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Data Requirement Comparison Between the Fixed Site Upgrade Rule Guidance Compendium and the Structured Assessment Approach Licensee Submittal Document

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Prepared for
U.S. Nuclear Regulatory Commission

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FOREWORD

The work described in this report was conducted by the Nuclear Systems Safety/Safeguards Program at Lawrence Livermore National Laboratory for the U.S. Nuclear Regulatory Commission Office of Nuclear Regulatory Research under FIN number A0115. This document deals with the Structured Assessment Approach, a technique for automated vulnerability assessment of fixed-site nuclear fuel cycle facilities developed for the NRC, which is described fully in four volumes:

A. A. Parziale and I. J. Sacks. Structured Assessment Approach. Version 1. Analysis Package (Executive Summary), Vol. 1. Lawrence Livermore National Laboratory, Livermore, CA. NUREG/CR-1233, Vol. 1, UCRL-52735, Vol. 1.

A. A. Parziale and I. J. Sacks. Structured Assessment Approach. Version 1. Licensee Submittal Document Content and Format for Material Control and Accounting Assessment, Vol. 2. Lawrence Livermore National Laboratory, Livermore, CA. NUREG/CR-1233, Vol. 2, UCRL-52735, Vol. 2.

A. A. Parziale and I. J. Sacks. Structured Assessment Approach. Version 1. Applied Demonstration of Output Results, Vol. 3. Lawrence Livermore National Laboratory, Livermore, CA. NUREG/CR-1233, Vol. 3, UCRL-52735, Vol. 3.

A. A. Parziale and I. J. Sacks. Structured Assessment Approach. Version 1. Computational Analysis Package, Vol. 4. Lawrence Livermore National Laboratory, Livermore, CA. NUREG/CR-1233, Vol. 4, UCID-18146.

The comparison reported upon herein was motivated by requests from Dr. R. Shepard (NRC/RES) and Mr. J. Partlow (NRC/NMSS) to compare the data requirements of the Licensee Submittal Document and the Fixed Site Physical Protection Upgrade Rule Guidance Compendium.

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ABSTRACT

We compared the Structured Assessment Approach's (SAA) Licensee Submittal Document (LSD) with the Fixed Site Physical Protection Upgrade Rule Guidance Compendium Standard Format and Content (SFC) Guide using correlation matrices to see how well the data requirements of the SFC Guide coincided with those of a specific automated vulnerability assessment technique for fixed-site nuclear fuel cycle facilities, namely, SAA. We found that a limited SAA assessment is possible using the SFC Guide, but significant and critical safeguards vulnerabilities might be missed. Also, it was found that in some cases the organization and format of the SFC Guide input data and information made the preparation of data for the SAA somewhat awkward.

EXECUTIVE SUMMARY

In this report we summarize the major findings and conclusions of a comparison between the data requirements of the Structured Assessment Approach (SAA) Licensee Submittal Document (LSD)[1] and those of the Nuclear Regulatory Commission Fixed Site Physical Protection Upgrade Rule Guidance Compendium, Standard Format and Content (SFC) Guide.[2]

The objective of this effort is twofold. The first is to determine the information on the facility and the safeguards system that the LSD elicits but the SFC Guide does not. The second is to estimate the impact on and the limitations to an SAA assessment caused by the limited information elicited by the SFC Guide. When differences in data format and organization between the LSD and SFC documents had a significant impact on performing an assessment, we included them in this report as well.

The results, conclusions, and recommendations presented in this report are based upon a comparison between the SAA (Version 1, October 1979 status) and the December 21, 1978, NRC draft of the "Fixed Site Upgrade Rule Guidance Compendium" and recent revisions to that draft report entitled Attachment A, "Sample Portion of Security Plan" dated September 19, 1979, and Appendix I, "Component List Information Request Sheets" dated October 5, 1979. We concentrated on the review of Attachment A and Appendix I because they are more current and regard information description in finer detail.

The results of the study are captured in the following summarizing statements. The most significant deficiencies in the SFC Guide information requirements when viewed in the context of the SAA LSD requirements include:

- Special Nuclear Material (SNM) piping system information is absent.
- Safeguards system interconnectivity information is incomplete.
- Signal transmission and utility system information is incomplete.
- Probabilistic information is incomplete.
- Licensee interpretation of SFC requests may be sufficiently uncertain to preclude data conpleteness.

