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# **A Systematic Assessment of the Safeguards Regulations**

Appendices

D. W. Fraley

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NOVEMBER 1979

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A SYSTEMATIC ASSESSMENT OF THE SAFEGUARDS  
REGULATIONS

APPENDICES

D. W. Fraley

November 1979

Prepared for  
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APPENDIX A

ORGANIZATIONS FOR THE SAFEGUARDS REGULATIONS

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## APPENDIX A

### ORGANIZATIONS FOR THE SAFEGUARDS REGULATIONS

*This Appendix summarizes the various sources which organize the safeguards regulations or other safeguards concerns.* In order to select the bases and identify their elements, a number of safeguards studies and NRC documents were reviewed. Most of the studies or documents describe safeguards structures; however, because their purposes differ, the structures which were presented to support the specific needs or objectives of the document are different.

The two sections of this Appendix present the categories used by various sources to organize the safeguards regulations. Section A.1 surveys how safeguards concerns are organized by NRC. A number of safeguards studies also provide organizations for various safeguards concerns; these are discussed in Section A.2.

#### A.1 ORGANIZATIONS USED WITHIN NRC

A number of sources are available that provide general and specific classifications which can be used to divide the regulations for the purpose of structuring. NUREG-0377, "The Structure and Drafting of Safeguards Regulatory Documents,"<sup>(1)</sup> lists sources within NRC.

The NRC has a number of alternative ways of organizing the structure of safeguards concerns and related activities. Many are also appropriate for organizing the content or objectives of the safeguards regulations. The organizations used by NRC can be determined by the interpretation of policy statements by agency officials, in the documents themselves, or by the way the NRC organizes itself into separate offices. The sources can be grouped into four categories:

1. Policy Statements.
2. Safeguards Regulations.

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3. Regulatory Guides.
4. NRC Organization, and Other Documents.

#### A.1.1 Organization Based on Policy Statements

The first source of possible organizations for the safeguards regulations is statements by agency officials; these may be made in the form of speeches or remarks given before organizations like the Institute for Nuclear Materials Management, issued as formal policy statements, or issued in memoranda to various persons.

How statements can reflect the structure of safeguards systems are illustrated by these examples:

- Dixy Lee Ray, former AEC Chairman, divided spending in 1974 for safeguards as follows; 1) research and development, 2) protection of materials in transit, 3) physical protection at plants, 4) material control and accountability, 5) detection and response capability, and 6) regulatory activities.<sup>(2)</sup>
- Later the same year, the "Proposed Final Environmental Impact Statement for LMFB" <sup>(3)</sup> gave the concerns of the safeguards program as 1) definition of the nature and dimensions of the threat, 2) development and imposition on the nuclear industry of safeguards requirements directed toward countering the threat, 3) licensing activities, 4) inspections, 5) enforcement, 6) support for response and recovery, 7) development and testing of safeguards methods, techniques, and equipment, and 8) review to assure responsiveness to changing industrial, technical, social, and political concerns.

Both statements characterize the safeguards program as defining the threat, and implementing safeguards systems, response capability, and research and development. In the case of spending for safeguards, implementation is directed toward activities similar to the structure of Parts 70 and 73 of 10 CFR. The proposed final impact statement deals with activities of the regulatory process; e.g., licensing, inspections, and enforcement. These two characterizations identify the scope of possible bases which can be used to structure the regulations.

The range of possible threats to the safeguards system has been classified by Carl Builder into the following organization:<sup>(4)</sup>

- 1) Objectives
  - a. Theft
  - b. Sabotage
- 2) Focus
  - a. Facilities
  - b. Transport
- 3) Source
  - a. Internal
  - b. External
  - c. Combinations of Both
- 4) Qualitative Characteristics
  - a. Motivation and Dedication
  - b. Training and Skills
  - c. Arms and Equipment
  - d. Access to Positions of Trust
- 5) Quantitative Characteristics
  - a. Time
  - b. Money
  - c. People

A more detailed structure for the safeguards regulations is depicted in Tables A.1 through A.6, from a threat orientation;<sup>(5)</sup> this structure also provides a number of possible elements. This structure characterizes threats as being either assault or diversion, and groups according to possible actions, location, and by activity.

The basic structure consists of a matrix of functions related to specific threats. The specific threats are of assault against both fixed sites and material in transit, and diversion of material. The functions associated with protecting against these threats are: detection and response for assault threats and containment; personnel access control; material accounting; and response for the diversion threat. Matrices for functions of a physical nature (Tables A.1-A.4) are dimensioned according to the physical location or mode of transport. The matrix for response (Table A.5) has response actions for dimensions. The material accounting matrix (Table A.6) is based

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on the material balance equation. Only the principle elements of each matrix are shown. For each element, a list of requirements or criteria are specified in detail. For example, requirements for guards may include training and qualifications, numbers, weapons, security clearance, and required actions.

**TABLE A.1. Diversion Threat-Personnel Access Control at Fixed Site**

	Function/Subsystem			
	Barriers	Controls	Alarms and Detection Aids	Surveillance
Offsite(a)				
Protected Area Perimeter		Ingress Control Egress Control	Alarms	Patrols Lighting CCTV(b)
Within Protected Area				Patrols Lighting CCTV
Material Access Area Perimeter		Ingress Control Egress Control	Occupied MAA(c) Unoccupied MAA Duress Alarms	Exterior Interior
Within Material Access Area			Occupied Unoccupied	Occupied Unoccupied Lighting
Material				

- (a) Offsite means that area of company property or company-controlled area beyond the facility perimeter isolation zone.
- (b) CCTV = Closed Circuit Television
- (c) MAA = Material Access Area

**TABLE A.2. Diversion Threat-Containment at Fixed Site**

	Function/Subsystem			
	Barriers	Access Control	Alarms and Detection Aids	Surveillance
Offsite(a)		Ingress/Egress Control Emergency Control		
Protected Area Perimeter		Ingress Control Egress Control Emergency Control	Alarm	Patrols Lighting CCTV
Within Protected Area		Storage and Handling Emergency Control		Patrols Lighting CCTV
Material Access Area Perimeter		Ingress Control Egress Control Emergency Control	Occupied MAA Unoccupied MAA Duress Alarm	Exterior Interior
Within Material Access Area		Storage Process and Handling 1 Person/1 MAA	Occupied Unoccupied	Occupied Unoccupied Lighting
Material		Tamper Safed Containers Standard Container		

- (a) Offsite means that area of company property or company-controlled area beyond the facility perimeter isolation zone.

TABLE A.3. Assault Threat-Detect Fixed Sites

	Function/Subsystem			
	Barriers	Access Controls	Alarms and Detection Aids	Surveillance
Offsite(a)				
Protected Area Perimeter		Ingress Control Egress Control Emergency Control		Patrols Lighting CCTV
Within Protected Area				Patrols Lighting CCTV
Material Access Area Perimeter		Ingress Control Egress Control	Occupied MAA Unoccupied MAA Duress Alarms	Exterior Interior
Within Material Access Area			Occupied Unoccupied	Occupied Unoccupied
Material				

(a) Offsite means that area of company property or company controlled area beyond the facility perimeter isolation zone.

TABLE A.4. Assault Threat-Transportation

	Cargo, Vehicle, and Package Security	Location/Subsystem		
		Guards and Escorts	Communication and Reports	Planning
General	Packaging	Guards and Escorts	Reports	Shipping Plan Quantity Limit
Road	Cargo Vehicle	Guards Escort/Guards Escorts	Communication	No Transfers No Intermediate Storage Intermediate Stops
Air	Cargo Vehicle	Guards Escort Crew	Communication	Transfers Intermediate Storage Stops
Rail	Cargo Vehicle	Guards Escort	Communication	Transfers Intermediate Storage Stops
Sea	Cargo Vehicle	Guards Escort Ships' Officers	Communication	Transfers Intermediate Storage Stops
Transfers	Cargo	Guards Continuously Manned	Communication	
Stops	Cargo	Guards Continuously Manned	Communication	
Response Functions		Guards/ Escorts	Licensee Recovery Response Network	LLEA <sup>(a)</sup> Tactical Plan Recovery Plan

(a) LLEA = Local Law Enforcement Agency

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TABLE A.5. Physical Threat Response (Assault or Diversion) at Fixed Sites

	Function/Subsystem			
	Alarms and Detection Aids	Communications	Planning	Organization
Receive Alarm	Alarm Stations Alarm Annunciation Patrol Duress Alarms	Patrol		Security Supervisor
Assess Threat	Alarm Annunciation CCTV Patrol Duress Alarms	Patrol		
Alert Offsite LLEA	Alarm Annunciation at LLEA		LLEA	
Mobilize Onsite Force	General Quarters Alarm			Guards/Watchmen Security Supervisor
Action	Remote Automatic Countermeasures			Guards/Watchmen Security Supervisor

TABLE A.6. Diversion Threat Control and Accounting (Ending Inventory = Beginning Inventory + Receipts - Shipments - Discards) Fixed Site

	Procedures/Objectives		
	Assurance	Prevent/ Detect	Response
Inventory		Continuous Knowledge Tamper Safed Shift Inventory Scrap	
Receipts		S/R Difference	
Shipments		Tamper Safed	
Discards			
Material Balance			
Measurements	Control Program	Independent Samples Prior Measurements Verification Control Program	
Records and Reports	Double Entry To NRC Licensee	Licensee	To NRC
Organization	Establish Material Control Areas Management Review Fundamental Material Control	Independent Functions Fundamental Material Control	Management Review

Some general goals for an effective safeguards system were described by R. G. Page.<sup>(6)</sup> The set of effective and acceptable safeguards must provide for public safety and security by adequate deterrence of 1) thefts or diversion, 2) sabotage, and 3) hoaxes. Deterrence is accomplished through measures which a) detect, b) prevent, or c) respond to such acts which may be either covert or overt. The effectiveness of safeguards may be evaluated by assessing methods to prevent covert theft:

1. Barriers and personnel identification which permit access to special nuclear material (SNM) only by authorized personnel.
2. Entry, search and inspection of personnel, packages, and vehicles to prevent the introduction of weapons, explosives, or other contraband.
3. Alarms and surveillance to detect unauthorized personnel access to SNM.
4. The integrity of physical barriers to prevent the authorized removal of SNM through a barrier penetration.
5. Exit searches and inspection of personnel, purchases, and vehicles to prevent the unauthorized removal of SNM through an authorized portal.
6. Accounting systems to track the location and movement of all discrete items on inventory and to monitor in-process material for indicators of theft.
7. Systems to detect, in a timely manner, any theft of five kilograms of SNM.

The effectiveness of safeguards in preventing overt theft by an attacking group is evaluated by assessing:

1. Alarms, lighting, guard patrols, and surveillance for timely detection of an assault.
2. Barriers and vaults to delay the attacking force access to SNM sufficiently long to permit mobilization and engagement of response forces.
3. Deployment of response forces to assure a timely and effective response.
4. Communications to assure sufficing for mobilization and deployment of response forces.

The characterization of safeguards from the threat viewpoint is important. The above categorizations describe the threat in terms of the nature of the attempt, the direction of its intent, the characteristics of the adversary and responses. The latter organization above also introduces objectives of the safeguards systems responsive to the threats as being to deter, prevent, detect and delay. These concepts, as objectives or goals for the safeguards system, also appear in other contexts.

Other public statements on safeguards approaches by NRC have grouped the safeguards concerns along similar lines.<sup>(7,8)</sup> The same general areas or groupings tend to cover safeguards concerns to varying degrees and at various levels of abstraction. The general concern of risk analysis, dealing with potential threats, systems to combat them, and consequences, are present in the more current formulations. Different perceptions about the concerns are evident from the different emphases placed on certain attributes of the safeguards problem. The major concern appears to be procedures rather than performance and the focus is upon the implementation of a set of actions or mechanisms whose performance is assumed effective.<sup>(1)</sup>

#### A.1.2 Organizations Based on The Safeguards Regulations

The current regulations concerned with safeguarding special nuclear material are contained in Parts 70 and 73 (and to a degree in Part 71) of Chapter 10 of the Code of Federal Regulations (10 CFR). Part 73, "Physical Protection of Plants and Materials" deals almost exclusively with safeguards concerns. Conversely, Part 70, "Special Nuclear Material," deals not only with safeguards but with licensing procedures for facilities not covered in Part 50, "Licensing of Production and Utilization Facilities." Whereas Part 70 deals almost solely with facilities, Part 71 deals with licenses for the transport of SNM, a necessity unless a facility is self-contained. Figures A.1 to A.3 outline the major sections of the regulations.

Other regulations in 10 CFR, besides Part 50, interact with the safeguards regulations. They are referenced by these parts to a degree, but sometimes contain terminology necessary for the interpretation of their contents. Transportation and safety requirements spelled out by other chapters also interact with these regulations.

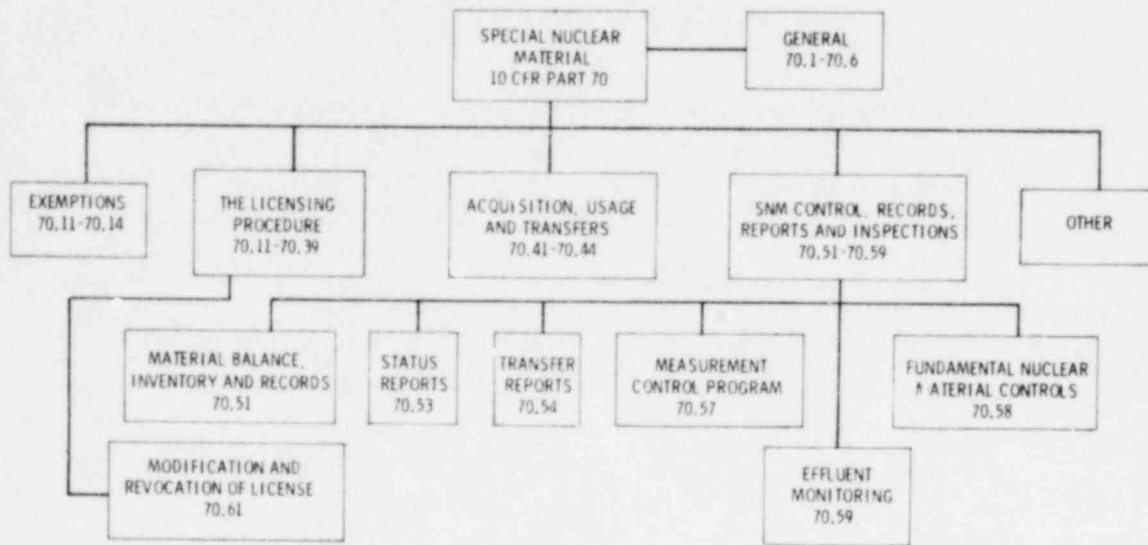


FIGURE A.1. 10 CFR Part 70

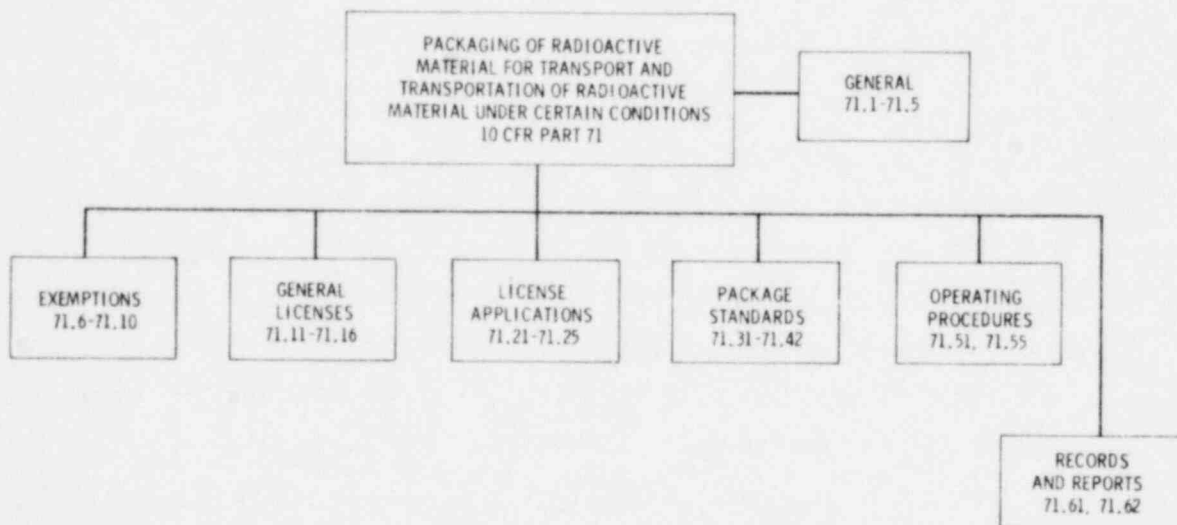


FIGURE A.2. 10 CFR Part 71

The principal organizing categories used in 10 CFR separate the safeguards concerns into:

1. Material control and accounting.
2. Physical protection.

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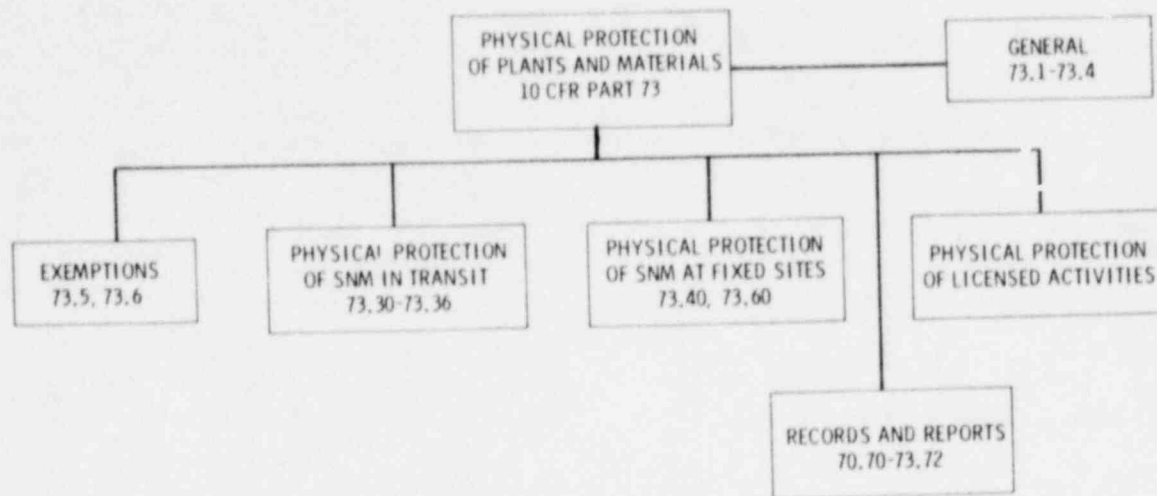


FIGURE A.3. 10 CFR Part 73

Part 73 further divides the regulations into those which control;

1. SNM in transit,
2. SNM at fixed sites,
3. Fixed sites themselves; e.g., not specifically dealing with material.

This substructure provides two additional organizing categories, although they are not pervasive among the other parts. The first deals with a separation between fixed sites and material transit, and the second deals with quantity and kind of SNM the licensee can possess.

The material control and accounting requirements prescribed in Part 70 primarily deal with fixed sites. Part 71 deals specifically with transit operations. The various kinds of transit operations or specific types of facilities are not readily separable in the regulations. For transportation, the responsibility is upon license holders at either shipper or receiver facilities and not with the carrier, who is not required to be a licensee. The physical protection requirements for transportation are spelled out in Part 73 by specific type of transport used. Separation of the various

facility types is primarily made by exemptions rather than stated explicitly; in fact, Part 70 deals with all operations not covered in Part 50 "Licensing of Production and Utilization Facilities."

Knowledge of the operations involved at specific kinds of facilities is necessary to adequately identify the regulations with respect to kinds of facility. The general types of facilities identified in the safeguards regulations are:

1. Uranium and plutonium processing plants,
2. Fuel reprocessing plants,
3. Enrichment plants,
4. Power reactors,
5. Medical and research reactors,
6. Scrap recovery, and
7. Waste disposal operations.

The regulations also specify exemptions for the production or use of calibration, reference, or other sealed sources.

The second category is based on the quantity and kind of SNM that the licensee is authorized to possess. Levels of control of material depend also on the type of facility or application. It is possible to identify five levels of material control based on the following quantities:

1. One gram,
2. Three hundred fifty grams,
3. One effective kilogram [as defined in 10 CFR 70.4(t)],
4. Five thousand grams [as defined in 10 CFR 73.1(b)(1)],
5. Any amount.

Again, these material quantities are not used throughout Part 70. In the regulations, SNM is characterized by enrichment for its  $^{235}\text{U}$  content and by its degree of inclusion in other radioactive materials. The regulations in Part 71, dealing with packaging of radioactive material for transport, also identify materials by radioactivity in addition to quantity. This categorization is concerned primarily with packaging requirements and general safety concerns.



### A.1.3 Organization of the Regulatory Guides

The NRC issues regulatory guides in 10 basic categories. The fifth division, "Materials and Plant Protection Guides," contain the majority of the safeguards concerns. Two other divisions also deal with safeguards: Guide 1.17 (Revision 1), "Protection of Nuclear Power Plants Against Industrial Sabotage" and Guide 3.24, "Guidance on the License Application, Siting, Design, and Plant Protection for an Independent Spent Fuel Storage Installation." Within Division 5, the numbering system corresponds to the date a guide first appeared. The subject matter of the various guides is not systematically related to the corresponding regulations.

A post hoc classification of the present and proposed guides is presented in Reference 1. This examination found several possible categories which serve to characterize their structure; the guides may be divided with respect to:

1. Activity direction.
2. Items of concern.
3. Subject matter.

Activity Direction. Activity direction distinguishes between action directed toward people and action directed toward things. If the principal concern of safeguards is the willful misuse of nuclear materials and facilities, then a separation can be made along this dimension.

Items of Concern. The "items of concern" separation is related to activity direction in that the real concern is what people do to materials and facilities. According to the study,<sup>(1)</sup> safeguards activities are directed toward 1) protecting materials and facilities from people and 2) controlling the material and facilities to avoid or detect actions by people.

The recommended format and content for the safeguards sections of a license application provide potential structural perspectives based upon licensee plans, standard review plans and license conditions. The formats appear in two Regulatory Guides, 5.45 and 5.52.

Regulatory Guide 5.45, "Standard Format and Content for the Special Nuclear Material License Application," gives the following organization:

1. Design of Structures, Components, Equipment and Systems
2. Quality Assurance
3. Organization
4. Material Control Areas
5. Measurements
6. Measurement Control Program
7. Limits of Error
8. Physical Inventory
9. Material Accounting System
10. Internal Accounting System
11. Management
12. Production Documentation and Verification for Uranium Enrichment Facilities.

Regulatory Guide 5.52 (Revision 1), "Standard Format and Content for the Physical Protection Section of a License Application (for facilities other than nuclear power plants)," deals specifically with the control and protection of facilities. The contents of Regulatory Guide 5.52 also indicate a set of categories appropriate to the safeguards regulations. The major purpose of the guide is to establish the content of the physical security plan. Table A.7 summarizes the contents of Regulatory Guide 5.52.

The general content of the guides is consistent with the usual division of safeguards activity into "material control" and "physical protection". Physical protection usually covers both material and facilities. It would seem reasonable that a structure could be characterized along three basic dimensions:

1. Control of material,
2. Protection of material,
3. Protection of facilities.

However, it is difficult to determine a separation between protection of material and control and protection of facilities. The organization of the regulatory guides does not help resolve this dichotomy.

TABLE A.7. Contents of Regulation, Guide 5.52 (Revision 1)  
 "Standard Format for Physical Protection  
 Section of a License Application"

Chapter	Content
FIXED SITES - PART I AND II	
1. Site and Facility Description	<ul style="list-style-type: none"> <li>• describe the site with emphasis on physical protection features including location of LLEA's and all alarm stations</li> </ul>
2. Design Criteria	<ul style="list-style-type: none"> <li>• principal design features relative to design bases and incidents, criteria and features</li> <li>• criteria include quality assurance, isolation of areas, equipment placement and test capability</li> <li>• specific criteria include barriers, plant isolation, illumination, access control, shipping and receiving, surveillance, communicators, monitoring, and alarms</li> </ul>
3. Quality Assurance	<ul style="list-style-type: none"> <li>• establish a QA program to assure conformance with regulations</li> <li>• should include 1) organization, 2) design control, 3) procurement, 4) instructional procedures, 5) document control, 6) equipment control, 7) special processes, 8) inspection, 9) tests, 10) measuring and test equipment, 11) handling storage and shipping, 12) inspection, test and operating status, 13) corrective action, 14) QA records and 15) audits</li> </ul>

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TABLE A.7. (Cont'd)

- |                                    |  |
|------------------------------------|--|
| 4. Security Organization           | <ul style="list-style-type: none"><li>• management organization and security organization</li><li>• personnel qualifications, screening, training</li><li>• security equipment - weapons, vehicles, communicator devices, uniforms</li><li>• duties and drills</li></ul>   |
| 5. Security Areas                  | <ul style="list-style-type: none"><li>• protected areas - physical barrier and isolation zones</li><li>• vital and material access areas - specification of vaults, access locations, material and processes involved</li></ul>  |
| 6. Access Controls                 | <ul style="list-style-type: none"><li>• how the personnel, vehicles, and packages are to be controlled</li><li>• badge system - description of system, badge, information and function</li><li>• access authorization and registration procedures</li><li>• personnel escort and search procedures</li><li>• vehicle access procedures</li><li>• keys, locks, and combinations</li></ul> |
| 7. Intrusion and Detection Devices | <ul style="list-style-type: none"><li>• design and performance characteristics of alarm systems</li><li>• monitoring of isolation zones</li><li>• alarm annunciator</li><li>• emergency power</li></ul>  |

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TABLE A.7. (Cont'd)

- |   |   |
|---|---|
| 8. Central Alarm and Communication System | <ul style="list-style-type: none"><li>• describe facilities and equipment, staffing</li><li>• describe communication system both internal and off-site</li></ul>  |
| 9. Response to Security Contingencies     | <ul style="list-style-type: none"><li>• organization and procedures</li><li>• define responses to specific events and contingencies</li><li>• define response actions including forces, numbers, arrangements</li></ul>         |
| 10. Local Law Enforcement Authorities     | <ul style="list-style-type: none"><li>• size of force</li><li>• kind of assistance</li><li>• arrangements</li></ul>   |
| 11. Reports to NRC                        | <ul style="list-style-type: none"><li>• incidents, unusual occurrences, security plan changes</li></ul>   |
| 12. Tests and Inspections                 | <ul style="list-style-type: none"><li>• information on the tests and inspections to ensure integrity and operability of 1) barriers and access points, 2) alarms, 3) detectors, 4) communications, 5) other equipment</li></ul> |
| 13. Security Records                      | <ul style="list-style-type: none"><li>• records of 1) maintenance, 2) alarm annunciation, 3) security response, 4) authorized individuals, 5) nonemployee access, 6) employees, 7) security plan changes</li></ul>              |
| 14. Security Audits                       | <ul style="list-style-type: none"><li>• audits of programs and compliance</li></ul>   |
| TRANSIT (PART II)                         |   |
| 15. Scope of Plan                         | <ul style="list-style-type: none"><li>• identify activities</li></ul>   |

TABLE A.7. (Cont'd)

- |   |  |
|---|--|
| 16. Planning                                  | <ul style="list-style-type: none"><li>• arrangement with carriers</li><li>• means of transfer</li><li>• storage in route</li><li>• communications and monitoring</li></ul>   |
| 17. Equipment                                 | <ul style="list-style-type: none"><li>• protective equipment by vehicle</li><li>• communications</li><li>• seals, locks, containers</li><li>• markings</li><li>• personnel equipment</li></ul>   |
| 18. Security Personnel                        | <ul style="list-style-type: none"><li>• describe duties and responsibilities including<br/>1) selection, 2) training, and<br/>3) qualification</li></ul>   |
| 19. Operations                                | <ul style="list-style-type: none"><li>• describe operations for<br/>1) communications, 2) escorts,<br/>3) monitors and 4) shipper<br/>responsibilities</li><li>• notification arrangements</li><li>• trace investigations</li><li>• shipper records</li><li>• consignee responsibilities</li></ul> |
| 20. Local Law Enforcement<br>Responsibilities | <ul style="list-style-type: none"><li>• notification and contact<br/>responsibility</li></ul>  |
| 21. Transportation Security Audits            | <ul style="list-style-type: none"><li>• program and compliance audit<br/>requirements</li></ul>  |

Subject Matter. The third possible category given above deals with subject matter. It is somewhat independent of activation direction and items of concern, which were shown to be highly interrelated. A division based on subject matter is primarily procedural and separates: 1) administrative procedures, 2) technical procedures or devices, and 3) analytical and evaluative methods. The guides are oriented toward procedural rather than performance regulation and they are predominantly concerned with administrative and technical methods for material control.

