

**COST/BENEFIT ANALYSIS OF THE
INTEGRATED SAFEGUARDS INFORMATION
SYSTEM (ISIS) ALTERNATIVES**

**Final Report
May 15, 1978 - August 15, 1978**

Boeing Computer Services Company

**Prepared for
U. S. Nuclear Regulatory Commission**

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Manuscript Completed: August 1978
Date Published: September 1978

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Office of Nuclear Regulatory Research
U. S. Nuclear Regulatory Commission
Under Contract No. NRC-04-77-065

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ABSTRACT

The Offices of Nuclear Regulatory Research and Nuclear Materials Safety and Safeguards initiated a research effort to develop a general design for a comprehensive Integrated Safeguards Information System (ISIS) in March 1977. At the completion of that project in May 1978, the Executive Director of Operations instructed the NRC staff to review the results of the research study and to formulate recommendations as to how NRC should satisfy its safeguards information requirements. To assist the Safeguards Coordinating Group (SGCG) in formulating its recommendations for implementing a safeguards information system, NRC contracted with Boeing Computer Services Company to perform a cost/benefit analysis on seven ISIS alternatives. The results of that cost/benefit analysis are presented here. Five and ten year cost estimates have been developed for the seven alternatives. Costs have been compared with cost estimates for satisfying NRC's safeguards information requirements without an integrated system. Benefits are discussed for each alternative. The results of the analysis indicate that ISIS will provide, at reasonable cost, significant benefits achievable only through an integrated system approach.

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EXECUTIVE SUMMARY

The Nuclear Regulatory Commission, in fulfilling its public responsibility for safeguarding the use of nuclear materials, is developing an Integrated Safeguards Information System (ISIS). A competitive research contract for requirements analysis and general design for such an ISIS was made in March 1977 to the Boeing Computer Services Company. The ISIS general design was successfully completed in May 1978. ISIS was designed to possess sufficient flexibility to satisfy all current NRC requirements for safeguards information and to accommodate likely changes in the evolving safeguards regulatory environment. The next phases in developing the system are to complete a detailed design and to begin a pilot program.

In March 1978, the Executive Director of Operations for NRC directed the Safeguards Coordinating Group (SGCG), a project review task force established during the early phases of ISIS, to review the results of the research contract and to formulate a recommendation addressing the most effective way for NRC to satisfy all its current and future safeguards information requirements. In support of this review activity a contract was awarded to Boeing to perform a cost/benefit analysis of the major options available to NRC. Seven integrated alternatives, representing varying degrees of system and data integration, were analyzed and compared against two alternatives based on a non-integrated approach. Evaluation of the nine alternatives provides a basis for NRC management to begin implementing the most user responsive, cost-effective system to satisfy its safeguards information needs. This report presents the results of this cost/benefit analysis.

The seven integrated ISIS alternatives defined by NRC range from minimal integrated capability to the complete integration of all safeguards data as described in the ISIS Phase III final report. All ISIS alternatives would provide portions of the total ISIS requirements which would satisfy the most immediate or near-term requirements, while maintaining a flexible basis for evolving with future requirements. Table 1 shows the safeguards functional area supported by each of the seven ISIS alternatives.

The two non-integrated NO-ISIS alternatives are based on the assumption that NRC may not elect to integrate its safeguards information. The first NO-ISIS alternative assumes that NRC would satisfy the majority of its safeguards information needs by developing independent stand-alone systems to service individual office functions. This alternative, referred to as "NO-ISIS automated," assumes no data or system integration. The second non-integrated alternative referred to as "NO-ISIS manual," assumes that all currently non-automated information activities would remain manual.

The cost/benefit analysis of the alternatives is based on a "fixed benefits" approach. The benefits to be derived from each alternative were made as equal as possible, and then the costs of providing those benefits were compared. In the case of the ISIS alternatives, to make the capabilities comparable, and fix the level of benefit, NO-ISIS subsystem costs required to "complete" the safeguards information requirements are added to the costs of the various ISIS alternatives.

ALTERNATIVES	SAFEGUARDS FUNCTIONS SERVED										
	Material Control & Accounting	Licensing	Inspection	Ad Hoc	Contingency Planning	Safeguards Effectiveness	Threat Assessment	Physical Security Equipment	Material Control & Accounting Equipment	Transportation	Safeguards-Related Document Information
ISIS ALT 1	X										
ISIS ALT 2	X	X	X								
ISIS ALT 3	X	X	X	X							
ISIS ALT 4	X	X	X	X	X						
ISIS ALT 5	X	X	X	X	X	X	X		X	X	
ISIS ALT 6	X	X	X	X	X	X	X	X	X	X	X
SGCG	X		X		X	X	X				X

TABLE 1
ISIS ALTERNATIVE CAPABILITIES

Figure 1 shows the five year cost estimates for all nine alternatives (seven ISIS and two NO-ISIS) based on providing equal benefits. These costs indicate that cost discriminates little among the seven ISIS alternatives. The NO-ISIS automated cost is slightly less than any of the ISIS alternative costs. The NO-ISIS manual cost is significantly greater than any of the other alternatives.

In evaluating the nine alternatives, it is apparent that significant benefits are achievable with the seven integrated ISIS alternatives that are not feasible with the two non-integrated NO-ISIS alternatives. These unquantifiable benefits include: data integration and control, increased reporting capability (primarily ad hoc), data reliability, personnel efficiency, additional insight into safeguards problems, increased data usability and public awareness and credibility. Though the benefits associated with these qualitative characteristics of the ISIS alternatives are not directly quantifiable, the value to NRC decision makers of having accurate, reliable, complete, and timely information is real. Furthermore, increased industry-wide uniformity in regulating of the nuclear power industry is a valuable, though qualitative benefit of an integrated system. Because of these additional benefits characteristic and of an ISIS, cost is not used as the sole discriminator in this analysis.

The ISIS alternative labeled "SGCG," in Table 1 and Figure 1, forms the basis of the recommendation reported to the Executive Director of Operations. It serves the most urgent NRC needs. This alternative will provide NRC management significant benefits. It requires a minimum cost commitment by NRC.

In conclusion, the results of this cost/benefit analysis indicate the following:

- o If NRC does not implement any new automated safeguards information capability, the cost to satisfy its safeguards information requirements in the mid-1980s may be two to three times more than the cost of implementing an integrated safeguards information system now. The cost for additional NRC personnel constitute the primary reason for the increased cost.
- o Significant qualitative benefits for NRC management can be achieved only by integrating the control of safeguards information. New automated, but not integrated, safeguards information systems will not provide these real benefits.
- o The five year cumulative costs for ISIS are higher than comparable costs for the automated but non-integrated alternatives, primarily because of the costs of operating existing systems during total ISIS development. Projected annual operating costs in the mid-1980s for ISIS are less than the projected operating costs for the non-integrated alternatives considered.

5-YEAR SYSTEM COST (IN MILLIONS)

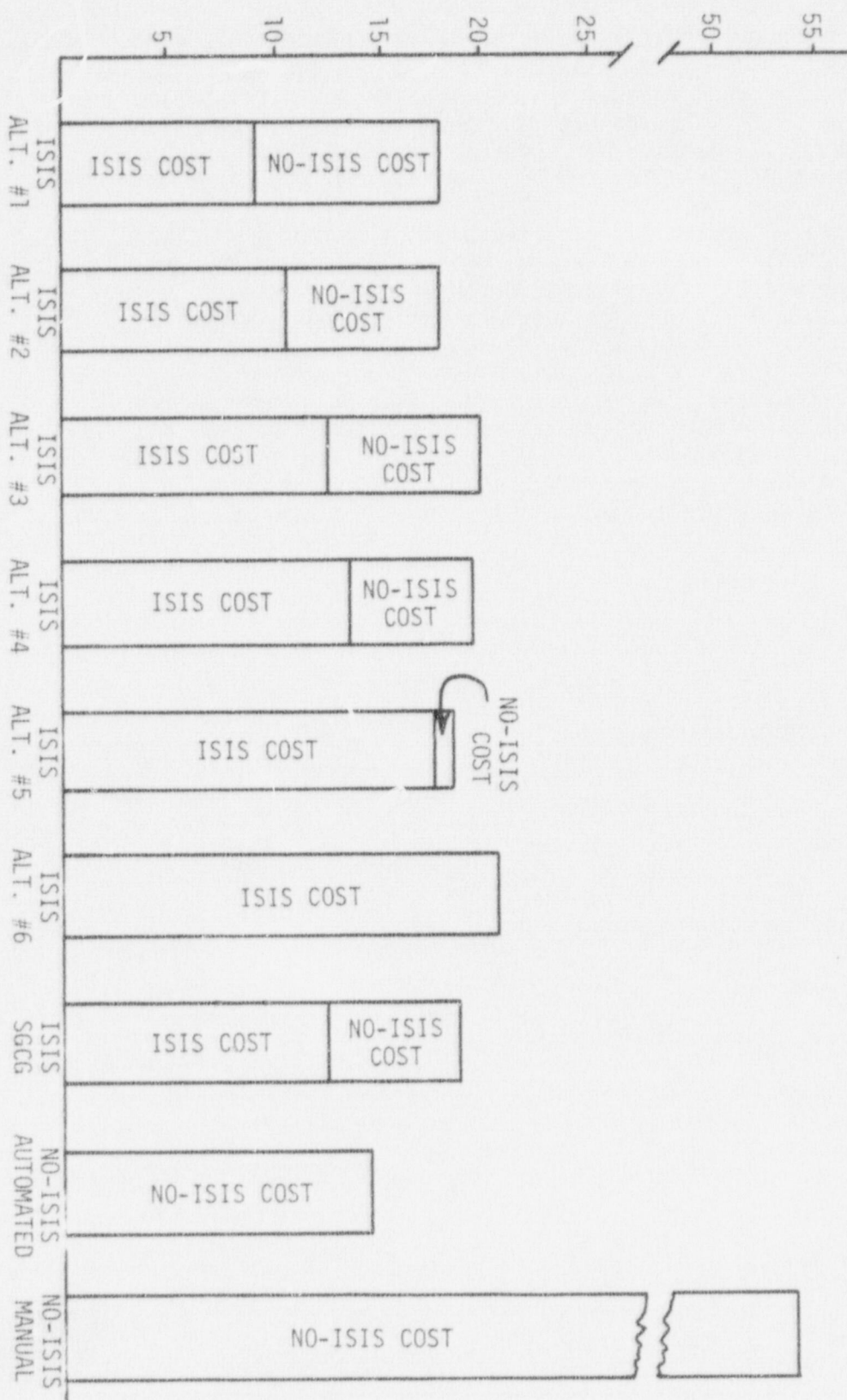


FIGURE 1
COMPARISON OF FIVE-YEAR CUMULATIVE "TOTAL COSTS" FOR ALTERNATIVES

NOTE: Cost estimates represent capabilities as nearly equal as possible. For a detailed comparison of benefits, see Section 6.

- o Cost savings identified for the NO-ISIS automated alternative should be interpreted as the maximum savings possible. Actual costs incurred in implementing this non-integrated alternative may exceed the conservative costs estimated in this analysis.
- o The total ISIS can be easily implemented in phases. Incremental capabilities can be developed and operated without jeopardizing the flexibility to fully expand the system later. Phasing ISIS enhances the flexibility of the integrated system to adjust to evolving safeguards information needs.
- o A pilot program representing a minimum cost commitment to NRC can be implemented and operated to demonstrate the benefits to NRC of an integrated information system. NRC can initially select those portions which address the most urgent well defined safeguards information problems facing NRC today.

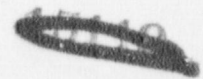
The results of this cost/benefit analysis fully support the SGCG recommendation to begin the initial implementation of an integrated safeguards information system (ISIS). The ISIS alternative recommended by the SGCG will provide NRC a powerful and cost effective capability to assist in accomplishing its responsibility to safeguard the use of nuclear materials.

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LIST OF ACRONYMS, ABBREVIATIONS & SPECIAL TERMS

ABDIST	Abstracts Distribution Service Module
AD	Assistant Director
BCS	Boeing Computer Services Company, a Division of The Boeing Company
CAISIS	Computer-Assisted ISIS Service Module
CEHIST	Comparable Events History Service Module
COTR	Contracting Officer's Technical Representative
CPOR	Contingency Planning and Operational Readiness Service Module
CPU	Central Processing Unit to control a computer configuration
DBMS	Data Base Management System
DCS	Document Control System
DCSINX	Document Control System Safeguards Index Service Module
DDR	Detailed Definition of Requirements developed by BCS
DOE	Department of Energy, old ERDA
EDO	NRC Executive Director for Operations
EFFEVAL	Safeguards Effectiveness Evaluation Service Module
EXPLIC	Import/Export Licensing Service Module
HARDSTAT	Hardware Status Service Module
IAEA	International Atomic Energy Agency and IAEA material accounting system which is under development
ICR	Inventory Change Report
I&E	NRC Office of Inspection and Enforcement

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LIST OF ACRONYMS, ABBREVIATIONS & SPECIAL TERMS (Cont'd)

INSKED	Inspection Scheduling Assistance Service Module
INSPLN	Inspection Planning Service Module
IP	NRC Office of International Programs
IPELTS	International Programs Export/Import License Tracking System being developed which will be incorporated into ISIS
IRS	Inspection Results Summaries, existing 766/766S system
ISIS	Integrated Safeguards Information System
KMP	Key Measurement Point
LER	Licensee Event Reporting system
LICSTAT	License Status Service Module
LICSUP	Licensing Support Service Module
LLEA	Local Law Enforcement Agency
MAC	Material Accounting Service Module
MAQUIP	Material Accounting Equipment Service Module
MBA	Material Balance Area
MBR	Material Balance Report
MP	Multi-processing
NMSS	Nuclear Materials Management and Safeguards Systems
NO-ISIS	Refers to the NRC option to not integrate its safeguards data. Also refers to the two NO-ISIS alternatives used in this cost/benefit analysis
NRC	Nuclear Regulatory Commission
NSA	National Security Agency
NUREG's	Nuclear Regulation documents

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LIST OF ACRONYMS, ABBREVIATIONS & SPECIAL TERMS (Cont'd.)

OIE or OI&E	NRC Office of Inspection and Enforcement
OMPA	NRC Office of Management and Program Analysis
ONMSS	NRC Office of Nuclear Material Safety and Safeguards
OM&B	Office of Management and Budget (U.S.)
ONRR	NRC Office of Nuclear Reactor Regulation
ONRR	NRC Office of Nuclear Regulatory Research (RES)
PCS	Project Control System
PHYSEC	Physical Security Components Service Module
PIL	Physical Inventory Listing
PN or P/N	Preliminary Notification
REGSTAT	Regulation Status Service Module
REPLIC	Reports to Licensees Service Module
RES	NRC Office of Nuclear Regulatory Research
RESTRK	Research Project Tracking Service Module
RIS	Report Identification Symbol
SG or S/G	Safeguards
SITS	Safeguards Item Tracking System Service Module
SSRS	Safeguards Status Reporting System to be incorporated into ISIS
STALIC	State Licenses Service Module
THRAN	Threat Assessment Service Module
TRANS	Transportation Safeguards Service Module

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1.0 INTRODUCTION

Section 1.1 presents the background for the decision to perform a cost/benefit analysis of the alternatives available to NRC for satisfying its safeguards information requirements. The approach taken to perform the analysis is described in section 1.2. The reader is introduced to the report format in section 1.3.

1.1 BACKGROUND

The nuclear power industry is expected to increase significantly over the next several years. Nuclear power already accounts for a significant percentage of all new baseload electrical generating capacity being developed in the U.S. today. With this growth in nuclear power will come increasing concern over safeguards against theft, diversion and sabotage involving nuclear materials and facilities. Thus the requirements for safeguarding nuclear materials will become considerably more extensive in the future.

Regulating the civilian nuclear power industry is the responsibility of the Nuclear Regulatory Commission (NRC), established under the Energy Reorganization Act of 1974. Under this act, NRC has four basic responsibilities.