The impact of these SFC Guide information deficiencies upon performing an SAA assessment include:

- A fairly thorough Level 1 (diversion path coverage) analysis is possible.
- At least partial Level 2 (adequacy), Level 3 (sensitivity), and Level 4 (tampering) analyses are possible.
- Reorganizing and reformatting the SFC Guide input data and information may often simplify an automated assessment.
- Significant and critical safeguards vulnerabilities could be missed due to lack of input data as obtained from the SFC Guide.

In light of the independent, parallel development of the SFC Guide and the SAA LSD, each addresses surprisingly similar information. Also, new NRC initiatives regarding information requests, especially recent revisions to the SFC Guide document, appear to be such as to more readily accommodate automated vulnerability assessments.

INTRODUCTION

The purpose of this report is to summarize the comparison between the SAA LSD[1] and the NRC Fixed Site Physical Protection Upgrade Rule Guidance Compendium, SFC.[2]

OBJECTIVE OF STUDY

The objective of this effort is to determine the information on the facility and safeguards system that the LSD elicits but the SFC Guide does not, and to estimate the impact on and limitations to an SAA assessment caused by the limited information elicited by the SFC guide. When differences in data format and organization between the LSD and SFC documents have a significant impact on performing an assessment, we have included them in this report as well.

SCOPE OF STUDY

The results, conclusions, and recommendations presented in this report are based upon a comparison between the SAA (Version 1, October 1979 status) and the December 21, 1978, NRC draft of the "Fixed Site Upgrade Rule Guidance Compendium" and recently received revisions to that draft report entitled Attachment A, "Sample Portion of Security Plan," dated September 19, 1979, and Appendix I, "Componenent List Information Request Sheets," dated October 5, 1979. We concentrated on the review of Attachment A and Appendix I because they are current and regard information description in finer detail.

This report is organized into three sections as follows:

1. Summary tabulation of comparison results
2. Major finding and impact on assessment
3. Summary and general recommendations

SUMMARY TABULATION OF COMPARISON RESULTS

This section provides the results of comparing the information elicited by the LSD and SFC. It also provides estimates of the impact of using the limited information which the SFC elicits on performing an SAA assessment.

The LSD elicits information in certain categories, each of which, in general, pertains to distinguishable and identifiable safeguard items, components, or procedures. Table 1 identifies those coarse categories of information which are used by the LSD to perform each SAA level of analysis. The essential question each level of analysis addresses follows:

Level 1: Are all diversion paths covered?
Level 2: Are all diversion paths covered adequately?
Level 3: Is the adequacy of diversion path coverage sensitive to failures?
Level 4: Is the safeguards system vulnerable to tampering?

In addition, collusion analyses are performed at Levels 1, 3, and 4. Although not expressed in Table 1, the information gathered in Level 1 is a necessary requirement for performing Levels 2, 3, and 4.

The last two categories in Table 1, Component probabilistic data and Safeguards interconnectivity information, pertain to two basic kinds of information about safeguards components in general. Component probabilistic data refers to probability of detection and component availability statistics, such as mean time to failure and repair, for relevant safeguards components. Safeguards interconnectivity information refers to logical and physical relationships and dependencies between or among safeguards components.

In comparing the information elicited by both documents, we found, for example, that the SFC Guide could elicit all the required information on facility layout and location, none of the required information on SNM piping information, and approximately three-quarters of the required information on material transfer procedures. We estimated the percentage of information in each LSD category that is elicited by the SFC Guide and have presented the

Table 1: Categories of LSD Information Used at Each SAA Level of Analysis

LSD Information Categories	SAA Levels			
	Level 1 Coverage/Collusion	Level 2 Adequacy	Level 3 Sensitivity/Collusion	Level 4 Tampering/Collusion
Facility Layout and Locations	●			●
Piping System Elements	●			
Material Transfer Procedures	●			
Control and Tamper Monitors	●	●	●	●
Utility System Components		●	●	●
Signal Transmission System Components		●	●	●
Facility Personnel Access and Control	●		●	●
Accounting System Components				●
Facility Operational Modes	●	●	●	●
Component Probabitistic Data		●		
S/G Interconnectivity Information		●	●	●

results in Table 2. The estimates are rough, but come from careful review of the SFC Guide. The actual information received will vary according to the lisencee's interpretation of the requests the SFC makes. The information missing in each category is discussed in detail in the following section.