#### A.1.4 Organization Based on NRC Organization and Other Documents

The NRC staff organization, information gathering systems, and related NRC documents are all sources for possible structural perspectives. Organization charts may be important because the organization helps characterize the way regulatory actions address or determine the requirements of the regulations. The regulatory process, which includes licensing, standards, and inspection and enforcement, produces formal written communications which reflect the scope and intent of the regulations.

The set of offices within the NRC provides a scheme which serves to separate safeguards concerns. The formal organization of the NRC appears in Form NRC-30, "Organization Chart," published by NRC. The offices which are concerned with safeguards are as follows:

- Legal Matters (Office of the Executive Legal Direction) deals with the legal aspects of the regulations and formal rulemaking.
- Standards Development deals with engineering standards, health, and safeguards standards including writing regulations and guides.
- Nuclear Material Safety and Safeguards deals with the development of safeguards programs and licensing for all facilities but power reactors. Programs include security and accountability. Licensing is separated by physical security and material control. Other operations are Program Development and Evaluation, Operations and Evaluations which include Contingency Planning, Test Evaluation, Fuel Cycle Safety and Licensing.
- Nuclear Reactor Regulation deals with a number of aspects of power reactors including operation, safety, environmental analysis, and quality assurance associated with licensing private reactors.

- Nuclear Regulatory Research plans and coordinates reactor safety research, fuel cycle and environmental research, and associated safeguards research and deals with systems analysis, operations support and technical support.
- Inspection and Enforcement conducts inspection and enforcement in the field through various regional offices and performs reviews on a national level.

One of the NRC's most important sources of information is its inspection reports. NRC inspectors gather and report information on degrees of licensee compliance using a set of categories shown in Table A.8. These categories can generally be separated into physical protection and material control and associated follow-ups. There is a similarity in form and content between these subdivisions and those shown in Table A.7 for Regulatory Guide 5.52.

TABLE A.8. Inspection Reports Categories

Areas	Content
Management Meetings	Entrance and exit interviews
Physical Protection	Security plan Security organization Physical barriers Access controls Keys, locks, combinations Response controls Central alarm and communication system Testing and maintenance SNM protection Records and reports Reports of incidents
Material Control and Accounting	Facility organization Facility operation Measurement and statistical controls Shipping and receiving Storage and internal control Physical inventory Material unaccounted for Limits of error Records and reports Management of material control system
Followup	Licensee events Inspection identified problems Unresolved items Noncompliance/deviations IE Bulletin Headquarter and regional requests Events during inspection
Independent Inspection Efforts	

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The NRC communicates information regarding safeguards concerns in both formal and informal manners. Such communication may be written or oral. Informal written communication can be press releases, articles by NRC officials or letters to or from NRC. Oral communication such as generic or licensee hearings are formal whereas speeches by NRC officials or interviews are informal. Formal, written documents tend to contain the most structured information; these include the regulations themselves, the regulatory guides, notices, etc. These documents generally set basic rules and guidelines for all types of regulatory activity and have the widest circulation.

A classification of the various types of formal written documents is made in Reference 1. They include:

- Legislative--primarily for communication concerning legal requirements by a process designed to set general and future standards. (e.g., regulations, guides)
- Adjudicative--for communication concerning legal requirements and making judgments about individual cases. (e.g., license conditions, notices of violations)
- Administrative--communicating agency conduct. (e.g., organization charts, standard review plans)
- Informative--communicating general information. (e.g., NUREG documents, evaluation memoranda)
- Self-regulative--produced by regulated entities which may become legislative, adjudicative or administrative documents. (e.g., ANSI standards, licensee plans, conference proceedings)

Formal written documents form the major sources of possible organizations (structural perspectives) for the safeguards regulations. This subsection has considered primarily legislative and administrative documents, based upon their particular value as sources. Adjudicative documents, another source within NRC, primarily deal with individual cases. The information contained in informative and self-regulative documents is addressed in Subsection A.2.

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## A.2 ORGANIZATIONS USED IN SAFEGUARDS STUDIES

A number of safeguards studies have been made which present alternative organizing concepts for various safeguards concerns. This section briefly surveys several of the documents which present possible structures. The majority of the studies do not deal with structure per se, but develop structures while systematically presenting one or more related safeguards topics. In this subsection, ten studies are reviewed with respect to the organization and structure of the safeguards concern that they consider.

### A.2.1 Report of the Material Control and Material Accounting Task Force<sup>(10)</sup>

This study defines the role and objectives of material control and material accounting within the context of the NRC safeguards objective. It also assesses current requirements and performance and recommends actions necessary to attain goals it identifies. To deal with its concern, the report presents a safeguards structure which allows a focus on the material control and material accounting aspects of the overall NRC safeguards program.

The major structural perspective used by the study is a risk approach. The study uses NRC guidelines for safeguards purpose and effectiveness. The purpose of an "effective and acceptable" safeguards systems is to provide for public safety and security. The adversary actions considered are: 1) thefts or diversion of nuclear materials, 2) sabotage of nuclear facilities, and 3) hoaxes arising from threatened sabotage or alleged thefts or diversions. The safeguards purpose is met by four functions which 1) deter the above acts, 2) prevent the consequences, 3) provide protection, and 4) provide assurance in the form of timely information on the status of nuclear material and facilities.

Figure A.4 depicts the structure of the above purposes and functions. Note that a specific material type--strategic special nuclear material (SSNM) is identified as the material of concern. Thus, each function given below deals with SSNM. The objects of the functions are given as measures below each function.

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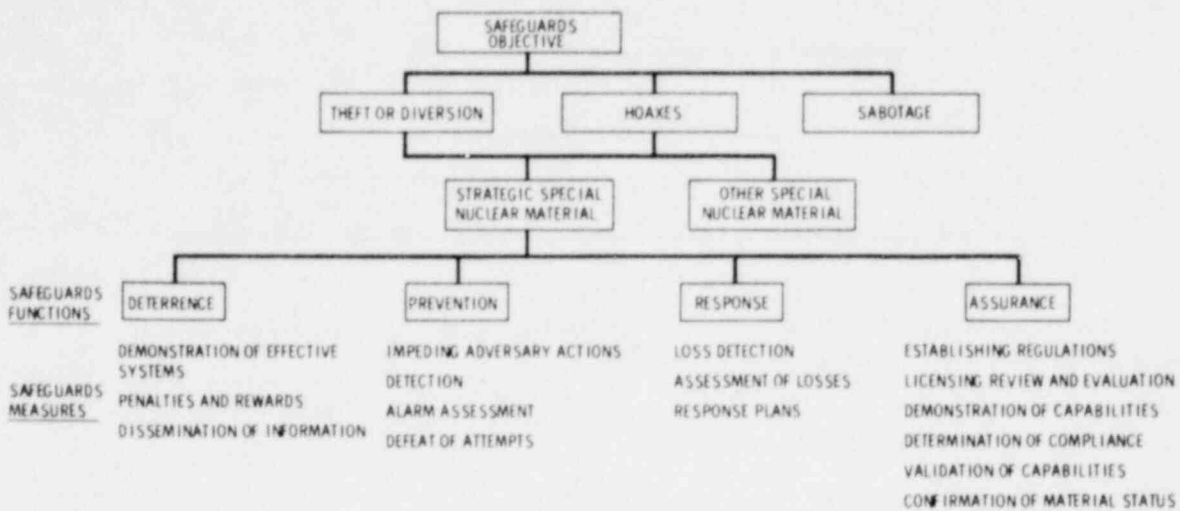


FIGURE A.4. Material Control and Accounting Task Force Safeguards Structure

A.2.2 Societal Risk Approach to Safeguards Design and Evaluation<sup>(9)</sup>

The title of this study indicates the overall approach taken. The safeguards system is defined to be an aggregation of protective mechanisms which contribute to the reduction of risk. The term "Mechanism" is used to characterize procedures or actions which are directed to the adversary. The term "function" refers to the way a particular mechanism affects the adversary; e.g. each mechanism serves a function. The functions defined in the approach are 1) deterrence, 2) detection, 3) defense, and 4) consequence reduction.

Mechanisms are separated as being either "passive" or "active". A mechanism is passive if its effectiveness is not modified by the lack of detection of an adversary action in progress. A mechanism is active if its effectiveness depends on or is modified by detection.

The structure given is related to the mathematical description of risk for an event. The definition of risk is:

$$\frac{\text{consequences}}{\text{unit time}} = \frac{\text{attempts}}{\text{unit time}} \times \frac{\text{events}}{\text{attempt}} \times \frac{\text{consequences}}{\text{event}}$$

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The equation states that risk is a function of the frequency of attempts, the conditional probability that the attempts will be successful, and, the consequences of the event produced. The definition of risk corresponds to the objectives of the safeguards system which are:

1. Reduce the probability that misuse will be attempted.
2. Reduce the probability to an acceptable level that attempts will be successful.
3. Reduce the consequences of any successful attempt.

How the risk equation relates to the functions is shown in Table A.9.

TABLE A.9. Functions of the Safeguards System Versus Risk

<u>Risk Equation Term</u>	<u>Applicable Functions</u>
Frequency of attempt	Passive Deterrence
Probability of sequence completion	Passive Defense Detection with Active Defense Passive Deterrence Detection with Active Deterrence
Consequence	Passive Consequence Reduction Detection with Active Consequence Reduction

The safeguards mechanisms which carry out the functions are guards, barriers, motion detectors, internal control procedures, measurements, response forces, etc. They may contribute to several different functions in either an active or passive manner. The mechanisms are considered as aggregations, not unlike the bases as described in Chapter 2, which make up subsystems of safeguards. The subsystems are defined so they can be related to risk for a specific set of adversary actions. Any subsystem structure is hierarchical where the hierarchy is the explicit choice, in order of importance of the independent parameters. The report provides 21 subsystems which are reproduced in Table A.10.

TABLE A.10. Subsystems in Terms of Subobjectives and Adversary Actions

Subsystem References	Safeguards Subobjective	Adversary Action	Adversary Mode
1	Reduce Frequency of Attempt		
2	Reduce Probability of Sequence Completion	Preparation Activities	
3a	Reduce Probability of Sequence Completion	Unauthorized Access - Fixed Site	Force
3b	Reduce Probability of Sequence Completion	Unauthorized Access - Fixed Site	Stealth
3c	Reduce Probability of Sequence Completion	Unauthorized Access - Fixed Site	Deceit
4	Reduce Probability of Sequence Completion	Diversion	
5a	Reduce Probability of Sequence Completion	Unauthorized Removal - Fixed Site	Force
5b	Reduce Probability of Sequence Completion	Unauthorized Removal - Fixed Site	Stealth
5c	Reduce Probability of Sequence Completion	Unauthorized Removal - Fixed Site	Deceit
6a	Reduce Probability of Sequence Completion	Unauthorized Access - In Transit	Force
6b	Reduce Probability of Sequence Completion	Unauthorized Access - In Transit	Stealth
6c	Reduce Probability of Sequence Completion	Unauthorized Access - In Transit	Deceit
7	Reduce Probability of Sequence Completion	Unauthorized Removal - In Transit	
8	Reduce Probability of Sequence Completion	Smuggling of Material	
9	Reduce Probability of Sequence Completion	Black Market Acquisition	
10	Reduce Probability of Sequence Completion	Destruction or Damaging Manipulation of Equipment or Material - Fixed Site	
11	Reduce Probability of Sequence Completion	External Penetration - Fixed Site	
12	Reduce Probability of Sequence Completion	External Penetration - In Transit	
13	Reduce Probability of Sequence Completion	Post Possession Material Preparation	
14	Reduce Probability of Sequence Completion	Delivery to Event Location	
15	Reduce Consequences		

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### A.2.3 Safeguard Systems Concepts for Nuclear Material Transportation<sup>(11)</sup>

This NUREG document develops system concepts for the safeguarding of nuclear materials during transportation. It uses an adversary action sequence approach directed at specific transportation activities and lists conceptual design requirements to reduce vulnerability. The modes of transport considered are 1) rail, 2) truck, 3) barge, and 4) airplane with emphasis on transporting Strategic Special Nuclear Material. Theft is viewed as the primary action requiring prevention.

Each mode of transport is considered in the context of a transport sequence. The activities in the transport sequence are shown in Figure A.5. Generic adversary action sequences are provided for a specified set of adversary characteristics. These sequences are applied to the transportation sequences for a vulnerability analysis. For each scenario considered, a set of safeguards strategies were developed and then used to recommend improvements in the transport safeguards. Table A.11 is an example of a set of strategies and associated design requirements. Note the use of an objective statement to link the strategy to a design requirement.

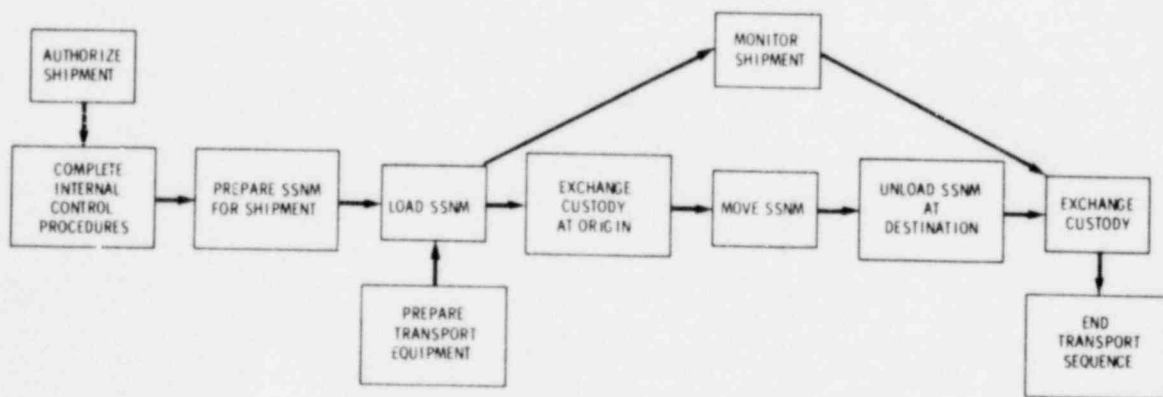


FIGURE A.5. The SSNM Transport Sequence

The study discusses the integration of the various recommendations into the overall safeguards system for transportation. In order to display the interrelations in the overall safeguards system, a hierarchical relation was given. Figure A.6 depicts the structure; note that the top level of the hierarchy would be deterrence since all the subsystems either directly or indirectly support that subsystem.

TABLE A.11. Strategy, Objectives, and Design Requirements

Strategy (Examples Only)	Objective (Examples Only)	Design Requirements (Examples Only)
Minimize transport distances	To lessen the chance of the material being acted upon while on the road	Co-locate or make the facilities close to one another
Minimize transport time	To lessen the chance of materials being acted upon	Increase vehicle speed Ship during low traffic hours
Keep transport origin/destination/routing secret	To keep the enemy uninformed	Secret procedures and shipping schedules
Intelligence gathering along transport route	To obtain advance information to uncover potential adversary actions so special precautions can be taken	Interface with intelligence gathering agencies
Haul an escort/monitoring system	To keep materials under guard and their location known at all times	Escort/surveillance/communication system installed
Use transport containers/vehicles that are difficult to move	To impose a difficult equipment requirement on the adversary, thereby increasing the probability of detection	Proper design of containers and vehicles
Random scheduling of movements	To lessen the chance of materials being acted upon	Random number generation techniques for schedules

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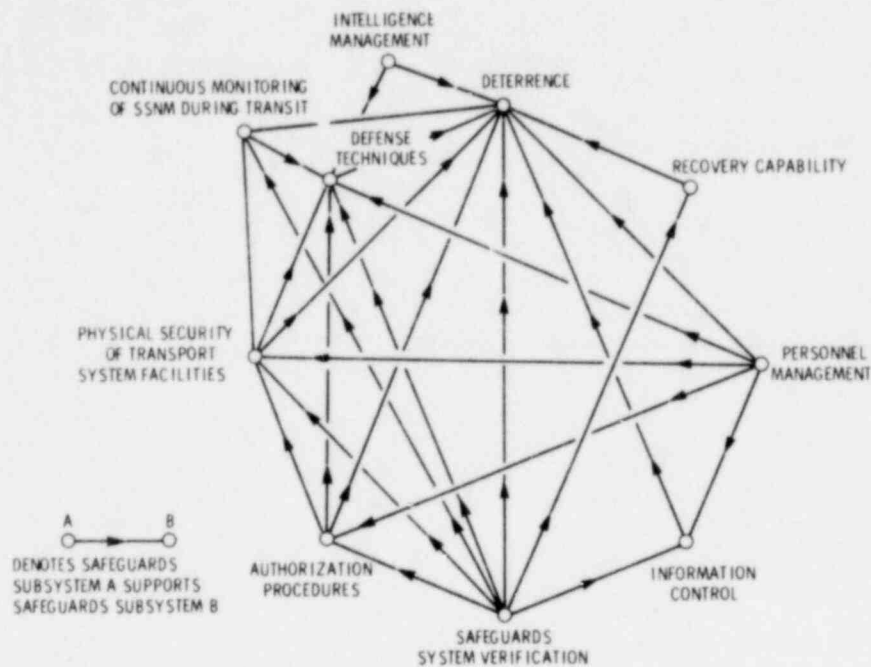


FIGURE A.6. Interrelations in the Safeguards System.

A.2.4 Master Plan - Division of Safeguards and Security, U.S. ERDA<sup>(12)</sup>

This document sets the program goals of ERDA's Division of Safeguards and Security in a way that "details the interrelationship among all the program elements" of the Division. The plan is organized along two lines with respect to safeguards: 1) safeguards design and development and 2) safeguards operations. The objectives of the safeguards and security plan are to:

1. Prevent successful malevolent acts involving nuclear materials or facilities, so as to protect the public against the risk of death, injury, and property damage that could arise from such acts.
2. Protect classified information from unauthorized disclosure.
3. Protect government property from theft or malevolence.

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The strategy which ERDA follows is to 1) deter malevolent attempts, 2) minimize possibilities of success, and 3) minimize consequences. This follows the general risk approach for characterizing the safeguards objectives. To achieve the objectives the general safeguards are divided into:

1. Physical protection--includes personnel reliability determinations and all those measures related to access controls, physical barriers, penetration alarms, and armed protective response and recovery forces.
2. Material control--measures in effect where SNM is handled and processed that provide constant and ready surveillance of materials.
3. Accountability systems--keep data on the location of SNM inventories and those procedures used to verify (through measurements) the physical inventory as compared with bookkeeping records.

Figure A.7 shows the general relation of the safeguards objectives to the process of safeguards design and development. Figure A.8 shows the considerations that are entailed in the implementation of safeguards improvement. Improvements are classified as being in one of the above three areas: physical protection, material control, and accountability. Note in Figure A.8 that inputs from this safeguards improvement process also benefit the regulatory process.

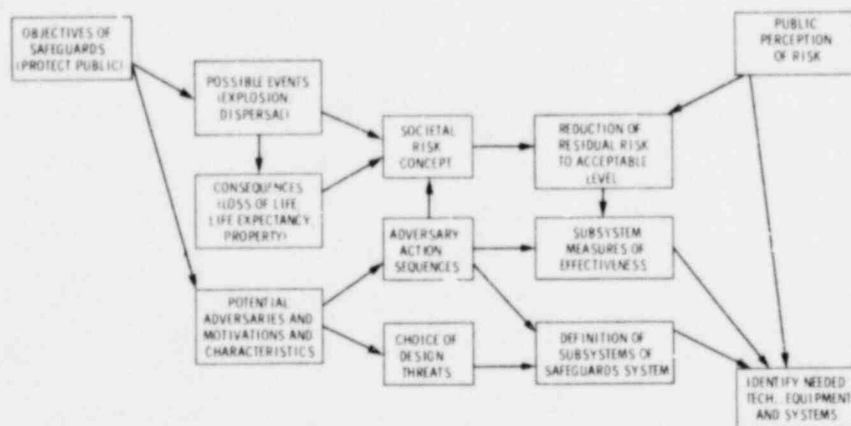


FIGURE A.7. Safeguards Design and Development

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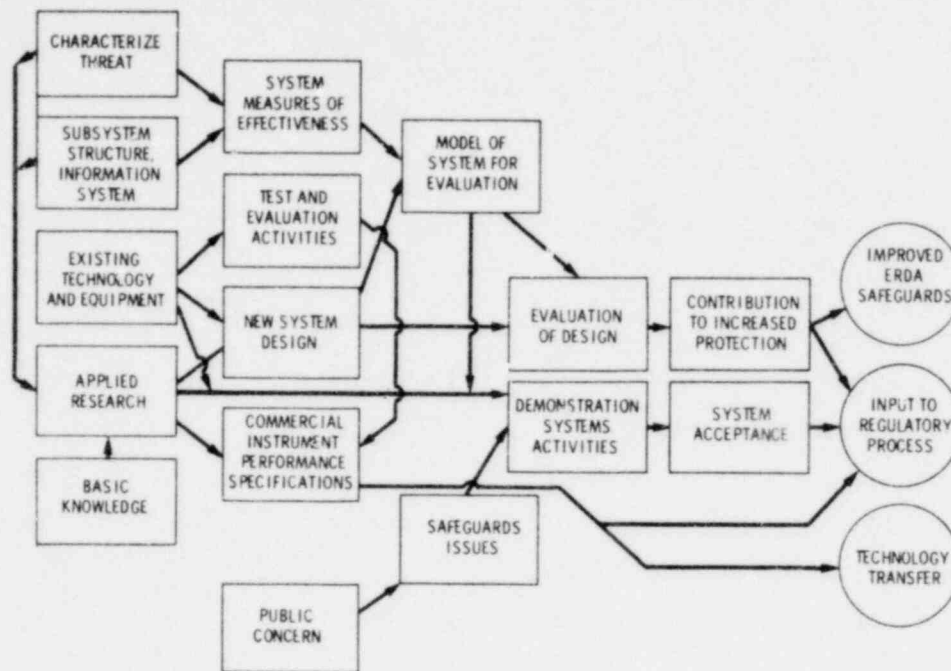


FIGURE A.8. Implementation of Safeguards Improvements

A.2.5 Systematic Approach to the Conceptual Design of Physical Protection Systems for Nuclear Facilities (13)

Conceptual design of a physical protection system requires development of the system to a stage which is adequate for the demonstration of system feasibility and which has sufficient detail to allow detailed design and implementation. The report outlines a basis for evaluating the effectiveness of physical protection systems. It describes a three-step approach which includes:

1. Facility characterization,
2. Development and evaluation of hardware-based safeguards systems configurations, and
3. Hardware and response force trade-off analysis.

The objective of a safeguards system is to provide four functions:

1. Detection of unauthorized activities and material balance discrepancies.

2. Delay of unauthorized activities until appropriate response can be made.
3. Response to unauthorized activities and discrepancies in an adequate and timely manner.
4. Deterrence of potential adversary actions through public awareness of the general capability of safeguards.

This study does not consider the function of deterrence. The three remaining objectives functions are provided by two major systems: 1) physical protection, and 2) materials measurement and controls. Physical protection requires access controls to exclude unauthorized persons or contraband, and zone operations controls to monitor activities and prevent unauthorized activity. The materials measurement and accounting system is used to obtain information on the quantity and location of SNM within the facility.

The principal concern is formalizing the process of design to allow for the evaluation of safeguards effectiveness. Figure A.9 depicts the three phases on which the conceptual design process is based. Evaluation is shown to occur at each phase of the process. This includes target analysis for the potential threats and evaluation of critical paths in the facility.

#### A.2.6 Conceptual Design of Integrated Safeguards Systems<sup>(14)</sup>

This paper describes a conceptual design process using a systematic approach. The approach includes definition of safeguards systems, a procedure for its implementation, and tools required. Conceptual design is the first stage of the design process whereby the designer scopes a complex problem. The problem requires structuring for the purpose of implementation including design interrelationships among the principal components. The design process provides insight into possible structures for the safeguards regulations by addressing functions that a safeguards system must perform and an estimate of how well each function can be performed.

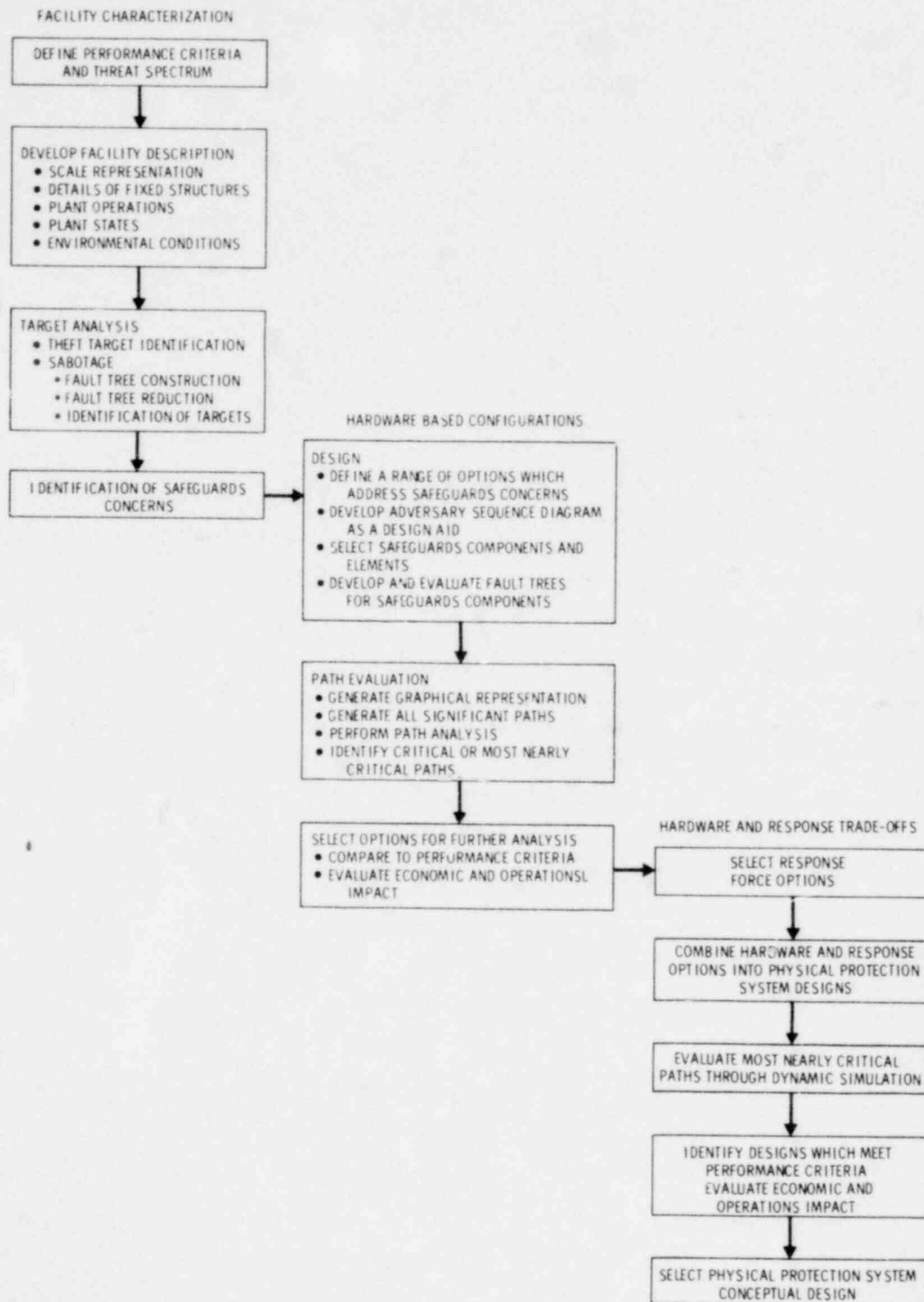


FIGURE A.9. Conceptual Safeguards Design Process

Conceptual design comprises five major steps:

1. Synthesis--combines building blocks into an orderly structure that would be capable of reaching system goals.
2. Analysis--quantifies the performance of the system.
3. Evaluation--examines the results of the analysis to determine whether the system meets performance goals.
4. Modification--depends on the outcome of the evaluation; it may be desirable to iterate on the first three steps.
5. Summation--compiles results.

