
A Systematic Assessment of the Safeguards Regulations

Summary

D. W. Fraley

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REGULATIONS

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Prepared for
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EXECUTIVE SUMMARY

OBJECTIVE

In this study, systematic analysis methods are used to assess the content and relative coverage of present physical protection and material control and accounting regulations. With the promulgation of the reactor physical protection rule (Section 73.55, Chapter 10 of the Code of Federal Regulations), basic safeguards for all facets of the nuclear industry will have been specified. However, no systematic assessment of the regulations as a whole has been made.

The objective of this study is to provide a systematic analysis of the safeguards regulations using a structural approach. Specifically, regulatory requirements are examined to determine if they are:

- *responsive to safeguards policy,*
- *consistent,*
- *complete, and*
- *do not contradict or render ineffective other safeguards, public safety, or worker safety requirements.*

SCOPE

The principal safeguards regulations that are the focus of the study are contained in Part 70 - Special Nuclear Material, Part 73 - Physical Protection of Plants and Materials, and the proposed upgrades to Part 73 of Chapter 10 CFR^(a). The requirements of Parts 50 and 71 of 10 CFR are considered for consistency and possible contradictions with Parts 70 and 73. Additionally, current worker and public safety requirements promulgated by NRC and other agencies are also considered for possible interactions.

APPROACH

To meet the study's objectives, it was necessary to compare the various requirements. In our study, we classified the regulations and formulated a

(a) Code of Federal Regulations, Chapter 10 - Energy, Office of the Federal Register, General Services Administration, January 1, 1977.

system specifying the safeguards requirements. *The methodology allows an interpretation of the regulations' contents and interactions, and provides a framework for representing their structure.*

The approach has two steps. The first step creates a taxonomy for the safeguards regulations; it determines a set of categories and terms that can be used to classify the regulations' contents. By classifying each requirement as to whether or not it deals with some aspect of each term, insight regarding content and possible gaps in coverage can be gleaned. By grouping the regulations that deal with a common set of terms, insight regarding interactions and possible conflicts can be afforded.

The second step of the approach is the determination of structure. A basic result of this study is that the regulations can be represented by many structures. Each of the structures represents a different point of view or concern regarding the interpretation of their requirements. A result of the approach is a systematic basis for assessing the content of the regulations.

RESULTS

The safeguards regulations were observed with regard to the following aspects:

- *Responsiveness to safeguards policy.* The objective of effective regulations is to communicate policy and intent to the persons and organizations responsible for their implementation. *One problem in the existing regulations is a lack of specified objectives or intents within the requirements.* The principal intents which may be determined from the context of the regulations are prevention, containment, control, consequence reduction, protection, and assurance. A second problem involves identification of the required performance necessary for compliance. *Measurable indicators of performance are almost totally absent from the present regulations.* The study classifies the possible intents of each regulation's requirement and identifies a need for defining measurable indicators of performance.
- *Consistency.* *The analysis found that, in general, the safeguards regulations are in agreement and coherent among the various parts.* At the detailed level of specific requirements, however, minor inconsistencies were found that cloud interpretation of the regulations. For example, Part 73 distinguishes between the liable party (i.e., the licensee) and the party responsible for performing the function

(e.g., the escorts for a shipment). However, Part 70 does not identify parties who perform the functions. The minor inconsistencies found in the analysis are not felt to significantly detract from the requirements' effectiveness. Better cross-referencing between rules dealing with the same activity would enhance their clarity.

- *Completeness.* All major activities within the scope of the Nuclear Regulatory Commission's policy are addressed in the safeguards regulations. They are however, addressed at different levels of detail. For example, many of the performance-oriented requirements, e.g., Section 73.20 - "General Performance Requirements: (for physical protection), allow the licensee to determine methods that comply. Elsewhere, necessary methods are spelled out in detail. For this example (73.20) specification of performance measures would enhance both the licensee's ability to comply and the NRC's ability to inspect. In many cases, further detail may not be necessary. A complete set of regulations both covers all activities and has sufficient detail to allow compliance and verification. The study indicates where the requirements inadequately cover certain activities.
- *Contradictions.* Only where the safeguards regulations interact, e.g., deal with the same activity, does there exist the possibility of contradiction. *Interactions within the safeguards regulations were primarily neutral or positive; that is, complying with all the regulations is the same or less difficult than complying with each separately. Interactions between the safeguards regulations and the various safety requirements were found to be similarly neutral.* For the instances of two or more regulations dealing with the same activity, the additional requirements added more constraints but did not introduce any contradictions.
- *Adequate structure.* The analysis used for this study represents a systematic approach which helps clarify the regulation's contents. As result of the assessment and the experience of developing the classifying methodology insight was gained regarding the regulations' structure. *A key finding is that the regulations can be represented by many structures.* The direction taken in the study was to analyze the regulations from a variety of viewpoints to discover whether all aspects of each are covered in the regulations. The classifying methodology developed for this purpose allows representation of the regulations' structure in a variety of ways.

