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Author(s): Leon D. Chapman

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Responsible NRC Individual and NRC Office or Division:

Richard C. Robinson, Safeguards Research Branch, SAFER:RES

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Prepared by
Sandia Laboratories
Albuquerque, New Mexico 87115

DISTRIBUTION:
S. Levine
C. Beck
B. Erickson
B. Evans
G. McCorkle
J. Partlow
E. Perchonok
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R. Jones
J. Montgomery
O. Chambers
W. Schwink

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INTERIM REPORT

PHYSICAL PROTECTION OF NUCLEAR FACILITIES

Progress Report

August 1979

Prepared by
Leon D. Chapman
Safeguards Methodology Development Division 4416
Sandia Laboratories

6 September 1979

PHYSICAL PROTECTION OF NUCLEAR FACILITIES

Progress Report

SUMMARY

Facility characterization activities during August included (1) vital area analyses of operating reactor facilities, (2) continued support of the Three Mile Island post-accident analyses, and (3) contract support by Science Applications, Inc. (SAI) for the expansion and revision of generic sabotage fault trees developed by Sandia Laboratories. The analysis of two pressurized water reactors (PWRs) was completed during August; three other PWRs are currently being analyzed.

The development of maintenance software for use in the Safeguards Engineering and Analysis Data-Base (SEAD) continued during this reporting period. In addition, a stand-alone FORTRAN interface to the BARRIER module of SEAD, which will be accessible from the Safeguards Automated Facility Evaluation (SAFE) methodology, was completed.

In other areas, work continued on the application of the SAFE methodology to nuclear facilities. During August, the digitized facility representation of a two-unit PWR facility was reviewed by Los Alamos Scientific Laboratory (LASL) personnel, and suggested changes to the representation were made. An analysis of both Type I and Type II targets within the facility was performed. Work also continued on the preparation of documentation of the SAFE methodology.

Additional activities included the modification and/or expansion of the Brief Adversary-Threat Loss-Estimator (BATLE) model and the Pathfinding Simulator (PATHS) code.

FACILITY CHARACTERIZATION

In-House Activities

Vital Area Analysis

The vital area analyses of operating reactor facilities, which are being performed jointly with LASL for the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, (NRC/HRR) continued in August. The current status of these analyses is as follows:

PWR12	Analysis completed.
PWR13	Analysis completed.
PWR14	Fault tree cards received from LASL, plot generated, and analysis begun.
PWR-Special Unit 1	Fault tree cards received from LASL, plot generated, and analysis completed. Changes made in tree locations and tree replotted and reanalyzed.
PWR-Special Unit 2	Logic drawings received from LASL and tree developed, plotted, and analyzed.

The application of probabilistic values for ranking vital areas continued during this reporting period. The computer code developed last month for calculating probabilistic values has been changed to increase efficiency. A number of theoretical developments of the "chain-rule" type indicate that the problem may be more amenable to solution than was previously believed.

Three Mile Island Support

During August, another SANDIA-ORIGEN computer calculation of the core radionuclide inventory in the Three Mile Island reactor was made for times immediately following initiation of the accident. This information will be used in the analysis of the hydrogen bubble problem.

Documentation

A detailed user's manual for the SANDIA-ORIGEN code has been approved for publication (SAND79-0299, NUREG/CR-0987). This manual documents the computer code and the accompanying radionuclide data library. The documentation will be available from the Radiation Shielding Information Center at Oak Ridge National Laboratory, the Argonne National Laboratory Code Center, and Sandia Laboratories.

Contractual Support

Representatives from SAI met with Sandia personnel on 3 August to discuss contract support for the expansion and revision of generic sabotage fault trees developed by Sandia Laboratories. Discussions centered on the methods investigated to date for developing the middle fault tree structure. Six possible methods were investigated and evaluated in terms of engineering concerns, analyst concerns, and Sandia developmental concerns. The six approaches are (1) whole system, (2) module, (3) pathway, (4) loop, (5) network, and (6) header. Of the six methods, the whole system and network approaches appear to warrant further analysis.

At another meeting, on 14 August, proposed revisions for existing generic sabotage fault trees were discussed with SAI.

COMPONENT FUNCTIONAL PERFORMANCE CHARACTERIZATION

In-House Activities

Safeguards Engineering and Analysis Data-Base

The development of COBOL maintenance software for all SEAD modules continued during August. Development of a stand-alone FORTRAN interface to the BARRIER module of SEAD has been completed, but the actual linkage of SEAD to SAFE is still being developed. Documentation of the BARRIER module, including a user's guide, has been started.

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SAFEREF, which has been designed, developed, and implemented under Department of Energy funding, is a data base of all safeguards bibliographic material produced by Sandia and under the sponsorship of Sandia Laboratories as of 30 June 1979. A subset of these reports can be obtained from SAFEREF, which will list only those reports that have been sponsored by NRC.

EVALUATION METHODOLOGY

In-House Activities

Automation of System Evaluation

SAFE Applications -- The digitized facility representation of the two-unit PWR facility has been reviewed by LASL personnel. As a result of this review, some changes to the digitized version were required. These changes were made, and the data were prepared for SAFE analysis. This facility is the largest that has been analyzed using SAFE; the digitized facility representation contains 391 nodes, 57 targets, 2059 arcs, and 196 regions.

Both Type I and Type II targets within the two-unit PWR were examined. Minimum interruption paths and minimum time paths from each guard start-node to each target were generated using the Minimum Detection Probability and Time (MINDPT) code. These times were then used to determine an expected response time to each target. The response times were used as input for the generation of minimum interruption paths. The procedure used for generating response times was similar to that used for the recent Standardized Nuclear Unit Power Plant System (SNUPPS) analysis, with the exception that MINDPT, rather than the PATHS code, was used to generate minimum time paths. The use of MINDPT resulted in faster generation of average minimum response time data.

A SAFE analysis of both Type I and Type II targets was performed. The results were presented to NRC personnel on 29 August.

Safe Documentation -- Final revisions have been made to the review draft of "Volume II: Method Description" of the SAFE documentation. In addition, work is continuing on the preparation of Volumes III and IV. Computer output, facility drawings, etc., are being generated for inclusion in Volume III, and several of the computer codes used in SAFE have been collected for use in Volume IV.

Model Development

Expansion of the BATLE Model -- The new BATLE model is now complete. In this new version, attrition rates are computed from an expanded set of combatant attributes which include weapon type, target posture, target cover, range, training, self posture, and illumination. The salient features of the expanded model are

1. An individual cover parameter that includes cover while firing, cover while reloading, and cover while delaying,
2. The combination of individual attributes to form side characteristics,
3. The potential to include an ambush by either side, and
4. The potential to schedule new arrivals, generate status reports, or make changes to the characteristics of any or all combatants at any time in the simulation.

Future work in this area includes the development of an interactive preprocessor to be used to build the input data file to BATLE and the preparation of a user's guide which describes the new system.

Modifications to PATHS -- Work was begun during August to modify the PATHS code. These modifications include (1) initilization of all variables, (2) elimination of PRINT statements, (3) elimination of two branch IF statements which contain EOFs, (4) consolidation of all the input into one subprogram, (5) amplification of the comments, and (6) changes to the output. These changes will be necessary to properly document the PATHS code as part of the SAFE user's manual.