- Protect the public health and safety
- Protect environmental quality
- Safeguard nuclear materials and facilities
- Ensure conformity with antitrust laws

A key element in satisfying these responsibilities is accurate, reliable, responsive safeguards information.

1.1.1 Integrated Safeguards Information System

In conjunction with the Office of Nuclear Regulatory Research (RES), the Office of Nuclear Materials Safety and Safeguards (ONMSS) identified a need for initiating development of a comprehensive Integrated Safeguards Information System (ISIS) which would satisfy the requirements of NRC and integrate the collection, processing, control, and dissemination of safeguards-related information. The system must possess sufficient flexibility to anticipate and meet safeguards information requirements into the mid-1980's and beyond.

To initiate this development, a competitive contract was awarded to Boeing Computer Services Company (BCS) in March 1977 to perform the first three phases of ISIS development. In Phase I, the contractor collected and documented the current and projected safeguards information needs identified by NRC. In Phase II, the contractor analyzed the capabilities of relevant existing and planned safeguards information systems within both the Government and the licensed nuclear industry.

In Phase III, the contractor developed a General Systems Design for ISIS which not only satisfies the requirements identified in Phase I, but which is flexible enough to accommodate likely changes in requirements which will be brought about by national energy policy and growth in the nuclear power industry.

To assist the Safeguards Coordinating Group (SGCG) in formulating its recommendations for implementing a safeguards information system, Boeing Computer Services Company was asked to perform a cost/benefit analysis on seven alternatives to the complete integrated information system.

1.1.2 Cost/Benefit Analysis

The Executive Director of Operations (EDO) of NRC requested that the Safeguards Coordinating Group (SGCG), a task force created to review the first three phases of the ISIS contract, review and recommend the best means of satisfying NRC's safeguards information requirements. In order to assist the SGCG in performing its review and formulating its recommendations, the ISIS contractor was asked to perform a cost/benefit analysis on options available to NRC. Options considered in the analysis ranged from not developing any additional automated capability to the development of a complete integrated safeguards information system.

1.2 COST/BENEFIT ANALYSIS FRAMEWORK

The decision facing NRC regarding how to satisfy its safeguards information requirements is whether or not to integrate its safeguards information systems. This cost/benefit analysis evaluates and compares the impact of both possible directions. The costs and benefits resulting from a decision to develop an integrated safeguards information system (ISIS) are compared against the costs and benefits of deciding to take the non-integrated (NO-ISIS) approach. Note the emphasis is on the word integrated. Automated alternatives are available in both ISIS and NO-ISIS options.

Meaningful evaluation in a cost/benefit analysis requires that all comparisons be made on as equal a basis as possible. A "fixed benefits" approach (as opposed to a "fixed cost" approach) formed the basis for comparisons in this analysis. Under this framework, an attempt was made to equalize the benefits derived from each option and then compare the relative costs of providing those benefits.

In the evaluation of the options, it became apparent that significant benefits were achievable via the integrated ISIS approach that were not even feasible in the non-integrated NO-ISIS approach. Furthermore, the value associated with these benefits was not directly quantifiable. For example, the value of having accurate, reliable, complete, and timely information available to NRC decision makers is very real but difficult to quantify. Similarly, increased industry-wide uniformity in regulation of the nuclear power industry is a valuable but unquantifiable benefit of an integrated system. As a result, cost can not be used as the sole discriminator in this analysis. The reviewer must evaluate the cost differential between options and then decide if the benefits justify the cost.

There are a number of alternatives possible for both the ISIS and NO-ISIS options. The alternatives considered in this analysis are discussed in the following sections.

1.2.1 NO-ISIS Alternatives

Two alternatives were considered based on the assumption that NRC would not integrate its safeguards information systems. The first alternative, "NO-ISIS automated", assumed that existing systems would continue to be upgraded and that new independent stand-alone automated information systems would be developed to satisfy the safeguards information needs of individual line and staff offices. The second alternative "NO-ISIS manual" assumed that currently existing systems and planned upgrades would be completed but that no new automated capability would be developed. All additional requirements would be satisfied via manual effort.

1.2.2 ISIS Alternatives

There is a near continuum of possible ISIS alternatives resulting from different decisions as to what particular capabilities are to be included in the integrated system. For the purpose of this cost/benefit analysis, the COTR defined six specific alternative configurations to be considered ranging from minimal integrated capability all the way to a completely integrated safeguards information system as described in the ISIS Phase III final report.

The basis for the definition of the alternatives was to provide portions of the total ISIS requirements which would satisfy the immediate or near-term requirements while maintaining a flexible basis for evolution of future requirements. Additionally, the alternatives were selected to ensure that the current major users of safeguards information were served. The capabilities included in each of the six alternatives are additive in the sense that each alternative includes all of the capability described for the previous alternative plus some additional capability.

While the cost/benefit analysis of the six alternatives was being conducted, the Safeguards Coordinating Group requested each NRC line office to identify its immediate safeguards information requirements. As a result of these surveys, the SGCG developed a seventh alternative configuration.

The SGCG alternative is similar, but not identical to any of the original six alternatives. The SGCG alternative formed the basis of the recommendation formulated for implementing a safeguards information system. This alternative was detailed in the SGCG preliminary report of July 19, 1978 to the EDO, and has been included in the cost/benefit analysis.

The functional capabilities of the seven ISIS alternatives are briefly identified in Table 1.1. Although all seven ISIS alternatives are referred to as "partial ISIS" alternatives, it should be noted that ISIS alternative 6 includes the complete capability as described in the ISIS Phase III final report.

1.3 REPORT OVERVIEW

The discussion of the framework provided in section 1.2 is expanded in section 2. The cost elements and methodologies used to estimate costs are discussed in detail in section 2. Section 3 presents the results of interviews conducted in order to collect and cross-check information about NRC safeguards costs, both current and projected. Section 4 presents the results of the NO-ISIS alternatives analysis. Detailed cost estimates for all of the cost elements of the NO-ISIS alternatives are discussed. Similarly, section 5 presents the detailed results of the ISIS alternatives analysis. Section 6 provides the comparisons between ISIS and NO-ISIS alternatives. Conclusions of the cost/benefit analysis are discussed.

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ALTERNATIVES	SAFEGUARDS FUNCTIONS SERVED																	
	ISIS ALT 1	ISIS ALT 2	ISIS ALT 3	ISIS ALT 4	ISIS ALT 5	ISIS ALT 6	SGCG	Material Control & Accounting	Licensing	Inspection	Ad Hoc	Contingency Planning	Safeguards Effectiveness	Threat Assessment	Physical Security Equipment	Material Control & Accounting Equipment	Transportation	Safeguards-Related Document Information
ISIS ALT 1	X							X										
ISIS ALT 2		X						X										
ISIS ALT 3			X					X										
ISIS ALT 4				X				X										
ISIS ALT 5					X			X										
ISIS ALT 6						X		X										
SGCG							X											X

TABLE 1.1
ISIS ALTERNATIVE CAPABILITIES

2.0 METHODOLOGY

This section describes how the costs of each alternative were estimated. The assumptions made in this activity are defined in section 2.2. In section 2.3, the cost equations developed to determine ten year costs are given, and the individual terms of each equation are defined. Detailed methods for estimating the cost factors in each equation are outlined. The basis for determining benefits for each alternative is provided in section 2.4 and the interviewing techniques used to collect the data required for the NRC costs used in this analysis are described in section 2.5.

2.1 COST/BENEFIT ANALYSIS METHODOLOGY

A methodology was developed that allowed a comparative cost analysis of each alternative based on ten year costing. Each alternative represents a particular capability. The full ISIS (alternative 6) satisfies NRC's total information requirements as defined by the ISIS Phase III Final Report. The other ISIS alternatives, however, satisfy only partially the information requirements. Therefore to allow the alternatives to be compared, the additional capability required to satisfy the remaining requirements had to be included in the partial ISIS costs. This cost was the NO-ISIS automated cost necessary to produce that remaining information. An additional alternative, the NO-ISIS manual was also defined to provide a capability as equal to the full ISIS alternative as possible. The ten year costs of these alternatives was also estimated.

2.2 ASSUMPTIONS FOR COST/BENEFIT ANALYSIS

Several assumptions were made in order to provide a degree of consistency to the analysis. A baseline was established for the NRC safeguards information requirements. It was assumed that NRC requirements were completely defined by the reports in the Detailed Definition of Requirements of the ISIS Phase III final report.

Additional assumptions established for the cost/benefit analysis were:

- o The alternatives being compared should be as equal in capability as possible.
- o The NO-ISIS alternatives were favored in the analysis.
- o Flexibility for system upgrades was maintained in the ISIS alternatives.

- o The hardware costs for each recommended configuration were deflated 10% per year over the life cycle of the system. (This is based on BCS computer operating experience and is conservative compared to the trade literature.(Ref 1,2)
- o Personnel costs for contractor support were assumed to increase at the rate of 7.5% per year.
- o Government personnel costs were assumed to increase at 8.5% per year.
- o Where government personnel costs were used they have been increased by a factor of 1.24 to account for overhead. (This factor is recommended in OMB Circular A-76.)

2.3 COST EQUATION

Ten year costs were estimated for each of the nine alternatives. The elements considered in the cost analysis were system development, hardware, operation, data preparation, and existing systems.

2.3.1 ISIS Cost Equation

ISIS costs = Development costs + Hardware costs + Operational costs + Data Preparation costs + Existing system phase-out costs.

Development Cost - all of the costs associated with producing the computer programs required to operate the ISIS system.

Hardware Cost - the cost of the computer mainframe and its associated peripheral equipment and facilities.

Operational Cost - the cost of the personnel to maintain and operate the data processing equipment.

Data Preparation Cost - the personnel cost associated with the manual effort to collect and analyze data before it is loaded into the ISIS data base. It does not include the clerical effort to load data into ISIS; this would be included in the operational cost.

Existing System Phase-out Cost - during the first 2-1/2 years of ISIS development, it is assumed that the existing systems would be operated during the implementation and testing of the integrated system. This additional cost for a parallel operation is considered part of the overall ISIS life cycle cost.

The procedures used to estimate each of these cost elements are discussed in the following sections.

2.3.1.1 Development Cost Estimates

The development cost for the ISIS alternatives was based on the development effort for the total ISIS system identified in the ISIS Phase III final report. The total ISIS estimate was based on a detailed analysis of the ISIS general system design using a cost estimating procedure developed by BCS as a part of Systematic Software Development and Maintenance (SSDM) methodology. Time and available resources did not permit this same level of detailed analysis to be conducted for the alternative systems used in this study. Therefore, a method was developed by which the total ISIS Phase III development effort could be prorated to the ISIS alternatives based on the size and complexity of the data bases and the number of reports produced by each alternative.

2.3.1.2 Hardware Cost Estimates

For each alternative system typical computer mainframe and peripheral equipment based on the data base size and output volume that would satisfy the system requirements were selected. Selection was intentionally conservative but representative, i.e. some excess processing was included to allow for anticipated growth. Configuration costs were estimated from standard industry sources. The equipment cost includes the cost of a secure facility to house the computing equipment. These security requirements were based on National Security Agency standards. The size and cost of the required facility was estimated using current industry standards.

2.3.1.3 Operational Cost Estimates

After the hardware was specified, the total number of personnel required to operate the computer facility was estimated from BCS experience in operating data centers. The operational costs were calculated from the total people required and the average skill mix for data center operations.

2.3.1.4 Data Preparation Cost Estimates

Cost estimates were prepared for the personnel costs associated with loading and maintaining the ISIS data base. These costs were developed using the following procedure. The size of the initial data load and the subsequent annual data load was estimated for each part of the ISIS data base. All of the data in the ISIS data base was categorized according to the type of data preparation required. Four input categories were considered:

- 1) Automated - the data is available for direct input.
- 2) Clerical - the data is available within NRC's offices and could be prepared and input by clerical personnel.
- 3) Manual - the data must be collected by NRC personnel, such as inspectors collecting data in the field.

- 4) Analytical - available data must be analyzed by someone with safeguards knowledge before it could be entered into the data base.

The volume of each category of data was calculated for the initial and annual data loads for each alternative. It was assumed that the clerical and automated data categories would be processed by the systems operations contractor staff and the manual and analytical data categories would require NRC staff. The NRC personnel requirements were assumed to be GS level 10 staff for the manual category and GS level 13 staff for the analytical category. Finally, data preparation rates in terms of bytes per hour were estimated for each category of data. By combining the data base volume estimates, data preparation rates, and corresponding staff salary levels, the data preparation costs were estimated.

2.3.1.5 Existing System Phase-out Cost Estimates

This factor represents the costs of operating existing systems during the implementation and testing of the integrated system. The cost of operating the existing system was obtained from NRC during office interviews, and full operation of the existing system was assumed during the first two years of ISIS operations. During the third year an operational cost reduction of 50% was assumed, because the existing systems would be phasing out, and in the fourth year ISIS would assume all of the existing system capability.

2.3.2 NO-ISIS Cost Equations

NO-ISIS Automated = Existing System Costs + Planned Upgrade Costs +
New System Costs + New Upgrade Costs

NO-ISIS Manual = Existing Systems Cost + Planned Upgrade Cost + Manual
Effort Costs

Existing Systems Costs - the cost of operating the existing systems which contain safeguards related information.

Planned Upgrades Costs - the cost for definitive plans to upgrade the capability of the existing safeguards information systems.

New Systems Costs - Cost of developing new systems to satisfy specific safeguards information requirements.

New Upgrades Cost - the costs of additional improvements to the existing systems in order to produce safeguards reports that they are not presently producing.

Manual Effort Costs - the personnel costs associated with the collection of data and the preparation of safeguards reports without an automated system.

The procedures used to estimate each of these cost elements are discussed in the following sections.

2.3.2.1 Existing System Costs Estimates

NRC information systems were included in the cost/benefit analysis if their functions were to be incorporated into ISIS. Those systems include:

- a) The Nuclear Materials Management and Safeguards System (NMMSS) maintained by the Office of Nuclear Material Safety and Safeguards.
- b) The Safeguards Status Reporting System (SSRS) - this system is maintained by the NRC Office of Inspection and Enforcement.
- c) The Import/Export License Tracking System (IPELTS) - this system was developed and is maintained by the Office of International Programs.

It should be noted that the Inspection Results Systems (IRS) was not included in the cost/benefit analysis as one of the existing NRC information systems because it will remain an operational system even if ISIS is developed.

These existing system costs were determined by interviewing individuals in each office responsible for the system. Section 2.5 fully explains the methods used to gather this information.

2.3.2.2 Planned Upgrade Costs Estimates

Any current plans to upgrade the capability of the existing systems used in this analysis was determined through interviews with the NRC personnel responsible for that system. See section 2.5 for a discussion of the methods used to obtain that data.

2.3.2.3 New System Costs Estimates

In the absence of ISIS, one method of satisfying NRC's information requirements would be to develop specific stand-alone non-integrated systems to produce small sets of safeguards reports. Each system would be developed and maintained by a single NRC office. The data bases would not be integrated. If the same data elements were required by two different sets of reports, the data would be maintained in two separate systems. (Also, it is assumed that these systems would be supported by data from a single functional area.)

These new system costs include costs for development, operation and data preparation. The development costs were estimated by the same procedures that were used to estimate the ISIS alternatives development costs.

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However, from general industrial experience, the loss of efficiency from an integrated system to multiple non-integrated systems is significant, on the order of 1.5 to 2.0 times the development effort. In this analysis 1.33 was used to account for this inefficiency. The operational cost for these new systems was based on the operational cost of the total ISIS, and prorated to each new system based on its output. The data preparation costs were estimated for the new systems by the techniques used in obtaining those costs for the ISIS alternative.

2.3.2.4 New Upgrade Cost Estimate

One method of producing the required safeguards reports would be to expand the capability of the existing systems so they could produce reports not currently available. Two classes of upgrades were considered.