The study provides an organization which characterizes the differing scopes, intents, objectives, and functions among and between the regulations. In the analysis, each requirement was classified and carefully compared with every other requirement. The specific observations are presented as results

of the analysis and their significance is discussed. The basic theme of the report is a systematic assessment of the safeguards regulations. It also provides a basis for determining if regulatory changes are compatible with, and improvements to, the existing requirements.

CONCLUSIONS

On the whole, no major gaps, inconsistencies, or conflicts were found in the regulations. The safeguards regulations are the subject of considerable review and interpretation of many persons, at all times. Obvious errors and omissions are resolved by the public and NRC review process. The analysis presented in the report substantiates the effectiveness of the regulatory process.

The safeguards regulations are complex, due in part to their purpose of promulgating requirements on complex activities. If they do not apply to the appropriate activities, the safeguards systems they create are not effective. The major questions of completeness, consistency, and possible contradictions in the safeguards regulations are simplified by the systematic analysis presented in this study.

Among the specific requirements, a number of instances were found that were unclear, represented minor inconsistencies, or addressed an activity at differing levels of detail. The systematic approach used in the study, in addition to identifying these difficulties, provides an approach that may be used to give the regulations organization and clarity.

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1.0 STUDY SUMMARY

1.1 BACKGROUND

In 1974, Congress emphasized the importance of safeguards by establishing an Office of Nuclear Material Safety and Safeguards (NMSS) in the NRC. The mandate of NMSS is to license and regulate essentially all commercial nuclear facilities, materials, and operations with the exception of reactors: NMSS is also responsible for reviewing nuclear safeguards.

Under this mandate, NRC has been conducting efforts to assure that all nuclear facilities achieve a highly efficient and capable safeguards program. These efforts emphasize upgrading control and protection of nuclear materials and developing plans for dealing with threats, thefts, and sabotage.

To support these concerns, several task forces were formed to clarify objectives and recommend specific actions. In 1976, NRC conducted a review, with the Energy Research and Development Administration, to improve the control and protection of nuclear materials at NRC-licensed fuel cycle facilities possessing significant quantities of high-enriched uranium and plutonium.⁽¹⁾ One result of the review was the formation of a task force to study the roles of material control and material accounting in the safeguards program.⁽²⁾ Also in 1976, a team consisting of NRC staff and U.S. Army personnel assessed the vulnerability of nuclear materials transportation. These studies resulted in actions to change licensing conditions and to strengthen physical security and access control over material at fixed sites and in transit.^(3,4) A series of proposed upgrades for material accounting procedures were also developed.

Another aspect of NRC's mandate is to support research directed to improve safeguards. The NRC, in cooperation with the Department of Energy (DOE), is developing methodologies for analyzing the vulnerabilities of fixed sites and transportation systems. For fixed sites, the evaluation methodologies may be separated into those dealing with material control and accounting and those dealing with physical protection. Summaries of the

various evaluation methodologies for physical protection at fixed sites are given in Reference 5. Models which address material control and accounting, except for the Comprehensive Evaluation Program⁽⁶⁾ are currently under development. Discussion of and references for the methodologies can be found as Appendix E of Reference 2. The "Nuclear Safeguards Technology Handbook,"⁽⁷⁾ and NUREG-0141⁽⁸⁾ also contain summaries of methodologies currently in use or under development.

The studies just described represent two activities directed at improving safeguards: 1) assessment of regulatory needs and 2) development of models or methodologies to measure effectiveness. This study primarily supports item 1, both by helping identify possible regulatory needs and providing a context in which to help implement these needs as regulations.

The distinction between evaluation of safeguards effectiveness and the regulatory process (the focus of this study) is important. Figure 1.1 depicts the relation between the regulatory process, the safeguards system surrounding an operation or facility and effectiveness evaluation methodologies. The regulatory process determines needs and prescribes safeguards requirements for an operation or a facility. The purpose of NRC evaluations is twofold. The primary purpose is to assure that implementation of the regulations and operation of the safeguards system meet the intent of the regulations. Feedback to the regulatory process is a secondary purpose.