The first step--synthesis--provides the greatest insight to the structuring process. The report gives an example for the problem of materials accounting.

The synthesis step for materials accounting has three primary goals: 1) effectiveness as measured by sensitivity to diversion, 2) minimum operational impact, and 3) minimum cost. These goals must be met by the systems resources, subject to a set of constraints. The resources are used to perform the systems mission which is in turn based on a set of strategies. Figure A.10 depicts the synthesis process.



FIGURE A.10. Synthesis of Safeguards Systems

#### A.2.7 A Structured Approach to Inspection<sup>(15)</sup>

The paper describes a structured approach to inspection, the purpose of inspection, and its specific objectives. Its intent is to provide the inspection process with a basis such that inspection results may be expressed quantitatively.

Inspection is intended to provide assurance that a material or the system protecting the material is functioning as intended. Traditional inspection activities have been a management function to confirm 1) quality of a product, 2) conformance to a standard, 3) performance of a process or personnel, and 4) presence and quantity of material in inventory. This paper relates the inspection function to the origin of the threat, the degree of assurance, and to the inspection body.

The fundamental point made by the study regards the role of assessment. It is necessary that any system have an inherent capability to measure and evaluate its own effectiveness. Without such capability, there is no way of knowing or assessing if the system is capable of doing what is intended. The study doesn't actually structure the inspection process but rather, deals with the concepts regarding the role of inspection as part of the safeguards system.

#### A.2.8 Some Ideas on Structuring the Problem of Collusion<sup>(16)</sup>

The objective of this study is to provide a cursory examination of the vulnerability of a facility to collusion. Voluntary collusion is a tactic of two or more people acting in concert to accomplish an objective. The relevant implication is the need to establish knowledge and familiarity with the individuals involved. Figure A.11 depicts the possible modes of collaboration.

Possible means to detect and deter collusion are presented in the paper. The approach used is basically a probabilistic analysis. General thoughts on safeguarding the problem are also presented.

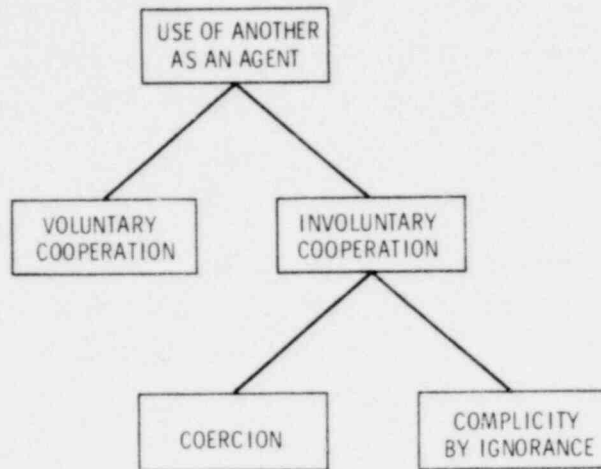


FIGURE A.11. Modes of Collusion

A.2.9 The Development of a Statement of Objectives for the Safeguards Program<sup>(17)</sup>

This study used a group approach similar to the Delphi Technique involving two workshops to produce a hierarchical structure of safeguards objectives. From the results of the first workshop, a general set of component-objective statements were developed. A second workshop was held to develop a formal structure for the safeguards objectives. Figure A.12 exhibits the resulting intent structure.

The report indicates a number of difficulties in interpretation of objectives and conflicts which appeared in the determination of the structure. It does, however, provide a degree of insight into the interrelationships between the set of possible objectives of safeguards. At the top of Figure A.12, the primary objectives are shown to be

- to attain acceptable levels of risk,
- to be responsive to public concerns,
- to ensure that the safeguards program is compatible with national energy goals.



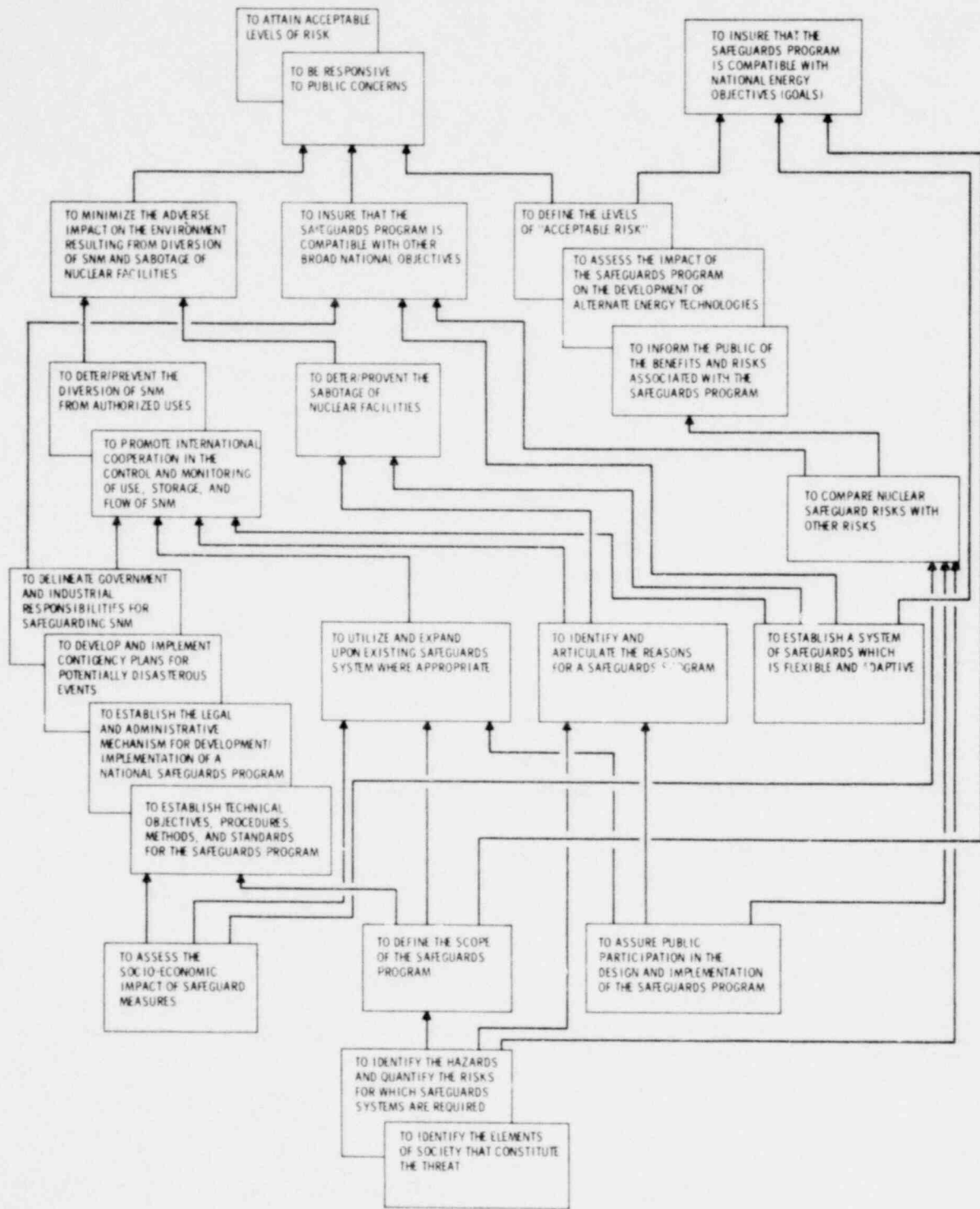


FIGURE A.12. Intent Structure for Safeguards Objectives



All the other objectives in the structure are desirable in order to support attaining these primary objectives. The clusterings and order of objectives reflect equality and level of the relations respectively. A cluster of objectives can be viewed as a single concept; objectives are independent if they have no supporting relations.

#### A.2.10 An Approach to Performance-Based Regulation Development (18)

The notion of performance of safeguards systems and its evaluation is an important factor in considering structure. This paper presents an objective-based, hierarchical structure which allows decomposition of societal objectives, functions, and components in support of the higher-order objectives.

Performance-based regulations impose minimum acceptable bounds on system functions which collectively satisfy the safeguards objectives. When regulations require the performance of system functions to exceed a specified level, those regulations are performance-based. Performance requirements can be in the form of design specifications.

The basic framework for developing performance-based regulations is a hierarchy. At the top of the hierarchy, the basic goal of assuring societal objectives is represented. The second level consists of functions which independently or collectively represent the ways to satisfy the basic function. Subsequent levels, in turn, satisfy functions in levels immediately above. The bottom level contains functions whose performance can be expressed in terms of physical parameters. The completed framework has explicit or implicit performance measures associated with each level.

The paper discusses a conceptual approach, using the above hierarchy, to develop performance-based regulations. Figure A.13 shows an example hierarchy for theft at a nuclear facility. The top function is to "protect the public against the consequences of theft". Two ways are shown which provide protection. One is to minimize consequences and the other is to protect against the theft of material.

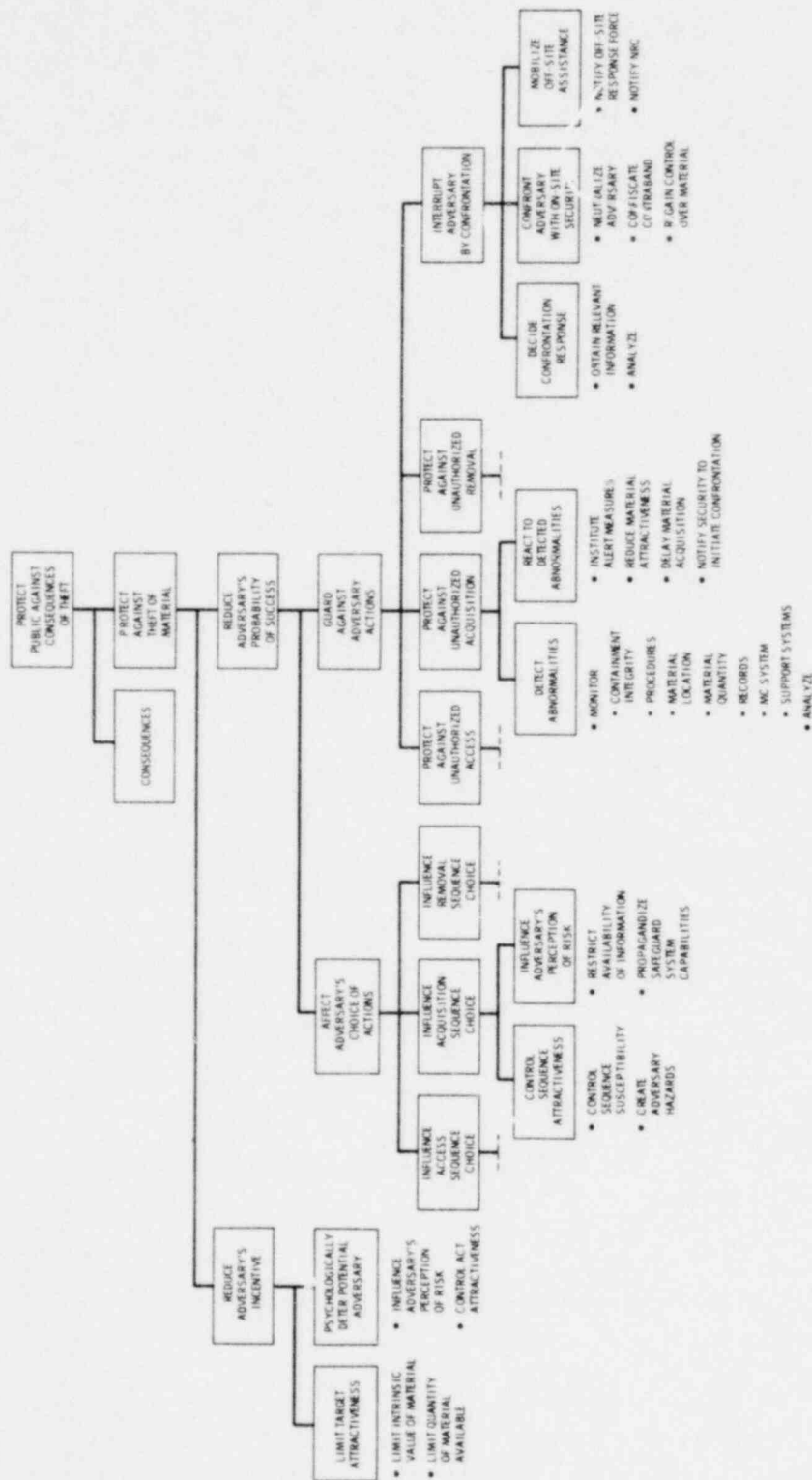


FIGURE A.13. Performance Based Regulation Development for Theft at Facilities

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## APPENDIX A

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APPENDIX B  
SAFEGUARDS INDEX

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## B.1 DISCUSSION

*This appendix provides a taxonomy of a number of the elements of the safeguards system.* A study of alternative structures exhibited by the regulations naturally begins with definitions of terms.

As exhibited by the alternative structures given in the main body of this report, the safeguards regulations are informational in nature. Thus, the organization of a safeguards system is based upon an interpretation of the regulations. For purposes of structuring, an organization is defined to be the collection of all properties producing the behavior of the system. These properties are referred to as elements.

In order to conduct the first stage of the structuring process it was necessary to identify a set of elements for the safeguards regulations. The terms which are defined in the following index represent such a possible collection of elements. The elements are parts of safeguards systems that may or may not be specified by the regulations.

Rather than simply define the elements as in a glossary or list, they are categorized along several dimensions based on actual or perceived ways they may be structured. One purpose of this study is to identify alternative conceptual structures for the safeguards regulations, hence it is assumed that there exists no "best" structure for the regulations. However, there are a number of logical groupings for the various elements. These groupings or categories are referred to as "bases."

The categories in the index were selected to facilitate the study of the content of the regulations. A number of studies which present safeguards structures as well as the regulations themselves were reviewed and the various aspects of each were incorporated either as bases or as elements. Definitions for some of the elements are formally given by the regulations, others were inferred by the context in which they are used, and others are given in several of the glossaries which are currently available. Sources for the definitions are provided as notes at the end of the index. For those elements not described in the literature, informal definitions were developed.

The index has been used as both a tool for the structuring process and to help identify content of the regulations. The informational structure of the safeguards regulations deals with a number of concerns including objectives, functions, mechanism, procedures and activities. Each of the bases deals with one or more of these concerns. The elements within a given base characterize the attributes of that base. The use of the index as a structuring tool is discussed in the body of the report.

The index is organized into thirty-three different bases. Each contains as many as thirty elements. The first page of the index lists the bases in key-word form. The index then lists the elements contained in that base and gives a definition for each. Where not self-explanatory, a brief discussion or definition is provided which characterizes the concern with which the base deals. Elements are not arranged in any particular order (alphabetical or otherwise) since the information system discussed in Appendix C has an ordering capability. To facilitate the look-up of specific terms, an alphabetical listing of elements is given at the end of the index.

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1. REGULATORY REQUIREMENT

- A. Goal Requirement
- B. Performance Requirement
- C. Procedural Requirement

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1. REGULATORY REQUIREMENT (1)

Regulatory Requirement - Legal requirements stipulated by the Code of Federal Regulations regarding form and detail.

- A. Goal Requirement - gives the primary purpose or objective to be achieved. It answers the question - "What output must be achieved?"
- B. Performance Requirement - gives the output and level of achievement required but does not prescribe the procedures or methods except in a general way. It provides a quantitative basis for measuring compliance. It answers the question - "how much output must be achieved?"
- C. Procedural Requirement - gives the action the regulatee must take; i.e., it prescribes the required procedures, actions, frequencies, and perhaps hardware. It answers the question "What and perhaps how much input must be used?"

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2. REGULATORY ACTIVITY

- A. Rulemaking
- B. Licensing
- C. Amendments to licenses
- D. Appeals
- E. Inspection
- F. Enforcement
- G. Research
- H. Guidance and/or standards
- I. Environmental impact analysis
- J. Technology transfer

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## TERMS - BASE 2: REGULATORY ACTIVITY

Regulatory Activity - Those activities conducted by the Nuclear Regulatory Commission to meet the requirements of their charter. It entails such supportive functions as proposing safeguards legislation, promulgating regulations, providing regulatory guides, disseminating information concerning penalties for theft and rewards for information about potential or actual thefts, assisting in the analysis of intelligence information, conducting a safeguards research program, and assessing the effectiveness of safeguards across the licensed nuclear industry.

- A. RULE MAKING - The issuance, amendment and repeal of regulations.<sup>(2)</sup> Includes rule development, the publication and public comment process, evaluation of comments, and final issuance.
- B. LICENSING - The process of granting a license, including evaluation of application, license review, conduct of hearings, etc.
  - a. license - except where otherwise specified, means a license issued pursuant to the requirements of parts 50, 70, and 71, CFR Chapter 10.<sup>(3)</sup>
- C. AMENDMENT TO LICENSES - Submission of an application for amendment to a license by licensee desiring to make a change or by the NRC on its own initiative.<sup>(4)</sup> See 10 CFR 70.32(b).
- D. APPEALS - requests by applicants, licensees, intervenors, or other parties, for reconsideration of regulatory decisions.
- E. INSPECTIONS - Official examination or review. Each licensee and each holder of a construction permit shall permit inspection, by duly authorized representatives of the Commission, of his records, premises, activities, and of licensed materials in possession or use, related to license or construction permit as may be necessary to effectuate the purpose of the act.<sup>(5)</sup>  
Also see 10 CFR Part 70, Sections 70.55<sup>(6)</sup> and 71.63.<sup>(7)</sup>
- F. ENFORCEMENT - To compel observance of the regulations by defining violations and by actions such as injunctions and penalties. An injunction or other court order may be obtained prohibiting any violation of any provision of the Atomic Energy Act of 1954, as

amended, or Title II of the Energy Reorganization Act of 1974, or any regulation or order issued thereunder. A court order may be obtained for the payment of a civil penalty imposed pursuant to section 234 of the Act for violation of section 53, 57, 62, 63, 81, 82, 101, 103, 104, 107, or 109 of the Act, or section 206 of the Energy Reorganization Act of 1974, or any rule, regulation, or order issued thereunder, or any term, condition, or limitation of any license issued thereunder, or for any violation for which a license may be revoked under section 186 of the Act. Any person who willfully violates any provision or order issued thereunder may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both, as provided by law. 40 FR 8793, Mar. 3, 1975. (8-11)

- G. RESEARCH - Research and development means: (1) theoretical analyses, exploration, or experimentation; or (2) the extension of investigative findings and theories of a scientific or technical nature into practical application purposes, including the experimental production and testing of models, devices, equipment, materials, and processes. (12)
- H. GUIDANCE and/or STANDARDS - Development of regulation criteria, guidelines, standards, and codes regarding safeguards aspects of locations, design, construction, and operation of nuclear facilities; and management and uses of nuclear materials held by licensees.
- I. ENVIRONMENTAL IMPACT ANALYSIS - Analysis which provides input balancing economic as well as environmental costs and benefits as to whether or not a specific action, e.g., licensed activity, can be implemented in an environmentally acceptable manner.
- J. TECHNOLOGY TRANSFER - The dissemination of research results to nuclear industry through technical reports, journal papers, guides, consensus standard and other informational processes on design methods, models, and procedures.

3. DESIGNATED PARTY

- A. Licensees
- B. Designers
- C. Construction contractor
- D. Nonlicensees
- E. Government boards, commissions
- F. Employees of licensee
- G. Carriers
- H. Security escorts
- I. Nuclear Regulatory Commission
- J. United States
- K. Agreement State
- L. Creditor
- M. Physician

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TERMS - BASE 3: DESIGNATED PARTY

DESIGNATED PARTY - the identified individuals or groups who must comply with regulations or are legally responsible for noncompliance.

PERSON - means (1) any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, Government agency other than the Commission or the Administration, except that the Administration shall be considered a person within the meaning of the regulations in this part to the extent that its facilities and activities are subject to the licensing and related regulatory authority of the Commission pursuant to section 202 of the Energy Reorganization Act of 1974 (88 Stat. 1244),<sup>(9)</sup> any State or any political subdivision of or any political entity within a State, any foreign government or nation or any political subdivision of any such government or nation, or other entity; and (2) any legal successor, representative, agent, or agency of the foregoing.(118)

- A. LICENSEES - Those persons authorized through the systems established by the Nuclear Regulatory Commission to possess or use special nuclear material.
- B. DESIGNERS - Architects or engineers responsible for design of facilities or equipment.
- C. CONSTRUCTION CONTRACTOR - The individual or organization performing construction or providing material for construction of a facility or process.
- D. NONLICENSEES - Auditors, consultants, and other parties providing services to the licensee (other than authorized individuals).
- E. GOVERNMENT BOARDS, COMMISSIONS - Government agencies other than the NRC including Atomic Safety and Licensing Board, Appeals Boards, State Agencies, etc., who interact formally with the Nuclear Regulatory Commission.

F. EMPLOYEES OF LICENSEE - including:

Authorized individual - any individual including an employee, a consultant, or an agent of a licensee who has been designated in writing by the licensee to have responsibility to enter a security area or for surveillance of special nuclear material.<sup>(13)</sup>

Guard - a uniformed individual with a firearm whose primary duty is the protection of special nuclear material against theft and/or the protection of a plant against radiological sabotage.<sup>(14)</sup>

Watchman - an individual, not necessarily uniformed or armed with a firearm, who provides surveillance for a plant and the special nuclear material therein in the course of performing other duties.<sup>(15)</sup>

Accountants - individuals performing the safeguards function of accounting. (BASE 23)

Safeguards manager - the manager of the safeguards organization or of specific functions within the safeguards system such as material control manager and accounting or security manager.(BASE 22)

Process managers - managers of the facility or its specific operations.

Operators - employees performing functions of facility operation.

Technicians, analysts - employees performing evaluative or technical functions such as measuring or assay.

Armed response individual - a trained and qualified person not necessarily uniformed whose primary duty in the event of attempted theft of SNM and/or sabotage of the facility shall be to respond, armed and equipped to prevent, delay or neutralize such actions.

- G. CARRIERS - Any person (or organization) engaged in the transportation of passengers or property, as common, contract, or private carrier, or freight forwarder, as those terms are used in the Interstate Commerce Act, as amended, or the U. S. Postal Service.<sup>(16)</sup> (Includes warehousemen, shipping agents, freight forwarders, etc.)



- H. SECURITY ESCORT - Any person engaged in the protection of special nuclear material in transit or transfer by accompanying that activity.
- I. NUCLEAR REGULATORY COMMISSION<sup>(117)</sup> - The organization charged with the responsibility for authorizing the possession and use of special nuclear material and for assuring that such possession and use is not inimical to the public health and safety or the national defense and security.
- J. UNITED STATES - When used in a geographical sense, includes all territories and possessions of the United States, the Canal Zone and Puerto Rico.<sup>(121)</sup>
- K. AGREEMENT STATE - As designated in Part 150 of Chapter 10 CFR means any State with which the Commission has entered into an effective agreement under subsection 274b. of the Atomic Energy Act of 1954, as amended. "Non-agreement State" means any other State.<sup>(122)</sup>
- L. CREDITOR - Includes, without implied limitation, the trustee under any mortgage, pledge, or lien on special nuclear material made to secure any creditor, any trustee or receiver of the special nuclear material appointed by a court of competent jurisdiction in any action brought for the benefit of any creditor secured by such mortgage, pledge, or lien, any purchaser of such special nuclear material at the sale thereof upon foreclosure of such mortgage, pledge, or lien or upon exercise of any power of sale contained therein, or any assignee of any such purchaser.<sup>(123)</sup>
- M. PHYSICIAN - An individual licensed by a state or territory of the United States, the District of Columbia or the Commonwealth of Puerto Rico to dispense drugs in the practice of Medicine.<sup>(124)</sup>

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4. SAFEGUARDS INTENTS

- A. Prevention
- B. Deterrence
- C. Containment
- D. Control
- E. Detection
- F. Apprehension and recovery
- G. Consequence reduction
- H. Protection
- I. Defense
- J. Assurance

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TERMS - BASE 4: SAFEGUARDS INTENTS

SAFEGUARDS INTENTS - Aims or purposes of the safeguards system.

- A. PREVENTION - The interruption of an adversary action sequence at any stage (BASE 32) from conception to completion.
- B. DETERRENCE - That function or activity whereby an adversary is influenced to decide to stop a sequence designed to obtain or misuse special nuclear material or to decide against commencing such a sequence. (BASE 19)
- C. CONTAINMENT - To keep an event within prescribed bounds, or to limit access to materials.
- D. CONTROL - To exercise direction over use and location of SNM.
- E. DETECTION - A determination that an adversary action sequence (BASE 32) is in progress, or has been completed.
- F. APPREHENSION AND RECOVERY - Legal arrest of unauthorized possessors and retrieval of nuclear material that exists outside the procedures and criteria specified by the Code of Federal Regulations. (Not an NRC function except for contingency plans).
- G. CONSEQUENCE REDUCTION - An action to reduce the loss to society should an adversary action (BASE 31) be perpetrated. Also refers to the aggregated effect of the entire safeguards system and its function.
- H. PROTECTION - To guard against the occurrence of an event.
- I. DEFENSE - The capability to prevent or reduce the possibility of an adversary from completing a sequence designed to obtain or misuse special nuclear material.
- J. ASSURANCE - Measures to satisfy the NRC and the public that safeguards are in place and can provide protection against attempted acts of theft, diversion, or sabotage that would significantly increase the risk to the public health, injury, or property damage. (126)

5. FACILITY TYPE

- A. Power reactor
- B. Research and test reactor
- C. Fuel production or fabrication
- D. Fuel reprocessing
- E. Waste storage, interim
- F. Final storage
- G. Spent fuel storage
- H. Enrichment plant

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TERMS - BASE 5: FACILITY TYPE

FACILITY - A reactor, a critical facility, a conversion plant, a fabrication plant, a reprocessing plant, an isotope separation plant, or a nuclear material storage location, containing or to contain nuclear material.<sup>(17.a)</sup> An education institution, manufacturing plant, laboratory, office, or building.<sup>(17.b)</sup> A production facility or a utilization facility as defined in Section 50.2 of Chapter 10 CFR. Fixed sites where nuclear material are located. (See below.)