In the first, it was determined that all data required to produce a safeguards report were available in the existing system data base and the only development cost included was the cost of the software to produce that report. In the second, it was assumed that it would be necessary to add data elements into the existing data base to produce new reports not currently available from that system. In the cost benefit analysis, new system upgrades were considered for NNMSS, IPELTS, and IRS.

The cost for development and operation of these upgrades were estimated using the same techniques as outlined in the NO-ISIS new system costs section (2.3.2.3).

2.3.2.5 Manual Effort Cost Estimates

This factor was the estimate of the cost to NRC if the ISIS Phase III reports that are not presently available through an existing system, or a planned upgrade to one of these systems, were generated using only manual effort. For all reports which are not currently available from an automated system, NRC safeguards personnel were asked to estimate how long it would take to generate each report using only manual procedures. This time multiplied by the frequency of the report also estimated by NRC gave the manual effort for each safeguards report. The total manual effort times the labor rate for a GS 13 employee give the estimated manual cost for producing the required safeguards reports.

2.4 BENEFIT BASIS

There are benefits associated with each of the alternative systems. The following guidelines were developed for specifying the benefits associated with each system:

Benefits may relate directly to the systems capability. They can be identified and the increased capability they provide can be determined. An example of this type of benefit is the ability of a system to produce a specific report, not produceable by an alternative system. These benefits can be quantified and their resultant capability costed.

Another type of benefit cannot be expressed in terms of system capability; however, these benefits significantly increase the utility of the information produced. Examples of these benefits include greater information reliability and reduced information response time.

Benefits of this kind are very difficult to quantify, and therefore cannot be explicitly incorporated in the cost analysis. These benefits represent a major factor in the decision to integrate safeguards information.

2.5 DATA GENERATION BY INTERVIEWS

As part of the cost/benefit analysis, a series of interviews was conducted with NRC offices that had safeguards responsibilities or functions. The objective of these interviews was to obtain additional information in two areas: NRC safeguard budgets, and use of existing safeguards information systems.

NRC safeguards budgets are summarized in Section 3.0. In this section the general format of the interviews conducted is outlined. There were basically two sets of interviews: the first with offices that have responsibility for one of the existing information systems; the second with those offices that had any identifiable safeguards functions or responsibilities.

2.5.1 Existing Systems Responsibility

Each office that had the responsibility for maintaining one of the existing information systems was asked the following questions:

- o What upgrades were planned to the existing system and what was their estimated cost?
- o What were the current manpower and computer costs of operating and maintaining the system?
- o What was the estimated future cost of operating the system?
- o How was the system being used?

2.5.2 Offices with Safeguards Functions

Each office that had any safeguards function was asked the following set of questions:

- o Did the office use any of the existing information systems?
- o Did the office have any upgrades planned for the existing systems? If so, what was their nature and cost?
- o Did the office have any plans to develop new information systems related to safeguards? If so, what was their function and estimated costs?

REFERENCES

- ¹ "IBM Expected to Unwrap Double-Powers 'E Series'," Computer World, June 5, 1978.

- ² "IBM Systems in the 80's," Advanced Computer Techniques Corporation, Technology Analysis Group, New York, N.Y.

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3.0 SAFEGUARDS BUDGET ESTIMATES

In order to ensure the data reliability of various cost estimates in the cost/benefit study, a number of cross-checks were undertaken. NRC's budget was analyzed for safeguards related expenditures. Since this review would only provide gross expenditures at the macro level, it was necessary to develop a methodology that would more clearly delineate the current costs (in 1978 dollars) associated with safeguards information expenditures.

Section 3.1 discusses the procedures used in this methodology, Section 3.2 discusses the results of the interviews conducted, and Section 3.3 compares the data obtained through the interviewing process with similar information obtained from NRC.

3.1 PROCEDURES

To obtain these estimates, those staff within NRC who are responsible for safeguards functions were contacted at the branch level. Through a series of semi-structured interviews with the appropriate branch chiefs, a better understanding of safeguards information cost evolved.

To ensure consistency of the data gathered in this analysis, it was first necessary to define certain terms to be used in the interviews:

- o Safeguards Activity -- any activity performed by NRC personnel that is directly safeguards related.
- o Safeguards Information -- any piece of information needed to perform a safeguards function.
- o Safeguards Information Activity -- the collection, maintenance, analysis, and report production of safeguards information

There are three categories of safeguards resources:

- o NRC Personnel
- o Technical Assistance Contracts
- o Research Contracts

All Research Contracts are administered by the Office of Nuclear Regulatory Research and all other dollars quoted in this cross-check analysis are technical assistance monies.

Two questions were then asked of the branches with safeguards responsibilities. They were:

- (1) How much safeguards related activity does your branch perform, in terms of the percent of your total activity? What are the numbers of personnel, technical assistance dollars, and additional contract dollars devoted to safeguards activities?
- (2) What percent of your total costs for safeguards activities is associated with the collection, maintenance, analysis, and report production of safeguards information?

Five of the NRC line offices and three of the staff offices identified in the BCS organizational analysis in the Phase I ISIS final report were contacted in this cost/benefit analysis. A total of twelve branches were contacted, and they are identified in Table 3.1.

3.2 RESULTS OF INTERVIEWS

The results of the interviews with those organizations with safeguards responsibility are depicted in Table 3.2. A total of 164 man-years and \$12.1 million were attributed to safeguards activities, and of that, 106 man-years and \$3.5 million were attributed to safeguards information activities. These information activities represent 65% of the safeguards manpower and 30% of the Technical Assistance and Research Contract dollars.

The Office of Nuclear Material Safety and Safeguards and the Office of Inspection and Enforcement expended the most resources on safeguards information activities with 60 and 29 man-years respectively.

NRC estimates its computer costs at approximately \$5 million per year. This estimate contains provisions for:

- o Equipment purchase, rental and maintenance;
- o Computer time sharing, both commercial and interagency;
- o Software program purchase, rental and maintenance;
- o Software development, both commercial and interagency;
- o Keypunch services.

3.3 COMPARISON WITH OTHER SIMILAR INFORMATION

Gross estimates of safeguards expenditures were obtained by analyzing NUREG 0039-3, U. S. Nuclear Regulatory Commission Budget Estimates, Fiscal Year 1979, January 23 (1978). Data in Table 3.3 summarizes this information, and shows 243 man-years and \$14.3 million are directly related to safeguards activities. It should be noted that these estimates include resources used for administration and management, whereas in the interviews, non-direct safeguards resources were not reported. This may account for the discrepancy in manpower (243 versus 164). However, the Technical Assistant and Research Contract dollars are quite consistent (\$14.3 compared to \$12.1 million).

In addition, BCS had the opportunity to review an internal, yet unreleased report describing NRC safeguards activities. This report concludes that 248 man-years and \$12.9 million were associated with safeguards activities.

This data is consistent with the budget data, and when corrected for management activities is consistent with the data obtained through the interviewing process.

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TABLE 3.1
OFFICE CONTACTS

Office of Standards Development (SD)

- o Chief, Materials Protection Standards Branch

Office of Nuclear Material Safety and Safeguards (ONMSS)

- Division of Safeguards

- o AD for Requirements and Technology
Chief, Requirements & Technology Branch
Member, Technology Assessment Branch
- o AD for Operations and Evaluation
Member, Contingency Planning Branch
Acting Chief, Test and Evaluation Branch
- o AD for Licensing
Chief, Physical Security Licensing Branch
Chief, Material Control Licensing Branch

- Division of Fuel Cycle and Material Safety

- o AD for Material Safety and Licensing
Chief, Transportation Branch
- o AD for Operations and Technology
Member, Technology Assessment Branch

Office of Nuclear Reactor Regulation (ONRR)

- Division of Operating Reactors

- o Asst. Director for Reactor Safeguards

Office of Nuclear Regulatory Research (RES)

- Division of Safeguards, Fuel Cycle and Environmental Research

- o AD for Safeguards Research

TABLE 3.1, continued

Office of Inspection and Enforcement (OIE)

- Division of Safeguards Inspection
 - o Division Representatives

Office of International Programs (IP)

- o Member, AD for Export-Import and International Safeguards

Office of Management Planning and Analysis (OMPA)

- o Office Representative

Office of State Programs (SP)

- o AD for State Agreements Program

TABLE 3.2
1978 SAFEGUARDS RESOURCE ALLOCATION
\$(000)

Office	Safeguards Activities		Safeguards Information Activities	
	Manpower	TA & Contract Dollars	Manpower	TA & Contract Dollars
SD	14	\$ 1,500	7	\$ 750
ONMSS	(97)	(2,568)	(60)	(1,693)
-Contingency Plan. Br.	18	800	6.5	280
-Test & Eval. Br.	23	512	19.5	435
-Physec. Lic. Br.	13.5	90	3.0	20
-Mat. Cont. Lic. Br.	12.5	81	8.0	59
-Requirements Anal. Br.	18	450	11	270
-Tech. Assessment Br.	12	635	12	629
ONRR	8	800	8	600
RES	10	6,600	1	80
OIE	32	382	29	344
TP	3	6	1	2
OMPA	0	250	----	----
	164	\$12,106	106	\$3,469

TABLE 3.3
 1978 BUDGET ESTIMATES
 \$(000)

<u>Office</u>	<u>Safeguards Activities</u>	
	<u>Man-Years</u>	<u>Dollars</u>
SD	14	\$ 2,450
ONMSS	112	3,285
ONRR	16	600
RES	10	6,650
OIE	91	1,345
IP	--	--
GMPA	--	--
	243	\$14,330

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4.0 NO-ISIS ALTERNATIVES

NRC is currently analyzing alternatives to fulfill their safeguards information needs. A decision is required to either establish an information system integrating some or all of the safeguards data generated by the diverse branches, or to continue in the present mode. If NRC does not build an integrated data base, each office, indeed each branch, will continue to perform their functions choosing the most effective mode of operation for meeting their information needs.

The costs and benefits of non-integration (NO-ISIS) must be weighed against the similar costs and benefits of each alternative in the integrated approach ("ISIS Alternatives") in order to determine the best course of action for NRC. This section discusses the non-integrated (NO-ISIS) alternatives to an integrated information system; what they are, why they are considered, how costs are estimated, and the results of the costing activity.

4.1 PURPOSE OF NO-ISIS CONSIDERATION

The NO-ISIS costing activity provides a basis for comparison of all ISIS and NO-ISIS alternatives. Because of the need to address as nearly equivalent capability as possible in each of the alternatives to effect a valid comparison, NO-ISIS costs are employed in two types of comparisons.

The first comparison is one in which the cost of a single partially integrated alternative is compared to the cost of providing equivalent capability via a non-integrated approach. The second comparison is one in which the cost of all of the alternatives are compared one with another. This is based on the concept of "total capability," derived from the assumption (see section 2.2) that the ISIS Detailed Definition of Requirements (DDR) (see Appendix B, ISIS Phase III final report) is a valid statement of NRC safeguards information requirements. This means that all of the capabilities defined will be requirements in the mid-1980 time frame. The alternatives may be compared one with another if the capabilities being compared are nearly equivalent. To obtain this equivalence, the cost of providing the additional capability (the NO-ISIS cost) not addressed by a partially integrated system is added to the cost of that system.

In summary there are two major purposes for considering a non-integrated approach:

- (1) Provide estimates of NRC costs of providing complete capability, as defined by ISIS reports, in a non-integrated approach.
- (2) Provide a basis for comparison of each alternative.

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4.2 FORMULATION OF NO-ISIS ALTERNATIVES

Section 4.2.1 presents the NO-ISIS alternatives used in the cost/benefit analysis. Section 4.2.2 addresses other cost elements that must be considered in any non-integrated approach, and describes how they were handled in this activity. Cost elements unique to the NO-ISIS alternatives addressed in this cost/benefit analysis are presented in sections 4.3 and 4.4.

4.2.1 Description

There are two approaches which could be taken by an NRC office given the decision not to integrate. The first involves the assumption that with increasing use of automated systems to perform data manipulation tasks of storing, sorting, maintaining, and disseminating information, an office would be likely to automate data as needed to support a specific function. The second approach arises from the assumption that an office may choose not to automate based on concern for losing control over data and perceived expenditures of such a system. Given that no ISIS is available, there will conceivably be use throughout NRC of both the manual and the automated approach to solving safeguards information problems. In considering which approach to use as the basis for cost/benefit comparison, it was decided that to favor the NO-ISIS alternative (see section 2.2), both approaches would be costed and the least expensive method for each functional area would be used.

The required capabilities as defined by the ISIS standard reports were grouped into functional areas and development, operational, and data preparation estimates were made for each. In all cases, the costs for an automated approach were less than the manual effort to produce those same reports. Thus, there emerged two alternatives bounding the range of possibilities:

- o The upper bound set by the more costly manual data collection, sort, and report production (NO-ISIS manual alternative).
- o The independent stand-alone automated system approach (NO-ISIS automated alternative).

4.2.2 Existing Systems Cost

Costs associated with currently employed systems must be considered. If all current systems would continue to operate whether or not an integrated information system were built, then it could be assumed that the cost would not impact the comparison. However, for all of the partially or fully integrated alternatives (see section 5.0), the functions of three existing systems would be incorporated. During the development and testing of the integrated systems, those existing systems would be phased out. To make the comparison valid, the cost of these systems must also be considered in the NO-ISIS alternatives. "Existing systems cost", then, is defined to be the cost associated with those systems which would be phased out if an

integrated system were to be built. These systems were identified in the ISIS Phase III final report to be NMMSS, SSRS, and IPELTS.

Costs include not only computer costs, but associated personnel, and costs of the development of planned upgrades. These are shown in Table 4.1, and are the result of interviews with the appropriate NRC offices.

The NMMSS costs shown were projected through 1985 by ONMSS, and BCS continued the trend through 1988. These include computer costs and hardware and software support costs for 13 people, and encompass the entire NRC use of Oak Ridge facilities, including SSRS activities. The sharp rise in the initial years is due to development of planned upgrades to NMMSS, to include more extensive edit checks, and expansion of international material tracking. As mentioned, SSRS computer costs are included in this first figure, but whereas NMMSS and some SSRS data comes in on 741 and 742 forms or an equivalent, ready for keypunching, personnel are required to compile a portion of the data for SSRS. This effort was defined by OIE as 1 man-year collectively from the regions, and 1 man-month from headquarters.

OMPA identified planned upgrades for IPELTS to include the licensing of components as well as material, and the tracking of material by facility as well as by license, thus increasing IPELTS operating costs to an estimated \$8000 per year. OMPA did not project expenditure over subsequent years. Due to possible rise in costs to cover increased usage, and projected decline in computer costs, it was decided to not attempt to increase or decrease this estimate. Personnel involved were estimated at 1 person full-time, and 2-3 calendar months with 4 man-months effort to effect the upgrades. Labor rates were based on 7-9 GS level for IPELTS and 13 level for SSRS and were loaded and inflation applied as outlined in section 2.2.

4.3 NO-ISIS MANUAL ALTERNATIVE

The cost equation for the NO-ISIS manual alternative is:

NO-ISIS Manual Alternative Cost = Existing Systems + Planned Upgrades + Manual Effort.

The existing systems and planned upgrades have been discussed in detail in section 4.2

In order to obtain an estimate for the cost to NRC of satisfying total information requirements through manual effort (the third term in the equation), the first step was to obtain a description of the effort that could be quantified. Since the DDR defines the projected NRC environment in terms of associated information requirements, and the ISIS reports describe the vehicle through which NRC would receive, in appropriate format and necessary response time, this information, the reports were used as a basis for this estimate. The availability of each report was identified in terms of percent currently available. Those reports not currently available through an automated system are either currently produced manually, or will, by this approach, be so produced, and thus have some effort associated

with their production. NRC provided estimates of the time necessary to obtain the report data in a usable format. The time to analyze the data, although a significant NRC labor consideration, is not included in these estimates, since this effort will be present whether the report will be prepared by an automated system, or whether the data will be manipulated manually.