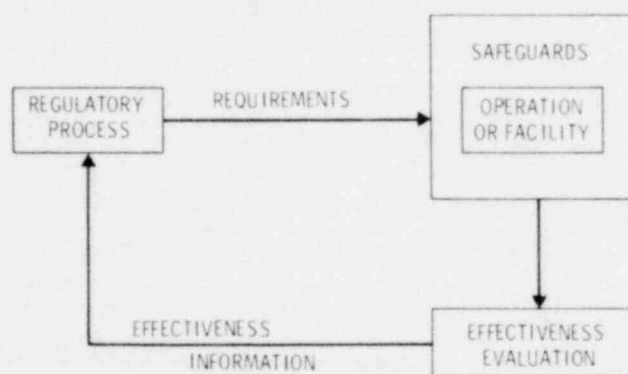


FIGURE 1.1. Feedback Relation of Regulatory Process

Determining regulatory needs has information sources in addition to effectiveness evaluation. These sources include perceptions from NRC staff (particularly NMSS, Inspection and Enforcement, and Standards Development); site reviews by NMSS and contractors; inspection evaluation reviews; research to improve safeguards; and others.

The concern of this study is development of a structured approach to improve the regulatory process. It takes place at the level of the requirements as specified by the regulations. To improve the regulatory process, the regulations require a structure whereby changes can be made systematically. In effect, the increased understanding gained from examining the logical structure should help provide a basis upon which to implement regulatory improvements.

1.2 APPROACH

This study examines the safeguards regulations in a systematic manner to determine if they are:

- *responsive to safeguards policy,*
- *consistent,*
- *complete, and*
- *do not contradict or render ineffective other safeguards, public safety, or worker safety requirements.*

The approach entails the classification and formulation of the regulations as a system which specifies safeguards requirements. Its purpose is to facilitate the interpretation of the regulations' contents and interactions and to provide a framework for representing their structure. The approach also provides a methodology for determining if regulatory changes are compatible and supportive of the existing requirements. Structuring the safeguards regulations provides an organization which characterizes the differing scopes, intents, objectives and functions among and between the regulations.

The structuring process has two steps. The first step creates a taxonomy for the safeguards regulations; it defines a set of categories and terms that

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classify regulations' contents. By classifying each requirement, insight regarding content and possible gaps in coverage can be gleaned. By grouping the regulations that deal with a common set of terms, insight regarding interactions and possible conflicts can be afforded.

The second step of the approach is the determination of structure. A basic assumption of this study is that the regulations can be represented by many structures. Each of the structures represents a different point of view or concern regarding the interpretation of their requirements. In addition, the study suggests a general structure; this structure summarizes the various activities addressed by the requirements and the viewpoints taken in their interpretation.

The methodology described in the second chapter forms the basis for much of the analysis presented in the report. The reader who is interested in the specific findings may wish to proceed to the subsequent chapters, referring back to this chapter only if certain terms or concepts presented there are confusing and prevent understanding the results. Because the development of structure is often a conceptual process, Chapter 2 is presented to give order and insight into the methodology used.

In the third chapter, thirty-three categories are defined for classifying the content of the regulations. Within each category are a number of terms that focus on the object of the requirement. They include all the common classifications used by NRC and several others that represent alternative ways of viewing the concern of the regulations.

The classifying scheme and terminology were selected after a review of the various sources of possible structures for the safeguards regulations. The review is summarized as Appendix A of the report. Sources within the current regulations and within the NRC are discussed. The appendix also reviews a number of safeguards studies which present differing perspectives regarding the structure of the regulations or other concerns.

The terms used within each of the classifying categories are defined in Appendix B. This appendix, entitled Safeguards Index, provides a detailed glossary of safeguards terms. Where possible, definitions in current use are

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given and their sources are noted in the notes to the Appendix. A number of terms, however, had no formal definitions in the safeguards literature. Consequently, informal definitions were developed for these terms.

1.3 RESULTS OF THE ASSESSMENT

The safeguards regulations are a major line of communication for safeguards policy between the NRC and the licensees. This two-way communication is necessary to assure that safeguards measures achieve their purpose, which is protection from malevolent acts against nuclear facilities or unauthorized use of nuclear materials. To be effective, the regulations must be focused, understandable, usable, and enforceable.

The safeguards regulations are complex, due in part to their promulgation of requirements for complex activities. If they do not apply to the appropriate activities, the safeguards systems they create are not effective. The major questions of completeness, consistency, and possible contradictions in the safeguards regulations are simplified by the systematic analysis presented in the study.