Even though the SFC elicits too little information to support a full SAA assessment, it is capable of obtaining sufficient kinds and amounts of information to support at least a partial analysis at each SAA level.

Using information gathered by the SFC Guide, approximately 75% of Level 1 could be completed, and 50% of Levels 2, 3, and 4 (Table 2). At Level 1, the absence of SNM piping system information may cause potential theft targets to be overlooked. At Levels 2, 3, and 4 the lack of safeguards interconnectivity information, especially with regard to signal transmission and utility systems, is the most significant limiting factor. The limited data available may leave the collusion sets determined by the SAA incomplete. Individuals may be able to use their access and control to move material through piping to unprotected points, or defeat protection systems by access to signal transmission paths or utility components.

The specific impact of particular information category deficiencies on assessment output results is addressed in more detail in the next section.

Table 2. Estimate of Portion of Information which may be Elicited by the SFC Guide and an Estimate of Assessment Output Impact.

For SFC Guide LSD INFORMATION CATEGORIES	SAA Levels			
	Level 1	Level 2	Level 3	Level 4
Facility Layout and Locations	●	NA	NA	●
Piping System Elements	○	NA	NA	NA
Material Transfer Procedures	◔	NA	NA	NA
Control and Tamper Monitors	●	●	●	●
Utility System Components	NA	◐	◐	◐
Signal Transmission System Components	NA	◐	◐	◐
Facility Personnel Access and Control	◔	NA	◔	◔
Accounting System Components	NA	NA	NA	◴
Facility Operational Modes	◴	◴	◴	◴
Component Probabilistic Data	NA	◔	NA	NA
S/G Interconnectivity Information	NA	◐	◐	◐
Estimate of amount of output given partial absence of input information	◔	◐	◐	◐

Key: Information Available

○ 0% ◐ 50% ● 100%

◴ 25% ◔ 75% NA Not Applicable

MAJOR FINDINGS AND IMPACT ON ASSESSMENT

This section presents major SFC Guide information deficiencies and attempts to estimate the impact of these deficiencies on assessment output results. We had to approximate and extrapolate to assess impact, because of the uncertainty concerning how the nuclear facility licensee may interpret and respond to particular information requests forwarded in the SFC Guide. Uncertainty in licensee response is primarily due to occasional vagueness in SFC Guide elicitation questions. The format and organization of the SFC Guide should assure greater certainty of obtaining the desired information content about the facility and safeguards system. This issue is addressed in more detail in subsequent subsections.

The remainder of this section is organized into the following subsections:

- Facility Layout and Location Information
- SNM Piping System Information
- Procedures Information
- Control and Tamper Monitor Information
- Utility System Information
- Signal Transmission System Information
- Facility Personnel Access and Control
- Facility Operational Mode Information
- Component Probabilistic Information
- Safeguards Interconnectivity Information
- SFC Guide Format/Organization Impact on Assessment

In each subsection, the differences in the amount, type, and importance of the information elicited by each of the documents is discussed. Having found these differences, we also discuss the deficiencies and problems encountered in attempting an SAA automated assessment using the SFC Guide rather than the LSD.

FACILITY LAYOUT AND LOCATION INFORMATION

Finding

The SFC guide will most likely elicit the necessary facility layout and location information. However, the SFC Guide does not explicitly request the licensee to reference and uniquely label location, rooms, portals, and barriers, or the safeguards components which will reside in particular locations in the facility.

Impact

The NRC analyst must reference and label locations, safeguards components, etc., and verify with the facility licensee any of his assumptions. Since the licensee is obviously most knowledgeable about the particular facility under assessment, he is therefore better suited to perform the identification and labeling process than the NRC analyst.