This one-time estimate for each report was then multiplied by the NRC-estimated frequency of request per year for that report (recorded in the DDR). Table 4.2 summarizes the results by service module. Manual estimates were not made for twenty reports. These reports were identified as either not useful except in conjunction with an automated system (e.g., computer-assisted instruction CAISIS reports), or the manual effort would be too extensive to even warrant being requested if not automated. Of these 20, 12 were indicated as of primary interest to NRC. Seven of the remaining eight are CAISIS reports.

Table 4.3 summarizes the estimated costs that would be incurred by NRC if it chose not to build any new automated systems. The manual effort estimated to be required to satisfy all of NRC safeguards information requirements in the mid 1980's is 240 man-years per year. As a result of the safeguards budget cross-check activity (section 3.0) it was noted that there are currently 106 people involved in the collection, maintenance, and report production of safeguards information. This implies a growth of 134 required to satisfy NRC's information requirements manually.

Benefits associated with the NO-ISIS manual alternative are:

- o 86% of total ISIS standard reports (minimal ad hoc capability is available)
- o No need to attempt to cross organizational or functional boundaries.
- o Allow each office to decide whether or not automation would best serve its needs.

The quantified benefits are a measure of the capability received. The following factors may reduce the availability and usefulness of manually produced reports:

- o Although a report may be identified as available through manual means, it may not be possible to provide accurate information in the response time required. Thirty-eight reports were so identified. Of these, 15 were identified as being needed in an interactive mode.
- o All reports depend upon the availability of the information in the manual search process.

- o Manual effort estimates were given for the time required to obtain information on the equivalent of one input parameter, that is, data for one site, on one event, etc. Thus, comprehensive or trend-oriented reports may be infeasible to produce manually.
- o Estimates were based on obtaining data for a limited time frame. That is, a one year summary report may be possible in terms of time required to collect the data, but information for a ten-year time span may not be feasible to collect and verify.
- o The requirements for the data are often rendered infeasible by limited resources. When manpower is not available, data timeliness and completeness may be sacrificed, and old reports may be used rather than recollecting the data. Less reliable sources may be accepted rather than to expend the time to ensure complete and accurate data. Therefore, although a report may have been indicated as required frequently, this frequency may not be met.

4.4 NO-ISIS AUTOMATED ALTERNATIVE

The cost equation used in the NO-ISIS automated alternative is:

$$\text{NO-ISIS Automated Alternative Cost} = \text{Existing Systems} + \text{Planned Upgrades} + \text{New Systems} + \text{New Upgrades}$$

The existing systems and planned upgrades costs were addressed in detail in Section 4.2. A description of the third and fourth terms in the equation were derived by considering the information requirements as stated in the ISIS DDR. Through the interview process, each line office and three staff offices (Table 3.1) were contacted, and were asked to consider the following:

"If no integrated information system were made available between now and 1990, how do you envision satisfying your safeguards information requirements, given that the ISIS DDR has been accepted as a valid description of these requirements?"

The goal of this activity was to reach an understanding of how NRC viewed its functions, in order to postulate the most reasonable set of automated systems.

Section 4.4.1 describes the new system and new upgrade definition process. Section 4.4.2 presents the cost elements considered, and Section 4.4.3 looks at total NO-ISIS automated costs and benefits.

4.4.1 Results of Interviews

Most of the offices considered the question and concluded that although an automated information system would certainly make their job easier and provide benefits in terms of turnaround and data accuracy, they would

probably not individually build a system for their function alone. One of the major problems they identified in such an approach is that much of the information required for a comprehensive analysis of any problem was collected and maintained by another office. Hence, the only access to that data is through office contacts. Any attempt to automate the storage and maintenance of data received via this method is difficult. Five offices expressed an interest in automation, and two have gone so far as to estimate expenditure for a system. A frequent comment was that before automation was attempted, the purpose of such a system must be clear; that is, it must not be viewed as capable of performing the office safeguards function, but rather as a useful, advanced tool that could be used to store, maintain, and disseminate data which the office needs as background support in performing its analyses. In other words, an automated system would not do any of the current analysis involved in, for instance, the licensing process, but would enable the analysts to request similar previous license analysis results, performance data on the proposed physical security equipment, etc. This would enable the analyst to spend more time as an analyst and less time as a data collector.

Given that specialized stand-alone systems could be built to meet the needs of a given function, the next step was the definition of those systems.

4.4.2 New Systems and New Upgrades Costs

To define the new systems, the ISIS reports were once again used as a definition of capability. The activity discussed in Section 4.2 was expanded. That is, once the current availability of reports was determined, those not or little available were grouped according to functional area. Those reports that are not currently available, but that will be produced as a result of planned upgrades to existing systems were identified.

Of the remaining reports, several had data requirements that could feasibly be supported by existing systems. These were classified as new upgrades, and were identified for NMMSS, IRS, and IPELTS. The remaining reports provided the basis for the definition of nine new systems. Assumptions made in this activity were:

- o The new systems would serve one functional requirement, and would be controlled by one office. This is based on NRC's present mode of operation.
- o If more than one office has a similar function, each office would satisfy its own requirements. This may result in multiple systems performing the same function. While this is a very real possibility, each identified new system was considered only once in the NO-ISIS automated alternative costing activity.

Table 4.4 summarizes the report classification results by service module. Table 4.5 describes the capability, in terms of reports, of the nine new systems.

The development costs, operating costs, and data preparation costs were estimated for each new system and new upgrade.

4.4.2.1 Development Costs

The methodology for deriving an estimated development cost was applied to each of the new systems and new upgrades. The man-months of development effort for each year spread over three years were then multiplied by the contractor labor estimates, inflated by 7.5% per year. Three-year development cost totals are given for each postulated new system and upgrade in Table 4.6.

4.4.2.2 Operating Costs

It was assumed that, in order to consider the least costly approach, existing hardware would be used. Operating costs were estimated which include computer time and contractor hardware and software support personnel. These operating costs were estimated using the method described in Section 2.3. Operating costs were assumed to be half of the total during the first year, and increased to full support during the second year. Due to the projected decrease in computer costs and increase in labor rates, this number was assumed approximately constant through the end of the considered 10-year period. The operating costs given in Table 4.6 are for 1985 as representative of the mid-1980 time frame.

4.4.2.3 Data Preparation

The data preparation effort for each new system and new upgrade was estimated based on the four data preparation categories:

- (1) automated
- (2) clerical
- (3) manual
- (4) analytical

As explained in section 2.3, the automated and clerical effort is included in the operating costs. NRC effort is required to collect and analyze the data that will be stored. Estimated costs of NRC personnel are shown in Table 4.7. Some new upgrades and new systems do not have associated data preparation costs. This indicates that the data required to support the capability is of a clerical or automated nature.

4.4.3 Cost of the Automated Approach

The estimated costs associated with each of the defined new systems and upgrades are combined to render an estimated life cycle cost for developing and maintaining several functionally-based, independent systems. Development costs were spread over a three year period to maintain comparability between this alternative and the integrated alternatives. Total costs per year are given in Table 4.8.

Benefits derived from the NO-ISIS automated alternative are:

- o 100% of the total ISIS standard reports are available (partial ad hoc capability may be available)
- o No need to attempt to cross office or functional boundaries
- o Allow each office to decide whether or not automation would best serve its needs
- o Data responsiveness
- o Data credibility
- o Interactive capability

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TABLE 4.1
EXISTING SYSTEMS COSTS
\$(000)

<u>Year</u>	<u>NMMSS/ SSRS Costs</u> ¹	<u>SSRS Personnel (Man-Months)</u>	<u>IPELTS</u> ² <u>Costs</u>	<u>IPELTS Personnel (Man-Months)</u>
1979	820	13	8	16
1980	923	13	8	12
1981	1,020	13	8	12
1982	1,091	13	8	12
1983	1,168	13	8	12
5 YR CUM	5,022		40	
1984	1,250	13	8	12
1985	1,337	13	8	12
1986	1,429	13	8	12
1987	1,526	13	8	12
1988	1,628	13	8	12
10 YR CUM	12,192		80	

¹Includes costs of planned upgrades to NMMSS, and NMMSS personnel support costs.

²Includes cost of planned upgrades. Costs do not reflect inflation/deflation because interviewed office estimates costs remaining essentially the same.

NOTE: All costs are measured in 1978 dollars.

TABLE 4.2
MANUAL REPORT AVAILABILITY

Service Module	Number of Standard Reports	Number Currently Automated or Planned Upgrades	Number Estimated Manually	Total Potential Manual Effort
LICSTAT	3	0	3	65.4MM
LICSUP	2	0	2	51.7MM
REGSTAT	2	0	1	2.7MM
INSPLN	3	1	1	580.7MM
INSKED	3	3	0	0
CEHIST	13	4 $\frac{1}{2}$	8 $\frac{1}{2}$	2.4MM
HARDSTAT	4	0	3	1.0MM
PHYSEC	7	0	5	952.4MM
MAQUIP	4	0	3	1161.4MM
CPOR	7	0	7	1.6MM
EFFEVAL	8	0	8	13.4MM
THRAN	6	1 $\frac{1}{2}$	3	1.2MM
MAC	36	34	0	0
STALIC	3	0	3	.9MM
TRANS	8	$\frac{1}{4}$	8	4.0MM
EXPLIC	6	3	3	13.0MM
RESTRK	5	0	4	9.0MM
ABDIST	5	0	2	10.6MM
DCSINX	1	0	1	9.8MM
SITS	4	4	0	0
REPLIC	1	1	0	0
CAISIS	7	0	0	0

TABLE 4.5
ANNUAL COST BREAKOUT
EXISTING SYSTEMS + MANUAL EFFORT
(NO-ISIS)

Year	Total Existing Costs \$(000) ¹	Manual Effort Man-months	Manual Effort ² \$(000)	Total \$(000)
1979	890	2881.5	8,333	9,223
1980	992	2872.5 ³	9,014	10,006
1981	1,093	2872.5	9,781	10,874
1982	1,170	2867.5 ⁴	10,593	11,763
1983	1,253	2867.5	11,493	12,746
5 YR CUM	5,398		49,214	54,612
1984	1,342	2867.5	12,471	13,813
1985	1,436	2867.5	13,532	14,968
1986	1,536	2867.5	14,687	16,223
1987	1,641	2867.5	15,929	17,570
1988	1,752	2867.5	17,282	19,034
10 YR CUM	13,105		123,115	136,220

¹ See Table 4.1. Includes computer and labor costs.
² Based on NRC labor, GS 13 average, with annual inflation rate of 8.5%.
³ RESTRK costs subtracted, due to planned PCS.
⁴ THRAK costs subtracted due to planned threat assessment system.

Note: All costs are measured in 1978 dollars.

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TABLE 4.4
AUTOMATED REPORT AVAILABILITY

<u>Service Module</u>	<u>Number of Standard Reports</u>	<u>Number Currently Automated or Planned Upgrades</u>	<u>Number Currently Available Manually</u>	<u>Number Potentially Available via New Systems/Upgrades</u>
LICSTAT	3	0	3	3
LICSUP	2	0	1	2
REGSTAT	2	0	1	2
INSPLM	3	1	1	2
INSKED	3	3	0	0
GEHIST	13	4 $\frac{1}{2}$	0	8 $\frac{1}{2}$
HARDSTAT	4	0	2	4
PHYSEC	7	0	0	7
MAQUIP	4	0	0	4
CPOR	7	0	2	7
EEFEVAL	8	0	1 $\frac{1}{2}$	8
THRAN	6	1 $\frac{1}{2}$	0	4
MAC	36	34	0	2
STALIC	3	0	0	3
TRANS	8	$\frac{1}{4}$	3 $\frac{1}{2}$	8
EXPLIC	6	3	$\frac{1}{2}$	3
RESTRK	5	0	0	5
APDIST	5	0	0	5
DCSINX	1	0	0	1
SIIS	4	0	0	0
REPLIC	1	0	0	0
CAISIS	7	0	0	0

TABLE 4.5
NEW SYSTEM CAPABILITY

<u>New System</u>	<u>Service Module</u>	<u>Report ID</u>	<u>Report Name</u>
Licensing Support System	LICSTAT	R5169	Status of Pending Licenses Changes
		R8823	Copy of a License Plan
		R3973	Copy of All Versions of a Section(s)
	LICSUP	R6497	License to Regulation Cross-Reference
		R6787	License Subject Location
REGSTAT	R1286	Cross-Reference Regulations to Regulation Document	
	STATLOC	R8210	State License Status
	TRANS	R7075	NRC Carriers
Contingency Planning and Operational Readiness	CPOR	R2060	Licensee Contingency Plan Objectives by Stimulus
		R5326	Licensee and Headquarters Contingency Plan Generic Data
		R9193	Licensee Contingency Planning Base Data
		R2127	Licensee and Headquarters Responsibility Matrix - By Stimulus
		R2228	Licensee and Headquarters Responsibility Matrix - By OP Element
		R9717	Lists of Specific Operational Elements and Specific Stimuli
	R7437	Interfacing Agencies Agreements Data	

TABLE 4.5 (continued)
NEW SYSTEM CAPABILITY

<u>New System</u>	<u>Service Module</u>	<u>Report ID</u>	<u>Report Name</u>
Effectiveness Evaluation	EFFEVAL	R0884	Assessment Observations By License
		R3561	Assessment Observations By Site
		R7647	Synthesis Reports By License
		R0597	Synthesis Reports By Facility
		R5433	Synthesis Reports By Transport
		R9596	Assessment Observations By Question
Physical Security/Material Acctg Component File	REGSTAT	R3074	Component Acceptance Industry Standards
	HARDSTAT	R4500	Hardware Test and Evaluation Results
		R9294	Hardware Specifications
		R6315	Safeguards Equipment By Vendor
	PHYSEC	R3824	Site Layout Information
		R4159	Site Physical Security Equipments List
		R9395	Site-Specific Equipment Performance Data
		R9614	Site-Specific Physical Security Personnel Data/Status
		R1829	Security Component Event History
		R8513	Industry-Wide Physical Security Equipment Performance
		R1111	Location of Specified Components
		MAQUIP	R1664
	R6844		Site-Specific Material Accounting Equipment
	R4936		Site/License-Specific SNM Accounting Equipment Performance Data
	R5056		Industry-Wide Performance of SNM Accounting Equipment

TABLE 5 (continued)
NEW SYSTEM CAPABILITY

<u>New System</u>	<u>Service Module</u>	<u>Report ID</u>	<u>Report Name</u>
Threat Assessment	EFFEVAL	R8098	Safeguards Status Index For Transport
		R4703	Safeguards Status Index For Facility
	THRAN	R0071	Potential Adversary Attributes
		R4019	List Actual Threat Occurrences/Events
		R8140	An Actual Threat Occurrence/Event
		R5732	Fictional Threats
R1020	Composite Threats		
R0018	Adversary Action Sequence		
Transportation	TRANS	R7075	NRC Carriers
		R9976	Transportation Component Type
		R8746	Transportation Component Ownership
		R4877	Transportation Routes
		R5845	Shipment Detail Shipper
		R7290	Shipment Detail Receiver
		R2382	Shipment Detail Carrier
		R6291	Transportation Incident (Event)
Research Tracking	RESTRK	R0968	Status of All Research Projects
		R6152	Status of All Research Projects
		R2453	Research Project Deliverables
		R2493	Delinquent Contract Deliverables
		R2731	Keyword Logical Group

TABLE 4.5 (continued)
NEW SYSTEM CAPABILITY

<u>New System</u>	<u>Service Module</u>	<u>Report ID</u>	<u>Report Name</u>	
Safeguards Item Tracking	SITS	R0107	Work/Action (W/A) Item Milestone Status (By) Responsible NRC Employee(s)	
		R3178	Work/Action (W/A) Item Milestone Status (By) NRC Organization	
		R3379	Work/Action (W/A) Item Status by W/A Type	
		R3480	Work/Action (W/A) Item Summary by NRC Office	
Abstract Distribution	DCSINX	R3785	Document Information Retrieval	
		HARDSTAT	R2604	Hardware Vendors Equipment Line
		RESTRK	R2731	Keyword Logical Grouping
		ABDIST	R5221	Document Title Retrieval Via Keyword
			R4601	Document Title Retrieval Via Author
			R1565	Abstract Retrieval
R2508	Production Distribution of Abstracts			
R8409	Subject Keyword Display			

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TABLE 4.6

NO-ISIS NEW SYSTEMS AND NEW UPGRADES

<u>System</u> ¹	<u>Development Man-months</u>	<u>Development \$(000)</u> ²	<u>Operations \$(000)</u> ³
NMMSS	28.0	165.4	15.0
Licensing Support	54.7	323.6	92.2
IPELTS	15.0	88.8	5.3
IRS	35.6	211.1	134.7
Contingency Planning	44.8	265.1	21.3
Threat Assessment	72.6	430.0	15.7
Effectiveness Evaluation	34.5	204.3	101.4

¹ If existing system named, then costs given are for new upgrades.