On the whole, no major gaps, inconsistencies, or conflicts were found in the regulations. The safeguards regulations are the object of considerable review by many persons, at all times. Obvious errors and omissions are resolved during the NRC review process. The analysis in the report substantiates the general effectiveness of the regulatory process.

In examining the completeness, consistency, and contradictions in the safeguards regulations, their organization and clarity were found to be the principal problem. Among the specific requirements, a number of instances were found that were unclear, represented minor inconsistencies, or addressed an activity at differing levels of detail.

These difficulties do not necessarily detract from the purpose of the requirements but they reduce understandability and hence may impede their implementation and enforceability. Better organization of the safeguards requirements in the form of cross references, indexing, and clear delineation

of their scope would improve the regulations. Persons who are knowledgeable regarding the various requirements often have such an organization or structure in their minds.

The principal observations regarding the safeguards regulations are separated into four categories. These are:

- Responsiveness to Safeguards Policy
- Consistency
- Completeness
- Contradictions

1.3.1 Responsiveness to Safeguards Policy

It is the objective of effective requirements to communicate policy and intent to the persons or organizations responsible for their implementation. If they are not concise or if they do not clearly specify their intent they do not meet this objective. One problem in the existing regulations involves identification of the required performance necessary for compliance. A second problem is a lack of specified objectives or intents within the requirements, i.e., specifying the policy that the regulation supports.

How to characterize the regulations as legal requirements is the subject of some issue. At issue is the use of "performance based" regulations as opposed to regulations which give specifications or define procedures. A possible source of confusion is the difficulty of defining actions necessary for compliance.

The regulations were classified as being either goal, performance, or procedural oriented. If the regulation allows the licensee to propose decisions regarding performance or procedures then it is a goal requirement. A goal requirement gives a purpose or objective. A performance requirement gives an output and level of achievement required but does not describe the necessary procedures except in a general way. Procedural requirements give the action or procedure, or perhaps specify hardware.

- *The majority of the regulations are procedural or performance oriented but these orientations are difficult to separate.*

- *The revisions and proposed revisions to Part 73 include performance-oriented requirements.*

Performance statements improve clarity and may contribute to improved consistency and structure. However, such statements require specific criteria which measure performance.

- *Safeguards performance criteria are almost totally absent from present regulations. General performance requirements, without measures or indices of performance, are being proposed as revisions to Part 73.*

In order to have a clear legal requirement that communicates NRC policy, it is necessary that the requirement specify its intent or purpose. In the regulations it is difficult to identify a purpose beyond general terms such as "to protect" or "to control".

- *The principal intents which may be determined from the context of the regulations are prevention, containment, control, consequence reduction, protection, and assurance.*
- *The goals of consequence reduction and assurance are not explicitly mentioned but many of the regulations can be subjectively interpreted as supporting these functions.*

Assurance is commonly accepted as one of the intents of the material control and accounting requirements but is never mentioned. Apprehension and recovery is an objective which is not a specific portion of NRC's regulatory charter. Several of the requirements, however, can be considered to be supportive of this activity. Detection and deterrence are the other intents not regularly appearing in the regulations. Detection and deterrence are not generally singled out as specific safeguards functions but rather appear as a subpart of protection or defense. These underlying intents can be extracted from requirements dealing with activities such as surveillance or access control.

To effectively communicate safeguards policy the safeguards requirements should:

- *Carefully characterize the intent of a regulation, including a complete set of intents which communicate policy objectives.*
- *For "performance" oriented regulations, define measurable indicators of performance for purposes of compliance and enforcement.*

1.3.2 Consistency

The analysis found that, in general, the safeguards regulations are in agreement and coherent among the various parts. At the detailed level of specific requirements, however, many minor inconsistencies were found that reduce the regulations' clarity. These minor inconsistencies were not felt to inhibit the effectiveness of the regulations, only to make their interpretation more difficult.

Good regulations are consistent: each of their requirements are compatible and in logical agreement among successive sections. Where two or more rules are involved, conflicts or gaps between them inhibit their interpretation. Problems of consistency in the safeguards regulations occur in three different ways. First is the identification of who is responsible for prescribed compliance. Next, the identification of the specific activities of concern and the scope of the requirement is in some cases inconsistent. Finally, the use of inconsistent terminology occurs in several of the regulations.