PRODUCE - when used in relation to special nuclear material, means

- (1) to manufacture, make, or refine special nuclear material;
- (2) to separate special nuclear material from other substances in which such material may be contained; or (3) to make new special nuclear material;<sup>(119)</sup>

"Production facility" means:

- (1) Any nuclear reactor designed or used primarily for the formation of plutonium or uranium-233; or
- (2) Any facility designed or used for the separation of the isotopes of uranium or the isotopes of plutonium, except laboratory scale facilities designed or used for experimental or analytical purposes only; or
- (3) Any facility designed or used for the processing of irradiated materials containing special nuclear material, except (i) laboratory scale facilities designed or used for experimental or analytical purposes, (ii) facilities in which the only special nuclear materials contained in the irradiated materials to be processed are uranium enriched in the isotope U-235 and plutonium produced by the irradiation, if the materials processed contains not more than  $10^{-6}$  grams of plutonium per gram of U-235 and has fission product activity not in excess of 0.25 millicuries of fission products per gram of U-235, and (iii) facilities in which processing is conducted pursuant to a license issued under Parts 30 and 70 of Chapter 10 CFR, or equivalent regulations of an Agreement State, for the receipt, possession, use, and transfer of irradiated special nuclear material,

which authorizes the processing of the irradiated material on a batch basis for the separation of selected fission products and limits the process batch to not more than 100 grams of uranium enriched in the isotope 235 and not more than 15 grams of any other special nuclear material.<sup>(18)</sup>

"Utilization facility" means:

any nuclear reactor other than one designed or used primarily for the formation of plutonium or U-233.<sup>(15)</sup>

A. POWER REACTOR - Means a nuclear reactor of a type described in sections 50.21(b) or 50.22 of Chapter 10, CFR designated to produce electrical or heat energy.<sup>(19)</sup>

50.21(b) -(1) A production or utilization facility the construction or operation of which was licensed pursuant to subsection 104b of the Act prior to December 19, 1970;

(2) A production or utilization facility for industrial or commercial purposes constructed or operated under an arrangement with the Administration entered into under the Cooperative Power Reactor Demonstration Program, except as otherwise specifically required by applicable law; and

(3) A production or utilization facility for industrial or commercial purposes when specifically authorized by law.<sup>(20)</sup>

50.22 - (a) A class 103 license will be issued, to an applicant who qualifies, for any one or more of the following: to transfer or receive in interstate commerce, manufacture, produce, transfer, acquire, possess, use, import, or export under the terms of an agreement for cooperation, a production or utilization facility for industrial or commercial purposes; provided, however, that in the case of a production or utilization facility which is useful in the conduct of research and development activities of the types specified in section 31 of the Act, such facility is deemed to be for industrial or commercial purposes if the facility is to be used so that more than 50 percent of the annual cost of owning and

operating the facility is devoted to the production of materials, to the sale of services, other than research and development or education or training. (Secs. 103, 161; 68 Stat. 948, 84 Stat. 1472; 42 U.S.C. 2133, 2201) 28 DR 11446, May 8, 1973 <sup>(20)</sup>

- B. RESEARCH AND TEST REACTOR - "Research reactor" means a nuclear reactor licensed by the Commission under the authority of subsection 104c of the Act and pursuant to the provision of section 50.21(c) Chapter 10 CFR for operation at a thermal power level of 10 MW or less, and which is not a testing facility as defined by paragraph (m) of section 170.3 Chapter 10 CFR. <sup>(21)</sup>

"Testing facility" means a nuclear reactor licensed by the Commission under the authority of subsection 104c of the Act and pursuant to the provisions of 50.21(c) of Chapter 10 CFR for operation at:

- (1) A thermal power level in excess of 10 MW; or
  - (2) A thermal power level in excess of 1 MW, if the reactor is to contain:
    - (i) A circulating loop through the core in which the applicant proposes to conduct fuel experiments; or
    - (ii) A liquid fuel loading; or
    - (iii) An experimental facility in the core of excess of 16 square inches in cross-section. <sup>(22)</sup>
- C. FUEL PRODUCTION OR FABRICATION - "Fabrication." In nuclear material management, the manufacture of fuel elements for a reactor. <sup>(23)</sup>

"Plutonium Process and Fuel Fabrication Plant" means a plant in which the following operations or activities are conducted.

- (1) Operations for manufacture of reactor fuel containing plutonium, including any of the following:
  - (i) Preparation of fuel material;
  - (ii) Formation of fuel material into desired shapes;
  - (iii) Application of protective cladding



- (iv) Recovery of scrap material; and
  - (v) Storage associated with such operations; or
- (2) Research and development activities involving any of the operations described in subparagraph (1) of this paragraph, except for research and development activities utilizing unsubstantial amounts of plutonium.<sup>(24)</sup>
- D. FUEL REPROCESSING - The processing of nuclear fuel, after its use in a reactor to remove fission products and recover fissile, fertile, and other valuable materials.<sup>(22)</sup>
- E. INTERIM STORAGE: Storage operations for which (a) monitoring and human control are provided and (b) subsequent action involving treatment, transportation, or final disposition is expected.<sup>(26)</sup> Concepts for interim storage include bulk and unitized storage of solid, liquid, and gaseous wastes. (See BASE 9-F for waste definition)
- F. FINAL STORAGE - Storage operations for which (a) no subsequent waste treatment or transportation operations are anticipated and (b) conversion to disposal (i.e., termination of monitoring and human control) is considered possible.<sup>(28)</sup> The current concept for final storage is emplacement of wastes in geologic formations. The geologic formations may be on or near the earth's surface and augmented by engineering technology (i.e., burial grounds), or subsurface and augmented with engineering technology.
- G. SPENT FUEL STORAGE - In the uranium fuel cycle initially conceived for light water reactors (LWR) spent fuel was to be discharged from the reactors and then stored (at the reactor site) for five months. This cooling period would allow short-lived radioactive isotopes to decay and thereby reduce the heat generated. After the cooling period, the fuel was to be shipped to a chemical reprocessing plant, which would recover uranium and plutonium. Water-cooled storage of either base spent fuel or a package of fuel

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would normally be in a near-surface facility with water-filled cells of heavily reinforced concrete lined with stainless steel. (29)

H. ENRICHMENT PLANT - a facility that increases the amount of U-235 in uranium. (See BASES 9-I and 10-F)

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6. FIXED SITE OPERATION

- A. Mining
- B. Milling
- C. Refining
- D. Scrap recovery
- E. Chemical separation
- F. Enrichment
- G. Fuel fabrication
- H. Chemical conversion
- I. Assay
- J. Irradiation
- K. Waste glassification
- L. Interim storage, fuel
- M. Interim storage, waste
- N. Final storage
- O. Utilization
- P. Power production

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TERMS - BASE 6: FIXED SITE OPERATIONS

FIXED SITE OPERATIONS - Production activities and physical processes that take place at facilities. (BASE 5)

- A. MINING - The excavation of the earth for the purpose of extracting ores, e.g. uranium.
- B. MILLING - The grinding of ores to fine particle size. A uranium mill extracts uranium from the ore by mechanical and chemical processing of the mineral into a semi-refined product, commonly called "yellowcake," which contains 70-90%  $U_3O_8$ .
- C. REFINING - The removal of undesirable elements, oxides, etc., and of gases from ore to improve its purity.
- D. SCRAP RECOVERY -

Scrap: The byproduct forms of source and special nuclear materials generated during chemical and mechanical processing which are unsuitable for use as finished product.<sup>(30)</sup>

The term used for the nuclear material which accumulates during the fabrication of fuel elements, which may be recovered in a fabrication plant or a conversion plant.<sup>(31)</sup>

Scrap, Nonrecoverable: Scrap not economically recoverable at present nor in the foreseeable future.<sup>(32)</sup>

Scrap, Potentially Recoverable: Scrap which cannot be economically recovered at present but whose recovery appears likely to become feasible in the future.<sup>(33)</sup>

Scrap, Recoverable: Scrap containing nuclear materials which can be reclaimed economically as suitable feed by means of existing plant facilities.<sup>(30)</sup>

- E. CHEMICAL SEPARATION - The isolation of an element from a mixture by taking advantage of the element's chemical characteristics - used for fuel fabrication and reprocessing. Examples include solvent extraction and ion exchange.

F. ENRICHMENT - (1) The process of increasing the relative concentration of a desired constituent (especially an isotopic constituent).<sup>(17)</sup> (2) A number representing the degree of enrichment (above), expressed, for example, as weight per cent of U-235 in uranium.<sup>(23)</sup>  
(Gaseous diffusion is the technology often used for performing the enrichment operation)

G. FUEL FABRICATION - Fabrication: In nuclear materials management, the manufacture of fuel elements for a reactor.<sup>(23)</sup> Includes casting, machining, extraction and encapsulation.

In a light water reactor fuel fabrication plant, the following main operations might be carried out:

(1)  $UF_6$  is converted to  $UO_2$ .

(2) Pellets of the  $UO_2$  are formed and sintered to the desired density.

(3) The pellets are loaded into Zircaloy tubes.

(4) The tubes are fitted with end caps which are then welded into place.

(5) The tubes (fuel elements) are assembled into fixed arrays to be handled as fuel assemblies.

For plate fuel fabrication, melting, rolling, annealing, machining and inspection can be involved. An additional operation consists of recovery of uranium from scrap and material failing to meet the specification.<sup>(34)</sup>

H. CHEMICAL CONVERSION - Conversion: A process by which the chemical or physical properties of a material are changed so as to facilitate further use, usually fluorination or purification of mixed oxides.

I. ASSAY - To determine the concentration of the principal constituent of interest, sometimes by nondestructive means.

- J. IRRADIATION - Exposure of a target material to some form of emissions from a radiation source; i.e., x-rays, neutrons, or other radiation.

At the reactor, fresh-fuel assemblies are placed in the reactor core, and each is burned at a specific power and for a total burnup\* that may be the result of a complex decision process aimed at overall economic optimization.<sup>(35)</sup>

\*Specific power, commonly expressed in units of thermal megawatts per metric ton of uranium (MW/MTU), represents the rate at which energy is extracted from the fuel, and the burnup commonly expressed in thermal megawatt-days per metric ton of uranium (MWD/MTU), represents the total energy extracted. For MOX fuel, the unit of fuel is a metric ton of heavy metal (MTHM), i.e., a metric ton of (U + Pu).

- K. WASTE GLASSIFICATION - The vitrification of waste into glass for permanent waste storage.
- L. INTERIM STORAGE, FUEL - Spent Fuel Storage: In the uranium fuel cycle initially conceived for light water reactors (LWR), spent fuel was to be discharged from the reactors and then allowed to cool (at the reactor sites) for five months. This cooling period would allow short-lived radioactive isotopes to decay and thereby reduce the heat generated. After the cooling period, the fuel was to be shipped to a chemical reprocessing plant, which would recover uranium and plutonium. Water-cooled storage of either base spent fuel or package of fuel would normally be in a near-surface facility with water-filled cells of heavily reinforced concrete lined with stainless steel.<sup>(36)</sup>
- M. INTERIM STORAGE, WASTE - There are several points during the operational sequence of an integrated waste management program at which interim storage may be provided for various waste forms. The interim storage may be a holding, or surge, point between operations, as is the case with interim liquid storage of both high-level and intermediate level wastes. Interim storage may also

be a holding point for final solid waste products prior to final isolation or disposal.

Storage technologies include tank storage of liquid wastes, water basin storage of spent fuel elements, and warehouse and other engineered surface storage of solid wastes.<sup>(36)</sup>

- N. FINAL STORAGE, WASTE - Storage operations for which (a) no subsequent waste treatment or transportation operations are anticipated and (b) conversion to disposal (i.e., termination of monitoring and human control) is considered possible.<sup>(37)</sup>

The current concept for final storage is emplacement of wastes in geologic formations. The geologic formations may be on or near the earth's surface or subsurface and augmented by engineering technology (e.g., burial grounds).

- O. UTILIZATION - "Utilization facility" means any nuclear reactor other than one designed or used primarily for the formation of plutonium or U-233.<sup>(38)</sup>

"Utilization facility" means (1) any equipment or device, except an atomic weapon, determined by rule of the Commission to be capable of making use of special nuclear material in such quantity as to be of significance to the common defense and security, or in such manner as to affect the health and safety of the public, or peculiarly adapted for making use of atomic energy in such quantity as to be of significance to the common defense and security, or in such manner as to affect the health and safety of the public; or (2) any important component part especially designed for such equipment or device as determined by the Commission.<sup>(39)</sup>

"Utilization facility" means any nuclear reactor other than one used primarily for the formation of plutonium or U-233 and any other equipment or device determined by rule of the Commission to be a utilization facility within the preview of subsection 11cc of the Act.<sup>(40)</sup>

- P. POWER PRODUCTION - The production of electrical power by a nuclear reactor. (BASE 5.B)

7. TRANSIT

- A. Road
- B. Air
- C. Rail
- D. Sea
- E. Transfer
- F. Interim Storage
- G. Stops
- H. Internal Waterway
- I. Import - Export

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TERMS - BASE 7: TRANSIT

Transport: any land, sea, or air conveyance (41)

Transit: - operations, activities and modes used in the transportation of nuclear material.

- A. ROAD - conveyances used on roads or highways. These include: armored cargo vehicles, vehicles specially designed to undergo immobilization to delay penetration (e.g. SST safe secure trailer), public shippers, and exclusive use vehicles.
- B. AIR - Alternative shipping techniques available via aircraft. Methods of transport include: public shippers (cargo), exclusive use shippers, or U.S. certified shippers.
- C. RAIL - Alternative modes of rail transport including exclusive use trains or as cargo.
- D. SEA - Alternative modes of sea transport including: securely locked compartments, container ships, container surrounded; domestic or exclusive use.
- E. TRANSFER - the physical movement from one conveyance to another at points external to facilities.
- F. INTERIM STORAGE - the storage of material on a temporary basis during transfer.
- G. STOPS - locations in the transport system or routes designated for stopping of conveyance.
- H. INTERNAL WATERWAY - A river, channel, canal, or other navigable body of water within the continental United States used for transport.
- I. IMPORT - EXPORT - To bring in/send material from/to a foreign country - usually an agreement state (BASE 3 -K).



8. TIME PHASE OF FACILITY

- A. Planning
- B. Public hearings
- C. Design
- D. Site approval
- E. Commencement of construction
- F. Construction
- G. Operational test
- H. Normal Operations
- I. Maintenance
- J. Modification or backfitting
- K. Dismantling or decommissioning
- L. Threat or alarm mode (abnormal)
- M. Criticality

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TERMS - BASE 8: TIME PHASE OF FACILITY

TIME PHASE OF FACILITY - the temporal aspect of facilities (BASE 5) which relate to the regulatory process.

- A. PLANNING - The a priori activity including mental formulation of scope, program development, conceptual engineering and other assessments worked out before initiation of formal activities. Sessions in which public testimony is taken prior to issuance of license.
- B. PUBLIC HEARINGS - (a) In any proceeding in which a draft environmental impact statement is prepared, the draft environmental impact statement is made available to the public at least fifteen (15) days prior to the time of any relevant hearing. At any such hearing, the Commission's position is not presented until the final environmental impact statement is furnished to the Council on Environmental Quality and commenting agencies and is made available to the public. Any other party to the proceeding may present its case on NEPA matters prior to the end of the fifteen (15) day period.  
  
(b) In a proceeding in which a hearing is held for the issuance of a permit, license, or order, or amendment to or renewal of a permit, license, or order, covered by 10 CFR Section 51.5(a) the staff will offer the final environmental impact statement in evidence. Any party to the proceeding may take a position and offer evidence on the aspects of the proposed action.<sup>(42)</sup>
- C. DESIGN - The development of plans including specification of functions, detailed engineering, scale drawings, etc.
- D. SITE APPROVAL - The interim period when the Nuclear Regulation Commission reviews plans prior to allowing commencement of construction.

- E. COMMENCEMENT OF CONSTRUCTION - Any clearing of land, excavation, or other substantial action that would adversely affect the natural environment of a site but does not include changes desirable for the temporary use of the land for public recreational uses, necessary borings to determine site characteristics or other preconstruction monitoring to establish background information related to the suitability of a site or to the protection of environmental values.<sup>(43)</sup>
- F. CONSTRUCTION - The term "construction" includes pouring the foundation for, or the installation of, any portion of the permanent facility on the site, but does not include: (1) site exploration, site excavation, preparation of the site for construction of the facility, including the driving of piles, and construction of roadways, railroad spurs, and transmission lines; (2) procurement or manufacture of components of the facility; (3) construction of non-nuclear facilities (such as turbogenerators and turbine buildings) and temporary buildings (such as construction equipment storage sheds) for use in connection with the construction of the facility; and (4) with respect to production or utilization facilities, other than testing facilities, the construction of buildings which will be used for activities other than operation of a facility and which may also be used to house a facility. (For example, the construction of a college laboratory building with space for installation of a training reactor is not affected by this paragraph.) This paragraph does not apply to production or utilization facilities subject to paragraph (c) of this section.<sup>(44)</sup>
- G. OPERATIONAL TEST - Period in time prior to commencement of normal operation wherein system and processes are verified as capable of normal function.
- H. NORMAL OPERATIONS - Facility is operational and operating within its design basis limits.

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- I. MAINTENANCE - The act of keeping equipment in proper condition for operation. The act may occur during operation or require operation shutdown. Includes refueling.
- J. MODIFICATION OR BACKFITTING - "Backfitting" of a production or utilization facility means the addition, elimination or modification of structures, systems or components of the facility after the construction permit has been issued.<sup>(45)</sup>
- K. DECOMMISSIONING - The execution of a program to reduce the radioactivity levels in a nuclear facility to reduce any potential health and safety impact on the public.<sup>(46)</sup>

DISMANTLING - Dismantlement: Fully decontaminate or remove facility to reduce contamination to unrestricted level.

- L. THREAT or ALARM MODE - (See BASE 15-L,M)
- M. CRITICALITY - An alarm situation (safety and/or evacuation) wherein nuclear materials become critical.

CRITICAL - Fulfilling the condition that a medium capable of sustaining a nuclear chain reactor has an effective multiplication factor equal to unity. (A nuclear reactor is critical when the rate of neutron production, excluding neutron sources whose strengths are not a function of fission rate, is equal to the rate of neutron loss.)

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9. MATERIAL TYPE CLASSIFICATION

- A. Special Nuclear Material
- B. Source Material
- C. Strategic Special Nuclear Material
- D. By-Product Material
- E. Waste, Scrap
- F. Fissile Material
- G. Fertile Material
- H. Ultimate Product
- I. Enrichment Category
- J. Material in Process
- K. Unopened Receipts
- L. Removals from Material in Process
- M. Additions to Material in Process
- N. Sealed Sources

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TERMS - BASE 9: MATERIAL TYPE CLASSIFICATION

MATERIALS(S), NUCLEAR - A generic term used to refer to those materials of interest to the nuclear industry.<sup>(23)</sup>

- A. SPECIAL NUCLEAR MATERIAL - Means (1) plutonium, uranium 233, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission determines to be special nuclear materials, but does not include source material; or (2) any material artificially enriched by any of the foregoing, but does not include source material.<sup>(47)</sup>
- B. SOURCE MATERIAL - Means (1) uranium or thorium, or any combination thereof, in any physical or chemical form or (2) ores which contain by weight one-twentieth of one percent (0.05%) or more of (i) uranium, (ii) thorium or (iii) any combination thereof. Source material does not include special nuclear material.<sup>(49)</sup>
- C. STRATEGIC SPECIAL NUCLEAR MATERIAL - Means uranium-235 (contained in uranium enriched to 20% or more in the U-235 isotope), uranium-233, or plutonium.<sup>(52)</sup>
- D. BYPRODUCT MATERIAL - Any radioactive material (except SNM) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing SNM.<sup>(53)</sup>
- E. WASTE, SCRAP -

WASTE: A term applied to any source and special nuclear material which is no longer useful. Includes that which has become radioactive to the extent that the material itself exhibits an emission of radioactivity of such a level that it must be handled and disposed of by special methods such as sea disposal, land burial, or tank storage in order to protect the general public. Also includes scrap which has been evaluated and determined to be uneconomical to recover, but which is not necessarily radioactive.<sup>(30)</sup>

SNM SCRAP: Special nuclear material scrap means the various forms of special nuclear material generated during chemical and mechanical processing, other than recycle material and normal process intermediates, which are unsuitable for use in their present form, but all or part of which will be used after further processing.<sup>(54)</sup>

- F. FISSILE MATERIAL - Means uranium-233, uranium-235, plutonium-238, plutonium-239, and plutonium-241.<sup>(55)</sup>

FISSILE ISOTOPE - means (i) uranium-233 or (ii) uranium-235 by enrichment category.<sup>(57)</sup>

- G. FERTILE MATERIAL - An isotope, not itself fissionable by thermal neutrons, which can be converted into a fissionable material by irradiation in a reactor through capture of a single neutron per nucleus. There are two naturally occurring fertile materials, uranium-238 and thorium-232. When these fertile materials capture neutrons they are converted into fissionable plutonium-239 and uranium-233, respectively.<sup>(56)</sup>  
(Compare with Fissile Material.)

- H. ULTIMATE PRODUCT - Any special nuclear material in the form of a product that would not be further processed at the licensed location.<sup>(58)</sup>

- I. ENRICHMENT CATEGORY - For uranium-235 means high-enriched uranium - that uranium whose isotope content is 20 percent or more uranium-235 by weight, and low-enriched uranium - that uranium whose isotope content is less than 20 percent uranium-235 by weight.<sup>(59)</sup> (See BASE 10-F)

- J. MATERIAL IN PROCESS - Means any special nuclear material possessed by the licensee except in unopened receipts, sealed sources, and ultimate product maintained under tamper-safing.<sup>(60)</sup>

- K. UNOPENED RECEIPTS - Means receipts not opened by the licensee, including receipts of sealed sources, and receipts opened only for sampling and subsequently maintained under tamper-safing.<sup>(61)</sup>

- L. REMOVALS FROM MATERIAL IN PROCESS - Includes measured quantities of special nuclear material disposed of as discards, encapsulated as a sealed source, or in other ultimate product placed under tamper-safing or shipped offsite. (62)
- M. ADDITIONS TO MATERIAL IN PROCESS - Means receipts that are opened except receipts opened only for sampling and subsequently maintained under tamper-safing, and opened sealed sources. (63)
- N. SEALED SOURCES - Means any special nuclear material that is encased in a capsule designed to prevent leakage or escape of the special nuclear material. (128)

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10. ELEMENTAL OR ISOTOPIC FORMS

- A. Plutonium 238
- B. Plutonium 239-241
- C. Plutonium 242
- D. U-233
- E. U-235
- F. Uranium-enriched
- G. U-natural
- H. U-depleted
- I. Am-241, 243
- J. Curium
- K. Berkelium
- L. Californium
- M. Lithium(Li<sup>5</sup>)
- N. Neptunium
- O. Helium 3
- P. Deuterium
- Q. Tritium
- R. Thorium

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TERMS - BASE 10: ELEMENTAL OR ISOTOPIC FORMS

NUCLEAR MATERIALS - Any source or special fissionable material as defined in Article XX of INFCIRC 66/Rev. 2.

ELEMENTAL FORMS - The chemical description of the material as a metallic or molecular species, or a designation based on other material descriptors such as mixtures.

ELEMENT - Uranium or plutonium<sup>(64)</sup>

F. URANIUM-ENRICHED -

Fully Enriched: Uranium having a U-235 isotopic percent of 93 or more.<sup>(30)</sup>

Enriched Material: Material in which the percentage of a given isotope has been artificially increased, so that it is higher than the percentage of that isotope naturally found in the material.

Enriched uranium contains more of the fissionable isotope uranium-235 than the naturally occurring percentage (0.711%).<sup>(65)</sup>

(See BASE 9-1)

G. U-NATURAL - Uranium whose isotopic composition is as it occurs in nature, 0.711% U-235.<sup>(30)</sup>

H. U-DEPLETED - Uranium in which the percentage by weight of the isotope uranium-235 in the total uranium present is less than that occurring in natural uranium.<sup>(65)</sup>

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II. MATERIAL MEASURES

- A. Weight
- B. Radioactivity
  - Large quantity
  - Transport group
  - Type A and Type B
- C. % Enrichment
- D. Fissile Classification
- E. Effective Kilograms
- F. Special Form
- G. Formula Quantity
- H. Critical Mass
- I. Significant Amount

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TERMS - BASE 11: MATERIAL MEASURES

A. WEIGHT - A measure of mass, usually expressed in grams or kilograms.

B. RADIOACTIVITY -

Curies: means that amount of radioactive materials which disintegrates at the rate of 37 billion atoms per second.<sup>(66)</sup>

Large quantity: means a quantity of radioactive material, the aggregate radioactivity of which exceeds any one of the following: (1) for transport groups as defined in paragraph (p) of section 71.4 Chapter 10 CFR; (i) Group I or II radionuclides: 20 curies; (ii) Group III or IV radionuclides: 200 curies; (iii) Group V radionuclides : 5,000 curies; (iv) Group VI or VII radionuclides: 50,000 curies; and (2) for special form materials as defined in paragraph (o) of section 71.4 Chapter 10 CFR: 5,000 curies.<sup>(67)</sup>

Transport group: means any one of seven groups into which radionuclides in normal form are classified, according to their toxicity and their relative potential hazard in transport, in Appendix C of part 71 Chapter 10 CFR.

(1) Any radionuclide not specifically listed in one of the groups in Appendix C shall be assigned to one of the Groups in accordance with the following table:

---

Radionuclide	Radioactive Half-Life		
	0 to 1000 days	1000 days to 10 <sup>6</sup> years	Over 10 <sup>6</sup> years
Atomic Number 1-81	Group III...	Group II....	Group III.
Atomic Number 82+	Group I.....	Group I.....	Group III.

---

(2) For mixtures of radionuclides the following shall apply:

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- (i) If the identity and respective activity of each radionuclide are known, the permissible activity of each radionuclide shall be such that the sum, for all groups present, of the ratio between the total activity for each group will not be greater than unity.
- (ii) If the groups of the radionuclides are known but the amount in each group cannot be reasonably determined, the mixture shall be assigned to the most restrictive group present.
- (iii) If the identity of all or some of the radionuclides cannot be reasonably determined, each of those unidentified radionuclides shall be considered as belonging to the most restrictive group which cannot be positively excluded.
- (iv) Mixtures consisting of a single radioactive decay chain where the radionuclides are in the naturally occurring proportions shall be considered as consisting of a single radionuclide. The group and activity shall be that of the first member present in the chain, except that if a radionuclide "x" has a half-life longer than that of that first member and an activity greater than that of any other member, including the first, at any time during transportation, the transport group of the nuclide "x" and the activity of the mixture shall be the maximum activity of that nuclide "x" during transportation.<sup>(68)</sup>

"Type A quantity" and "Type B quantity": means a quantity of radioactive material the aggregate radioactivity of which does not exceed that specified in the following table:

Transport Groups see part 71 Chapter 10 CFR, section 71.4(p)	Type A quantity (in curies)	Type B quantity (in curies)
I.....	0.001	20
II.....	0.05	20
III.....	3	200
IV.....	20	200
V.....	20	5,000
VI and VII.....	1,000	50,000
Special Form.....	20 <sup>1</sup>	5,000

<sup>1</sup>Except that for californium-252, the limit is 2 Ci.(69)

Low specific activity material means any of the following:

(1) uranium or thorium ores and physical or chemical concentrates of those ores;

(2) unirradiated natural or depleted uranium or unirradiated natural thorium;

(3) tritium oxide in aqueous solutions provided the concentration does not exceed 5.0 millicuries per milliliter.