SNM PIPING SYSTEM INFORMATION

Finding

The SFC Guide elicits virtually none of the SNM piping information addressed in the SAA LSD. However, it identifies itemized material and its location as potential SNM theft targets, as does the LSD.

Impact

The SAA diversion path analysis will not identify theft targets associated with piping systems, because the SFC Guide does not elicit the piping system information. The licensee and analyst can diminish this inadequacy by identifying the potential Material Access Points (MAP) in the processing system by direct visual inspection and then treating the MAP as if they were itemized containers of SNM stored at the location of the MAP.

PROCEDURE INFORMATION

Finding

Section 18 of the SFC Guide provides most of the information for describing procedures. However, in some cases the narrative descriptions are unclear, especially those dealing with protective measures and tamper mechanisms that protect operational aspects associated with procedures.

Impact

A fairly thorough assessment of procedures is possible. The assessment would be more thorough and more organized if it elicited information first at a coarse level and then at progressively finer levels of detail as the LSD does.

CONTROL AND TAMPER MONITOR INFORMATION

Finding

The SFC Guide addresses most of the structural and physical data pertaining to safeguards monitors, but a few weak areas were found. Aspects of monitors which were captured adequately for the most part include monitor field of view, required utilities for proper operation, physical location of the device, personnel control and access to the monitor, tamper protection, and device annunciation. Not addressed is the information on monitor signal transmission paths and the information on the effects that facility operational modes have on monitor on-off status. These deficiencies are discussed again in the following sections.

Impact

The information is sufficient to perform analyses. In a few cases, additional information may have to be obtained from the licensee.

UTILITY SYSTEM INFORMATION

Finding

The SFC Guide elicits utility and power system information at a coarser level of detail than the LSD. The SFC Guide elicits information concerning secondary alarm station power supplies, controlled security lighting, emergency generator systems, night vision illumination and uninterruptible power systems. But it does not explicitly elicit information concerning the distribution of utilities and power from primary and back-up power sources to safeguards components which require the utilities.

Impact

Not all potential vulnerabilities associated with components that distribute utilities and power can be determined by the assessment, because these components are not uniquely identified at the data input. Single failures which defeat the safeguards system may be missed.

SIGNAL TRANSMISSION SYSTEM INFORMATION

Finding

The only reference to signal transmission path information in the SFC Guide is found within the information request sheets under the heading "Interfaces Between Alarm Station and Sensors...." In our estimate, signal transmission paths from monitors to specific annunciators, including the primary and secondary alarm stations, will not be properly identified.

Impact

The assessment cannot determine all the potential vulnerabilities associated with the transmission of detection signals. Single component failures in the signal transmission system that defeat the safeguards system may be missed.

FACILITY PERSONNEL ACCESS AND CONTROL

Finding

The SFC Guide requests personnel access and control information for most of the safeguards system components the Guide addresses. Information seems to be missing on CCTV monitoring. Information concerning authorized control and access to utility and signal transmission lines is incomplete, at least to the extent that not all of these components are explicitly addressed in the SFC Guide.

Impact

The assessment cannot determine all potential collusion vulnerabilities associated with insider tampering and misuse of safeguards components, because complete access and control information is not specified. We still estimate, however, that the assessment can achieve many valuable collusion results.

FACILITY OPERATIONAL MODE INFORMATION

Finding

The SFC Guide does not explicitly request information about operational modes of the facility with the exception of the emergency modes, such as evacuation. It does not request information about the normal operating modes of the facility or these modes' effect upon the safeguards system.

Impact

The assessment can determine the diversion path coverage, as well as the adequacy and sensitivity of that coverage, for only those facility operational modes specified by the licensee.

COMPONENT PROBABILISTIC INFORMATION

Finding

The SFC Guide requests most of the probabilistic and statistical information for monitors and other safeguards components, including probability of detection for monitors, mean time between failure, maintenance/inspection/supervision policy, and tamper protection delay times. Information missing includes the probability of false alarms for monitors and the mean time to repair statistic for safeguards components in general.