In Part 70, the licensee is the object of the requirements in terms of both responsibility and liability. In this part, individuals within the licensee's organization are not singled out as functionaries. In the regulations dealing with physical protection, e.g., Part 73, this separation is usually made. However, the regulations are fairly explicit about liability (e.g., "the licensee shall provide assurance that...") and less explicit about who must conduct the activity.

- *Licensees are the principal parties designated by the safeguards regulations; only for physical protection requirements are licensee employees singled out for performing functions.*

In the regulations, the principal safeguards concerns are separated into material control and accounting or physical protection. Part 73 further divides the requirements into those which deal with strategic nuclear material (SNM) at fixed sites, SNM in transit, and fixed sites themselves, e.g., protection of the facility. Knowledge of the operations and materials involved at specific kinds of facilities is necessary to adequately identify the regulations with respect to kinds of facility.

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To some extent, the specific facilities or operations can be inferred from the exemptions and reference is occasionally made to a particular type of facility, e.g., power reactor or reprocessing plant. Guides such as Tables 5.5, 5.6 and 5.7 and Figures 5.8 and 5.9 in this report are helpful in understanding the rules.

The organization of the regulations in reference to facilities or transit operations can be characterized as:

- *For facilities, the regulations deal with material types and amounts; the types of facilities sometimes must be discerned by the material types and quantities used.*
- *For transit operations, the physical protection requirements of Part 73 are organized by mode or activity.*

Multitudinous rules specify applicability to certain ranges of SNM quantities, particularly Part 70. It is difficult to determine what conditions apply for what amounts of material. In some cases it must be located in previously stated general conditions or in statements of exemptions. The relationships between quantities and facilities are not apparent. In sum:

- *Where the quantity of SNM affects the applicability of a given rule in Part 70, the quantity is often not stated explicitly.*

The third problem of consistency is with the selection of consistent terminology. In the development of the classification methodology, a number of informal definitions were made. A consistent set of regulations must use a common set of terminology. The safeguards terms given in Appendix B represents a compilation of a significant number of commonly used terminology for safeguards concerns. Of these, over one-third were informally defined for this study.

- *A dictionary or glossary of terms commonly used but not defined in the regulations would be a useful guide for consistent interpretation of the requirements.*

A specific example appearing in the requirements is:

- *The term "fissile material" used in Part 71 is not defined in terms relating it to SNM or strategic SNM.*

1.3.3 Completeness

All major activities within the scope of the Nuclear Regulatory Commission's policy are addressed in the safeguards regulations. They are, however, addressed at different levels of detail. The example of performance-oriented requirements, discussed above in the context of communicating NRC policy, exemplifies a differing level of detail.

A complete set of regulations both covers all activities and has sufficient detail to allow compliance and verification. A clearer structure for the regulations would help allay questions regarding their completeness. The study provides a number of groupings of requirements which are similar in nature. Tables 4.4, 4.5, 5.5, 5.6, and 5.7 serve as guides to structuring and identifying similar requirements.

To assess for completeness, twelve categories were defined as safeguards systems functions. The two major groupings used in the regulations are: 1) material control and accounting, and 2) physical protection. Here, the techniques of material control and accounting and physical protection are grouped together and decomposed by the functions that people conduct to carry out the requirements. The following observations deal with the completeness of the regulations as they were assessed by function.

- *The function of access control is confined exclusively to Part 73 dealing with physical protection.* This function is oriented primarily to fixed sites yet may be interpreted as a transport concern as well. 10 CFR Part 70 does not specify requirements for access controls for material access areas and for secure material containment. These items are covered in Part 73. References in Part 70 to these requirements are advisable. There is a great contrast between the detail and specificity in Parts 70 and 73.
- *Surveillance is not separated by the regulations as a specific function.* Design considerations to facilitate personnel surveillance in material access areas, and for contingencies or emergency situations are not provided except in the case of nuclear power reactor protection (Section 73.55).
- *Investigation is addressed by the regulations for accounting or shipping losses and assessment of alarms.* The regulations do not specify that investigations be conducted by the licensee in case of an incident in which safeguards procedures are compromised or requirements are not achieved. The only exceptions are for the cases of excessive shipper-receiver differences (70.58(g)) and by implication, excessive materials unaccounted for (MUFs) (70.53(b)(2)).