(4) material in which the activity is essentially uniformly distributed and in which the estimated average concentration per gram of contents does not exceed:

(i) 9.0001 millicurie of Group I radionuclides, or;

(ii) 0.005 millicurie of Group II radionuclides, or;

(iii) 0.3 millicurie of Groups III or IV radionuclides.<sup>(70)</sup>

C. % ENRICHMENT - See BASES 10-F and 9-I.

D. FISSILE CLASSIFICATION - Classification of a package or shipment of fissile materials according to the controls needed to provide nuclear criticality safety during transportation as follows:

(1) Fissile Class I: packages which may be transported in unlimited numbers and in any arrangement and which require no nuclear criticality safety controls during transportation. For purposes of nuclear criticality safety control, a transport index is not assigned to Fissile Class I packages. However, the external radiation levels may require a transport index number.

(2) Fissile Class II: packages which may be transported together in any arrangement but in numbers which do not exceed an aggregate transport index of 50. For purposes of nuclear criticality safety control, individual packages may have a transport index of not less than 0.1 and not more than 10. However, the external radiation levels may require a higher transport index number but not to exceed 10. Such shipments require no nuclear criticality safety control by the shipper during transportation.

(3) Fissile Class III: shipments of packages which do not meet the requirements of Fissile Classes I or II and which are controlled in transportation by special arrangements between the shipper and the carrier to provide nuclear criticality safety.<sup>(71)</sup>

Transport index - determined from the following table<sup>(125)</sup>

Maximum quantity of fissile material in a single package

U-234 (grams)	U-233 (grams)	Plutonium (grams)	Pu-Be Sources (grams)	Corresponding Transport Index
35-40	27-30	23-25	320-400	10
30-35	24-27	21-23	240-320	8
25-30	21-24	19-21	160-240	6
20-25	18-21	17-19	80-160	4
15-20	15-18	15-17	15-80	2

Combinations of fissile materials are authorized. For combinations of fissile materials, the transport index is the sum of the individual corresponding transport indices. The total transport index shall not exceed 10 per package.

- E. EFFECTIVE KILOGRAM (SPECIAL NUCLEAR MATERIAL) - Means (1) for plutonium and uranium-233 their weight in kilograms; (2) for uranium with an enrichment in the isotope U-235 of 0.01 (1%) and above, its element weight in kilograms multiplied by the square of its enrichment expressed as a decimal weight fraction; and (3) for uranium with an enrichment in the isotope U-235 below 0.01 (1%), by its element weight in kilograms multiplied by 0.0001.<sup>(72)</sup> In the case of depleted uranium with an enrichment of 0.005 (0.5%) or below, and in the case of thorium, its weight in kilograms multiplied by 0.00005.<sup>(31)</sup>
- F. SPECIAL FORM - Means any of the following physical forms of licensed material of any transport group:
- (1) The material is in solid form having no dimension less than 0.5 millimeter or at least one dimension greater than five millimeters; does not melt, sublime, or ignite in air at a temperature of 1,000<sup>0</sup>F; will not shatter or crumble if subjected to the percussion test described in Appendix D of Chapter 10 CFR Part 71; and is not dissolved or converted into dispersible form to the extent of more than 0.005 percent by weight by immersion for 1 week in water at 68<sup>0</sup>F or in air at 86<sup>0</sup>F;
  - (2) The material is securely contained in a capsule having no dimension less than 0.5 millimeter or at least one dimension greater than five millimeters, which will retain its contents if subjected to the tests prescribed in Appendix D of Chapter 10 CFR part 71; and which is constructed of materials which do not melt, sublime, or ignite in air at 1,475<sup>0</sup>F, and do not dissolve or convert into dispersible form to the extent of more than 1 week in water at 68<sup>0</sup>F or in air at 86<sup>0</sup>F.<sup>(73)</sup>
- G. FORMULA QUANTITY - SSNM in any combination in a quantity of 5000 grams or more computed by the formula:
- $$\text{Grams} = (\text{grams contained U-235}) + 2.5 (\text{grams U-233} + \text{grams Plutonium})^{(74)}$$



FIVE FORMULA KILOGRAMS - A quantity of 5,000 grams of the isotope uranium-235 (contained in uranium enriched to 20% or more in the uranium-235 isotope), uranium-233, or plutonium alone or in any combination, computed by the formula, grams = (grams contained uranium-235) + 2.5 (grams uranium-233 + grams plutonium).

- H. CRITICAL MASS - (a) For the purposes of this Part 150, 10 CFR special nuclear material in quantities not sufficient to form a critical mass means uranium enriched in the isotope U-235 in quantities not exceeding 350 grams of contained U-235; uranium-233 in quantities not exceeding 200 grams, plutonium in quantities not exceeding 200 grams; or any combination of them in accordance with the following formula: for each kind of special nuclear material, determine the ratio between the quantity of that special nuclear material and the quantity specified above for the same kind of special nuclear material. The sum of such ratios for all kinds of special nuclear materials in combination shall not exceed unity. For example, the following quantities in combination would not exceed the limitation and are within the formula as follows<sup>(75)</sup>:

$$\frac{175 \text{ (grams contained U-235)}}{350} + \frac{50 \text{ (grams U-233)}}{200} + \frac{50 \text{ (grams Pu)}}{200} = 1$$

I. SIGNIFICANT AMOUNT -

Five formula kilograms or more of strategic special nuclear material (See strategic special nuclear material BASE 9-C and five formula kilograms BASE 10-G.)

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12. SAFEGUARDS PERFORMANCE CRITERIA

- A. Protect
- B. Single mode failure
- C. Common mode failure
- D. Neutralize
- E. Fail safe
- F. Avoidance
- G. Prevention
- H. Delay
- I. Timeliness, Rapid, Real-Time
- J. Test
- K. Continuous knowledge
- L. Natural wariness
- M. Level of protection
- N. Self-checking
- O. Quality assurance
- P. Material-attractiveness
- Q. Integrity
- R. Not Accessible to Theft
- S. Interruption

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TERMS - BASE 12: SAFEGUARDS PERFORMANCE CRITERIA

EFFECTIVENESS - A level of performance determined by the value of a selected, relevant performance parameter.<sup>(76)</sup>

PERFORMANCE CRITERIA - A value of a performance parameter established as an acceptable minimum level in or by the regulatory process; same as performance requirement.<sup>(76)</sup>

PERFORMANCE PARAMETER - A measureable dimension or a numerical indicator whose value describes the level of performance of a safeguards system or subsystem in relation to a specified safeguards objective or function.<sup>(76)</sup>

- A. PROTECT - To guard from attack, or loss, to cover or shield from danger. (See BASE 4-H)
- B. SINGLE-MODE-FAILURE - A failure of a single physical component.
- C. COMMON-MODE-FAILURE - A failure of two or more physical components at a given time by a single causative event.
- D. NEUTRALIZE - (1) To destroy the effectiveness of adversaries by responses, (2) to disarm or otherwise render safe.<sup>(77)</sup> (See BASE 16)
- E. FAIL-SAFE - A system whose function is not lost given failure of power, control circuits, structural members, or other components; will not endanger people operating the system or other people in the vicinity; or whose failure is announced.
- F. AVOIDANCE - To avert the compromise of safeguards systems functions by not including certain actions or procedures which would compromise safeguards systems functions.
- G. PREVENTION - (1) To keep from happening as by some prior action or (2) to keep (someone) from compromising safeguards systems. (See BASE 4-A)
- H. DELAY - An increase in the time required for completion of some part of an adversary action sequence.<sup>(76)</sup> (See BASE 32)

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- I. TIMELINESS - Speed at which safeguards systems functions are performed or how soon results are obtained.
- RAPID - Providing or analyzing information in a timely manner. For example, a rapid material control system provides material status information at the end of each shift.
- REAL-TIME - Providing or analyzing information with no perceptible delay. For example, a real-time material control system is a system, consisting of an on-line computer interfaced directly with material assay stations throughout a plant, to provide current material status information.
- J. TEST - A process for trying or assessing performance.
- K. CONTINUOUS KNOWLEDGE - Uninterrupted awareness of an activity which is monitored by the safeguards system.
- L. NATURAL WARINESS - The awareness of personnel to potential abnormal circumstances which detract or obstruct safeguards system.
- M. LEVEL OF PROTECTION - A measure of system effectiveness in protecting.
- N. SELF-CHECKING - The ability of a system to indicate intrusion, modification or minor failures.<sup>(78)</sup>
- O. QUALITY ASSURANCE - Testing and inspecting all of or a portion of the safeguards system to ensure that a desired performance level is maintained.<sup>(77)</sup>
- P. MATERIAL ATTRACTIVENESS - Material properties such as form, enrichment, purity, fissile isotope content, packaging, or quantity which makes it desirable for potential theft.
- Q. INTEGRITY - Property of being complete, sound, unimpaired, intact, or perfect condition. For example, checking the integrity of a tamper-safed container would consist of ensuring that the seal had not been broken and that the container had not been otherwise breached.
- R. NOT ACCESSIBLE TO THEFT - Special nuclear material is considered to be not accessible to theft if it is a) not readily separable from

other radioactive material and the combined materials have a total external radiation dose rate in excess of 100 rems per hour at a distance of 3 feet from any accessible surface without intervening shielding, b) locked in a vault-type room which is tamper-safed and under continuous electronic intrusion detection surveillance, or c) of a size and form which prohibits diversion or theft without rapid detection, such as a fuel assembly.

- S. INTERRUPTION - interception of an adversary sequence by a response force before an adversary sequence (BASE-32) is complete. Implies only a meeting of response force and adversary which may result only in delay.

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13. ACCESS CONTROL

- A. Identification Procedures
- B. Visitors
- C. Employee procedures
- D. Identification information
- E. Search, personnel
- F. Search, packages
- G. Personnel escort
- H. Authorization criteria
- I. Badge display
- J. Vehicle access
- K. Vehicle exclusion
- L. Vehicle searches
- M. Confirmation
- N. Doorway monitors
- O. Door locking, interlocking
- P. Vouched for
- Q. Continuously manned
- R. Clothing change
- S. Temporal, scheduling, time limits
- T. Nude walk through
- U. Isolation
- V. Personnel Duties
- W. Access registration
- X. Prohibit stops
- Y. Safe haven
- Z. Transit storage, interim
- AA. Access authorization
- BB. Closed-loop control
- CC. Contraband

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TERMS - BASE 13: ACCESS CONTROL

ACCESS CONTROL - The monitoring and enabling of authorized movement of personnel, vehicles, and packages entering and exiting security areas.

PROCEDURE - A predefined course or conduct of action.

- A. IDENTIFICATION PROCEDURES - The recognition and establishment of identity (badge checking/identify/log) of personnel. Includes establishment of organization component, position title, authorization, and identification information.
- B. VISITORS - Characterization of all personnel desiring access to facility on an irregular basis or requiring special authorization (vendors, servicemen, deliverymen, utility personnel, manufacturer's representatives, repairmen, inspectors, dignitaries, etc.)
- C. EMPLOYEES - Procedures for personnel requiring access under normal operations.
- D. IDENTIFICATION INFORMATION - Information which uniquely describes an individual and can be easily used to identify him. Generally includes photograph, security clearance, expiration date, identification number, name, birthdate, fingerprints, signature, coding, etc.
- E. SEARCH, PERSONNEL - The examination either by physical contact or by instruments of a person to determine if contraband or excluded items are being carried.
- F. SEARCH, PACKAGE - Examination of personal items such as valises, tool boxes, etc., to determine or verify contents and identify contraband or excluded items such as weapons, explosives, or possibly substitute materials for special nuclear material. (Do not confuse with Packaging of nuclear material BASE 26.P.)
- G. PERSONNEL ESCORT - The personnel escort program for visitors or uncleared personnel and the responsibilities of the escort in accompanying the visitor in controlled areas.

- H. AUTHORIZATION APPROVAL CRITERIA - The standards or rules to formally sanction access including the personnel having authority to approve access.
- I. BADGE DISPLAY - Standards for locating identification information on a person.
- J. VEHICLE ACCESS - The entry and exit control procedures established for controlling vehicles' ingress to/egress from security areas, including time periods, mode of access, delivery and shipping activities.
- K. VEHICLE EXCLUSION - Vehicle access denial.
- L. VEHICLE SEARCHES - The examination of vehicles to determine and verify contents and identify contraband or excluded items. (See search, package and search, personnel.)
- M. CONFIRMATION - The corroboration and verification of access control procedures.
- N. MONITORS, DOORWAY - Instruments used to measure either continuously or at intervals to detect excluded items for access denial or to detect special nuclear material or metal for egress denial. Includes standards and guidelines for their utilization.
- O. DOOR LOCKING, INTERLOCKING - Procedures for tamper-proof sealing of access points.
- P. VOUCHERED FOR - Method of establishing identity of an individual by personal confirmation from second party who is an identified, authorized individual.
- Q. CONTINUOUSLY MANNED - Locations having safeguards personnel on duty at all times.
- R. CLOTHING CHANGE - Method of reducing potential concealment of contraband or excluded items through access points, prior to access. (See BASE 13-T)



- S. TEMPORAL-SCHEDULING, TIME LIMITS - Time constraints and limitations in access control procedures; applied to both access control personnel and those requiring access.
- T. NUDE WALK THROUGH - Removal of an individual's clothing during access.
- U. ISOLATION - Location of access points separate from other activities allowing containment and enhancing surveillance.
- V. PERSONNEL DUTIES - Responsibility of personnel in controlling access.
- W. ACCESS REGISTRATION - Procedures for recording certain access events.
- X. PROHIBIT STOPS - Transportation procedure excluding all intermediate stops in transit.
- Y. SAFE HAVEN - A location intermediate to initial and destination points in transit with additional (to normal transit) safeguards.
- Z. INTERIM STORAGE - Storage procedures for locations intermediate to initial and destination points in transit.
- AA. ACCESS AUTHORIZATION - An administrative determination that a person is eligible for access to a secured area or to restricted information.
- BB. CLOSED-LOOP CONTROL - A function which monitors specific access or operational sequences, compares the monitored sequence to a previously authorized sequence and either permits the sequence to continue or, in case of a discrepancy, halts or corrects the sequence and/or initiates an alarm.
- CC. CONTRABAND - Material or equipment defined as presenting a potential safeguard hazard which is not allowed in a facility; includes items such as explosives, weapons, or tools that may be used for adversary actions. (BASE 31)

14. SURVEILLANCE

- A. Periodic
- B. Random
- C. Continuous
- D. Portal checks
- E. Seal checks, vault checks
- F. Personnel duties
- G. Procedures
- H. Informants
- I. Key personnel
- J. Monitoring
- K. Patrols
- L. Locations
- M. Illumination, visibility
- N. Temporal, scheduling
- O. Guard posts
- P. Remote

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TERMS - BASE 14: SURVEILLANCE

SURVEILLANCE - The direct or indirect observation of individuals and/or materials to detect activities potentially involving access to nuclear material for diversion.

- A. PERIODIC - Regularly scheduled events whose time of occurrence can be predicted through knowledge of past history of occurrences of the event.
- B. RANDOM - Scheduled on the basis of chance.
- C. CONTINUOUS - Without stopping, at all times or over a prescribed period of time.
- D. PORTAL CHECKS - Access or egress controls over personnel.
- E. SEAL CHECKS, VAULT CHECKS - Sealed material locations which are surveyed.
- F. PERSONNEL DUTIES - Surveillance duties to be performed by individuals under normal circumstances.
- G. PROCEDURES - Rules and standards for conduct of surveillance.
- H. INFORMANTS - Personnel other than security personnel who provide detection information.
- I. KEY PERSONNEL - Identification of personnel requiring additional surveillance, or principal individuals in a safeguards system, e.g., custodians of special nuclear material.
- J. MONITORING - A collection of safeguards actions, including surveillance, designed to confirm whether or not a prescribed event of safeguards interest has taken place. Examples of such usage are (1) the monitoring of a transfer of an SNM shipment to assure the transfer has taken place in the prescribed way; and (2) the monitoring of an isolation area following a false alarm to determine whether or not an intrusion has occurred.
- K. PATROLS - The action of moving about and inspecting an area for purposes of surveillance. (Scope, extent, route.)

- L. LOCATIONS - Identifications or specifications of locations in the safeguards system requiring surveillance. (See BASE 29)
- M. ILLUMINATION-VISIBILITY - Design and equipment requirements which permit or enhance surveillance.
- N. TEMPORAL-SCHEDULING - Time constraints and limitations in surveillance procedures.
- O. GUARD POSTS - Locations in the safeguards system (other than access) where personnel are either continuously or periodically stationed for purposes of surveillance or access control.
- P. REMOTE - Surveillance performed using devices such as closed circuit television (BASE 24-H) at locations removed from site such as central station (BASE 21-B).

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15. INVESTIGATION

- A. Deviation from authorized
- B. Need-to-know
- C. Liaison with law enforcement agencies
- D. Abnormal situations
- E. Identification of security threats
- F. Tracing
- G. Non routine events
- H. Natural event
- I. Nuclear event
- J. Civil disturbance
- K. Threat event
- L. Alarm limits
- M. Alarm assessment
- N. Security Clearance

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TERMS - BASE 15: INVESTIGATION

- INVESTIGATION - The systematic inquiry, examination, identification and assessment of activities, or circumstances to prevent, avoid, or alert of potential compromise of a safeguards system.
- A. DEVIATION FROM AUTHORIZED - An abnormality or departure from authorized procedures or activities requiring investigation.
  - B. NEED-TO-KNOW (or need to have access) - - The official (NRC) authorization of an individual's access to a safeguards location. Investigation procedures establish and verify the information requirements for authorization. (See BASE 13-AA)
  - C. LIAISON WITH LAW ENFORCEMENT AGENCIES - The interaction with and reliance upon local police or federal security agencies for purposes of interdiction (BASE 16-C) or investigation.
  - D. ABNORMAL SITUATIONS-EVENTS - Occurrences or incidents which require investigation.
  - E. IDENTIFICATION OF SECURITY THREATS - The ascertaining of the origin and nature of possible threat events including adversary characteristics in order to initiate response procedures. (See Alarm Assessment BASE 15-N.)
  - F. TRACING - (1) The process of tracking a transaction as a recorded occurrence back to its origin or back to source documents.  
(2) Locating of shipments that are misrouted in transport.
  - G. NONROUTINE EVENTS - Power outage, damage to records, equipment malfunctions, outage of critical safeguards equipment, strikes, and other abnormal events which affect operations of safeguards activity.
  - H. NATURAL EVENTS - Floods, earthquakes, storms.
  - I. NUCLEAR EVENT - An event which may cause a radioactive release including: nuclear accident, criticality, nuclear explosion or dispersion.

- J. CIVIL DISTURBANCE EVENT - Activities conducted by groups, e.g., mobs, protests, crowds, riots.
- K. THREAT EVENT - Known presence of adversary group at some location (BASE 29) intent upon illegitimate willful, anti-social, final acts involving nuclear material or nuclear facilities which cause or threaten to cause damage to society. (See BASE 31)
- L. ALARM LIMITS - Prescribed maximum and/or minimum quantities which, if exceeded, cause a warning signal is to be given.<sup>(23)</sup>
- M. ALARM ASSESSMENT - The gathering of sufficient information to determine, and the final determination of, the significance of evidence that a malevolent act may have occurred. Assessment techniques should provide such information as the nature of the threat which cause an alarm and the reliability of the alarm.<sup>(126)</sup>
- N. SECURITY CLEARANCE - The investigation of the background history of an individual and the evaluation of that information to determine whether the individual is a satisfactory candidate for a job involving access to nuclear material or access to safeguards information or service in a safeguards function. (Need to have have access BASE 15-B is a separate issue.)

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16. RESPONSE

- A. Response to security threats
- B. Warnings
- C. Liaison
- D. Call assistance
- E. Tactics
- F. Response level, force
- G. Hot pursuit
- H. Arrest
- I. Response to contingency events
- J. Alarm annunciation
- K. Assessment of threat
- L. Assessment of contingency
- M. Temporal

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TERMS - BASE 16: RESPONSE

RESPONSE - A safeguard reaction taken to interrupt, or delay an adversary's action sequence, to recover lost material, and to reduce potential consequences of an adversary's end event.

- A. RESPONSE TO THREAT EVENTS - Measures that are enacted to neutralize a threat event (BASE 15-K) based upon an assessment of the threat.<sup>(68)</sup> (BASE 16-K)
- B. WARNING - Methods of advising potential adversaries that they are about to or have committed a violation (warning shots, vocal, signs, show of force).
- C. LIAISON - Interaction with local, state, federal, and military agencies for purpose of response or interdiction; procedures, authority to contact.
- D. CALL ASSISTANCE - Call to local law enforcement agency or the summoning of off-duty guards or watchmen to augment the on-duty forces.
- E. TACTICS - The strategy of response including the deployment and direction of security personnel.
- F. RESPONSE LEVEL - The degree of force exercised, size and composition of force making a response.
- G. HOT PURSUIT - Response procedures which occur immediately or within a reasonable time after material leaves facility boundaries.
- H. ARREST - Procedures for detention and incarceration for prosecution of transgressors.
- I. RESPONSE TO CONTINGENCY - Immediate measures that are enacted to neutralize events which reduce the efficiency of the safeguards systems.
- J. ALARM ANNUNCIATION - Annunciation of a threat or detection of an adversary action. (See BASE 21-J)

- K. ASSESSMENT OF THREAT - Estimate of adversary group size, action mode, stage of action, armament and intent.(BASE 30)
- L. ASSESSMENT OF CONTINGENCY - Estimate of degree of consequence of events other than threat events.
- M. TEMPORAL - Expected response time and maximum response times for specific events.

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17. PLANNING -- DESIGN

- A. Design basis incident
- B. Design bases for basic physical protection
- C. Plant isolation
- D. Security area isolation
- E. Design features
- F. Design relationships
- G. Equipment
- H. Surveillance design
- I. Emergencies, contingencies
- J. Test control
- K. Handling, storage, shipping
- L. Nonconforming materials, parts, or components
- M. Badge system
- N. Weapons
- O. Security equipment
- P. Keys, locks, combinations
- Q. Responsibilities
- R. Arrangements for assistance
- S. Security plan changes
- T. Special temporary procedures
- U. Schedules
- V. Shipping plans
- W. Physical security plan

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TERMS - BASE 17: PLANNING-DESIGN

PLANNING - The a priori activities which provide assurance of safeguards systems performance in all phases of operation and conformance with applicable regulatory requirements.

DESIGN BASES - That information which identifies the specific functions to be performed by a structure, system, or component of a facility, and the specific values or ranges of values chosen for controlling parameters as reference bounds for design. These values may be (1) restraints derived from generally accepted "state of the art" practices for achieving functional goals, or (2) requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals.<sup>(127)</sup>

- A. DESIGN BASIS INCIDENT - A postulated credible incident and the resulting conditions for which security related equipment must meet its functional objectives. (Also DESIGN BASIS THREAT)
- B. DESIGN BASES FOR PHYSICAL PROTECTION - Specification for the effectiveness of the functioning of the safeguards security system in providing physical protection of nuclear material and including the safeguards systems elements. (BASES 24-28)
- C. PLANT ISOLATION - A design criteria which prescribes isolation zones on both sides of the outer physical barrier and of the monitoring systems that will detect the presence of individual or vehicles external to the outer barrier.
- D. SECURITY AREA ISOLATION - A design criteria which prescribes the locations of isolation zones and security areas.
- E. DESIGN FEATURES - Characteristics of the design which demonstrates safeguards effectiveness and/or ability to meet criteria.
- F. DESIGN RELATIONSHIPS - Design interrelationships among design bases and features.

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- G. EQUIPMENT - Design, placement, performance of equipment in security areas necessary for the function of safeguards activities.
- H. SURVEILLANCE DESIGN - The design of illumination, line of sight, galleries, etc., which permit meeting surveillance performance requirements.
- I. EMERGENCY, CONTINGENCIES - In response to nonroutine events, (BASE 15-G), the provision of backup systems such as emergency power, redundant hardware, and procedural options such that a level of protection consistent with requirements will be provided.
- J. TEST CONTROL - Test program to demonstrate that structures, systems and components will perform satisfactorily in service.
- K. HANDLING, STORAGE, SHIPPING - Planning of measures to ensure that damage or reduced performance during testing and inspection will not occur.
- L. NONCONFORMING MATERIALS, PARTS OR COMPONENTS - Planning measures to prevent inadvertent use of materials, parts, or components not meeting specifications including identification, documentation, and disposition of such items.
- M. BADGE SYSTEM - Types of badges, tamper-resistance features, methods for issuance, accountability and control, coding system and utilization. (See BADGE DISPLAY BASE 13-I.)
- N. WEAPONS - Types of weapons supplied guards including descriptive data and/or performance characteristics, methods for issuance, accountability, and utilization. (See BASE 27)
- O. SECURITY EQUIPMENT - Equipment provided guards or watchmen including methods for issuance, standards, accountability and utilization. (See BASES 27 & 28)
- P. KEYS, LOCKS, COMBINATIONS - Types and kinds of locks used for security or plant protection purposes, design of manipulation-resistant characteristics by type, issuance and controls of keys and combinations. (See BASE 28)

- Q. RESPONSIBILITY - Personal accountability or ability to act without guidance or superior authority.
- R. ARRANGEMENTS FOR ASSISTANCE - A priori liaison arrangements including individuals, procedures, police duties including arrest, apprehension, detention, conduct of investigation, crowd control, bomb searches. (See LIAISON BASE 16-C.)
- S. SECURITY PLAN CHANGES - Procedures for modification of approved security plans other than corrective action; approval requirements.
- T. SPECIAL TEMPORARY PROCEDURES - Procedures which are situation specific or represent unforeseen events or contingencies including out-of-service equipment for repair, maintenance or testing.
- U. SCHEDULES - Programs and timetables for activities.
- V. SHIPPING PLANS - Plans for anticipated contingencies and arrangements with carriers to provide protection of nuclear materials and satisfy regulatory requirements including transit times, transfers, routes, receipts, records, etc.
- W. PHYSICAL SECURITY PLAN - A site specific document that gives a comprehensive description of the measures employed for the physical protection of facilities against adversary actions.

