERIZATION

Contractual Support

Guard Response Tactics for Engagement Experiments

MGI is presently developing a program of instruction for security officers who participate in the MILES exercises. Lesson outlines have been developed for the following training areas:

1. Communications--Active/Passive. Radio communications for use by the security officer and some passive types of communications which may be of possible use by the guard in response operations are discussed.

2. Weapons Training. This training module consists of a discussion of basic marksmanship techniques which may be applied to the MILES system.

3. Response Tactics. This module provides the security force with recommendations for response to various adversary actions.

Future work on the program of instruction will involve filming the presentations for each of the training areas. This activity is scheduled to commence in May.

EVALUATION METHODOLOGY

In-House Activities

Automation of System Evaluation

SAFE Applications -- A briefing was given to personnel at NAVWSC in Crane, Indiana. Topics covered during this briefing included the history of Sandia's involvement in the development of techniques for evaluating physical protection systems and the SAFE methodology. A demonstration of SAFE was presented using a NAVWSC terminal and the Sandia NOS time-sharing system. NAVWSC is interested in using SAFE to assist in the evaluation of security for munitions storage areas.

As a consequence of the NAVWSC briefing, a representative of NAVWSC visited Sandia in order to use some of the available evaluation models on an example facility representative of the facilities about which NAVWSC is concerned. The Estimate of Adversary Sequence Interruption (EASI) Graphics model, the BATLE model, and SAFE were all applied to the example facility. SNAP was discussed, but an actual application was not performed.

The results obtained through the model applications provided information concerning the importance of adequate delay, early detection, and timely response by the security force. NAVWSC agreed that this information was useful, and it is expected that NAVWSC will continue to use some or all of the Sandia models in evaluating their facilities.

Also during April, a representative of AGNS returned to Sandia in order to complete the analysis of a spent fuel separations facility. The analysis of a mixed-oxide and waste facility continues.

An introductory Network Operating System (NOS) class was held during April for staff members of the NRC Office of Nuclear Material Safety and Safeguards. This class emphasized basic information about NOS with special attention to text editing and procedure files which are needed to execute SAFE on the NOS time-sharing system.

SAFE Documentation -- Work continues on Volume III of the SAFE Users May al. This volume, which presents an example application of the SAFE methodology, is nearing completion. The sections which remain to be documented are various appendices which provide detailed examples of the SAFE/user interactions.

BATLE Modifications -- Modifications to the BATLE model have been completed, and a user's guide for the model is currently being prepared. A condensed version of the user's guide has been prepared for inclusion in the appropriate volumes of the SAFE Users Manual.

Preliminary work was begun on a BATLE Graphics code. This code will provide two-dimensional and three-dimensional plots of many combinations of BATLE parameters for use by the analyst in studying various scenarios. The effect of varying tactics such as range, weapon types, posture, exposures, delaying tactics, number of combatants, time between reinforcements, etc. on the probability of guard/adversary win or an expected number of guards/adversaries remaining in the scenario at a given time will be readily shown in the graphics plots. Once the code is completed, a "BATLE Graphics User's Guide" will be prepared.

Contractual Support

SNAP Application Development

The following activities were undertaken by Pritsker & Associates, Inc. during April:

1. A review of the modeling and graphical procedures used in SAFE,
2. Examination of the potential graphic capabilities to be used in SNAP, and
3. Commencement of work on the design of a graphical interface to SNAP which focuses on the generalized graphical trace.

Graphics Input/Output -- The development of a graphics capability for SNAP will concentrate initially on the output segment of SNAP. The graphics will provide a generalized capability to display guard/adversary movement in SNAP simulation runs using a digitized facility diagram by SAFE. This work will also include a preliminary design of automatic SNAP facility network generation from the SAFE facility diagram.

The design of the program structure and interface required for the efficient linking of SAFE and SNAP to the graphical routines will begin in May. It is presently anticipated that the graphics capabilities will be performed using GCS and the NOS time-sharing system.

New BATLE Statistics -- The implementation of new BATLE statistical output routines that have been designed to provide information on

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engagements in SNAP was presented to the NRC on 22 April 1980. Work on these statistics will continue in order to analyze the information provided and to upgrade the capability of the output. One option which will be explored is to allow the user to selectively display statistics for engagements which either won or lost.

Documentation -- Three documents are currently being prepared or modified: the Site-X application document, documentation concerning SNAP modeling techniques, and additions to the SNAP User's Guide which reflect the implementation of the new BATLE model in SNAP. Work will continue on these documents throughout the next three months.

Insider Reactor Sabotage Analysis

The insider reactor sabotage analysis work, which is being performed by SAI, continued during April. Modifications have been made to the baseline PWR data base, and new assumptions which better reflect the situation at a typical PWR facility have been formulated based on recent SAI personnel visits to a PWR. These changes have been incorporated into a revised facility model for the PWR facility. This facility model has been translated into a form that is acceptable by the MAIT code.

As currently modeled, the "reduced" PWR facility consists of 110 different facility locations (33 of which are target areas), 8 personnel categories with unique access and control privileges, and 4 separate types of safeguards.

Work continues on the reduction of data from the selected BWR and the information collected on site. These data will be placed into a "reduced" facility model that can be input into the MAIT program.

A method has been developed to consider several combinations of multiple (Type II) targets in a single pass through the MAIT program. This method should eliminate the need for the development of a post-processor to meet these criteria.

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