- *Response is primarily a physical protection function.* The concept of graded protection and graded response depending on the location or type of event is not evident in the regulations. Responses to deficiencies, alarms, threats, etc. are treated in a more explicit and systematic manner in the recent revisions and proposed revisions of Part 73.
- *The functions of planning and design must be exhibited in the licensee's application.* Design, planning and preoperational testing are mentioned in 10 CFR 70.57 and in the upgrade rules in Part 73 but all other requirements apply to normal operations and maintenance. There are no safeguards provisions specifically for decommissioning, remodeling, or modification of facilities.
- *Classification of the regulations in terms of records and reports showed that documentation was required for the majority of safeguards activities.* Material control and accounting records must be retained a minimum of five years but retention of records on matters of physical security not involving material accounting is not specified. Record retention is specified in the proposed revisions to Part 73.

The time periods within which specified notices or reports must be submitted to NRC are stated in various ways and the meaning is often unclear. The terms "file within a period of fifteen (15) days..." (73.71), "submit a report...within 60 days..." (70.59), "submit a copy...within ten (10) days..." (70.54), and "notify...by U.S. Mail, postmarked at least seven days in advance..." (73.72) exemplify the differing time periods and notification requirements.

- *Deterrence is a function of safeguards as well as an intent.* The safeguard rules are designed specifically to provide deterrence. Deterrence is explicitly mentioned as a purpose (73.1). The regulations do not explicitly specify measures to detect and neutralize the threat of diversion, sabotage or subversion by insiders. However, they do direct the licensee to plan his safeguards system against this threat, among others.
- *The performance-oriented requirements can be interpreted as providing assurance.* This function was never specified as the object of a given requirement. In Part 70, the principal assurance concerns appear as part of the material control and accounting sections (70.56 - 70.58). The provision of assurance through redundant safeguards measures or systems is not identified in the requirements.
- *Communications as a function, differs from records and reports in that it is an active part of physical protection.* The proposed requirements in Part 73 detail communication as a function necessary at both fixed sites and during transport of material. Communication timing and schedule requirements at fixed sites are not as well defined as those for transport.

- *The operation of a security organization is a key safeguards function. The necessity for such an organization as specified in Part 73 is only implied within the licensing requirements in Part 70 (Sections 70.22, 70.23 and 70.58).*
- *Accounting as a function is easily singled out in the content of the regulations. It is contained primarily in Part 70, Sections 70.51, 70.57, and 70.58. Here the quantity of SNM directly affects the applicability of a given rule.*
- *Consequence reduction is defined as activities which take place after occurrences such as accidents or adversary acts. The regulations as well as some safety requirements deal with a priori methods that would affect consequences. The requirement of contingency plans is an example of consequence reduction measures in the regulations.*

1.3.4 Contradictions

Only where the safeguards regulations interact, e.g., deal with the same activity, does there exist the possibility of contradiction. *Interactions within the safeguards regulations were primarily neutral or positive.*

A neutral interaction results when complying with a set of regulations is the same as complying with each separately. In some instances several requirements dealing with the same activities compliment one another; when two requirements may clarify one another or enhance compliance, the interaction is positive. In cases of two or more regulations dealing with the same activity, the additional requirements added more constraints but did not introduce significant contradictions.

There are three principal areas of interactions within the safeguards regulations. They fall in the regulatory areas dealing with:

- license application and conditions
- material control and accounting
- physical protection.

Chapter 5 of the report addresses each of these areas of interaction by reviewing various classifications of the regulations for possible internal conflicts.

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The fact that current regulations do not substantially conflict is not surprising considering the process involved in developing requirements. Regulations are developed based on a detailed analysis of needed requirements, a knowledge of current requirements, resolving difficulties early in the process, experience in compliance, and a review process that includes all the parties involved in creating or meeting their requirements.

The first set of regulatory interactions that are considered in detail span contents of Parts 70 and 73. A major purpose of the two parts is to promulgate the conditions for licensing of persons or organizations having nuclear material. Tables 5.1 to 5.4 of this report serve as a guide to the interaction of these rules concerned with licensing.

One of the key criteria for the applicability of the safeguards requirements is material type identified by quantity. The safeguards regulations impose various levels of control dependent upon the quantity and kind of material which the licensee possesses or is authorized to use. The second set of interactions considers these quantity requirements with the facilities in which material may be located.

As noted previously, a number of the requirements have implicit rather than explicit specifications of material quantities. Similarly, relating material quantities with specific facility types proved difficult due to the regular omission of facility type designations. However, the "level of control" as a function of material quantity is applied in a consistent manner.

The third comparison of the regulations consider physical protection requirements in Part 73. Sections 73.46, 73.50 and 73.55, although dealing with different materials and facilities, have almost parallel requirements. These regulations are compared in Table 5.8. Table 5.9 similarly compares transportation physical protection requirements. The contents of Section 73.26 are intended to supplant and hence parallel a number of requirements in Sections 73.30 through 73.36.