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18. RECORDS AND REPORTS

- A. Tests and inspections
- B. Response
- C. Surveillance
- D. Access control
- E. Shipping records
- F. Description of nuclear material
- G. Communications
- H. Violations, infractions, incidents
- I. Personnel
- J. Design plans
- K. Document control
- L. Reports to NRC
- M. Registration of material and equipment
- N. Quality assurance
- O. Access registration
- P. Procurement
- Q. Alarm annunciations
- R. Accounting

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TERMS - BASE 18: RECORDS AND REPORTS

RECORDS AND REPORTS - The documentation of activities in conduct of safeguards systems functions. (68)

- A. TESTS AND INSPECTIONS - Records for reporting and documentation of tests and inspections to ascertain the integrity and operability of safeguards systems elements (BASES 24-28) in meeting specified performance and effectiveness requirements.
- B. RESPONSE - Records for reporting and documentation of response plans to security contingencies (BASE 16) in meeting specified performance and effectiveness requirements.
- C. SURVEILLANCE - Records for reporting and documentation of surveillance procedures (BASE 14) used in meeting specified performance and effectiveness requirements.
- D. ACCESS CONTROL - Records for reporting and documentation of access control procedures (BASE 13) in meeting specified performance and effectiveness requirements.
- E. SHIPPING RECORDS - Documentation and reporting of shipping plans and operations including names of carriers, major roads used, flight numbers, dates and times, names and addresses, container seals and descriptions, locations and telephone numbers of local law enforcement agencies along route and other data.(BASE 7)
- F. DESCRIPTION OF MATERIAL - Records of material type classification (BASE 9) and material measures.(BASE 11)
- G. COMMUNICATIONS - Reports of communications.(BASE 21)
- H. VIOLATIONS, INFRACTIONS, INCIDENTS - Reports of investigations. (BASE 15)
- I. PERSONNEL - Recording system for each employee issued a permanent badge for access to security areas, security clearance, background, and security organization.(BASE 22)



- J. DESIGN - Records related to planning.(BASE 17)
- K. DOCUMENT CONTROL - A system for management of documentation and recordkeeping systems.
- L. REPORTS TO NRC - Specification of record requirements which must be submitted to NRC.
- M. REGISTRATION OF MATERIALS AND EQUIPMENT - Description of measures for control of purchased equipment including identification, control, evidence of quality and conformance requirements.
- N. QUALITY ASSURANCE - Records specifically serving to document quality assurance including measures of adequate performance.(BASE 12)
- O. ACCESS REGISTRATION - Documentation of entries and exits. (See BASE 13-W.)
- P. PROCUREMENT - Records and procedures for procurement and surplus items including all activity prior to delivery and subsequent to declaration of surplus.
- Q. ALARM ANNUNCIATIONS - Records of all security alarm annunciations and subsequent follow up.
- R. ACCOUNTING - Records related to BASE 23.

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19. DETERRENCE

- A. Advertisement
- B. Rewards
- C. Arrest of other terrorists
- D. Publication of failure
- E. Briefings and educational programs
- F. Legal sanctions
- G. Infiltration
- H. Informers
- I. Restriction of information
- J. Signs, warnings
- K. Vehicle markings
- L. Hardware
- M. Tamper-Safing
- N. Tamper-Indicating

TERMS - BASE 19: DETERRENCE

DETERRENCE - Safeguards functions or activities which discourage or cause potential adversaries to refrain from or voluntarily halt a sequence designed to obtain or misuse special nuclear material. (See BASES 4-B, 31 and 32.)

- A. ADVERTISEMENT - Public announcement of safeguards systems effectiveness via various information media.
- B. REWARDS - Incentives given in return for information regarding potential adversary actions.
- C. ARREST OF OTHER TERRORISTS - Arrest, prosecution, conviction of terrorists for acts other than adversarial to safeguards system.
- D. PUBLICATION OF FAILURES - Notification and advertisement of unsuccessful adversary attempts and subsequent punitive actions.
- E. BRIEFINGS AND EDUCATIONAL PROGRAMS - The provision of training and information dissemination to the public regarding safeguards systems effectiveness.
- F. LEGAL SANCTIONS - Civil and criminal penalties (fines, license revocations, imprisonment, and the like) for violations of safeguards requirements. Includes Acts of Congress which among other things, give the Commission the authority to establish and enforce safeguards regulations and to establish penalties for violations of the regulations or requirements.
- G. INFILTRATION - Taking up of positions surreptitiously in potential adversary groups by security personnel.
- H. INFORMERS - Members of adversary groups or associated parties who provide information on potential adversary activity. (Note distinction from INFORMANTS in BASE 14-H.)
- I. RESTRICTION OF INFORMATION - Limiting access to information regarding material quantities, forms, locations, protective systems, and operations of the safeguards system.

RESTRICTED DATA - means all data concerning (1) design, manufacture or utilization of atomic weapons; (2) the production of special nuclear material; or (3) the use of special nuclear material in the production of energy, but shall not include data declassified or removed from the Restricted Data category pursuant to section 142 of the Atomic Energy Act of 1954, as amended.<sup>(120)</sup>

- J. SIGNS, WARNINGS - Boards, posters, or placards indicating warnings, laws, regulations or other safeguards requirements, procedures, or designated areas.
- K. VEHICLE MARKINGS - Identification of vehicles utilized in the transport of nuclear material.
- L. HARDWARE - Highly visible systems which by their presence cause deterrence.
- M. TAMPER-SAFING - Means the use of devices on containers or vaults in a manner and at a time that ensures a clear indication of any violation of the integrity of previously made measurements of special nuclear material within the container or vault.<sup>(78)</sup>
- N. TAMPER-INDICATING (FRANGIBILITY) - Relates to a seal's property to provide evidence of attempts at unauthorized removal or tampering.<sup>(76)</sup>

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20. ASSURANCE

- A. Quality assurance
- B. Drills
- C. Test control
- D. Performance
- E. Maintenance
- F. Compliance
- G. Program audit
- H. Inspections
- I. Requalification
- J. Operating status
- K. Corrective action
- L. Provisions
- M. Contingency plans
- N. Avoidance of population center
- O. Redundancy

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TERMS - BASE 20: ASSURANCE

ASSURANCE - Measures to satisfy the NRC and the public that safeguards are in place and can provide protection against attempted acts of theft, diversion, or sabotage that would significantly increase the risk to the public health, injury, or property damage. (126)

- A. QUALITY ASSURANCE - Procedures including testing and inspecting all or a portion of the safeguards system to ensure that a desired performance level is maintained. (BASE 12-0)
- B. DRILLS - Security exercises which demonstrate or improve the degree of effectiveness of security measures, procedures, personnel, and equipment; frequency, records, evaluation.
- C. TEST CONTROL - Test program to demonstrate that structures, system and components will perform satisfactorily in service.
- D. PERFORMANCE - The specification and verification that equipment and systems including personnel will function within effectiveness requirements specifications (BASE 12).
- E. MAINTENANCE - Procedures for keeping safeguards equipment and structures in a state that will satisfy specified requirements; service and schedule to ensure continuous integrity and operability.
- F. COMPLIANCE - The ability for safeguards systems to act in accordance with regulatory requirements.
- G. PROGRAM AUDIT - The verification that the overall safeguards plan (BASE 17) has been implemented and maintained in an effective manner and in compliance with regulations.
- H. INSPECTIONS - Observation measures taken to indicate the operating status of structures, systems, components and equipment.

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- I. REQUALIFICATION - Testing and retraining of personnel for security purposes including security personnel duties, equipment operation, procedures, arms qualification for guards, and medical examination.
- J. OPERATING STATUS - The state or condition of operating effectiveness of safeguards systems.
- K. CORRECTIVE ACTION - Actions taken to rectify reduced safeguards system effectiveness or unsatisfactory performance in compliance with regulations.
- L. PROVISIONS - Preparatory measures or performance criteria for continuing effectiveness (BASE 12). Note: Often synonymous with regulatory requirements (BASE 1).
- M. CONTINGENCY PLANS - Measures in safeguards systems for either fixed sites or transit which reduce potential for accidents or unforeseen occurrences.
- N. AVOIDANCE OF POPULATION CENTERS - Route selection for reduction of potential consequences of shipping accidents or adversary actions.
- O. REDUNDANCY - Duplication or repetition of elements either physical or procedural in the safeguards system to provide alternative function in case of failure or compromise of the element.  
(PROTECTION IN DEPTH.)

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21. COMMUNICATIONS

- A. Common language
- B. Central station
- C. Locations
- D. Transport
- E. Facilities
- F. Scheduling
- G. Non-normal
- H. Non-voice
- I. Telephone
- J. Alarm annunciation
- K. Primary, secondary
- L. Specifications
- M. Maintenance
- N. Timing
- O. Report Status

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TERMS - BASE 21: COMMUNICATIONS

COMMUNICATION - The transmission of information between two or more points by writing, speaking, coded, or signals using devices. (See also BASE 18.)

- A. COMMON LANGUAGE - A requirement that all communication occur in a universal or general language.
- B. CENTRAL STATION - A centrally located center for communication which is continuously manned - a command post serving as (1) security control room, (2) communication center (3) repository of safeguards data and/or (4) a headquarters.
- C. LOCATIONS - Sites within the safeguard system designated as communication points having fixed equipment or requiring enactment of communication procedures (BASE 29).
- D. TRANSPORT - Organization and physical location during transit (BASE 7) including designation of receiving and transmitting personnel, reports and type of communication (e.g., remote-control center, patrol-patrol, etc.)
- E. FACILITIES - Procedures for primary (central station) and secondary communication at facilities (BASE 5) including control-patrol, patrol-patrol, central-remote, and patrol-remote. Includes staffing requirements and alarm annunciation procedures.
- F. SCHEDULING - Designation of either continuous or periodic communication.
- G. NON-NORMAL - Emergency, backup, or standby communication including operability requirements for all possible events.
- H. NON-VOICE - All communications other than voice, written reporting or alarms; e.g., codes, signals, key boxes, etc.
- I. TELEPHONE - Conventional telephone service for all fixed site or transport communication.

- J. ALARMS - Annunciation procedures and types of alarm signals such as intrusion or emergency exit alarms.
- K. PRIMARY, SECONDARY - Primary communications are via a central communication station; secondary are all others.
- L. SPECIFICATIONS - Includes type, frequency, and performance requirements for communications equipment.
- M. MAINTENANCE - Procedures for keeping equipment in proper condition including reliability, and service and schedules to ensure continuous integrity and operability.
- N. TIMING - Intervals for routine communication, maximum period permitted to elapse with no report and action to be taken if planned or scheduled reports are not received.
- O. REPORT STATUS - Procedures for patrol communication including timing and verification of surveillance.

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22. SECURITY ORGANIZATION

- A. Management
- B. Chain of command
- C. Responsibilities
- D. Qualification
- E. Screening
- F. Training
- G. Tests
- H. Duties
- I. Numbers
- J. Posts and patro's
- K. Types of individuals
- L. Equipment custody
- M. Capabilities
- N. Special skills

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TERMS - BASE 22: SECURITY ORGANIZATION

ORGANIZATION - The interaction of all safeguards systems elements, e.g., people, physical objects, and objectives in a functional, coordinated manner. (68)

- A. MANAGEMENT - The organizational structure for planning and controlling the safe-guards system's personnel and activities; includes functions, responsibilities and authority for conduct of activities.
- B. CHAIN OF COMMAND - The authority hierarchy for decision-making on security matters; organizational units positions.
- C. RESPONSIBILITIES - Personal accountability or ability to act without guidance on decision-making including alarm annunciation and legal authority for conduct of duties.
- D. QUALIFICATION - Requirements of age, education, physical condition and experience for safeguards systems personnel.
- E. SCREENING - The system for qualifying, selecting and hiring of safe-guards systems personnel including application, verification of information and approval authority.
- F. TRAINING - The act or process of making proficient with specialized instruction for performance of duties.
- G. TESTS - The exhibition of proficiency by examination either written or by demonstration of security operating procedures and duties.
- H. DUTIES - The conduct of functional job requirements for safeguards systems functions including job descriptions.
- I. NUMBERS - The number of safeguards related personnel on duty, by shift for each post or patrol, and for response forces.

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- J. POSTS AND PATROLS - The plan for posting access control, surveillance and response forces including numbers, duties, and chain of command.
- K. TYPES OF INDIVIDUALS - Safeguards systems personnel; guards, watchmen, communications persons, and supervisors, designated by duty or responsibility.
- L. EQUIPMENT CUSTODY - Permits, accounting, qualifications on use and procedures for the issuance, operation and maintenance of security equipment.
- M. CAPABILITIES - Performance of effectiveness of safeguards system personnel (BASE 12).
- N. SPECIAL SKILLS - Investigative, crowd control, bomb search and defusing, or para-military.

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23. ACCOUNTING

- A. Accountability
- B. Accuracy
- C. Adjustment
- D. Audit
- E. Corrective action
- F. Custody
- G. Discards
- H. Inventory
  - 1. Beginning inventory
  - 2. Book inventory
  - 3. Ending inventory
  - 4. Fiscal year end inventory
  - 5. In-process inventory
  - 6. Physical inventory
  - 7. Write-off
- I. Measurements
- J. Material balance
- K. Quality control
- L. Sampling
- M. Shipments
- N. Receipts
- O. Records
- P. Unaccountable
- Q. Measurement System
- R. Reference Standard
- S. Traceability
- T. Random Error
- U. Systematic Error
- V. Uncertainty
- W. Calibration
- X. Limit of Error
- Y. Measurement Error

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TERMS - BASE 23: ACCOUNTING

ACCOUNTING - material control or protection by making certain or verifying that material quantities are measured, enumerated, and recorded.

MATERIAL ACCOUNTING SYSTEM - The part of the safeguards system encompassing the procedures and systems to: (1) perform nuclear material measurements, (2) maintain records, (3) provide reports, and (4) perform data analysis to account for nuclear material.

- A. ACCOUNTABILITY - The part of safeguards and materials management which encompasses the measurement system and records and reports to account for source and special nuclear material to minimize the possibility of diversion and to detect diversion promptly should it occur. Accountability does not include physical protection.<sup>(81)</sup>

ACCOUNTABILITY - The capability of facility's material control and material accounting programs to control and account for the nuclear material in its possession.<sup>(126)</sup>

- B. ACCURACY - The degree of conformity of a measured value to the value accepted as true or exact.<sup>(82)</sup> Accuracy is a qualitative and frequently subjective term whose exact usage should be consistent with the definitions of bias and precision (q.v.) Accuracy of measurement indicates how closely it agrees with the true value of the quantity being measured. Thus it is meaningful to discuss the accuracy of a single measurement. If repeated measurements are made of the same quantity, the difference between the arithmetic mean of the measurements and the true value indicates the accuracy of the measurements. This difference is usually called bias, and it can be either positive or negative. A high degree of accuracy is equivalent to a low absolute value of the bias.<sup>(17)</sup>

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- C. ADJUSTMENT - An entry into the accounting records to obtain agreement between the book inventory and the physical inventory consisting of shipper/receiver differences, and/or material unaccounted for.<sup>(17)</sup>
- D. AUDIT - An examination of accounts which purport to reflect not only actual transactions but also valuations, estimates, and opinions, for the purpose of determining whether the accounts are properly stated and fairly reflect the matters with which they purport to deal.<sup>(83)</sup> An official examination and verification according to accepted procedures, of practices, accounts, and records<sup>(126)</sup>.  
NOTE: It is the duty of management, and not of audit, to establish systems of accounting procedures and arrangements which, by reason of their own soundness and internal checks on controls, preclude errors and fraud. Audit by an independent body is to verify that those systems and procedures are being operated satisfactorily and to point out, where necessary, any weaknesses or deficiencies with suggestions for their correction. Audit does not relieve management of the duty of ultimate accountability. For economic reasons it is generally not possible for audit to duplicate all measurements or other prime data, and some sampling system is required. Thus, audit is a combination of record examination with some independent measurement, whose frequency may be varied so as to keep the uncertainty within predetermined limits.<sup>(84)</sup>
- E. CORRECTIVE ACTION - That action when the material balance or measurement uncertainty exceeds prescribed limits.
- F. CUSTODY - The guardianship and responsibility for safeguard materials.
- G. DISCARD(S) - Material which has been intentionally removed from inventory and which has been disposed of by an authorized person using an approved disposal method.<sup>(27)</sup>

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H. INVENTORY - (1) The actual amount of material on hand. (2) The quantity of material which is determined to be on hand. (Cf. Physical Inventory.) (3) The act of determining the above, i.e., taking an inventory. (4) The number representing the material on books. (Cf. Book Inventory.)<sup>(85)</sup>

1. BEGINNING INVENTORY - The quantity of materials on hand at the beginning of a specific time period.<sup>(30,86)</sup>
2. BOOK INVENTORY - The amount of material shown by the records to be present at a given time.<sup>(30)</sup>

BOOK INVENTORY - A determination of the quantity of special nuclear material on hand at a given time based on records which are themselves based on measurements. The book inventory is calculated by subtracting the amount of material removed from inventory since the previous physical inventory from the sum of the amount of material on inventory during the previous physical inventory and the additions to inventory since the previous physical inventory.<sup>(126)</sup>

BOOK INVENTORY (of a Material Balance Area) - The algebraic sum of the most recent physical inventory of that material balance area and of all inventory changes that have occurred since that physical inventory was taken.<sup>(17)</sup>

BOOK-PHYSICAL INVENTORY DIFFERENCE (BPID) - The arithmetic difference between the book and physical inventories.<sup>(23)</sup>

3. ENDING INVENTORY - The quantity of material determined to be on hand at the end of a specific time period.<sup>(30,86)</sup>
4. FISCAL-YEAR-END INVENTORY - Material on hand at the close of business on the last day of the fiscal year.<sup>(30,86)</sup> (Term no longer used.)
5. IN-PROCESS INVENTORY - The quantity of material present in the fabrication or process line in processing vessels, machines, etc., at any specified time;<sup>(30,86)</sup> material that is not in the form of unopened receipts and all final products.

6. PHYSICAL INVENTORY - (1) The quantity of material which is determined to be on hand by physically ascertaining its presence using techniques which include sampling, weighing, and analysis (2) The process by which the quantity of material on hand is determined.<sup>(23)</sup>

7. WRITE-OFF - (Approved inventory write-off). A removal from the records of a known quantity of good material, usually restricted to that material which will be used in such a manner as to lose its identify as a nuclear material, per se, such as material incorporated in an instrument.<sup>(81)</sup>

Write-off is an accounting procedure by which material is removed from inventory records because it has been incorporated as an integral part of an item of equipment so that the recovery of the material is not practicable.<sup>(87)</sup>

APPROVED INVENTORY WRITE-OFF - A removal from inventory records which has been approved by the proper authority.<sup>(23)</sup>

I. MEASUREMENT - Includes sampling and means the determination of mass, volume, quantity, composition or other property of a material where such determinations are used for special nuclear material control and accounting purposes.<sup>(88)</sup>

J. MATERIAL BALANCE - A determination of inventory difference (ID) and limit of error on inventory differences (LEID) and subsequent reconciliation of records through: (1) the taking of a physical inventory, (2) determination of ID by comparing the book inventory and the physical inventory, (3) determination of LEID from the measurement control program using appropriate statistical techniques, (4) reconciliation of the book inventory with the physical inventory, and (5) reconciliation of subsidiary accounts with the central records.

ID OR INVENTORY DIFFERENCE - The quantity determined by subtracting inventory (EI) plus removals (R) from beginning inventory (BI) plus additions to inventory (A). Mathematically,

$$ID = BI + A - EI - R.$$

For historical reasons, inventory difference is also called MUF or material unaccounted for.

- K. QUALITY CONTROL - A system for verifying that an item or group of items meet certain specifications.
- L. SAMPLING - The process of selecting specific items or materials for analysis.
- M. SHIPMENTS - The quantities of materials which are shipped by a plant to other plants for their use.<sup>(86)</sup>
- N. RECEIPT(S) - Material acquired at a facility from another source; includes written acknowledgement recording the physical receipt of material.
- O. RECORDS - To document, in a preestablished manner and format, data and information for the purpose of preserving evidence.
- P. UNACCOUNTABLE - (Total issues + closing inventory) - (opening inventory + receipts). Positive figure = unaccountable gain. Negative figure = unaccountable loss.<sup>(91)</sup>
- Q. MEASUREMENT SYSTEM - All of the apparatus, equipment, instruments and procedures used in performing a measurement.<sup>(92)</sup>
- R. REFERENCE STANDARD - A material, device, or instrument whose assigned value is known relative to national standards or nationally accepted measurement systems.<sup>(93)</sup>
- S. TRACEABILITY - The ability to relate individual measurement results to national standards or nationally accepted measurement systems through an unbroken chain of comparisons.<sup>(94)</sup>
- T. RANDOM ERROR - refers to the variation encountered in all measurement work, characterized by the random occurrence of both positive and negative deviations from a mean value.<sup>(95)</sup>
- U. SYSTEMATIC ERROR - A constant unidirectional component of error that affects all members of a data set; its value can, in some instances, be estimated by the deviation of the mean of a measurement process from a reference value. A systematic error

whose value has been determined in this manner is called a bias, whose effect can be corrected for.<sup>(96)</sup> (Also called MEASUREMENT BIAS.)

- V. UNCERTAINTY - The extent to which a measurement result is in doubt because of the effects of random error variances and the limits of systematic errors associated with a measurement process, after the measurements result has been corrected for bias.<sup>(97)</sup>
- W. CALIBRATION - The process of determining the numerical relationship between the observed output of a measurement system and the value, based upon reference standards, of the characteristics being measured.<sup>(98)</sup>
- X. LIMIT OF ERROR - The uncertainty component used in constructing a 95% confidence interval associated with a quantity after any recognized bias has been eliminated or its effect accounted for. For example, the limit of error for an unbiased normally distributed random variable is 1.96 times its standard deviation.<sup>(126)</sup>

LECID OR LIMIT OF ERROR ON CUMULATIVE INVENTORY DIFFERENCE - The limit of error, based upon estimates of measurement errors and statistical analysis, on cumulative inventory difference.

LEID OR LIMIT OF ERROR ON INVENTORY DIFFERENCES - The limit of error, based upon estimates of measurement errors and statistical analysis on inventory differences. For historical reasons, this is also known as LEMUF or Limit of error on MUF.

CID OR CUMULATIVE INVENTORY DIFFERENCE - The quantity determined by summing a series of consecutive inventory differences (see also ID). In most places where CID is referred to in this report, the Task Force means the sum of six consecutive inventory differences calculated from the bimonthly material balances over the past year.<sup>(126)</sup>

MEASUREMENT ERROR - A deviation from the correct value. It does not mean a mistake made in making a measurement.

24. INTRUSION AND DETECTION DEVICES

- A. Animals
- B. Mines
- C. Detectors, pressure sensitive
- D. Detectors, metal
- E. Detectors, explosive
- F. Detectors, SNM
- G. Detectors, motion
- H. Television
- I. Traps
- J. Test Equipment
- K. Seals
- L. Optical
- M. Monitoring Instruments

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TERM; - BASE 24: INTRUSION AND DETECTION DEVICES

- A. ANIMALS - Trained animals such as dogs used to assist in the intrusion detection into or through the isolation zone at the perimeter of a protected area.
- B. MINES - An explosive device placed in a concealed position designed to be detonated on contact or remotely.  
  
DETECTOR - An electrical, electromechanical, or other device used to detect (sense) a change in the environment which it monitors and capable of annunciating such detection, e.g., alarm activation.
- C. DETECTORS, PRESSURE SENSITIVE - Instruments (transducers) used to detect small variations in mechanical stress caused by contact with activating medium (vibration, strain, trip wires).
- D. DETECTORS, METAL - Usually devices used to sense ferrous metals, usually based on changes caused in local magnetic field due to introduction of ferrous objects.
- E. DETECTORS, EXPLOSIVE - Devices used for detecting dynamite, TNT, and similar nitrogenous compounds usually using electron capture (vapor) or bulk.
- F. DETECTORS, SNM - Detectors and doorway monitors for detection of SNM usually using scintillators or neutron activation.
- G. DETECTORS, MOTION - Devices using microwaves, infrared, acoustic, temperature or other emissions to indicate intrusion by sensing activity within an area.
- H. TELEVISION - Closed circuit television used for monitoring and surveillance including video recording equipment.
- I. TRAPS - Automatic door-locking, and other mechanisms which automatically respond to alarms or detection.
- J. TEST EQUIPMENT - Equipment used to validate and ensure continuing performance of intrusion and detection devices.

- K. SEALS - Devices used to detect tampering or entry, usually used on containers; seals can be broken, but cannot subsequently be put together without evidence of the break.
- L. OPTICAL - Mirrors, telescopes, periscopes, etc., used to assist the surveillance function, including photographic equipment.
- M. MONITORING INSTRUMENTS - other instruments used in the performance of surveillance.

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25. ALARM AND COMMUNICATION SYSTEM

- A. Alarm stations
- B. Central station
- C. Communication system, fixed site, internal
- D. Communication system, fixed site, external
- E. Communication system, transit
- F. Communication system, portable
- G. Hot line
- H. Emergency system
- I. Equipment specification
- J. Type of alarm
- K. Silent alarm
- L. Dual-premise alarm
- M. Intrusion alarm
- N. Duress alarm

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TERMS - BASE 25: ALARM AND COMMUNICATION SYSTEM

- A. ALARM STATIONS - Locations displaced from alarm sensors which annunciate alarms to security personnel.
- B. CENTRAL STATION - A centrally located center for communication which is continuously manned - a command post serving as (1) security control room, (2) communication center, (3) repository of safeguards data, and/or (4) a headquarters.
- C. COMMUNICATION SYSTEM, FIXED SITE INTERNAL - Intercoms, telephone system, or substation radio system used for internal communications.
- D. COMMUNICATION SYSTEM, FIXED SITE EXTERNAL - Telephone, radiotelephone, radio, or other system(s) for communication from central alarm station to points remote from site.
- E. COMMUNICATION SYSTEM, TRANSIT - Radio and telephone access points along transportation routes.
- F. COMMUNICATION DEVICE, PORTABLE - Any hand held radio device carried by security personnel, usually 2-way.
- G. HOT LINE - A direct, special telephone linkage to local law enforcement authorities or other assistance forces or authorities.
- H. EMERGENCY SYSTEM - Backup or standby communication systems and power to ensure continuing safeguards system performance and effectiveness.
- I. EQUIPMENT SPECIFICATION - Specifications for manufacturers, ranges, frequency, or other performance characteristics.
- J. ALARM TYPES - Intrusion, emergency exit, alert status, etc.
- K. SILENT ALARMS - An alarm which annunciates at some location separate from detector or activation point.
- L. DUAL-PREMISE ALARM - An alarm which requires redundant activation; e.g., two or more sensors above a given threshold.

- M. INTRUSION ALARM - A tamper indicating electrical, electromechanical or electroptical, electronic or similar device which will detect intrusion into a security area (BASE 26) and alert safeguards personnel by means of activated signals.
- N. DURESS ALARM - A device which is activated in the event of an emergency providing a signal which annunciates at a central alarm station or other continuously manned station.

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26. SECURITY AREAS.

- A. Barrier, vehicle offsite, access
- B. Barrier, fences
- C. Barrier, walls
- D. Barrier, ceilings and floors
- E. Barrier, other
- F. Protected area
- G. Vital area
- H. Material access area
- I. Isolation zone
- J. Temporary exclusion area
- K. Exclusion area
- L. Portals, people, ingress
- M. Portals, people, egress
- N. Portals, material
- O. Emergency exits
- P. Package, Packaging
- Q. Material balance area
- R. Item control area
- S. Vault
- T. Vault-type room
- U. Movement control center
- V. Containment
- W. Containment vessel
- X. Access denial apparatus
- Y. Lighting
- Z. Other areas
- AA. Breaches
- BB. Camouflage
- CC. Windows, bullet-resisting

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TERMS - BASE 26: SECURITY AREAS

AREA - A two or three dimensional projection of the space enclosed by a connected set of barriers and controlled openings.

BARRIER - Any passive physical constraint to persons or material movement.