² Given are total development costs. Development costs were spread over 3 years, with contractor rates and annual inflation rate of 7.5%.

³ Estimated annual contractor operations and additional computer time on existing systems.

Note: All costs are measured in 1978 dollars.

TABLE 4.6 (cont.)

NO-ISIS - NEW SYSTEMS AND NEW UPGRADES

<u>System</u> ¹	<u>Development Man-months</u>	<u>Development \$(000)</u> ²	<u>Operations \$(000)</u> ³
Component File	88.8	526.0	826.6
Transportation	86.6	512.9	26.1
Research Tracking	24.3	143.9	7.2
Abstract Distribution	28.0	165.4	52.2
Safeguards Item Tracking System	26.2	156.0	87.0

¹If existing system named, then costs given are for new upgrades.

²Given are total development costs. Development costs were spread over 3 years, with contractor rates and annual inflation rate of 7.5%.

³Estimated annual contractor operations and additional computer time on existing systems.

Note: All costs are measured in 1978 dollars.

TABLE 4.7
NRC PERSONNEL DATA PREPARATION
COST ESTIMATES

<u>New System/ New Upgrade</u>	NRC Personnel For Initial Load		NRC Personnel For Annual Load (1985)	
	<u>Man-Months</u>	<u>Dollars \$(000)</u>	<u>Man-Months</u>	<u>Dollars \$(000)</u>
NMSS	-	-	-	-
Licensing Support	4.0	10.20	.2	.92
IPELTS	.1	.30	.1	.24
IRS	-	-	-	-
Contingency Planning	23.8	60.36	18.6	76.70
Threat Assessment	9.0	22.84	4.1	16.92
Effectiveness Evaluation	.3	.66	.1	.55
Component File	100.7	253.83	91.3	271.67
Transportation	1.2	2.45	23.1	94.87
Research Tracking	-	-	-	-
Abstract Distribution	.5	1.30	.3	1.10
S/G Item Tracking	-	-	-	-

NOTE: All costs measured in 1978 dollars.

TABLE 4.8

ANNUAL COST BREAKOUT
EXISTING SYSTEMS + NEW SYSTEMS

Year	Total Existing Costs \$ (000) ¹	New System & New Upgrade Development Man-months	Development \$ (000) ²	Data Preparation ³ \$ (000)	Operations \$ (000) ²	Total \$ (000)
1979	890	179.7	988.3	117.4	0	1995.7
1980	992	179.7	1062.6	127.2	692.4	2874.2
1981	1093	179.7	1142.2	138.1	1384.7	3758.0
1982	1170			371.9	1384.7	2926.9
1983	1253			403.9	1384.7	3041.6
5 YR CUM	5398		3193.1	1458.5	4846.5	14596.1
1984	1342			438.0	1384.7	3164.7
1985	1436			475.2	1384.7	3295.9
1986	1536			515.7	1384.7	3436.4
1987	1641			560.0	1384.7	3585.7
1988	1752			607.3	1384.7	3744.0
10 YR CUM	13105			3754.7	11770.0	31822.8

¹See Table 4.1.

²Based on contractor rates with annual inflation rate of 7.5%.

³See Section 4.4 for description of data preparation effort and required NRC personnel level. Based on annual inflation rate of 8.5%.

Note: All costs are measured in 1978 dollars.

5.0 INTEGRATED SYSTEM ALTERNATIVES

The Integrated Safeguards Information System described in the ISIS Phase III final report was designed to satisfy all of the safeguards information requirements identified within NRC (see ISIS Phase I final report). These safeguards information requirements included both current and projected needs as identified by NRC staff.

In order to assist the Safeguards Coordinating Group (SGCG) in formulating its recommendations for implementing a safeguards information system, six alternative service module configurations, each representing a "partial ISIS," were defined by the COTR. Implementation and operational costs were estimated for each of the six alternatives. Ten year life cycle costs were projected for each alternative.

The capabilities included in each of the six alternatives are additive in the sense that each alternative includes all of the capability described for the previous alternative plus some additional capability. Alternative 1 therefore contains the smallest capability and alternative 6 the largest (alternative 6 corresponds to the complete ISIS as described in the Phase III final report).

The development costs for each alternative were estimated under the assumption that system flexibility for subsequent expansion must be maintained. Design decisions which would reduce development costs at the expense of future expansion capability were not considered. It should be noted however that system expansion costs are greater than the corresponding costs during initial development. For example, the costs for implementing alternative 1 and then expanding that system to a capability equivalent to alternative 2 is more costly than the initial implementation of alternative 2.

While the cost/benefit analysis of the six alternatives was being conducted the Safeguards Coordinating Group requested each NRC line office to identify its immediate safeguards information requirements. As a result of these surveys, the SGCG developed a seventh alternative service module configuration.

The SGCG alternative was similar, but not identical to any of the original six alternatives. This alternative formed the basis of the recommendation formulated for implementing a safeguards information system. The SGCG recommended alternative has therefore been included in the cost/benefit analysis.

The cost estimates developed for the partial ISIS alternatives are most useful for comparison purposes. The life cycle costs estimates are necessarily a function of the following factors:

- o Initial start date
- o Economy inflation rates
- o Technology advances in data processing

- o Growth rate in the nuclear power industry
- o Major regulatory decisions (reprocessing etc.)

The ability to accurately forecast systems life cycle costs is dependent upon the ability to accurately forecast all of these factors. Therefore, the cost estimates are most useful for comparative purposes.

The remainder of this section discusses the results of the cost/benefit analysis of the seven partial ISIS alternatives. Section 5.1 provides a description of each of the seven alternatives. System capabilities, users, and benefits in terms of reports received are discussed for each alternative. Section 5.2 compares development cost estimates of the alternatives. Section 5.3 discusses the data preparation costs estimated for the alternatives and section 5.4 provides estimates of the computer and operations costs for the alternatives. Section 5.5 summarizes the total life cycle costs for the seven "partial ISIS" alternatives and discusses the total benefits derived from each alternative.

5.1 PARTIAL ISIS ALTERNATIVE DESCRIPTIONS

The seven partial ISIS alternatives are discussed in terms of the safeguards functional service modules as defined in the ISIS Phase III Final Report. Appendix B of that report should be referenced for a more detailed discussion of each of the service modules.

Table 5.1 shows percentage service module availability for each of the seven partial ISIS alternatives. Percentage of service module availability was measured in terms of the number of standard reports, as documented in the ISIS Phase III final report, supported by the specific alternative. Table 5.2 provides a detailed list of all of the reports available for each alternative.

The discussion of each alternative which follows provides descriptions of the report capabilities included in the alternative and the primary users of the capabilities. Benefits which are applicable to all partial ISIS alternatives are described in section 5.5. Finally, a functional implementation phasing is discussed for each alternative.

5.1.1 Description of Alternative 1

Alternative 1 provides a complete material accounting system. Reports supply information such as present and historical material possession by region, by license, or by facility and RIS/MBA within facility. Detailed inventory reports are available by requested inventory period. Details which may be requested include DOE/non-DOE amounts, composition of that material, and actual RIS/MBA location of serial-numbered items. Inventory difference reports for each standard material type may be selected for a specified MB', or for all MBA's under a particular license type.

Material transaction records are available in various formats. Shipper and receiver transaction values for a specified facility are reported flagging those values outside of the established limit of error.

Errors identified on submitted transaction forms are reported daily and summarized monthly. Administrative data such as number of a type of reporting error, average number of errors per transaction form, and average time for correction are calculated at time of report generation. Summary reports for internal facility (MBA-MBA) transactions, and facility-facility transactions are available upon request. Open transactions and late transactions are flagged.

Specialized reports are also available. These include location of sealed source items, and frequency of leak checks for same; amount of DOE-owned material; amount of material of a specified origin sequence by licensee (available in various sort orders). Administrative reports such as a list of active RIS numbers, and list of NRC licensees may be requested.

A significant amount of data is stored and maintained for purposes of cross-checking incoming data. Transaction and inventory forms are processed against valid license numbers, valid RIS numbers, and valid licensee names. Actual material possession is compared against license and MBA possession limits, and violations are reported.

IAEA requirements for nuclear material possession and transfer data from NRC are satisfied. The Physical Inventory Listing (PIL), Inventory Change Report (ICR), and Material Balance Reports (MBR) required for IAEA will be produced by the system.

Support capability is provided in terms of general state-licensed facility data, and import/export activity data. Reports will provide information concerning state license material possession, and concentration of material by zip code, state, and region.

Summary reports of exports and imports in a specified time period are available on request. Another report tracks material from country of origin to U.S. (if not country of origin) for processing and on to its end use facility. Support is provided in the way of general facility information, such as possession limits and actual on-site possession, to determine if a facility may import a particular balance material.

In alternative 1 all nuclear material accounting capability as defined in the MAC service module and as described above is available except a portion of a report requiring site detail layout information. All STALIC information is also provided. EXPLICIT capability is only partially made available, providing only that data dealing with material tracking and export/import activities. Detailed country data, support data for transportation routes, and inspection/evaluation results are not available in this alternative.

The total REPLIC capability, as defined in the service module is available providing a means to have the licensee validate his input data.

The turnaround for requested reports is overnight. In addition, there are several scheduled reports.

Organizations identified as users of reports available with the selection of alternative 1 include all line offices except the Office of Nuclear Regulatory Research (RES).

In the Office of Nuclear Material Safety and Safeguards (ONMSS), Division of Safeguards, the AD for Operation and Evaluation requires general support reports such as lists of licensees by region and listing of countries by material origin sequence. In addition, they would receive book balance reports sorted on various criteria, physical inventory results, inventory difference results, shipper and receiver transaction values, indication of errors relating to transaction form submission and violations such as those relating to possession limits, and material balance by material origin. Another ONMSS office needing this broad set of material accounting data as defined in the MAC service module is the Division of Safeguards Material Control Licensing Branch. Several ONMSS organizations have a need for isolated material accounting data such as book balances, transaction summaries, physical inventory results, and possession limit violations. These organizations include Division of Safeguards Contingency Planning and Test and Evaluation Branches. ONMSS also has the requirement for import/export tracking. The Division of Safeguards Material Control Licensing and Physical Security Licensing Branches will receive a summary of imports and exports by facility, and licensee data information establishing the right of a facility to ship or receive foreign shipments of a given amount of material.

In support of their safeguards functions, the Office of Inspection and Enforcement (OIE), Division of Safeguards Inspections has a need for the same categories of reports as described for ONMSS, Division of Safeguards, AD for Operation and Evaluation, as well as import/export data for a facility.

OIE Regions require book balance data and physical inventory results, as well as transaction analysis reports and material balance by project or by origin sequence.

The Office of Nuclear Reactor Regulation (ONRR), AD for Reactor Safeguards and AD for Operations Technology may require for a facility a five-year shipment and receipt summary. They also may require location of quantities of material by origin sequence, and summary of transactions by owner of material. The ONRR, AD for Operating Reactors may have a need for current list of licensees by region, and their book balances and inventory results, including inventoried location of sealed source material.

In evaluation of established safeguards standards, and in the development of new standards, the safeguards office of the Office of Standards Development would receive support in the form of a shipment/receipt

summary for each facility, and random samples of transactions showing amount shipped or received and history of transaction errors.

Staff offices also need information support in their safeguards functions. Office of International Programs (IP) requires summary of transaction values and shipper/receiver differences for a facility. They also need material origin amounts including material origin book balance by facility, by origin sequence, and by a specified country in a particular origin sequence. A near-future requirement is the data formatted for the IAEA. IP also will receive import/export summaries for a facility, licensee background data such as import/export permit information and current material possession, and detailed material tracking data. The staff office of State Programs may require notice of possession limit violations, state material concentration survey, and current status of state licenses in the review or change process in order to answer questions concerning state-licensed nuclear material.

5.1.2 Description of Alternative 2

Alternative 2 will support the inspection and licensing process in addition to the material accounting functions supported by alternative 1. This alternative will be brought on line in two phases. The first phase will provide a complete material accounting system. Reports available include on-site material possession, detailed inventory reports, material transaction records, and summary transaction reports. Computational results produce reports such as inventory difference reports, shipper/receiver differences, summary of frequency and type of error made on submitted transaction form and average time for correction, and lists of open and late transactions. Actual material possession is compared against license and MBA possession limits. Other specialized reports are available (Section 5.1.1).

In short, phase 1 of alternative 2 will provide all MAC service module capability except a portion of a report requiring site detail layout information which will not be available in this alternative. All STALIC capability is provided. EXPLICIT capability is partially available, providing that data dealing with material tracking and export/import activities (detailed country data is not available; nor is support data in terms of transportation routes or inspection and evaluation results). Total REPLIC capability is available as defined in that service module providing a means to have the licensee validate his input data.

The second phase will provide inspection and licensing support. Statistical and planning data concerning the inspection, investigation, and inquiry activities, and associated enforcement actions are supported. To aid in planning for the inspection of a specified IE manual chapter (inspection module) at a particular location, historical reports indicating the licensee's previous performance in meeting the standards associated with that inspection module may be requested. Also, provided to the inspector is an inspection item checklist which lists inspection items to be inspected for a given inspection module under a specified license. Other inspection module status reports may be obtained on various sort orders, such as region or site.

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In addition to the above-mentioned historical reports by inspection module, other more general inspection and event reports are available enabling the analyst to search for common attributes. For example, a report is available, sorted by licensee, by license for all licensees within a region, by inspection module, by component type, or by associated regulation, listing all non-compliances identified during inspections in a specified timeframe. Event-related reports list Preliminary Notifications (PN's) and Licensee Event Reports (LER's) (and other "event documentation") by license or event type. Active events are indicated. General site event history is available, listing references to associated documentation. Investigation results are available along with indication of associated event (if applicable).

As general support of the inspection process, a report may be requested listing all non-compliance codes, with source requirement; the source may be a regulation or may arise from the text of a license(s). Further support may be in terms of material accounting and licensing information.

Safeguards-related portions of licenses will be maintained within ISIS. Any section (or plan) contained in these portions may be obtained upon request. Since this information is updated or modified as needed, and since new licenses are periodically reviewed, a status indication of the license's position in the review process is available. All versions of a license are maintained, and are available with specification of a date parameter.

As reference to the content of sections of a license, a report may be requested indicating all sections or paragraphs which contain references to a user-specified subject of interest. Sections or paragraphs are also cross referenced to all parts of the federal regulations which have jurisdiction over that specific part of the license. Further, cross-references are established between parts of the federal regulations and other regulation documents (NUREGS, Regulatory Guides), or another federal regulation.

In general, all of the defined INSKED capability will be brought on line in phase 2 of alternative 2. All of the CEHIST reports will be available as defined, with the exception of those making reference to component involvement in an event or non-compliance. The full capability of LICSTAT and LICSUP will be available. None of the background information necessary for license evaluation is available except material accounting and inspection data. About 30% of REGSTAT will be provided constituting the cross-reference between regulations and other regulations or associated regulation documents. Not present is the capability of identifying those components accepted as meeting a given standard.

Most of the NRC requirements for information are satisfied on an overnight turnaround basis. There are several scheduled reports (particularly in inspection results and material accounting areas). Two reports involving status of licenses changes and copies of a section of a license are interactive.

