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INTERIM REPORT

PHYSICAL PROTECTION OF NUCLEAR FACILITIES

Progress Report
March 1980

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PHYSICAL PROTECTION OF NUCLEAR FACILITIES

Progress Report

SUMMARY

In-house activities during March included (1) continuation of vital area analyses of operating reactor facilities, (2) application of the Safeguards Automated Facility Evaluation (SAFE) methodology to the Standardized Nuclear Unit Power Plant System (SNUPPS) facility, and (3) continued modification of the Brief Adversary Threat Loss Estimator (BATLE) model. In addition, work continued on the preparation of the SAFE Users Manual and instructional material related to the use of SAFE.

Science Application, Inc. (SAI) continued to provide assistance in the expansion and revision of generic sabotage fault trees (GSFTs) developed by Sandia National Laboratories, Albuquerque (SNLA). Other contractual support reported for March included work by Pritsker & Associates, Inc. on the application development for the Safeguards Network Analysis Procedure (SNAP). This effort concentrated on (1) development of a SAFE/SNAP interface, (2) preliminary design of a graphics input/output module, (3) implementation of the new version of BATLE into SNAP, and (4) application of SNAP to the Site-X facility.

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 March. Six boiling water reactor (BWR) facilities and two pressurized water reactor (PWR) facilities were evaluated during the month. The current status of these analyses is as follows:

1. Modifications were received and analyses rerun for PWR No. 12 and BWR Nos. 6, 7, 9, and 12,
2. Additional analyses were performed for BWR No. 7, and
3. Cards were received and analyses performed for PWR No. 17 and BWR Nos. 11 and 13.

Contractual Support

SAI continues to provide assistance in the expansion and revision of GSFTs developed by SNLA. These revisions are being made in order to improve the utility of the trees and to reduce analyst time required for their application. The period of performance for this work effort has been extended to 30 June 1980 in order to provide sufficient time for SAI to complete this task.

EVALUATION METHODOLOGY

In-House Activities

Automation of System Evaluation

SAFE Applications -- During March, the application of SAFE to the SNUPPS facility in support of the study on design concepts for sabotage protection was completed. An analysis was performed for three different variations of an alternate facility design and a minor variation of the baseline design. The three variations of the alternate SNUPPS design considered different configurations for the physical protection system. In particular, the effect of standard versus hardened doors at certain locations within the facility was examined. The variation of the baseline design included an addition to the baseline facility layout. For each facility design, sensitivities to

guard response time and detection at the outer fence were also considered.

Preparations are currently being made to conduct a class on the use of the Sandia time-sharing computer system for NRC staff members involved in the application of SAFE to physical protection evaluation problems. The purpose of this class is to describe the Sandia Network Operating System (NOS) time-sharing system, which contains the SAFE methodology. A knowledge of NOS is needed since the component performance, adversary path analysis, and effectiveness evaluation functions in SAFE are performed on NOS. This class, which will take place on 3 and 4 April 1980, will be taught by one of Sandia's NOS consultants.

SAFE Documentation -- New sections of Volume III: "Example Application" of the SAFE Users Manual have been written and incorporated into the existing draft. A draft section which addresses the use of the SAFE procedure on the NOS time-sharing system has been written and is currently being revised. Volume I: "Executive Summary" and Volume II: "Methodology Description" are essentially complete. Changes to Volume II will be necessary, however, in order to update the discussion of the BATLE model to reflect recent changes to this code.

Computer Code Modifications -- The BATLE model has been modified to replace the combatant characteristic "training" with a more effective characteristic, "proficiency." Proficiency affects the probability of a casualty inflicted by the individual. An individual's proficiency may be average, above average, or below average. If average proficiency is selected, the probability that the individual inflicts a casualty is not altered from the data already embedded in BATLE. If below-average proficiency is selected for an individual, the user must supply the percent decrease in probability of a hit (where hit means inflicting a casualty), and this individual's probability of inflicting a casualty is then decreased from that of an average firer's. Note that a 100% decrease in probability of a hit means that this below-average firer never inflicts a casualty. If

above-average proficiency is selected for an individual, the user must supply the percent decrease in probability of a miss (where miss means not inflicting a casualty), and this individual's probability of inflicting a casualty is then increased from that of an average firer's. Note that a 100% decrease in probability of a miss means that this above-average firer always inflicts a casualty. The effect of this new parameter can be substantial. Sensitivities for this and other parameters are included in the "BATLE User's Guide" which is being written.