The major observations regarding contradictions within the safeguards regulations are:

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- *Many redundancies appear in the regulations, including the proposed revisions to Part 73. Although the redundancies do not result in conflicts or inconsistencies, they make the requirements more difficult to read. Examples are: 70.52(a) (losses) and 70.52(b) (thefts); and the proposed revisions of Part 73, e.g., 73.46 and 73.55 with 73.50.*

The safeguards regulations are also compared to the related requirements of Part 50 - Licensing of Production and Utilization Facilities and Part 71 - Packaging of Radioactive Material for Transport and Transportation of Radioactive Material Under Certain Conditions. The assessment sought possible contradictions.

- *The requirements of Part 50 interact mainly with those of Part 70 dealing with licensing. Interactions were generally neutral. The function of planning and design, not addressed in Part 70, is in the scope of Part 50. Licensing requirements are generally parallel in the two Parts.*
- *A licensee who packages and ships nuclear material must also comply with the requirements of Part 71. The classification methodology was also applied to this part to test its general applicability. There are no interactions between Part 71 and Part 70 or 73 that may affect the safeguarding of shipments.*

It is possible to develop a sequence of determinations and decision points regarding packaging and shipping SNM but this involves selection of the applicable sections of 10 CFR 71, 10 CFR 73 and Department of Transportation requirements. This sequence is presented in Chapter 7 of the report.

The study also reviews the safety requirements promulgated by the NRC and other Federal agencies which might present conflicts with the safeguards regulations. It was found that:

- *Of those safety requirements that do interact with the safeguards regulations, most interact in a neutral way; complying with both the safety and safeguards requirements regulations is no more difficult than complying with each separately.*

The principal safety requirements that interact with safeguards requirements are found in the NRC requirements 10 CFR 19 and 10 CFR 20 dealing with worker instructions and radiation protection standards respectively. The major interaction having a potential conflict is:

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- *The prescribed controls over personnel when leaving a material access area or reactor vital areas may be violated when emergency exits are made for fire or criticality unless special provisions are made in the design of the exclusion areas. The regulations do not call for this consideration.*

Chapter 8 of the report provides an analysis of the various safety requirements which affect nuclear facilities. Key areas are identified and discussed in terms of their interaction.

The majority of the difficulties in the safeguards regulations rests with their organization and clarity. The analysis used for this study represents a systematic approach which helps clarify the regulations' contents.

1.4 ORGANIZING STRUCTURE

The safeguards regulations must be read with a purpose in mind. For each purpose, there may be a "best" organizing structure for characterizing the regulations' contents. A basic assumption supported by the results of this study is that the regulations can be represented by many structures. The reader's purpose and point-of-view in interpreting the requirements give a perspective on representing their structure.

The approach used in this study to assess the regulations is founded in classifying their contents and carefully comparing similar requirements. To do so, possible structures from a number of sources were reviewed. These sources are discussed in Appendix A.

As result of the assessment and the experience of developing the classifying methodology insight was gained regarding the regulations' structure. The direction taken in the study was to analyze the regulations from a variety of viewpoints to discover whether all aspects of that viewpoint are covered in the regulations. Chapter 6 of the report discusses the structure of the regulations.

The study also identifies a set of attributes which should be included in a comprehensive structure for the requirements. Before considering the attributes it is important to consider the purpose of considering structure.

First, the principal results of this study are that the difficulties in interpreting the regulations rest with their organization and clarity. *A structure provides a guide which spans the purview of the regulations.*

Second, the assessment found that the regulations are generally complete, consistent, and do not contain contradictions. This indicates that the current structure has a reasonably adequate foundation. *The structural approach is used as a tool to interpret the requirements, not a recommendation for reorganizing their contents.*

Finally, a structural representation for the safeguards regulations also provides a basis for determining if regulatory changes are compatible and supportive of the existing regulations. *The organization and classification of the various safeguards requirements allows ready identification of those requirements which interact with proposed changes.*

In the study, each regulation is classified according to its objectives, its scope, the activities it specifies, its functions, and the objects to which it is directed or are its focus. The classification of the regulations' contents allows identification of each regulation that deals with a similar concern.

1.5 OUTLINE OF THE REPORT

The report is organized into seven major chapters:

- Chapter 2 - The Structuring Process - gives the reasons for studying the structure of the safeguards regulations as being their complexity and the potential for confusion afforded in their interpretation. A methodology is presented that allows a systematic interpretation of their contents and interactions, and provides a framework for representing their structure.
- Chapter 3 - Classifications for the Safeguards Regulations - follows the conceptual methodology to develop a taxonomy for the regulations. A number of categories for classifying the contents of the regulations are defined.