With the selection of the safeguards information support capability detailed as alternative 2, all line offices have been identified as having requirements satisfied through defined reports.

As detailed in the description of alternative 2 capability, phase 1 will bring on line a complete material accounting system including general state-licensed facility data and import/export activity data. The reports made available in this phase are the same as those described in the more limited alternative 1. Thus, the users of those reports are as already described. With the completion of phase 2 in alternative 2, those offices will receive not only the material accounting data, but, as required in the safeguards functions of licensing and inspection, the reports detailed in the alternative 2 description.

The ONMSS Division of Safeguards, in addition to material accounting data, requires current and historical copies of all facility licenses, and the status of pending changes to any section. The Material Control and Physical Security Branches also require the cross-reference of sections of a license to applicable regulations, as established during the initial review process. This report may be supplemented by a report establishing cross references between regulations. All branches of the ONMSS, Division of Safeguards require knowledge of non-compliance histories, and PN's and LER's by license.

The OIE Division of Safeguards Inspections as well as the OIE Regions need material accounting data for a licensee, a current copy of his license, and general information on cross-references between regulations and sections of the license or between other regulations. This provides background data for inspections, as does a history of inspection status. Current inspection status includes status of inspection modules, and frequency of required inspections. Historical inspection results include non-compliance histories, and lists of event-related documentation and investigation results. ONRR would receive applicable historical reports of non-compliance history, and event-related documentation.

In support of its activity the Office of Standards Development would receive cross-references identified between regulations and standards. They would also be able to identify the validity of established regulations and standards and the need for new ones by receiving non-compliance history reports sorted in various formats for trend analysis.

RES Technical Support Branch may receive non-compliance history reports, and list of LER's by event type.

Staff offices also require support in the area of licensing. IP and the Office of State Programs require a current copy of the licenses, and cross-references to regulations.

5.1.3 Description of Alternative 3

Alternative 3 provides the same ISIS functional capability as that described in alternative 2. This functional capability is supplemented by the addition of a "Meta Data Base" (see ISIS Phase III Appendix C). This data

base supports ad hoc capability as described in the CAISIS service module. Other computer-assisted ISIS reports include a list of available service modules (i.e. functional capabilities), abstracts of each service module, and a list of available reports (since in the selection of alternative 3, only the indicated percentages of the indicated service modules will be available, the "service module list" report will contain only the implemented service modules, and the "list of reports" may not be the entire set of reports for that service module, corresponding to the percentage of that capability implemented in this alternative). Further aid to users is in the form of specific report abstracts and one-page examples of ISIS reports. These sample reports should aid users in determining what reports might be of use to them, thereby alleviating some of the load on the ad hoc query system.

As an administrative aid, a report is generated on a scheduled basis that identifies the active addressees receiving ISIS-MAC reports (may be expanded to include all ISIS reports), sorted on any one of several parameters.

In this alternative, two on-request reports have interactive turnaround. These are indications of the status of pending license changes and a copy of all versions of a specified section of a license.

For users of reports providing support to safeguards functional areas, (i.e. material accounting, licensing, and inspection) see the appropriate sections of alternatives 1 and 2. The system user oriented reports available in phase 3 of alternative 3 as described above will be used by anyone desiring information concerning reports available through the system, and instruction on obtaining those reports. Also, the ad hoc capability as described here will be widely used by all line and staff offices needing safeguards information in sort orders and groupings identified on an as needed basis.

5.1.4 Description of Alternative 4

Phase 1 of alternative 4 will support a complete material accounting system as described in alternative 1. Phase 2 will bring in the inspection and licensing process support capability detailed in alternative 2. To enhance this capability and that of later phases, phase 3 will provide ad hoc reporting capability, and other user aids. This is described more fully in alternative 3. In phase 4, contingency planning, threat assessment, and effectiveness evaluation activity information are added to the capability of the system.

Capability, in terms of reports received, will encompass contingency planning information requirements, including reference to headquarters and licensee contingency plans, list of stimuli and objectives, and responsibility matrices of stimuli vs. responses sorted by operational element and of operational element vs. responses sorted by stimulus. Status of interfacing agreements is available on request. Other data in support of the contingency planning function include possession limits for the facility, transaction summaries, current book balance, facility evaluation results

and safeguards status indices, and associated threat data. Much other support information in terms of site layout and physical security component data would be useful, but in this alternative the data is not available in the partially integrated system.

Effectiveness evaluations are performed for both facilities and transports. No transport data is available in this alternative. Results of facility evaluations include site-specific observations to specific procedural questions, and the most recent synthesized report. For review and analysis purposes, these results may be sorted by license, by site, or by question. The safeguards status indices for various threat composites modeled against a site are available on request.

In support of the modeling activities involved in the threat assessment process, generic adversary data, such as weapons, numbers of people and types of activities, is available as well as information on past actual nuclear threats, similar non-nuclear threats, and suggestive fictional (TV, magazines, books, etc.) threats. A list of threats sorted by any characteristic (type of threat, target, etc.) may be obtained, and then a detailed report requested that gives in-depth data concerning the threat of interest. This data may be formed into possible future threats (a composite of the various data) and analyzed into adversary action sequences against a facility. From these activities, a safeguards status index for that facility may be calculated.

In the event of an actual threat, supplemental data, other than a history of similar threats, may be desirable in the form of actual on-site material possession, evaluation and inspection history, and documentation associated with events occurring in a specified time frame.

Several reports are interactive, enhancing the ability to respond in a contingency situation, or allowing interactive modeling exercises. These reports include planned responses and responders to a stimulus, historical threat data, and adversary action sequences.

Data not available in this alternative includes component data, prohibiting a reference being established between operational elements and specific personnel, or a link between an actual threat and components (personnel or equipment) involved. Transportation data is not stored, limiting evaluation information and threat assessment exercises to facilities. Other data of assistance (such as site layout information or site-specific component data) in evaluating a site or reacting to a contingency is not available. In addition to the users previously described, the Test and Evaluation and Contingency Planning Branches of the ONMSS Division of Safeguards will be primary users of the new capabilities added to alternative 4.

5.1.5 Description of Alternative 5

Alternative 5 will incorporate all of the ISIS - defined functional capability described in the service modules with the exception of the document storage and retrieval and milestone tracking capabilities.

Phasing will proceed with phase 1, the material accounting system described in alternative 1; phase 2, the licensing and inspection support capabilities described in alternative 2; phase 3, ad hoc capability described in alternative 3; phase 4, contingency planning, threat assessment, and effectiveness evaluation information as described in alternative 4; phase 5, generic component (including personnel) information, and site-, and transport-specific component detail, described in the following paragraphs.

Generic component information is available, such as industry test and evaluation results for a brand/model, hardware specifications for a hardware item, and lists of all manufacturers/vendors of a particular component, or all hardware components offered by a given manufacturer/ vendor. This package incorporates the total of the described HARDSTAT capability except the document retrieval of hardware catalogs. All of the PHYSEC capability is available in this alternative. Site-specific physical security data includes site layout detail, equipment lists and allocation of critical components, personnel data lists, and performance characteristics (both projected and actual). Much of this information is available on several sort orders. As support information for physical security evaluation a copy of the physical security plan is available through LICSTAT.

The MAQUIP module defines two categories of data. The first is that information concerning material accounting equipment, available through reports on equipment component location, performance characteristics and historical performance data, and manufacturer/vendor lists. The second material accounting support category provides locations and coded identities of MBA's and ICA's, and key measurement points (KMP's) as they relate to in-plant material process flows. All of the MAQUIP defined capability is available in this alternative.

In this alternative is also available transportation detail concerning (future) NRC-licensed carrier data, and transportation component data such as industry-wide equipment performance information, brand/model information and assignment of transport-related components to facilities or licensed carriers (this may include driver identification and qualifications).

Other transportation data is concerned with the actual transport of material. Reports are available listing the approved shipping routes between licensed or foreign facilities, identifying individual paths comprising the route, description of restrictions, LLEA availability at various positions, and critical or stopping point locations. For a given shipper RIS in a given time period, a report will indicate all shipments made, destination, route taken, carrier, mobile configuration used, and, if desired, specific components employed. This same information may be retrieved for a RIS as receiver, or for a carrier, parameterized by beginning and ending dates of interest. For evaluation and planning purposes, a report is available on request which lists transportation-related events according to type of incident, time interval, or geographic location.

In phase 5 the ability to integrate transportation and component data with other functions is supported. For instance, the REGSTAT reports which identify acceptances of component types for safeguards application, based

on defined standards, are now made available. CEHIST reports which in previous phases were only partially available now include component involvement in an event. The CPOR report providing a site-specific safeguards-related organizational hierarchy, showing job titles and reporting relationships is made available as part of the contingency planning base. Effectiveness evaluation results and safeguards status indices and threat data may be retrieved for transports.

The MAC capability is completed with the addition of site layout data.

Several reports are interactive, enhancing the ability to respond in a contingency situation, or allowing interactive modeling exercises. These reports include planned responses and responders to a stimulus, historical threat data, adversary action sequences and hardware specification data. The capabilities added to alternative 5 service primarily the Division of Safeguards ONMSS and the OIE regional offices. The transportation and component data will be input and used by these offices. Other offices such as Office of Standards Development may benefit from the data but they are not primary users.

5.1.6 Description of Alternative 6

This alternative comprises the entire integrated safeguards information system. Phases 1-5 for alternative 6 are identical to the phasing of alternative 5. Phase 6 brings on line the document storage and retrieval capability and research effort tracking. In support of this is a report listing document titles/numbers by keyword, or by author. Abstracts of specified documents are available. On request, a hierarchical reference list of stored keywords may be obtained. On a routine basis, abstracts of documents of interest to NRC employees are routed to employees based on an employee-identified catalog-of-interest. With the interface of ISIS with the planned DCS system, a report will specify to the page level the microfiche location of safeguards information in a specified subject area.

Safeguards research requests are followed from submittal of request to award of contract to preparation of deliverables. Requestor and contract monitor, as applicable, are identified. On a monthly basis, delinquent contract deliverables are flagged.

Work/action item tracking is done by responsible employee, by organization or by work/action type. A management summary by NRC office provides a list of active work/action items by milestone, with statistical measures applied to completed milestones.

Interactive report capability is available where immediate response is required. Prompt action in contingency situations is facilitated by interactive query and response concerning planned reaction to a stimulus (action taken and by whom). Historical threat data of a similar nature may provide a basis for decision making during a threat. This also need be available on an interactive basis. Threat data used in modeling activities to obtain adversary action sequences is supported interactively.

Hardware specification data is immediately available, to aid in physical security measures and component acceptability. As an aid to management, a report is available interactively which shows outstanding work/action milestones by responsible individual.

Document title retrieval based on keyword or author, or abstract retrieval for a document of interest is available in interactive mode. Microfiche location of a document or of safeguards information in that document in the DCS system is also provided.

The new capabilities included in alternative 6 are intended to support all of the offices within NRC. The capability to track safeguards research effort may primarily serve the Office of Nuclear Regulatory Research; however, that information will also be available to other offices.

5.1.7 Description of the SGGC Recommended Alternative

The alternative recommended by the SGGC in their report to the Executive Director of Operations on July 19, 1978 includes capabilities to support material accounting (domestic and international), inspection and enforcement, contingency planning, threat assessment, safeguards effectiveness evaluation, and safeguards action item tracking. The recommended alternative also includes an interface with the Document Control System (DCS).

Material accounting reports include on-site material possession, detailed inventory reports, material transaction records, and summary transaction reports. Computational results produce reports such as inventory difference reports, shipper/receiver differences, summary of frequency and type of error made on submitted transaction form and average time for correction, and lists of open and late transactions. Actual material possession is compared against license and MBA possession limits.

Capability is provided for general state-licensed facility data and import/export activity data. The recommended alternative will provide all MAC service module capability except a portion of a report requiring site detail layout information. All STALIC capability is provided. EXPLIC capability includes data dealing with material tracking and export/import activities (detailed country data is not available; nor is support data in terms of transportation routes).

The recommended alternative will provide support to inspection and enforcement functions. Planning data concerning the inspection, investigation, and inquiry activities, and associated enforcement actions are supported. To aid in planning for the inspection of a specified IE manual chapter (inspection module) at a particular location, historical reports indicating the licensee's previous performance in meeting the standards associated with that inspection module may be requested. The inspector is provided an inspection item checklist which lists inspection items to be inspected for a given inspection module under a specified license. Other inspection module status reports may be obtained on various sort orders, such as region or site.

In addition to the above-mentioned historical reports by inspection module, other more general inspection and event reports are available, enabling the analyst to search for common attributes. For example, a report is available, by licensee, by license for all licensees within a region, by inspection module, by component type, or by associated regulation listing all non-compliances identified during inspection in a specified time frame. Event-related reports list PN's and LER's (and other "event documentation") by license or event type. Active events are indicated. General site event history is available, listing references to associated documentation. Investigation results are available, along with indication of associated event (if applicable).

The recommended alternative will include contingency planning information requirements, including reference to headquarters and licensee contingency plans, list of stimuli and objectives, and responsibility matrices of stimuli vs. responses. Status of interfacing agreements is available on request. Other data in support of the contingency planning function include possession limits for the facility, transaction summaries, current book balance, facility evaluation results and safeguards status indices, and associated threat data.

Effectiveness evaluations are performed for nuclear fuel cycle facilities. Results of facility evaluations include site-specific observations to specific procedural questions, and the most recent synthesized report. For review and analysis purposes, these results may be sorted by license, by site, or by question. The safeguards status indices for various threat composites modeled against a site are available on request.

In support of the modeling activities involved in the threat assessment process, generic adversary data, such as weapons, numbers of people and types of activities, is available as well as information on past actual nuclear threats, similar non-nuclear threats, and suggestive fictional (TV, magazines, books, etc.) threats. A list of threats sorted by any characteristic (type of threat, target, etc.) may be obtained, and then a detailed report requested that gives in-depth data concerning the threat of interest. This data may be formed into possible threats (a composite of the various data) and analyzed into adversary action sequences against a facility. From these activities, a safeguards status index for that facility may be calculated.

In the event of an actual threat, supplemental data, other than a history of similar threats, may be desirable in the form of actual on-site material possession, evaluation and inspection history, and documentation associated with events occurring in a specified time-frame.

Several reports are interactive, enhancing the ability to respond in a contingency situation. These reports include planned responses and responders to a stimulus, historical threat data, and adversary action sequences.

Safeguards action item tracking is also included in the recommended alternative. Work/action item tracking is done by responsible employee, by organization or by work/action type. A management summary by NRC office

provides a list of active work/action items by milestone, with statistical measures applied to completed milestones.

Data not available in this alternative includes component data, prohibiting a reference being established between an actual threat and components (personnel or equipment) involved. Transportation data is not stored, limiting evaluation information and threat assessment exercises to facilities. Other data of assistance such as site layout information or site-specific component data in evaluating a site or reacting to a contingency is not available.

5.2 DEVELOPMENT COST ESTIMATES

Estimates for the development costs of each of the seven alternatives were prepared using the methods discussed in section 2.3. The system development activities included in the definition of "development" were:

- o detailed systems design,
- o software construction,
- o system testing,
- o personnel training,
- o conversion/installation,
- o system documentation.

It was assumed that the entire development effort would be performed by contractor labor. The period of development ranged from 24 months to 36 months depending on the capabilities of each alternative. Table 5.3 shows the results of the development cost estimates.

5.3 DATA PREPARATION COSTS

The initial data base load and subsequent annual data maintained may constitute a significant portion of the cost of implementing and operating an information system. It is therefore important to include estimates of these costs in the system life cycle cost estimates.

As described in section 2.3 the data in the ISIS data base was categorized according to the type of data preparation activities required to input the data into the system. It was assumed that contractor staff would process the clerical and automated data preparation categories. The contractor costs for initial data load were included in the development cost estimates and the annual data load costs were included in the operational contractor costs estimates. The data preparation costs for the manual and analytical data categories were assumed to be NRC personnel costs. These two data preparation categories make up the majority of NRC staff costs associated with the operation of the safeguards information system.