Impact

A probability of detection adequacy analysis of diversion path coverage appears to be possible, at least in rough approximation, since the probabilistic information is requested. The NRC analyst can fill in the missing data subjectively. However, the lack of interconnectivity information, discussed subsequently, will cause an over-estimate of the performance of these systems.

SAFEGUARDS INTERCONNECTIVITY INFORMATION

Finding

The SFC Guide lacks safeguards interconnectivity information that describes the relationships and dependencies between or among safeguards components, especially with respect to signal transmission lines and utility distribution systems. This is primarily due to the way in which the Guide elicits information. The Guide requests information about safeguards components, such as monitors, at a local level, but does not require the unique identification and labeling of the signal lines and utility components that are connected to each safeguards component. As a result, we cannot establish the correct interconnectivity of the safeguards system as an integrated whole, especially with respect to signal transmission lines and

utility distribution systems. As an example, in responding to two different and separate information requests, the licensee may refer to an emergency back-up power generator. Since the licensee is not required to uniquely identify each safeguards component, we are completely unable to determine if he is referring to two different power generators or if these generators are indeed one and the same.

Impact

The assessment may overlook critical component failures and vulnerabilities, because of the lack of interconnectivity information. The assessment may also overestimate the probability of detection adequacy measures in favor of the safeguards system, because the SFC Guide does not identify all the components which contribute to the unavailability of the safeguards system.

SFC GUIDE FORMAT AND ORGANIZATION

Finding 1

The SFC Guide does not have a standard format for information requests pertaining to the same kinds of safeguards components. The absence of a standard elicitation format is most noticeable for safeguards monitors and detection devices, although many pertinent information requests are made about monitors. Because there is no standard or common list of relevant questions consistently applied to all monitors, particular pieces of data are apt to be overlooked. The standardization of information requests concerning other safeguards components is also a consistent problem throughout the SFC Guide.

Impact

Making the SFC Guide questions and forms standard would provide uniformity and systematic thoroughness, as well as assist the analyst by providing consistency and repeatability. Using the form as it is might result in difficulty in organizing data and perhaps even in incomplete data upon which to perform an assessment.

Finding 2

The overall organization and format of the SFC Guide is not conducive to efficiently and directly establishing an input data base for performing an automated assessment. An example of the SFC Guide organization of the information request sheets, which are ordered and addressed in alphabetical sequence, is in Appendix A of this report. The safeguards component information categories, upon which the LSD organization is based, is also shown in Appendix A. A correlation between the SFC Guide and LSD organizations is drawn in terms of subject matter and information content addressed by both documents. Thus, Appendix A illustrates two of our findings: first, the LSD and SFC Guide elicit much the same information; second, the LSD and SFC Guide organize information differently.

Impact

The organization of the SFC Guide does not facilitate generating and assimilating information in a form for automated assessment. Information collected under the organization of the SFC Guide will have to be reorganized and reformatted to establish a suitable input base compatible with the automated assessment.

SUMMARY AND GENERAL RECOMMENDATIONS

Significant SFC Guide/SAA LSD comparison findings are listed in succinct form below:

- Significant SFC Guide information deficiencies include:
  - SNM piping system information is absent.
  - Safeguards system interconnectivity information is incomplete.
  - Signal transmission and utility system information is incomplete.
  - Probabilistic information is incomplete.
  - Facility operational mode information is incomplete.
  - Licensee interpretation of to SFC requests may be sufficiently uncertain to preclude data completeness.

- A partial SAA assessment, given licensee responses to the SFC requests, is nonetheless possible. The impact of the deficiencies on performing an SAA assessment include:
  - A fairly thorough Level 1 analysis is possible.
  - At least partial analysis on Levels 2, 3, and 4 is possible.
  - Reorganizing and reformatting the input data and information may often simplify an automated assessment.
  - Significant and critical safeguards vulnerabilities may be missed due to deficiencies in SFC Guide content

In light of the independent parallel development of the SFC Guide and the SAA LSD, there is surprising overlap in information content addressed. Also, new NRC initiatives regarding information requests, especially as illustrated by recent revisions to the SFC Guide document, appear to be such as to more readily accommodate automated assessments.