- A. BARRIER, VEHICLE OFFSITE ACCESS - Approach roads, gates, moats, or other barriers which restrict vehicle approach.
- B. BARRIER, FENCE - Fences constructed of No. 11 American wire gauge, or heavier wire fabric, topped by three strands or more of barbed wire or similar material on brackets angled outward between 30<sup>0</sup> and 45<sup>0</sup> from vertical, with an overall height of not less than eight feet, including the barbed topping.<sup>(99)</sup> Fence specifications include type, location, wire gauge, mesh size, overall height, electrification, detection sensors, substrata, foundation.
- C. BARRIER, WALLS - Building walls constructed of stone, brick, cinder block, concrete, steel or comparable materials (openings which are secured by grates, doors, or covers of construction and fastening of sufficient strength such that the integrity of the wall is not lessened by any opening), or walls of similar construction, not part of a building, provided with a barged topping described in paragraph (f)(1) of this section of a height of not less than 8 feet.<sup>(100)</sup>
- D. BARRIER, CEILINGS AND FLOORS - Ceilings and floors constructed to offer resistance to penetration equivalent to that of building walls described in paragraph (f)(2) of this section.<sup>(101)</sup>
- E. BARRIER, OTHER - Any hardened barrier such as bunkers or obstacles which serve to restrict vehicle or personnel access. Barrier specifications include height, composition, thickness, roof, size, location, windows, grates, skylights, grills, etc.
- F. PROTECTED AREA - An area encompassed by a physical barrier and to which access is controlled.<sup>(102)</sup>

- G. VITAL AREA - Any area which contains vital equipment (BASE 28-I) within a structure, the walls, roof, and floor of which constitute physical barriers of construction at least as substantial as walls (see Barrier, Walls, BASE 26-C).<sup>(103)</sup>
- H. MATERIAL ACCESS AREA - Any location which contains special nuclear material, within a vault or a building, the roof, walls, and floor of which each constitute a physical barrier,<sup>(104)</sup> and that in turn is located within a protected area.
- I. ISOLATION ZONE - Any area, clear of all objects which could conceal or shield an individual, adjacent to a physical barrier, which is monitored to detect the presence of individuals or vehicles within that area.<sup>(105)</sup>
- J. TEMPORARY EXCLUSION AREA - Any area, access to which is controlled and which affords temporary isolation of special nuclear material in-transit and/or of the transports of such material.<sup>(106)</sup>
- K. EXCLUSION AREA - The area around a nuclear or radiation facility to which access is controlled.<sup>(25)</sup>
- L. PORTAL, PEOPLE, INGRESS - A doorway, entrance, gate or other opening in a barrier allowing personnel access.
- M. PORTAL, PEOPLE, EGRESS - A doorway, entrance, gate or other opening in a barrier allowing personnel exit under normal circumstances.
- N. PORTAL, MATERIAL - A doorway, entrance, gate, receiving or shipping dock or other opening in a barrier allowing only material to pass.
- O. EMERGENCY EXIT - A portal normally secured, for exit by personnel under emergency conditions.
- P. PACKAGE - Packaging and its radioactive contents.<sup>(107)</sup>
- PACKAGING - One or more receptacles, wrappers, and their contents excluding fissile material and other radioactive material, but

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including absorbent material, spacing structures, thermal insulation, radiation shielding, devices for cooling and for absorbing mechanical shock, external fittings, neutron moderators, nonfissile neutron absorbers, and other supplementary equipment.<sup>(108)</sup> Packages may also be tamper-safed, locked, alarmed, immobilized, or designed for other safeguarding requirements.

- Q. MATERIAL BALANCE AREA - An identifiable physical area such that the quantity of nuclear material being moved into or out of the area is represented by a measured value determined through an NRC approved measurement and measurement control program.
- R. ITEM CONTROL AREA - An identifiable physical area such that the quantity of nuclear material being moved into or out of the area is controlled and accounted for by item identity and count for previously determined special nuclear material quantities, the validity of which is assured by tamper-safing unless the items are sealed sources.
- S. VAULT - A burglar-resistant windowless enclosure with walls, floor and roof of: (1) Steel at least one-half inch thick, (2) reinforced concrete or stone at least 8 inches thick, (3) non-reinforced concrete or stone at least 12 inches thick, or (4) monolithic floor or roof construction of equivalent resistance to entry, with a built in lock in a steel door at least 1 inch thick, exclusive of the locking mechanism.<sup>(109)</sup>
- T. VAULT-TYPE ROOM - A room with one or more doors, all capable of being locked, protected by an intrusion sensing device which creates an alarm upon the unauthorized entry of a person into a room, exit from the room, or movement within the room.<sup>(110)</sup>
- U. MOVEMENT CONTROL CENTER - An operations center which is remote from transit activity (BASE-7) which provides tracking of convoy progress, receives reports of attempted attacks or thefts, provides a means for reporting these and other situations to appropriate agencies and can request and coordinate appropriate aid.<sup>(111)</sup>

- V. CONTAINMENT - As used in safeguards, the physical barrier and measures of physical protection that are designed to assure that the flow of source and special nuclear material into and out of a material balance area are known and that materials remain in the assigned area. These measures include gate controls, waste control, safing, and sealing, particularly during transportation.<sup>(23,112)</sup>
- Physical enclosures used to preclude the unauthorized change of location of nuclear materials.<sup>(113)</sup>
- W. CONTAINMENT VESSEL - The receptacle on which principal reliance is placed to retain the radioactive material during transport.<sup>(114)</sup>
- X. ACCESS DENIAL APPARATUS - Physical apparatus such as foaming, automatic closing, thermite welding, etc., which operate either automatically or manually to seal or deactivate access to security areas.
- Y. LIGHTING - Illumination for security areas for surveillance purposes including automatic and manual, manufacturers, intensity, locations.
- Z. OTHER AREAS - Designated security areas such as handling, storage, shipping and receiving areas, change rooms, observation galleries, item control areas, etc.
- AA. BREACHES - Openings in protected areas for items other than personnel or materials, including tunnels, storm and waste drains, water inlets, conduits, culverts, creeks, canals, etc. (Does not necessarily imply defeat of barrier integrity.)
- BB. CAMOUFLAGE - Methods of concealment of security areas or equipment.
- CC. WINDOWS, BULLET-RESISTING - Openings in barriers which are for the purpose of observation including specifications for resistance against penetration by projectiles.

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27. ARMAMENT, PROTECTIVE EQUIPMENT

- A. Handguns
- B. Small arms
- C. Arms specifications
- D. Bullet-resisting clothing
- E. Aerosol irritants
- F. Radiation protection
- G. Military weapons
- H. Ammunition
- I. Fire protection
- J. Other

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TERMS - BASE 27: ARMAMENT, PROTECTIVE EQUIPMENT

- A. HANDGUNS - Firearms which can be used with one hand; pistols.
- B. SMALL ARMS - Firearms which can be carried by hand, including rifles and shotguns.
- C. ARMS SPECIFICATIONS - Manufacturer, caliber, performance, portability, etc. of small arms and handguns.
- D. BULLET RESISTING CLOTHING - Vests, helmets, etc., which resist penetration of small arms fire.
- E. AEROSOL IRRITANTS - Tear gas, mace, and other irritants used to immobilize or detract from personnel function.
- F. RADIATION PROTECTION - Equipment used to protect from exposure, including clothing and handling devices.
- G. MILITARY WEAPONS - Automatic weapons, grenades, mortars, and other devices not accessible to general public normally associated with military organizations.
- H. AMMUNITION - The projectiles used in handguns, small arms and military weapons. Casings, cladding and other specifications or performance characteristics.
- I. FIRE PROTECTION - Equipment used to prevent, detect, or reduce consequences of fire to personnel.
- J. OTHER -

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28. OTHER SAFEGUARDS EQUIPMENT

- A. Locks
- B. Keys, card keys, combinations
- C. Uniforms
- D. Vehicles, fixed site
- E. Vehicles, transport
- F. Badges
- G. Signs
- H. Measurement system
- I. Vital equipment
- J. Automated entry control system

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TERMS - BASE 28: OTHER SAFEGUARDS EQUIPMENT

- A. LOCK - For vaults or vault-type rooms means a three-position, manipulation resistant, dial type, built-in combination lock or combination padlock and in the case of fences, walls, and buildings means an integral door lock or padlock which provides protection equivalent to a six-tumbler cylinder lock. Lock in the case of a vault or vault-type room also means any manipulation resistant, electromechanical device which provides the same function as a built-in combination lock or combination padlock which can be operated remotely or by the "reading" or insertion of information, which can be uniquely characterized, and which allows operation of the device. "Locked" means protected by an operable lock.
- B. KEYS - An implement designed to open a lock including metallic notched and grooved pieces, key cards using electromagnetic imprints, or combinations.
- C. UNIFORMS - Distinctive outfits intended to identify the presence of safeguards or security personnel.
- D. VEHICLES, FIXED SITE - A conveyance for transporting personnel, equipment, or materials within a fixed site including delivery.
- E. VEHICLES, TRANSPORT - A conveyance use for transport of nuclear material between fixed sites (see BASE 7).
- F. BADGES - A device or emblem worn for identification of personnel.
- G. SIGNS - A board, poster, or placard used to advertise or notify personnel about safeguards procedures, rules, or regulations.
- H. MEASUREMENT SYSTEM - all of the apparatus, equipment, instruments, and procedures used in performing a measurement.<sup>(92)</sup>
- I. VITAL EQUIPMENT - Any equipment, system, device or material the failure, destruction, or release of which could directly or indirectly endanger the public health and safety by exposure to radiation. Equipment or systems which would be required to function to protect public health and safety following such a failure, destruction, or release are considered to be vital.<sup>(129)</sup>

J. AUTOMATED ENTRY CONTROL SYSTEM - an entry control system in which entry to or exit from a controlled area is handled automatically, requiring security force intervention only when situations arise which cannot be handled in a normal manner. (129)

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29. LOCATION IN SAFEGUARDS SYSTEM

- A. Transit
- B. Offsite
- C. Protected area perimeter
- D. Within protected area
- E. Material access area perimeter
- F. Within material access area
- G. Access to material

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TERMS - BASE 29: LOCATION IN SAFEGUARDS SYSTEM

LOCATION - Position or boundaries within which personnel or material of interest are contained within the safeguards system (particularly location relative to areas in BASE 26).

- A. TRANSIT - Material in transit. (BASE 7)
- B. OFFSITE - The area of property or controlled area beyond the facility exclusion area, but within the proximity of the facility.
- C. PROTECTED AREA PERIMETER - In the proximity of a protected area, e.g. within an isolation zone or exclusion area.
- D. WITHIN PROTECTED AREA - Inside an area protected by a barrier.
- E. MATERIAL ACCESS AREA PERIMETER - In the relative proximity of a material access area.
- F. WITHIN MATERIAL ACCESS AREA - Access to material in process or packages containing material.
- G. ACCESS TO MATERIAL - Integrity of packages or containers is breached.

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30. ADVERSARY CHARACTERISTICS

- A. Number of personnel
- B. Degree of access
- C. Intelligence capability
- D. Armament
- E. Knowledge and expertise
- F. Dedication
- G. Organization
- H. Resourcefulness
- I. Backing
- J. Insider

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TERMS - BASE 30: ADVERSARY CHARACTERISTICS

ADVERSARY - An individual or an organized group intending to cause adverse societal consequences or to threaten public health and safety or national security through acts involving nuclear material<sup>(113)</sup> or nuclear facilities.

- A. NUMBER OF PERSONNEL - Quantity of people in adversary group.
- B. DEGREE OF ACCESS - Location in safeguards system achieved by adversary group or level of authorization of an inside member of an adversary group.
- C. INTELLIGENCE CAPABILITY - Level or detail of information regarding the safeguards system available to the adversary group.
- D. ARMAMENT - Types and performance of weapons (BASE 28) available to adversary group.
- E. KNOWLEDGE AND EXPERTISE - Familiarity with safeguards systems functions and understanding gained through experience.
- F. DEDICATION - The degree of commitment of adversary group to achieve its particular objective.
- G. ORGANIZATION - The orderly, functional structure of the adversary group (see BASE 23).
- H. RESOURCEFULNESS - Capability of adversary group in responding to action of safeguards responses.
- I. BACKING - Support of higher level adversary authority such as international terrorist organizations which can be drawn upon for resources when needed in particular stages of adversary action.
- J. INSIDER - A member of the adversary group who has authorized access to any or all portions of a facility or transport operation.

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31. TYPE OF ADVERSARY ACTION

- A. Covert theft
- B. Diversion
- C. Overt theft
- D. Sabotage
- E. Hoax

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TERMS - BASE 31: TYPE OF ADVERSARY ACTION

ADVERSARY ACTION - Means employed to gain access to material for radiological sabotage.

RADIOLOGICAL SABOTAGE - Any deliberate act directed against a plant or transport in which an activity licensed pursuant to the regulations is conducted or against a component of such a plant or transport which could directly or indirectly endanger the public health and safety by exposure to radiation other than such acts by an enemy of the United States, whether foreign government or other person. (116)

THEFT - An act of stealing, the illegal taking and carrying away of the goods of another; larceny. (126)

- A. COVERT THEFT - Any theft other than overt involving stealth where the adversary acts to avoid detection of his presence or act, or deceit where the adversary seeks to misrepresent his character or his act.
- B. DIVERSION - The deliberate, unauthorized movement or mislocation of nuclear material from its normal flow streams. Diversion is distinguished from theft in that theft of material involves the removal of the material from its authorized location, while diversion involves illicit use of the material in its authorized location.
- C. OVERT THEFT - Open and observable adversary action not concealed or hidden; theft using force.
- D. SABOTAGE - The damage of property, equipment, or procedures so as to obstruct safeguards systems from functioning by deliberate subversion in either covert or overt manner.
- E. HOAX - A threat made by a group or individual, lacking the capability to perform the actions threatened, with the intent of extorting concessions from the government or private individuals. (126)

32. STAGE OF ADVERSARY ACTION SEQUENCE

- A. Recruiting
- B. Motivation
- C. Planning - material use
- D. Planning - selection of target
- E. Planning - event
- F. Resource acquisition
- G. Practice and training
- H. Implement theft
- I. Post possession material preparations
- J. Delivery
- K. Fulfill intent - end event

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TERMS - BASE 32: STAGE OF ADVERSARY ACTION SEQUENCE

ADVERSARY ACTION - An activity which an adversary must perform in order to perpetrate an event.<sup>(113)</sup>

ADVERSARY ACTION SEQUENCE - An ordered set of adversary actions which commences with the decision to produce an end event and terminates with the occurrence of an end event, or interruption<sup>(113)</sup> of the sequence.

- A. RECRUITING - The collection or forming of a group of potential adversaries or perpetrators.
- B. MOTIVATION - The establishing of incentives or motives stimulating possible action (e.g., revenge, personal gain, or politics).
- C. PLANNING--MATERIAL USE - Determination of intended material use including detonation of nuclear device, dispersion, political blackmail, financial blackmail, sale to third party, damaging manipulation (sabotage), etc.
- D. PLANNING--TARGET SELECTION - Material attractiveness, vulnerable points in safeguards system, and other results of intelligence gathering.
- E. PLANNING--EVENT - Formulation of attack plans including defining required resources and attributes, reconnaissance, selection of operational mode, define acceptable degree of risk, establish specific responsibilities and sequence of activities, preparation, and contingencies.
- F. RESOURCE ACQUISITION - Insiders/outside (talents, knowledge, expertise), specialized equipment and armament, money, support of other organizations, etc.
- G. PRACTICE & TRAINING - Preparatory activity.
- H. IMPLEMENT THEFT - Adversary action including overcoming safeguards, material acquisition and getaway.
- I. DELIVERY - Transport of material to safe destinations.
- J. FULFILL INTENT - Culminate with planned material use.

END EVENT - An event involving nuclear material or facilities brought about by the completion of an adversary action sequence; an event producing societal consequences.

33. CONSEQUENCE REDUCTION (MITIGATION OF EFFECTS)

- A. Evacuation
- B. Shelter
- C. Medical
- D. Decontamination
- E. Dilution - denature
- F. Negotiation
- G. Use denial
- H. Damage control
- I. Assessment

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TERMS - BASE 33: CONSEQUENCE REDUCTION (MITIGATION OF EFFECTS)

CONSEQUENCES - Losses to society caused by perpetration of an event, including death, injury, and property damage, as well as other types of losses to society.

SOCIETAL RISK - The expected loss to society from a particular source of activity, or from all activities. In the safeguards context, the societal risk is the expected consequences which will arise from the perpetration of willful, illegitimate events, over a given period of time, involving nuclear material or nuclear facilities.

- A. EVACUATION - To relinquish possession or to remove personnel or general public from safeguarded areas or other areas under potential risk.
- B. SHELTER - To provide physical cover or refuge from potential consequences.
- C. MEDICAL - Medical facilities or procedures available to reduce risk from potential consequences.
- D. DECONTAMINATION - To make safe for personnel or general public by removal of nuclear materials to a level that is safe for habitation.
- E. DILUTION--DENATURE - To render material undesirable to an adversary consequences by adding a highly radioactive contaminant that will prevent the safe removal of the material from its containment, or by reducing the concentration of the material by adding another material to it which is difficult to separate by readily available means.
- F. NEGOTIATION - To assuage an adversary from his threat or reach an accommodation by conferring or discussing.
- G. USE-DENIAL - Prevention of potential consequences by sealing, dismantling, immobilizing, or other means activated at a particular stage of adversary action, particularly applying to occupation or takeover of facility or in-transit vehicle.

- H. DAMAGE CONTROL - Procedures to mitigate, account, repair, or replace losses due to events which impair or halt the functioning of activities.
- I. ASSESSMENT - The estimate of the impact of successful adversary acts in terms of economic, health and safety or other social costs.

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## ALPHABETICAL LISTING

<u>TERM</u>	<u>Base</u>
A	
Abnormal situations	15
Access control	13
Access control records	18
Access denial	26
Access registration	13
Access registration	18
Access, vehicle	13
Accident probability reduction	20
Accountability	23
Accountants	3
Accounting	18
Accounting	23
Acquisition, resources	32
Accuracy	23
Additions to material in process	23
Adjustment	23
Adversary action	32
Adversary action mode	31
Adversary action sequence	32
Adversary characteristics	30
Advertisement	19
Aerosol irritants	27
Agreement state	3
Air	7
Alarm and communication system	25
Alarm annunciation	16
Alarm annunciation procedures	21
Alarm annunciation records	18
Alarm assessment	15
Alarm, duress	25
Alarm limits	15
Alarm mode	8
Alarm station	25
Amendments to licenses	2
Ammunition	27
Analysts, measurement technicians	3
Animals	24
Appeals board	3
Appeals by applicant	2
Appeals by intervenor	2
Appeals by licensee	2
Apprehension and recovery	4
Approval site	8
Area, vital	26
Armament	30



TERM	Base
Armament, protective equipment	27
Arms specifications	27
Arrangements for assistance	17
Arrest	16
Arrest of other terrorists	19
Assay	6
Assessment of contingency	16
Assessment of threat	16
Assessment of consequence	33
Assurance	4
Assurance	20
Atomic safety and licensing board	3
Attractiveness, material	12
Audit	23
Auditors	3
Authorization criteria	13
Authorized individual	3
Automated entry control system	28
Avoidance	12
Avoidance of population center	20

B

Backfitting or modification	8
Badge display	13
Badges	28
Badge, system	17
Balance, material	23
Barrier, ceilings and floors	26
Barrier, fences	26
Barrier, other	26
Barrier, specifications	26
Barrier, vehicle offsite access	26
Barrier, walls	26
Beginning inventory	23
Book inventory	23
Breaches	26
Briefings and educational programs	19
Bullet-resisting clothing	27
Buyer's inspectors	3
By-product material	9

C

Calibration	23
Call assistance	16
Camouflage	26
Capabilities	22
Capability, intelligence (adversary)	30
Carrier, transportation	3
Ceilings and floors, barriers	26

<u>TERM</u>	<u>Base</u>
Central alarm station	25
Central station	21
Chain of command	22
Changes, security plan	17
Checks, portals	14
Chemical conversion	6
Chemical separation	6
Civil disturbance	15
Clothing change	13
Clearance, security	15
Commencement of construction	8
Common language	21
Common mode failure	12
Communications	18
Communications	21
Communication system	25
Communication system, fixed site, external	25
Communication system, fixed site, internal	25
Communication system, portable	25
Communication system, transit	25
Compliance	20
Confirmation	13
Consequence reduction	4
Consequence reduction	33
Construction	8
Construction contractor	3
Consultant agent	3
Containment	4
Containment	26
Containment vessel	26
Contingency response	16
Continuous knowledge	12
Continuously manned	13
Continuous patrols	14
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IMAGE EVALUATION  
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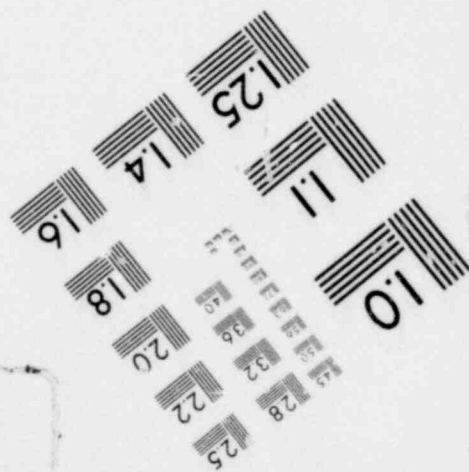
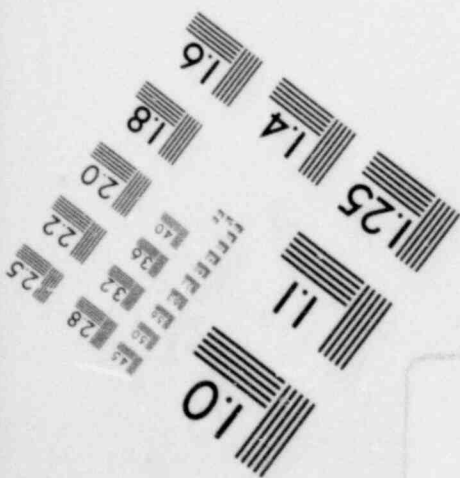
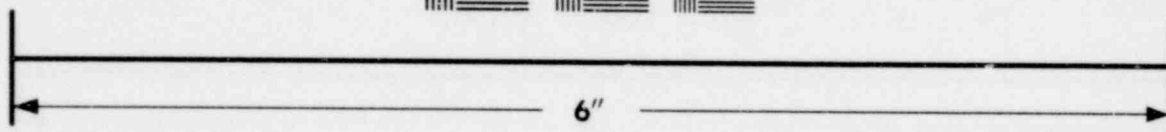
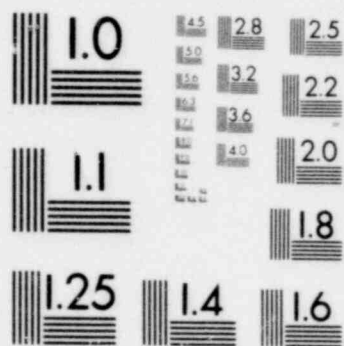
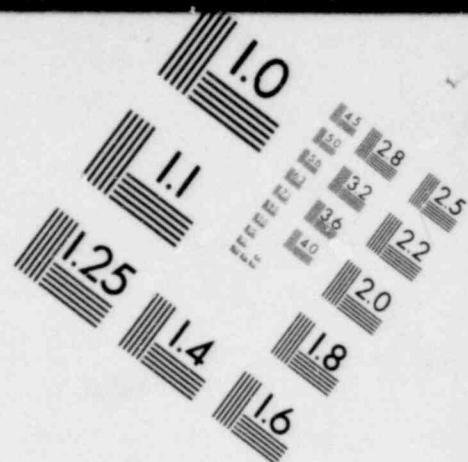
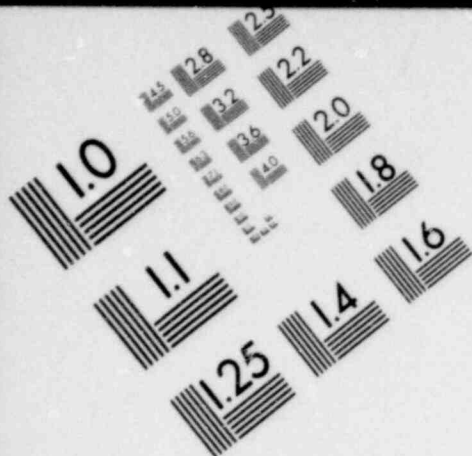
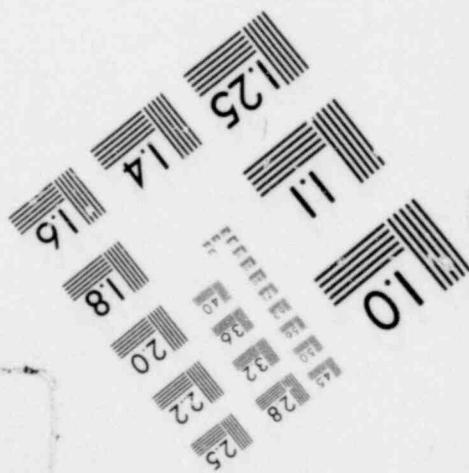
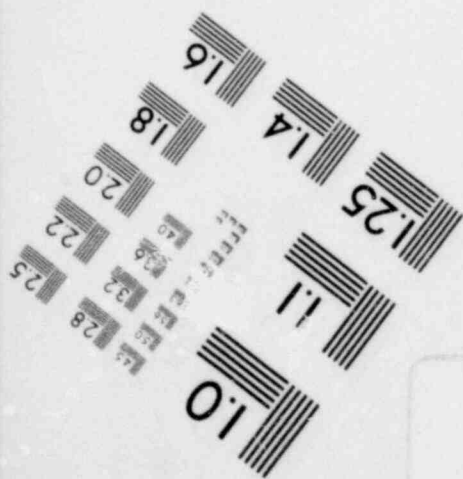
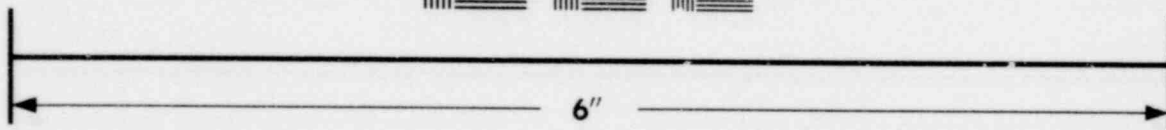
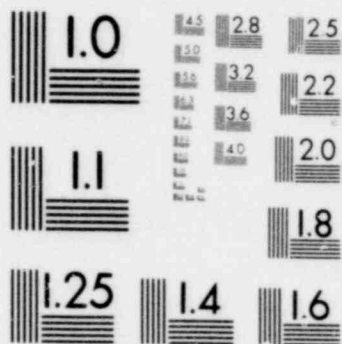
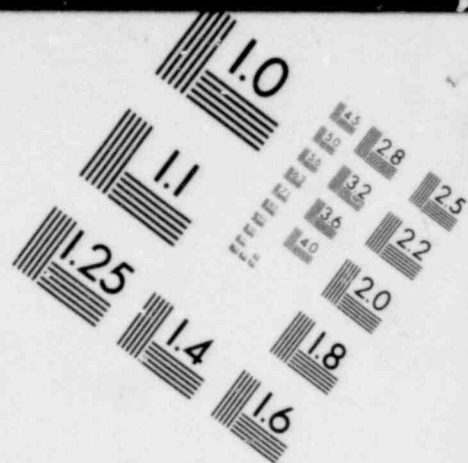
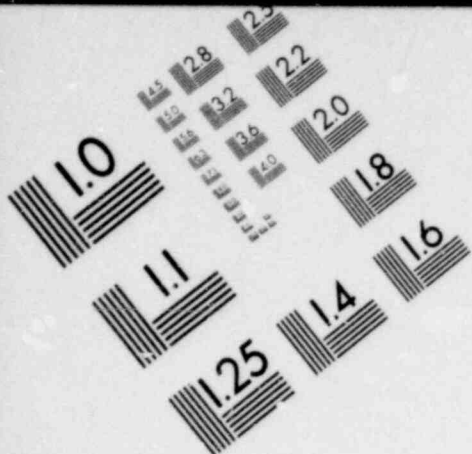
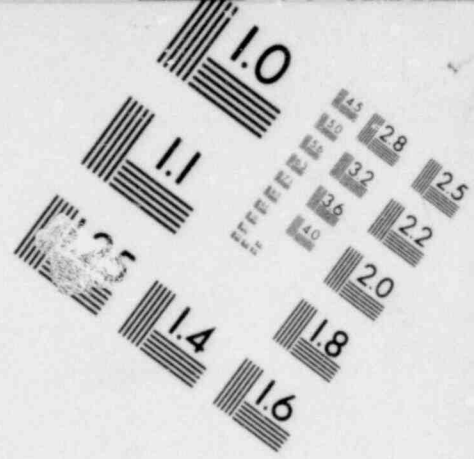
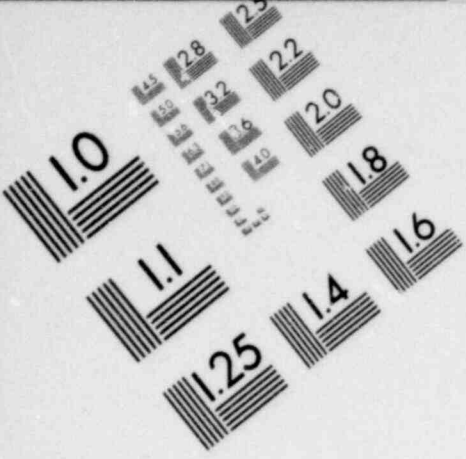