It should be noted that it is not the intent of an automated information system to make work for its users. That is, the information which is processed and input into an information system must be information which the users need, otherwise the information system is not responsive to its

users. If NRC doesn't need a particular data element, then that data element need not be input into ISIS. From this perspective, the majority of the costs of data preparation are costs which NRC must incur with or without an integrated safeguards information system. If anything, the data preparation costs should be less with an integrated system because each data element need be collected and entered only once. The only data preparation costs which should be considered the burden of the system should be the costs associated with converting the data to computer compatible format (i.e., keypunching etc.). However, in order to favor the NO-ISIS approach, the entire cost of data collection, processing, and inputting was estimated and included in the data preparation costs. No compensations were made for data which is already being collected and processed.

Tables 5.4 through 5.7 show the results of the data preparation cost estimates. The design volumes shown in this table are the data volumes estimated in the Phase III final report. These volume estimates represent the size of the data base for which the system is to be designed for optimal performance. Tables 5.5 and 5.6 show the data volumes by data preparation category for the ISIS alternative 6 and the SGGC recommended alternative respectively. Finally Table 5.7 shows the data preparation cost estimates in man-months and dollars for the initial load and annual load for each of the ISIS alternatives.

5.4 HARDWARE AND OPERATIONS COST ESTIMATES

Hardware cost estimates were developed based on the hardware requirements analysis performed during ISIS Phase III. As noted in section 5.3 all of the ISIS alternatives require supporting 70% or more of the entire ISIS data base. It has been assumed that each of the alternatives would be operating using some generalized Data Base Management System (DBMS) and that all of the alternatives would require a secure operating environment. The hardware configuration selected during the ISIS Phase III work was adapted to each of the partial ISIS alternatives (the hardware configuration for alternative 6, the full ISIS, is identical to the ISIS Phase III configuration). Table 5.8 shows the hardware configurations for the seven partial ISIS alternatives. The peripheral equipment (tape drive, disk drive, controllers, etc.) shows a gradual build-up which is directly proportional to the size of the data base. The major differences between the alternatives comes from the central processing unit (CPU) selection. The equivalent of an IBM 370/148 is the smallest CPU that ISIS can be developed for without limiting growth potential through design modifications and "programming trick" to shoe horn the system in a smaller computer. Growth to the equivalent of an IBM 370/158 is required to adequately support the necessary 4 mega bytes of core storage in the alternatives 3 and 4. Finally, the equivalent of IBM dual 370/158's operating in a Multi-Processing (MP) environment in alternative 6 was required for the necessary reliability and backup capability (see ISIS Phase III final report Appendix A). The hardware requirements identified for each alternative were considered to be "more than adequate" in keeping with the policy to favor the NO-ISIS alternatives.

The operations staff identified to run the hardware and information system started with eleven contractor personnel for alternative 1 and increased by two people for each alternative until reaching a maximum of nineteen contractor personnel for alternatives 5 and 6. Fifteen contractor personnel were estimated to be required for the SGGC recommended alternative. Table 5.9 summarizes the cost estimates for hardware equipment and systems operations. It should be noted that the equipment costs include the cost of operating a 7500 square foot computer facility with security provided to meet NSA standards.

5.5 PARTIAL ISIS ALTERNATIVES: TOTAL COSTS AND BENEFITS

The cost elements for each of the seven partial ISIS alternatives have been combined to compute annual labor costs, annual computer costs and total annual costs for fiscal year 1979 through 1988. During the first three years the annual labor costs were:

- o system development,
- o hardware operations,
- o systems operations,
- o data preparation, and
- o existing systems phase out costs.

For years after the development period, the annual labor estimates included only hardware and systems operations and data preparation. The annual computer costs included the estimates for hardware and facility for each alternative. Additionally, the cost of operating the existing systems which will be phased out as a result of the ISIS implementation have been included. Tables 5.10 through 5.16 show the results of the total cost calculations for each of the seven alternatives and table 5.17 summarizes the results of cost estimates.

As discussed in section 4.1, the capabilities of the seven alternatives vary substantially one to another so that the cost estimates represent costs for greatly varied capabilities. For the purpose of comparing costs as nearly equal in capability as possible, the cost associated with completing the total safeguards information requirements has been calculated for each alternative. The results of adding the NO-ISIS costs needed to complete the total safeguards information requirements to the partial ISIS costs are discussed in section 6.0. It should be noted that the addition of NO-ISIS costs still does not completely equalize the alternative capabilities. A number of benefits are achievable only through system and data integration. These benefits associated with an integrated system are difficult if not impossible to assign a cost.

Benefits of system integration are realized by each of the partial ISIS alternatives. The extent of the benefits vary from alternative to alternative according to the extent of all safeguards information integrated in a particular alternative. The benefits achievable through system integration can be grouped into seven general categories:

- o integration and control,
- o capability,
- o reliability,
- o efficiency,
- o insight,
- o usability, and
- o credibility.

Integration and control refers to both the system, and the data in the system. As a result of an integrated safeguards information system, NRC can control all of its needed safeguards information. The system can be established to respond to NRC's unique information needs and priorities. Through data integrations, the single integrated data base can provide the mechanism to integrate all of the safeguards activities of a facility; physical protection, material control, and material accounting. Integration of all safeguards data allows the user to assess the complete safeguards picture for a facility. It should be noted that while the control of the information within the system is the responsibility of the office assigned to operate the system, the ownership of the data does not change. Individual offices within NRC may still own their own data.

The integrated information systems approach offers some capabilities which are not feasible without an integrated data base. Ad hoc reporting allows the users to formulate new reports on an as needed basis. Integration of safeguards data allows the correlation of information which would not otherwise be feasible. Congressional requests for information may be more readily satisfied. The ISIS statement of requirements includes fourteen reports which are not feasible without an integrated data base because they correlate widely diverse safeguards data.

The reliability of the information stored in the data base can be significantly improved by integration. All users of the same information have access to the same data. This substantially reduces the problems of data redundancy and conflicts. Increased user confidence in the information increases the use made of the data. Additionally, an integrated data base provide extensive background information for consistency checks at the time new data are entered in the data base. This increases the probability of identifying false data before it ever enters the data base.

Work efficiencies are realized as a result of an integrated information system. The cost of inputting data can be reduced because any piece of data is only entered once in an integrated system. Data security is less of a problem because the information resides in only one system. The users of the information system have only one system to learn. As a result, NRC personnel may make more efficient use of their time.

An integrated information system can have the effect of providing greater insight to the users of the information. The ability to correlate safeguards information contained in the data base assists the users in understanding current safeguards data problems and identifying potential safeguards problems. Ability to easily compare safeguards procedures and conditions on an industry-wide basis helps to establish uniformity to the application of regulatory policy. The completeness associated with having all of the

safeguards duties in one system assists in locating what information may be available to help solve a safeguards problem.

The usability of the data is increased by maintaining an integrated data base. Having all of the data available in one system helps establish a common terminology for staff communications involving safeguards. Usability is increased because familiarity with safeguards data is increased. Use of this data is also increased because all of the data is stored in an internally consistent computer compatible format.

Finally, the existence of a comprehensive integrated safeguards information system would increase public awareness of the NRC's efforts to safeguard the nuclear power.

The benefits of an integrated safeguards information system discussed above are compared against the NO-ISIS automated and manual alternatives in section 6.0.

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TABLE 5.1
 ISIS SERVICE MODULE PERCENTAGE
 AVAILABILITY BY ALTERNATIVE

Service Modules	"Partial" ISIS Alternative						SGCG
	1	2	3	4	5	6	
ABDIST						100	
CAISIS			100 ¹	100 ¹	100 ¹	100 ¹	
CEHIST		80	80	80	100	100	80
CPOR				99	100	100	99
DCSINX						100	100
EFFEVAL				75	100	100	75
EXPLIC	66	66	66	66	100	100	66
HARDSTAT					90	100	
INSKED		100	100	100	100	100	100
INSPLN		100	100	100	100	100	100
IRS		100	100	100	100	100	100
LICSTAT		100	100	100	100	100	
LICSUP		100	100	100	100	100	
MAC	99	99	99	99	100	100	99
MAQUIP					100	100	
PHYSEC					100	100	
REGSTAT		30	30	30	100	100	
REPLIC	100	100	100	100	100	100	
RESTRK						100	
SITS						100	100
STALIC	100	100	100	100	100	100	100
THRAN				90	100	100	90
TRANS					100	100	25

¹For ad hoc reporting, 100% capability for the portion of the data base supported for that alternative.

TABLE 5.2
CAPABILITY AVAILABLE IN ALTERNATIVES

Service Module	Report ID	Report Name	Alternatives						
			1	2	3	4	5	6	SGCG
LICSTAT	R5169	Status of Pending Licenses Changes		X	X	X	X	X	
	R8823	Copy of a License Plan		X	X	X	X	X	
	R3973	Copy of All Versions of a Section(s)		X	X	X	X	X	
LICSUP	R6497	License to Regulation Cross-Reference		X	X	X	X	X	
	R6787	License Subject Location		X	X	X	X	X	
REGSTAT	R1286	Cross-Reference Regulations to Regulation Document	X ^(a)	X ^(a)	X ^(a)		X	X	
	R3074	Component Acceptance Industry Standards					X	X	
INSPLN	R7163	Inspection Module Historical Report		X	X	X	X	X	X
	R9822	Frequency of Inspection Report		X	X	X	X	X	X
	R7906	Inspection Item Checklist		X	X	X	X	X	X
INSKED	R8681	Inspection Module Status Report		X	X	X	X	X	X
	R5655	Facility Inspection History		X	X	X	X	X	X
	R6672	Outstanding Item List		X	X	X	X	X	X
CEHIST	R5541	Non-Compliance History By License	X ^(b)	X ^(b)	X ^(b)	X ^(b)	X	X	X ^(b)
	R5912	Non-Compliance History By Inspection Module	X ^(b)	X ^(b)	X ^(b)	X ^(b)	X	X	X ^(b)
	R3239	Non-Compliance History By Component Type							
	R4442	List of PNs By License	X ^(b)	X ^(b)	X ^(b)	X ^(b)	X	X	X ^(b)
	R0749	List of LERs By License	X ^(b)	X ^(b)	X ^(b)	X ^(b)	X	X	X ^(b)
	R6550	List of LERs by Event Type	X ^(b)	X ^(b)	X ^(b)	X ^(b)	X	X	X ^(b)
	R4251	List of Investigations By License	X ^(b)	X ^(b)	X ^(b)	X ^(b)	X	X	X ^(b)
	R0462	List of Investigations By Subject	X ^(b)	X ^(b)	X ^(b)	X ^(b)	X	X	X ^(b)
	R1489	List of Active Events	X ^(b)	X ^(b)	X ^(b)	X ^(b)	X	X	X ^(b)

TABLE 5.2 (continued)
CAPABILITY AVAILABLE IN ALTERNATIVES

Service Module	Report ID	Report Name	Alternatives						SGCG
			1	2	3	4	5	6	
CEHIST (cont)	R1734	Event History By Site		X	X	X	X	X	X
	R1135	List of Event Documentation By Event		X	X	X	X	X	X
	R2403	List of N/C Codes		X	X	X	X	X	X
	R6197	List of Non-Compliances By Regulation		X	X	X	X	X	X
HARDSTAT	R4500	Hardware Test and Evaluation Results					X	X	
	R9294	Hardware Specifications					X	X	
	R2604	Hardware Vendors Equipment Line						X	
	R6315	Safeguards Equipment Performance					X	X	
PHYSEC	R3824	Site Layout Information					X	X	
	R4519	Site Physical Security Equipments List					X	X	
	R9395	Site-Specific Equipment Performance Data					X	X	
	R9614	Site-Specific Physical Security Personnel Data/Status					X	X	
	R1829	Security Component Event History					X	X	
	R8513	Industry-Wide Physical Security Equipment Performance					X	X	
	R1111	Location of Specified Components					X	X	
MAQUIP	R1664	Site Layout Data For Material Accounting					X	X	
	R6844	Site-Specific Material Accounting Equipment					X	X	
	R4936	Site/License-Specific SNM Accounting Equipment Performance Data					X	X	
	R5056	Industry-Wide Performance of SNM Accounting Equipment						X	

TABLE 5.2 (continued)
CAPABILITY AVAILABLE IN ALTERNATIVES

Service Module	Report ID	Report Name	Alternatives						
			1	2	3	4	5	6	SGCG
MAC	R0399	List of RIS Numbers	X ^(d)	X ^(d)	X ^(d)	X ^(d)	X	X	
	R0742	List of NRC Licensees By Region	X	X	X	X	X	X	X
	R0451	Book Balance By Region	X	X	X	X	X	X	X
	R6549	Current Book Balance By License	X	X	X	X	X	X	X
	R4250	Historical Physical Inventory By MBA	X	X	X	X	X	X	X
	R8662	Data Book Balance By License	X	X	X	X	X	X	X
	R5681	Detailed Licensee Inventory By MBA	X	X	X	X	X	X	X
	R7172	Inventory Differences By MBA	X	X	X	X	X	X	X
	R2743	Inventory Difference Summary By Region	X	X	X	X	X	X	X
	R0131	Historical Inventory Difference By MBA	X	X	X	X	X	X	X
	R6655	Shipper and Receiver Transaction Values By Facility	X	X	X	X	X	X	X
	R7963	Historical Facility Shipper-Receiver Differences (SRD)	X	X	X	X	X	X	X
	R2906	Sealed Source Locations	X	X	X	X	X	X	X
	R3107	Reporting Errors	X	X	X	X	X	X	X
	R3479	MRA Possession Limit Violations	X	X	X	X	X	X	X
	R5280	General Possession Limit Violations	X	X	X	X	X	X	X
	R2565	Unresolved Transaction Errors	X	X	X	X	X	X	X
	R8408	Random Sample of Transactions	X	X	X	X	X	X	X
	R7009	Facility-Facility Transaction Summary	X	X	X	X	X	X	X
	R8776	Facility-Internal MBA-MBA Transactions	X	X	X	X	X	X	X
	R4846	Open Transactions	X	X	X	X	X	X	X
	R7254	Late Transaction Report	X	X	X	X	X	X	X
	R2891	Summary List of On-Site Gains and Losses	X	X	X	X	X	X	X
	R1992	Five-Year Shipment or Receipt Summary	X	X	X	X	X	X	X
	R9204	IAEA Physical Inventory Change Report	X	X	X	X	X	X	X
	R1694	IAEA Physical Inventory Listing	X	X	X	X	X	X	X

TABLE 5.2 (continued)
CAPABILITY AVAILABLE IN ALTERNATIVES

Service Module	Report ID	Report Name	Alternatives						SGCG
			1	2	3	4	5	6	
MAC (cont)	R6864	IAEA Material Balance Report	X	X	X	X	X	X	X
	R3378	Cumulative Inventory Difference Report	X	X	X	X	X	X	X
	R6282	Transaction Analysis Report	X	X	X	X	X	X	X
	R9975	Transaction Limit of Error Report	X	X	X	X	X	X	X
	R4621	DOE Material By Licensee	X	X	X	X	X	X	X
	R2390	Material Accounting Transaction By Owner	X	X	X	X	X	X	X
	R1501	Material Origin Book Balance	X	X	X	X	X	X	X
	R5877	Country Listing By Origin Sequence	X	X	X	X	X	X	X
	R3699	Location and Amount of Material of Specified Origin Sequence	X	X	X	X	X	X	X
	R2615	Location of Material of Specified Country in Origin Sequence	X	X	X	X	X	X	X
STALIC	R8210	State License Status	X	X	X	X	X	X	X
	R8957	State License Material Possession	X	X	X	X	X	X	X
	R7788	State Material Concentration Survey	X	X	X	X	X	X	X
TRANS	R7075	NRC Carriers					X	X	X
	R9976	Transportation Component Type					X	X	
	R8746	Transportation Component Ownership					X	X	
	R4877	Transportation Routes					X	X	
	R5845	Shipment Detail Shipper					X	X	
	R7290	Shipment Detail Receiver					X	X	
	R2382	Shipment Detail Carrier					X	X	
	R6291	Transportation Incident (Event)					X	X	X ^(b)