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2. Fixed Site Physical Protection Upgrade Rule Guidance Compendium, Volume I, U.S. Nuclear Regulatory Commission, Draft, (1978). (Final version published June 1980 as NUREG-0669, Volume I)

ADS/mk

Subjects of SFC guide information request sheets	LSD S/G component categories								
	Facility locations	Piping system element	Material transfer procedures	Control monitors	Utility system components	Signal transmission syst. components	Facility personnel	Accounting system components	Facility operational modes
Admittance authorization criteria & schedules			✓	✓					✓
Admittance authorization/verification procedures				✓					
Air & utility inlet barriers	✓								
Annunciation systems				✓					
Area zoning				✓					
Balanced magnetic switches				✓					
Breakwire systems				✓					
Buried line sensors				✓					
Capacitance alarms				✓					
CCTV monitoring				✓					
CCTV systems				✓					
Central & secondary alarm stations	✓			✓					
Close out inspection by 3rd party				✓					
Coded credential systems				✓					
Commercial telephone system						✓			
Contingency plans & procedures									✓
Controlled security lighting					✓				
Data link via R.F.						✓			
Direct line telephone/intercom						✓			
Direct monitoring/surveillance				✓					
Doors and associated hardware	✓								
Duress alarms				✓					
E-field fence				✓					
Electrical sensor & tilt switch				✓					
Emergency access procedures									✓
Emergency battery system					✓				
Emergency evacuation procedures			✓						✓
Emergency exits									
Emergency generator systems					✓				
Equipment checks/maintenance									
Escorts				✓					✓
Explosive detector-hand held, package				✓					
Explosive detector-hand held, personnel				✓					
Explosive detector-hand held, vehicle				✓					
Explosive detector-walk through				✓					
Explosive detector-volume				✓					
Fense systems	✓								
Floors, roofs, walls	✓								
Functional zoning	✓								
Gates & associated hardware	✓								
Guard force personal equipment					✓				
Guard force qualifications									
Guard patrols/intervention									
Guard post assignments				✓					

APPENDIX A

APPENDIX A (Continued)

	LSD S/G component categories								
Subjects of SFC guide information request sheets	Facility locations	Piping system element	Material transfer procedures	Control monitors	Utility system components	Signal transmission syst. components	Facility personnel	Accounting system components	Facility operational modes
Hardwire video system				✓					
Infrared beam system, exterior				✓					
Interfaces between alarm stations & sensors						✓			
Isolation zones	✓								
K-9, use of, package search				✓					
vehicle search				✓					
Local audible/visible alarms				✓					
Locks	✓								
Manual alarm recording			✓						
Manual alarm recording									
Microwave system, exterior				✓					
Mobile radio						✓			
Motion detectors				✓					
Multiman rule				✓					
Pat down search				✓					
Night vision search devices				✓	✓				
Personal identification numbers			✓						
Photo ID badges			✓						
Physical controls & procedures for keys			✓						
Portable radio						✓			
Positive personnel ID				✓					
Response vehicles									
Sallyport pedestrian									
Sallyport vehicle									
Shielding detectors-volume				✓					
Shielding detector-walk through				✓					
SNM detector-hand held, package search				✓					
SNM detector-hand held, personnel search				✓					
SNM detector-volume				✓					
SNM detector-walk through				✓					
SNM holding/storage areas		✓							
SNM identification/authorization procedures			✓						
SNM liquid & solid waste handling procedures			✓						
SNM scrap removal procedures			✓						
SNM shipping and receiving procedures			✓						
Tamper indicating & tamper seal protection			✓	✓					
Tamper indicating circuitry									
Team zoning				✓					
Uninterruptible power systems					✓				
Vaults	✓								
Vibration sensors				✓					
Visual inspection				✓					
Weapons detector-hand held, personnel search				✓					
Weapons detector-volume				✓					
Weapons detector-walk through				✓					

APPENDIX A (Continued)

	LSD S/G component categories								
Subjects of SFC guide information request sheets	Facility locations	Piping system element	Material transfer procedures	Control monitors	Utility system components	Signal transmission syst. components	Facility personnel	Accounting system components	Facility operational modes
Weapons-handgun				✓					
Windows and associated hardware	✓								
X-ray package/container search				✓					

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