IMAGE EVALUATION  
TEST TARGET (MT-3)





**IMAGE EVALUATION  
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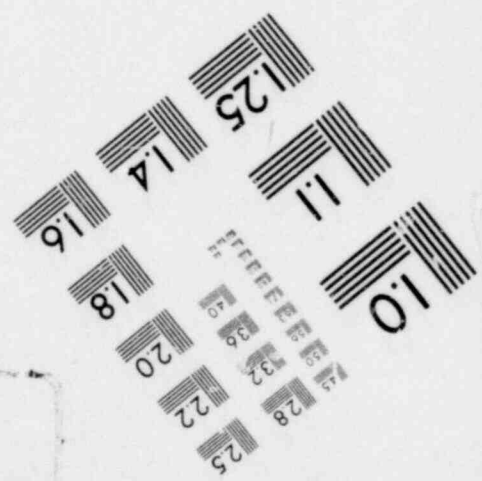
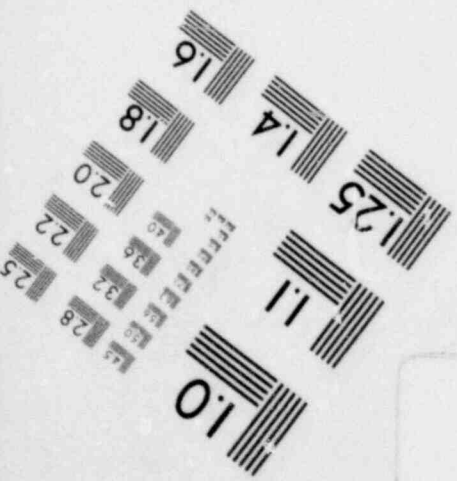
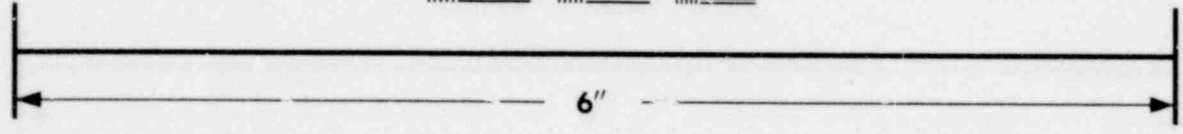
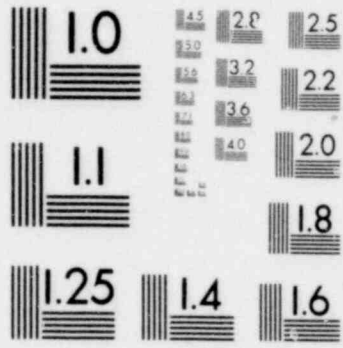
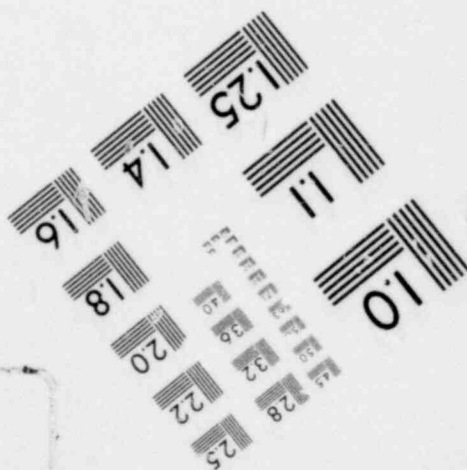
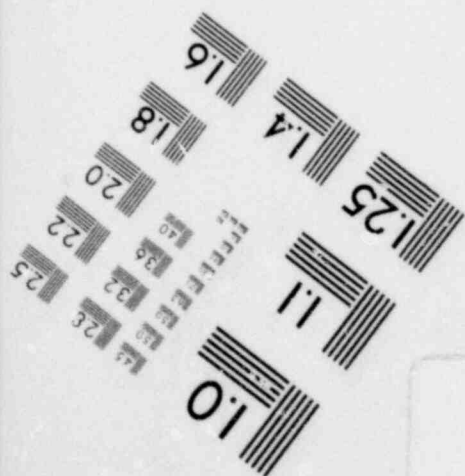
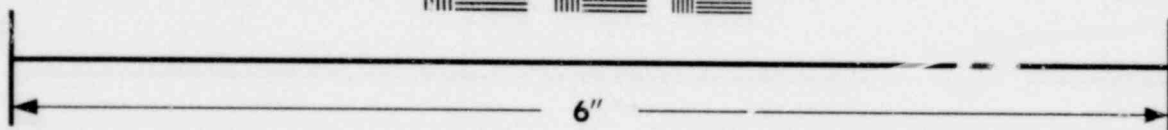
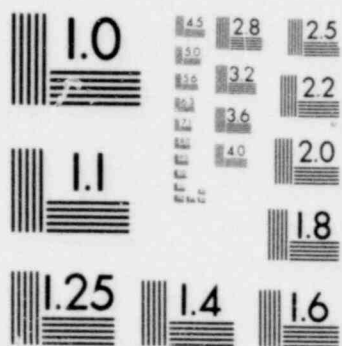
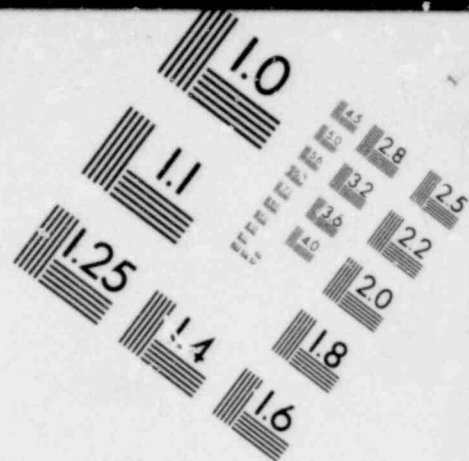
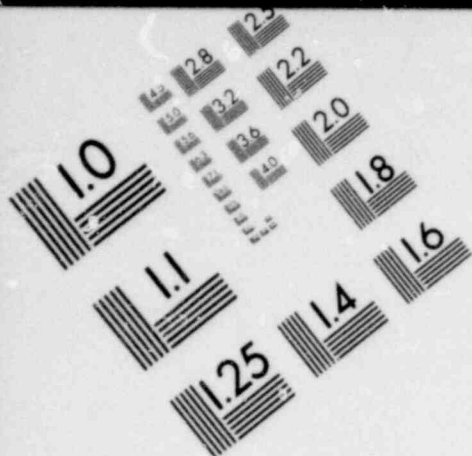


IMAGE EVALUATION  
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## NOTES

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2. Code of Federal Regulations, Title 10 Energy Parts ) to 199 (Include Chapter 1: Nuclear Regulatory Commission). Revised as of January 1, 1977. U.S. Government Printing Office, 1977, 2.800, pp. 66-67.
3. Ibid., Adapted from 70.4, p. 349.
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5. Ibid., 50.70, p. 286.
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### 70.55 Inspections.

- (a) Each licensee shall afford to the Commission at all reasonable times opportunity to inspect special nuclear material and the premises and facilities wherein special nuclear material is used, produced, or stored.
- (b) Each licensee shall make available to the Commission for inspection, upon reasonable notice, records kept by the licensee pertaining to his receipt, possession, use, acquisition, import, export, or transfer of special nuclear material.

(21 F.R. 764, Feb. 3, 1956, as amended at 32 F.R. 2583, Feb. 7, 1967. Redesignated at 25 F.R. 1607, Feb. 25, 1960 and 25 F.R. 12730, Dec. 13, 1960)

7. Ibid., 71.63, p. 387  
71.63 Inspection and tests.
  - (a) The licensee shall permit the Commission at all reasonable times to inspect the licensed material, packaging, and premises and facilities in which the licensed material or packaging are used.
8. Ibid., 50.110, p. 289.
9. Ibid., 70.71, p. 374.
10. Ibid., 71.64, p. 387.
11. Ibid., 73.80, p. 402.

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12. Ibid., 50.2(n), p. 253, 70.4(j), p. 349.
13. Ibid., 73.2(b), p. 391.
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17. Safeguards Dictionary, for the Office of Safeguards and Materials Management, United States Atomic Energy Commission, by Brookhaven National Laboratory, WASH-1173, July 1971.
  - (a) Ibid., p. 16, quoted: Safeguards Committee (1970), Agreements between states and the Agency requested in connection with the Treaty on the Nonproliferation of Nuclear Weapons, GOV/COM. 22162, 17 September 1970, and revisions dated 20 October 1970 and 30 October 1970.
  - (b) Ibid., p. 16, quoted: United States Atomic Energy Commission, Manuals, Rules, and Regulations and other Official Publications.
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19. Ibid., 100.3(d), p. 410.
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23. Safeguards Dictionary, op. cit., quoted: the Technical Support Organization, for the Office of Safeguards and Material Management, at Brookhaven National Laboratory.
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26. Alternatives for Managing Wastes from Reactor and Post-Fission Operations in the LWR Fuel Cycle. ERDA-76-43, Vol. 1, United States Energy Research and Development Administration, 1976. p. 4.2.
27. Ibid., adapted from pp. 6.90-6.91.

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29. Code of Federal Regulations, op. cit., 50.1(6), p. 252.
30. Safeguards Dictionary, op. cit., quoted: the Institute of Nuclear Materials Management, Standards Committee, Provisional Definitions of Commonly Used Terms in Nuclear Material Management.
31. Ibid., (adopted definition from International Atomic Energy Agency).
32. U.S.A. Standard Glossary of Terms in Nuclear Science and Technology, op.cit.
33. Safeguards Dictionary, op. cit.
34. Alternatives for Managing Wastes from Reactor and Post-Fission Operation in the LWR Fuel Cycle, op.cit., p. 2.9.
35. Ibid., p. 15.
36. Ibid., p. 17.1.
37. Ibid., p. 4.1.
38. Code of Federal Regulations, op. cit., 50.1(6) p. 252.
39. Ibid., 150.3(k), p. 455.
40. Ibid., 170.3(n), p. 462.
41. Ibid., 73.2(v), (as given in Federal Register, Vol. 42, No. 128, July 5, 1977, P. 34313).
42. Ibid., 51.52, pp. 338-339.
43. Ibid., 70.4(s), p. 350.
44. Ibid., 50.10(b) pp. 254-255.
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46. Technology, Safety, and Costs of Decommissioning a Reference Nuclear Fuel Reprocessing Plant, Battelle, Pacific Northwest Laboratory, October 1977, p. 12-9.
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51. Ibid., 150.3(h), p. 455.
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APPENDIX C

KEYWORD RETRIEVAL SYSTEM

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## APPENDIX C

### KEYWORD RETRIEVAL SYSTEM

The regulations contained in Parts 70, 71, and 73 of Chapter 10 of the Code of Federal Regulations have been established in a computerized information system. The system is based on keyword retrieval of the elements of the Safeguards Index given in Appendix A. The system was created to demonstrate the potential utility of automatically identifying specific requirements contained in the regulations.

Since the content of the regulations is informational, it is natural to explore some of the possibilities which may be afforded by an automated system. Although the system demonstrated here is limited in capability, it exhibits a number of the attributes of a more detailed information system.

This Appendix discusses the basic system which was implemented and demonstrates its capabilities. General comments regarding information systems and their potential application to structured safeguards regulations are also given. Possible extensions of the demonstrated system and guidelines for its use are also discussed.

#### C.1 NEED FOR INFORMATION SYSTEMS

To make effective use of the huge quantities of data that are being stored in computers, interest in database and information system theory and design has increased. Practical systems have been designed and implemented in numerous organizations, including banks, hospitals, manufacturing companies, universities, and the government.

A database is an efficient organization and structure of computer files for raw data storage. An information system is an ordered set of methods, procedures, and resources designed to process stored data into a form which facilitates its use in achieving some objective. Thus, a database contains unstructured raw data, information is selected data that is meaningful to the user, and an information system is a machine that converts raw data into information.

Information systems have potential utility in the context of structural safeguards regulation. For example, the ability to quickly retrieve requirements pertaining to a specific area of interest would be immediately beneficial. Similar systems can be used in the creation and analysis of proposed regulations. To illustrate this potential, a simple information system was created to retrieve selected contents of the list structures developed for classifying the safeguards regulations. The section below demonstrates the basic capabilities of the information system developed to assist with this study.

## C.2 SYSTEM OVERVIEW

The information system allows the retrieval of textual material based on the entry of one or more (key) words or phrases. The keywords are the elements of the various bases used for classifying the safeguards regulations. Once the desired text items are located within the database, listings may be produced that group the associated sections of the regulations.

As currently configured, the information system creates a randomly accessed database comprised of two data files. The first file, called the "abstract" file, contains a text identifier and a short descriptive sentence for each text item. A text item is identified by the paragraph and number of a given section in the regulations, and the description may be any text provided by the user, such as the regulation title. A typical abstract record might appear as:

70.1 (A)( ): SPECIAL NUCLEAR MATERIAL GENERAL PROVISIONS, PURPOSE

The second file is referred to as the "keyword" file. This file contains one record for each unique keyword provided by the user. In this application, keywords may be any of the elements (items) included in the Safeguards Index of Appendix A. The record itself contains the keyword and a "pointer" to each abstract in the abstract file to which that keyword applies. For instance, the keyword "REQUIREMENT" might apply to three text items, as shown below:

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REQUIREMENT: 70.1 (A)( ), 70.2 ( )( ), 71.25 ( ) ( )

The keyword file structure is indexed to allow random access of any keyword record, and the pointers contained within the record allow direct access of the associated abstract records. This structure allows interactive retrieval of the text items.

The actual retrieval of abstract text is performed by issuing appropriate commands and keywords to the system. For example, by issuing the retrieval command with the keyword "REQUIREMENT", the program will return abstracts for the three text items as previously shown. However, by further qualifying the retrieval with additional keywords, the results can be much different. For instance, issuing the command with the keyphrase "PERFORMANCE REQUIREMENT" will return only the text items associated with both words. As presently implemented, the retrieval program will allow keyword combinations of twenty words.

Five retrieval commands are currently available to the system user: SEEK, SEEK@, TYPE, PRINT, and QUIT. The basic use and operation of each command can be described by way of demonstration.

```
PDS > RUN RETRIEV
11:54:55
```

```
KEYWORD RETRIEVAL PROGRAM
```

---

```
ENTER DATABASE NAME:  NUCSAFE
```

After initiating the retrieval program and requesting the database of interest (in this case "NUCSAFE"), the user may begin selecting test items with the SEEK command. For example, all text items which relate to licensing might be of interest:

```
? SEEK LICENSING
CURRENT SET CONTAINS 0017 ITEMS.
```

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Note that the program has found 17 such items. If the user was only interested in items concerning licensing appeals, the SEEK command may have been entered differently:

```
? SEEK LICENSING APPEALS
CURRENT SET CONTAINS 0017 ITEMS.
```

In this case, the program has only located one text item related to licensing appeals.

The SEEK@ command allows the user to further qualify the set of items created by the preceding retrieval. For example, if after retrieving all items related to licensing as demonstrated above, the user could further qualify his retrieval for licensing appeals:

```
? SEEK LICENSING
CURRENT SET CONTAINS 0017 ITEMS.
? SEEK@ APPEALS
CURRENT SET CONTAINS 0001 ITEMS.
```

Note that this sequence has the same results as specifying both keywords in a single retrieval.

The TYPE and PRINT commands allow the user to view the results of his retrievals. TYPE displays the results at the user terminal while PRINT generates a printed copy of the results on the system line-printer:

```
? TYPE
KEYWORDS:
LICENSING
APPEALS
ITEMS:
01. 70.14 ( B) ( ): SPECIAL NUCLEAR MATERIAL EXEMPTIONS
? PRINT
```

The final command, QUIT, ends retrieval processing in an orderly manner, preserving the integrity of the database files:

```
? QUIT
<KRP> COMPLETED
```

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### C.3 USE OF THE INFORMATION SYSTEM

For purposes of this study, the information system was developed to exhibit its potential utility in the context of developing a structure for the safeguards regulations. The system was developed to ease the process of reviewing the content of the regulations and for determining first-order interactions within the regulations.

The results given in Chapter 4 classify the contents of various regulations by grouping those which are associated with a given base. As was discussed, each regulation was reviewed and a list structure was prepared for each. The list structure indicated the bases for which a regulation was deemed applicable. Furthermore, the elements of that base were marked as covered if the review so indicated. The resultant list structure developed for the regulations formed the source data for the information system.

In reviewing the overall content of the regulations, the system facilitated the search process necessary to link all the requirements with a given base. For example, consider Base 18, Records and Reports. Figure 4.15 lists all the requirements that are associated with that base. This same set of requirements can be established by keying in, under separate entries, each of the elements of that base.

In addition to identifying all the regulations associated with a given base, the system immediately provides a grouping of all the regulations dealing with a given element. This allows a comparison for possible interactions at the element level.

Although the information system was not extensively used in the structuring process - the expense of detailed improvements and validation was not justifiable - it does exhibit potential utility. For example, if an appropriate set of categories and elements could be determined that would completely classify the regulations then those parties concerned with some specific aspects of the requirements could readily identify those sections or paragraphs dealing with that topic. This would help streamline the process of

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assuring compliance through the various sections rather than dealing with each on a section by section basis.

Similarly, the process of regulatory improvements in the form of developing upgrades could be aided by an information system. As was discussed in Chapter 5 of this report, a systematic structure has the potential to be used to 1) identify gaps in the current requirements and 2) indicate the requirements that currently deal with a topic. The search for gaps could be facilitated by automatic retrieval of the current rules. Potential upgrades could be implemented consistently with advanced knowledge of interfaces with current requirements.

As mentioned in the preface to this appendix, the system that was implemented is basic in its capabilities. The information system was developed with minimal expense for purposes of exhibiting the concept. A number of improvements to extend the capability of the basic retrieval system were identified:

Full Text Retrieval. In the configuration currently implemented, the system presents only a text abstract (Regulation Title) for each retrieval item. An obvious extension to the system, and one which, from a programming viewpoint, is relatively simple to implement, is retrieval of the entire text item. This would allow a search of the actual contents of the requirements in addition to current method which the requirements in addition to current method which is based on a subjective classification.

The major disadvantage of this capability is the time and expense of data entry for the entire text (i.e., keypunching). However, as computerized typesetting becomes further established throughout the printing industry, the availability of text in computer-readable form such as paper or magnetic tape should increase.

Keyword in Context Processing. The keyword data used by the retrieval system in this application was provided directly by the user. Such keyword data most often consists of words describing the abstract thought or meaning of the text items, but which may not appear in the text itself. This is referred to as



"keywords out of context." A variation on this method of keyword selection is "keywords in context." In this form, significant words actually appearing in the + re themselves utilized as keys to the items.

Extended Boolean Retrievals. Currently, the keyword retrieval system provides only for the "AND" combination of retrieval keys. Essentially, this means that when multiple keywords are provided in the SEEK command, only text items referred to by al. of the keys are selected. That is, items with keys AND Keys AND keys, etc.

A desirable alternative would provide for "OR" combinations of the retrieval keys. In this situation, text items referred to by any one or more of the specified keys are selected.

Given an underlying structure for the safeguards regulations (e.g., a complete set of elements and bases) appropriate for organizing their contents, an information system with the above capabilities would serve to enhance their understanding. The use of an information system is yet another possible approach to simplify understanding of the complex structure of the safeguards regulations. The methodology developed in the study lends itself to take advantage of automated methods. The discussion here has only touched upon the potential of such an application.

The final section of this appendix serves to document the development and use of the system.

#### C.4 TECHNICAL OVERVIEW

The keyword retrieval system presently consists of three subsystems implemented on a Digital Equipment Corporation PDP 11/70: 1) Keyword Pre-processing, 2) Database Loading and 3) Keyword Retrieval.

Figure 1 is a flow diagram of the Keyword Pre-processing subsystem. Essentially, this subsystem performs the following operations:

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1. Keyphrase cards are entered into a direct access file, indexed by their base-number/key-code combination.
2. For each text item, the item identifier (subsection, paragraph, regulation number) and a short descriptive sentence (regulation title) are entered via an "abstract" card into the database data file.
3. Every keyphrase associated with a text item is entered on a "key" card containing the appropriate text identifier and the keyphrase index.
4. The name of the new database is established by submitting a "name" card.
5. The COBOL program "KEYCONV" creates a new database data file, substituting the parsed keyphrases for each key card input. The new data file contains one abstract record and a number of keyword records (one word per record) for each text item.

The keyword pre-processing subsystem is application dependent and can be altered to fit various forms of input data. For instance, in this particular application, the pre-processing was implemented only to reduce data entry efforts. The addition of computer-generated keyword capabilities would, for example, replace the current pre-processor.

Figure 2 contains a flow diagram of the Database Loading subsystem. Essentially, this system creates the direct access computer files used by the retrieval subsystem, using for input the data file created by the pre-processing routine. The COBOL program "BLDABS" creates the direct access abstract file and appends the abstract "pointer" to the appropriate keyword records. The "BLDKEY" program then creates the indexed keyword file containing a single record for each unique keyword. These keyword records contain the pointers to abstract records associated with the key.



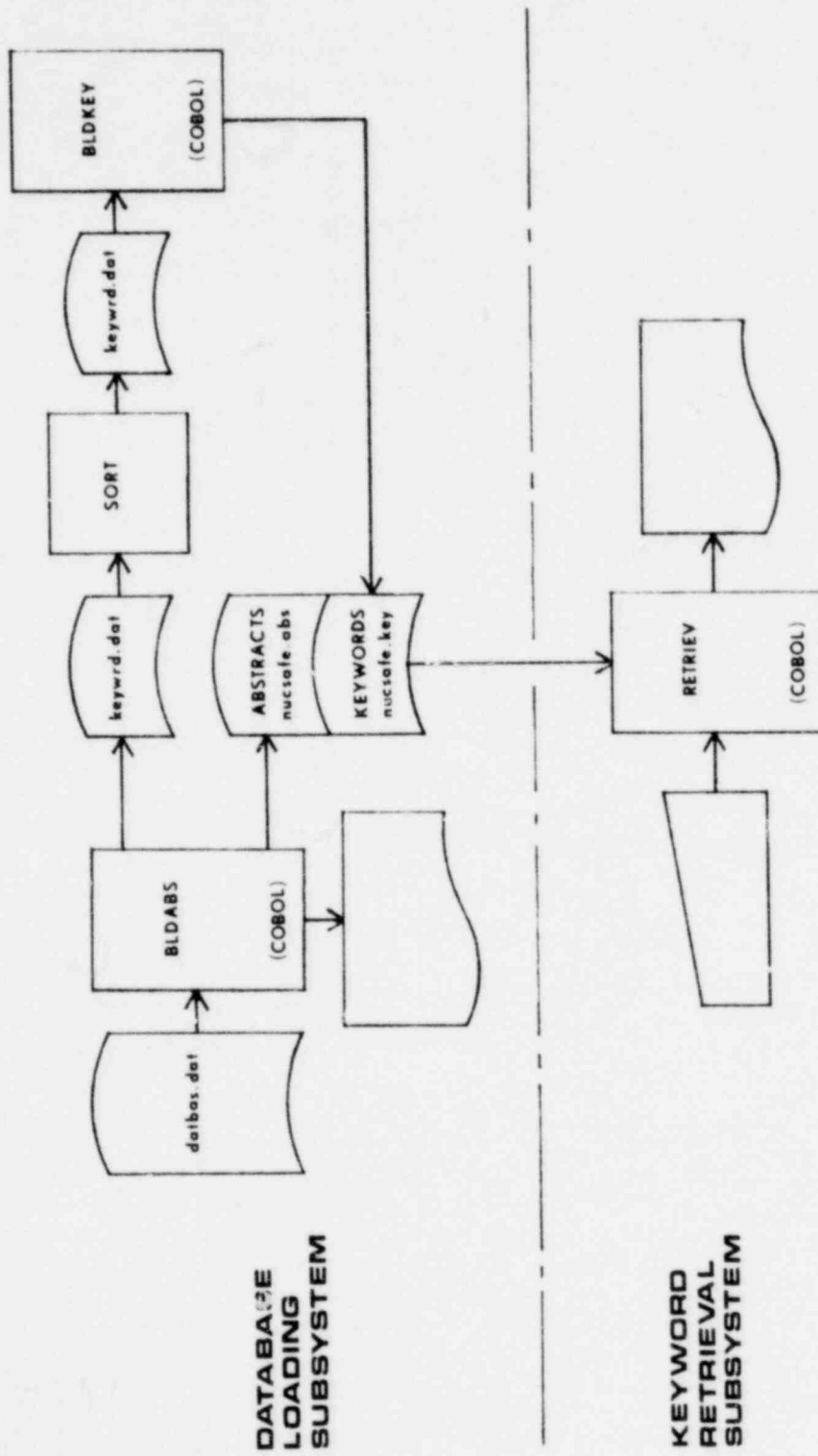


FIGURE 2. Database Loading and Keyword Retrieval System

The final subsystem, shown in Figure 2, controls interactive Keyword Retrievals. Once the database is loaded and operational, this is the only subsystem required for use of the keyword retrieval system.

Retrievals are initiated by typing RUN RETRIEV on the computer terminal. The program will first prompt the user to enter the name of the database to be accessed. If the database files are successfully opened, retrieval commands will be prompted by a question mark (?).

```
PDJ> RUN RETRIEVE
12:02:31
KEYWORD RETRIEVAL PROGRAM
ENTER DATABASE NAME: NUCSAFE
?
```

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