- Chapter 4 - Content of the Safeguards Regulations - applies the methodology in classifying the regulations' content. The various regulations are grouped together by their common concerns or application as characterized by the various categories.
- Chapter 5 - Interactions Within the Safeguards Regulations - several key areas where the regulations interact are investigated in more detail for consistency or gaps in coverage. A number of general observations are made regarding interactions and how they relate to the structure of the regulations.
- Chapter 6 - Structures - considers the structure of the regulations. Observations about the regulations' structure are made that tie together the methodology and the analysis of the regulations' contents.
- Chapter 7 - Interactions with Parts 50 and 71 - reviews their contents in the context of the methodology. The licensing requirements of Part 50 are assessed for possible contradictions with safeguards requirement. The methodology is applied to the transportation requirement and their contents are given structure.
- Chapter 8 - Interactions with Safety Requirements - surveys the general set of worker health and safety requirements that are in potential conflict with safeguards requirements. Specific safety requirements are compared with specific safeguards requirements and observations resulting from the analysis are presented.

The methodology introduced in the second chapter forms the basis for much of the analysis presented in the report. The reader who is interested in the specific findings may wish to proceed to the subsequent chapters, referring back to Chapter 2 only if certain terms or concepts presented there are unfamiliar and inhibit understanding of the results. Because the development of structure is often a conceptual process, this chapter is presented to give order and insight into the methodology used.

The third chapter defines a set of thirty-three categories as a general set for categorizing the content of the regulations. They include all the

common safeguards classifications as well as several others that represent alternative ways of viewing the contents of the regulations.

Each of the categories described in Chapter 3 contain from three to thirty elements as subgroupings. These terms are defined in Appendix B of the report which provides a detailed glossary of terms commonly associated with safeguards. In addition to being a necessary basis for this study, it provides a detailed compendium of terminology. Where possible, definitions in current use are given and their sources are noted in the notes to the Appendix. A number of the terms, however, had no formal definitions in the safeguards literature. Informal definitions were developed for these terms.

Chapter 4 uses the taxonomy developed in the previous chapter and detailed in Appendix A to classify the content of the various regulations. Section 4.1 elaborates on the use of the methodology by applying the classification process for one Section of Part 73.

The sections of Chapter 4 following 4.1 group related categories and the regulations that were classified as associated with one or more elements in the categories. By grouping the regulations by classifying categories, rather than considering each regulation one-by-one, a preliminary set of interactions can be displayed.

The classification process indicates a set of groupings that merit further consideration in terms of their interactions. The regulations can be considered to interact: 1) neutrally, e.g., deal with the same elements but in a manner whereby effectiveness is not complicated due to the interaction, 2) positive; e.g. effectiveness is enhanced; and 3) negatively, e.g. effectiveness is reduced.

Chapter 5 focuses on three major areas: those regulations dealing with licensing applications and conditions, material control or accounting, and physical protection. In each case, the principal regulations are viewed in terms of possible conflicts or inconsistencies. Chapter 5 provides a number of observations regarding interactions in these areas and discusses how they relate to the structure of the regulations.

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The structures of the regulations are discussed in Chapter 6. The assumption that the regulations afford alternative structural representation, based upon differing viewpoints, is the foundation for the presentation. Various structural perspectives or viewpoints are first introduced. These perspectives are then related to the methodology by associating subsets of the bases (classifying categories) with each perspective. This chapter completes the internal analysis of the safeguards regulations.

External consideration of the safeguards regulations is made in Chapters 7 and 8. In Chapter 7 the licensing requirements of Part 50 and the transportation requirements of Part 71 are considered for possible contradictions with Parts 70 and 73. In Chapter 8 the various safety requirements of other regulatory agencies are compared for possible interactions. The analysis first considers all of the various entities with concern for health and safety. Of those, a subset is determined as having regulatory authority over the same people or activities as the NRC safeguards requirements. Next, the specific regulations are pairwise compared for possible interactions. This chapter completes the main body of the report.

The report contains three appendices. Appendix A surveys the various sources of possible organizing structures for the safeguards regulations. Appendix B is a dictionary or glossary of the elements that were used in classifying the contents of the regulations. Appendix C briefly describes the computer information system that was used to search the contents of the regulations. The information system, although limited in scope, exhibits the potential utility of such a system given a set of categories and classification techniques.

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