Contractual Support

SNAP Application Development

SAFE/SNAP Interface -- Work on a SAFE/SNAP interface was begun by Pritsker & Associates, Inc. in March. The initial effort has been directed toward a review of the SAFE procedure in order to determine requirements for the interface software. It appears that some design changes to SNAP will facilitate creation of a unified SAFE/SNAP methodology. In particular, the SAFE facility representation module is being considered for direct incorporation into SNAP.

The intent of the SAFE/SNAP interface is to automatically produce SNAP models that emulate the results obtained from SAFE. (Preliminary tests with a simple SNAP model have been successful in duplicating the SAFE results.) These automatically generated models will form the basis for more extensive analyses and scenario modifications using SNAP.

Graphics Input/Output -- Preliminary design work has been initiated on the identification of graphics modules which will be required in conjunction with the SAFE/SNAP interface. It is anticipated that the first-cut design specification for these modules will be completed in the next few months.

Implementation of the New Version of BATLE -- The new BATLE model has been implemented into SNAP. Although the new version of BATLE is

statistically equivalent to the analytical BATLE model, the transition to discrete-event simulation has required the development of new procedures to handle the arrival of reinforcements and the modification of force characteristics. The computation of force characteristics is straightforward and, with minor modifications, follows the procedures for BATLE.

The necessity of permitting discrete changes in individual characteristics required a design change to SNAP. This change was accomplished by the addition of engagement "nodes" which may be linked together in any order to represent the changes in engagement status conditions. Now the user may predefine discrete changes in conditions in much the same manner as is done in BATLE. The resulting input requirements are not completely compatible with the two previous engagement models, but only minor modifications are required to execute the scenarios based on the earlier versions.

New statistical output has been designed and implemented to provide information on the characteristics of engagements in SNAP using the new BATLE model. This output will provide statistical information on the initial status of engagements and on the status of engagements as time progresses. The purpose of the new output is to extract data from engagements as they occur in SNAP and allow the user to use these data to perform a further analysis with the analytic version of the BATLE model available in SAFE.

Application of SNAP to Site X -- The four scenarios for Site X have been rerun using the new version of BATLE. When completed, the results of the Site-X study incorporating suggested modifications will be presented to the NRC. In addition, a report on the Site-X application is currently being prepared.

Documentation -- In addition to the Site-X report, a document that discusses general SNAP modeling techniques is being prepared. This report will present standard procedures for building SNAP networks to model frequently encountered safeguards system components such as guard patrols, response to alarms, and communications.

Insider Reactor Sabotage Analysis

Initial work on the analysis of the insider reactor sabotage problem was begun by SAI during March. This study will examine the vulnerability of typical PWR and BWR facilities to sabotage by an insider.

Two meetings were held during March preparatory to performing the analysis. An organizational and data-gathering meeting was held at the NRC offices early in the month. During this meeting, SAI presented their suggested approach to the analysis and a list of questions to be answered by the study. Specific PWR and BWR facilities to be used in the analysis were selected. During a second meeting, which was held during the week of 10 March 1980, Sandia and SAI representatives discussed the facility layout for the selected PWR and identified vital areas within this facility. Personnel access profile information which identifies individuals who have access to vital areas or who control access to vital areas within the PWR was developed during this meeting.

Additional information related to typical PWR and BWR facilities was gathered during visits to such facilities the last 2 weeks of March. Data collected during these visits included typical BWR facility layout drawings and additional access profile information.

Work commenced on the necessary modifications to the MAIT code. These modifications will permit the code to be used to analyze a reactor facility and to possess the capability to synthesize analytical results to represent the different combinations of Type II vital areas.