TABLE 5.2 (continued)
CAPABILITY AVAILABLE IN ALTERNATIVES

Service Module	Report ID	Report Name	Alternatives					
			1	2	3	4	5	6
CPOR	R2060	Licensee Contingency Plan Objectives By Stimulus			X	X	X	X
	R5326	Licensee and Headquarters Contingency Plan Generic Data			X	X	X	X
	R9193	Licensee Contingency Planning Base Data					X	X
	R2127	Licensee and Headquarters Responsibility Matrix - By Stimulus			X	X	X	X
	R2228	Licensee and Headquarters Responsibility Matrix - By OP Element			X	X	X	X
	R9717	Lists of Specific Operational Elements and and Specific Stimuli			X	X	X	X
	R7437	Interfacing Agencies Agreements Data			X	X	X	X
EFFEVAL	R0884	Assessment Observations By License			X	X	X	X
	R3561	Assessment Observations By Site			X	X	X	X
	R7647	Synthesis Reports By License			X	X	X	X
	R0597	Synthesis Reports By Facility			X	X	X	X
	R5433	Synthesis Reports By Transport					X	X
	R4703	Safeguards Status Index For Facility			X	X	X	X
	R8098	Safeguards Status Index For Transport					X	X
	R9596	Assessment Observations By Question			X	X	X	X
THRAM	R0071	Potential Adversary Attributes			X	X	X	X
	R4019	List Actual Threat Occurrences/Events			X(c)	X	X	X(c)
	R8140	An Actual Threat Occurrence/Event			X(c)	X	X	X(c)
	R5732	Fictional Threats			X	X	X	X
	R1020	Composite Threats			X	X	X	X
	R0018	Adversary Action Sequence			X(c)	X	X	X(c)

TABLE 5.2 (continued)
CAPABILITY AVAILABLE IN ALTERNATIVES

Service Module	Report ID	Report Name	Alternatives						SGCG	
			1	2	3	4	5	6		
EXPLIC	R8302	Country Status					X	X		
	R9011	Country File Report					X	X		
	R7505	Licensee Data Report	X	X	X	X	X	X	X	
	R6958	Material Tracking Report	X	X	X	X	X	X	X	
	R0630	Exports	X	X	X	X	X	X	X	
	R6066	Imports	X	X	X	X	X	X	X	
RESTRK	R0968	Status of All Research Requests							X	
	R6152	Status of All Research Projects							X	
	R2453	Delinquent Contract Deliverables							X	
	R2731	Keyword Logical Grouping							X	
ABDIST	R5221	Document Title Retrieval Via Keyword							X	
	R4601	Document Title Retrieval Via Author							X	
	R1565	Abstract Retrieval							X	
	R2508	Production Distribution of Abstracts							X	
	R8409	Subject Keyword Display							X	
DCSINX	R3785	Document Information Retrieval							X	
SITS	R0107	Work/Action (W/A) Item Milestone Status (By) Responsible NRC Employee(s)							X	X
	R3178	Work/Action (W/A) Item Milestone Status (By) NRC Organization							X	X
	R3379	Work/Action (W/A) Item Status by W/A Type							X	X
	R3480	Work/Action (W/A) Item Summary by NRC Office							X	X

TABLE 5.2 (continued)
CAPABILITY AVAILABLE IN ALTERNATIVES

Service Module	Report ID	Report Name	Alternatives						SGCG
			1	2	3	4	5	6	
REPLIC	R1983	Material Possession Authorization for Shippers	X	X	X	X	X	X	
CAISIS		Ad Hoc Capability			X	X	X	X	
		List of Service Modules			X	X	X	X	
		List of Module Abstracts			X	X	X	X	
		List of Reports			X	X	X	X	
		Report Abstracts			X	X	X	X	
		Report Usage History			X	X	X	X	
		ISIS Example Reports			X	X	X	X	
		List of Active ISIS-MAC Report Addresses			X	X	X	X	

^aRecord of acceptance of component types based on regulations and standards is not available in this alternative.

^bGeneric and site-specific component data and transportation event information are not available in this alternative.

^cTransportation event data are not available in this alternative.

^dSite description detail is not available in this alternative.

TABLE 5.3
 PARTIAL ISIS ALTERNATIVE
 DEVELOPMENT COST ESTIMATES

<u>Alternative</u>	<u>Development Period (Months)</u>	<u>Development Effort (Man-Months)</u>	<u>Development Cost \$(000)</u>
ISIS ALT 1	24	240	1,370
ISIS ALT 2	24	290	1,660
ISIS ALT 3	30	390	2,280
ISIS ALT 4	30	480	2,770
ISIS ALT 5	36	590	3,480
ISIS ALT 6	36	630	3,730
SGCG	30	370	2,150

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NOTE: All costs measured in 1978 dollars

TABLE 5.4
ISIS ALTERNATIVE DATA VOLUME ESTIMATES

<u>Alternative</u>	<u>Number of Constructs</u>	<u>Design Volume of Data Base (M-bytes)</u>	<u>% of Total Volume</u>	<u>Initial Load Volume (M-bytes)</u>	<u>Annual Data Load (M-bytes)</u>
ISIS ALT 1	49	1,382.4	73%	1,020.2	269.1
ISIS ALT 2	72	1,498.6	79%	1,055.5	280.7
ISIS ALT 3	72	1,498.6	79%	1,055.5	280.7
ISIS ALT 4	110	1,551.3	82%	1,066.3	285.9
ISIS ALT 5	146	1,887.2	~100%	1,087.9	304.3
ISIS ALT 6	158	1,889.0	100%	1,088.3	304.4
SGCG	98	1,514.7	80%	1,040.2	283.0

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TABLE 5.5
 CATEGORIES OF DATA PREPARATION¹
 ISIS ALTERNATIVE 6

<u>Category</u>	<u>Number of Constructs</u>	<u>% of Total Constructs</u>	<u>Design Volume</u>	<u>% of Total Volume</u>	<u>Initial Load</u>	<u>Final Volume</u>
Clerical	59	37%	49.1	3%	37.0	37.0
Manual	10	6%	7.4	0.4%	1.3	0.5
Analytical	61	39%	382.1	20%	27.7	22.7
Automated	28	18%	1,450.4	77%	1,022.3	276.5
TOTAL	158		1,889		1,088	304

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¹All volumes in terms of Meg-bytes of data

TABLE 5.6
 CATEGORIES OF DATA PREPARATION¹
 SGCG-RECOMMENDED ALTERNATIVE

<u>Category</u>	<u>Number of Constructs</u>	<u>% of Total² Constructs</u>	<u>Design Volume</u>	<u>% of Total² Volume</u>	<u>Initial Load</u>	<u>Repetitive Load</u>
Clerical	36	23%	16.0	1%	10.8	1.6
Manual	1	< 1%	0.3	< 1%	< 0.1	< 0.1
Analytical	35	22%	49.2	3%	7.3	4.9
Automated	26	16%	1,449.2	77%	1,022.0	276.4
TOTAL	98	62%	1,515	80%	1,040	283

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¹All volumes in terms of meg-bytes of data

²As compared to the full ISIS (ALT 6)

TABLE 5.7
 NRC PERSONNEL DATA PREPARATION
 COST ESTIMATES

<u>Alternative</u>	NRC Personnel For Initial Load		NRC Personnel For Annual Load (1985)	
	<u>Man-Months</u>	<u>Dollars \$(000)</u>	<u>Man-Months</u>	<u>Dollars \$(000)</u>
ISIS ALT 1	2	6	<1	1
ISIS ALT 2	8	23	3	13
ISIS ALT 3	8	23	3	13
ISIS ALT 4	39	110	24	106
ISIS ALT 5	135	400	110	490
ISIS ALT 6	135	400	110	490
ISIS SGCG	35	110	24	105

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NOTE: All costs measured in 1978 dollars.

TABLE 5.8
 HARDWARE CONFIGURATION FOR PARTIAL
 ISIS ALTERNATIVES

<u>Hardware</u> ¹	Partial ISIS Alternatives						<u>SGCG</u>
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	
CPU	148	158	158	158	158MP(1)	158MP(2)	158
CORE (MEG-BYTES)	2	2	4	4	4	4	4
TAPE DRIVES	6	6	7	7	8	8	7
DISK 3330-1	7	7	8	8	10	10	8
DISK 3330-2	3	3	4	4	4	4	4
CONTROLLERS	5	5	5	5	6	6	5
READER/PUNCH	1	1	1	1	2	2	1
PRINTER	1	1	1	1	2	2	1
STD. TERMINALS	8	8	8	8	8	8	8
INTELLIGENT TERMINALS	0	0	2	2	5	5	2
MODEMS	16	16	20	20	26	26	20
COMM. CONTROLLER	1	1	1	1	1	1	1
SECURITY EQUIPMENT	0	0	4	4	10	10	4

¹Although hardware requirements are given in terms of IBM equipment lines, requirements should be interpreted as equivalent capability from any vendor.

TABLE 5.9
EQUIPMENT¹ AND OPERATIONS COSTS

Alternative	Equipment \$(000) 1985 ¹	Operations \$(000) 1985 ²	Equipment \$(000) 5 Year Total ³	Operations \$(000) 5 Year Total
ISIS ALT 1	538	721	3,195	1,959
ISIS ALT 2	684	865	4,150	2,176
ISIS ALT 3	814	1,025	4,967	2,801
ISIS ALT 4	814	1,164	4,967	3,186
ISIS ALT 5	1,132	1,320	6,970	3,617
ISIS ALT 6	1,387	1,320	8,576	3,617
SGCG	1,028	1,053	4,967	2,801

¹Includes equipment and facility costs

²1985 taken as mid-1980 example operational year

³Cumulative total for first five years (1979-1983)

NOTE: All costs measured in 1978 dollars

TABLE 5.10
ESTIMATED ANNUAL COSTS
ALTERNATIVE 1

(All Dollar Amounts in Thousands)

<u>Fiscal Year</u>	<u>Total Labor Costs¹</u>	<u>Total Computer Costs²</u>	<u>Total Costs³</u>
1979	730	1,140	1,870
1980	990	1,750	2,740
1981	570	1,260	1,830
1982	580	690	1,270
1983	630	630	1,260
5 Year Cum.	3,500	5,470	8,970
1984	670	580	1,250
1985	720	540	1,260
1986	780	490	1,270
1987	830	450	1,280
1988	900	420	1,320
10 Year Cum.	7,400	7,950	15,350

¹Aggregate of development, operations, data preparation, and existing systems labor cost estimates.

²Aggregate of alternative equipment and existing systems costs.

³Total labor and total computer costs.

Note: All costs measured in 1978 dollars.

TABLE 5.11
ESTIMATED ANNUAL COSTS
ALTERNATIVE 2
(All Dollar Amounts in Thousands)

<u>Fiscal Year</u>	<u>Total Labor Costs¹</u>	<u>Total Computer Costs²</u>	<u>Total Costs³</u>
1979	870	1,220	2,090
1980	1,200	2,010	3,210
1981	510	1,490	2,000
1982	710	890	1,600
1983	760	820	1,580
5 Year Cum.	4,050	6,430	10,480
1984	820	750	1,570
1985	880	680	1,560
1986	940	630	1,570
1987	1,020	580	1,600
1988	1,090	530	1,620
10 Year Cum.	8,800	9,600	18,400

¹Aggregate of development, operations, data preparation, and existing systems labor cost estimates.

²Aggregate of alternative equipment and existing systems costs.

³Total labor and total computer costs.

Note: All costs measured in 1978 dollars.

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TABLE 5.12
ESTIMATED ANNUAL COSTS
ALTERNATIVE 3
(All Dollar Amounts in Thousands)

<u>Fiscal Year</u>	<u>Total Labor Costs¹</u>	<u>Total Computer Costs²</u>	<u>Total Costs³</u>
1979	930	1,270	2,200
1980	1,320	2,230	3,550
1981	1,310	1,690	3,000
1982	840	1,070	1,910
1983	900	980	1,880
5 Year Cum.	5,300	7,240	12,540
1984	970	890	1,860
1985	1,040	810	1,850
1986	1,120	750	1,870
1987	1,200	680	1,880
1988	1,290	630	1,920
10 Year Cum.	10,920	11,000	21,920

¹Aggregate of development, operations, data preparation, and existing systems labor cost estimates.

²Aggregate of alternative equipment and existing systems costs.

³Total labor and total computer costs.

Note: All costs measured in 1978 dollars.

TABLE 5.13
ESTIMATED ANNUAL COSTS
ALTERNATIVE 4
(All Dollar Amounts in Thousands)

<u>Fiscal Year</u>	<u>Total Labor Costs¹</u>	<u>Total Computer Costs²</u>	<u>Total Costs³</u>
1979	1,150	1,270	2,420
1980	1,600	2,230	3,830
1981	1,570	1,690	3,260
1982	1,020	1,070	2,090
1983	1,100	980	2,080
5 Year Cum.	6,440	7,240	13,680
1984	1,180	890	2,070
1985	1,270	810	2,080
1986	1,370	750	2,120
1987	1,470	680	2,150
1988	1,580	630	2,210
10 Year Cum.	13,310	11,000	24,310

¹Aggregate of development, operations, data preparation, and existing systems labor cost estimates.

²Aggregate of alternative equipment and existing systems costs.

³Total labor and total computer costs.

Note: All costs measured in 1978 dollars.

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TABLE 5.14
ESTIMATED ANNUAL COSTS
ALTERNATIVE 5
(All Dollar Amounts in Thousands)

Fiscal Year	Total Labor ¹ Costs	Total Computer ² Costs	Total ³ Costs
1979	1,260	1,420	2,680
1980	1,780	2,770	4,550
1981	2,410	2,180	4,590
1982	1,440	1,510	2,950
1983	1,560	1,370	2,930
5 Year Cum.	8,450	9,250	17,700
1984	1,680	1,240	2,920
1985	1,810	1,130	2,940
1986	1,950	1,030	2,980
1987	2,100	940	3,040
1988	2,260	860	3,120
10 Year Cum.	18,250	14,450	32,700

¹Aggregate of development, operations, data preparation, and existing systems labor cost estimates.

²Aggregate of alternative equipment and existing systems costs.

³Total labor and total computer costs.

Note: All costs measured in 1978 dollars.

TABLE 5.15
ESTIMATED ANNUAL COSTS
ALTERNATIVE 6
(All Dollar Amounts in Thousands)

<u>Fiscal Year</u>	<u>Total Labor Costs¹</u>	<u>Total Computer Costs²</u>	<u>Total Costs³</u>
1979	1,340	1,540	2,880
1980	1,860	3,200	5,060
1981	2,500	2,570	5,070
1982	1,440	1,860	3,300
1983	1,560	1,680	3,240
5 Year Cum.	8,700	10,850	19,550
1984	1,680	1,530	3,210
1985	1,810	1,390	3,200
1986	1,950	1,260	3,210
1987	2,100	1,150	3,250
1988	2,260	1,040	3,300
10 Year Cum.	18,500	17,220	35,720

¹Aggregate of development, operations, data preparation, and existing systems labor cost estimates.

²Aggregate of alternative equipment and existing systems costs.

³Total labor and total computer costs.

Note: All costs measured in 1978 dollars.

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TABLE 5.16
ESTIMATED ANNUAL COSTS
SGCG RECOMMENDED ALTERNATIVE
(All Dollar Amounts in Thousands)

Fiscal Year	Total Labor Costs ¹	Total Computer Costs ²	Total ³ Costs
1979	910	1,270	2,180
1980	1,300	2,230	3,530
1981	1,330	1,690	3,020
1982	910	1,070	1,980
1983	980	980	1,960
5 Year Cum.	5,430	7,240	12,670
1984	1,050	890	1,940
1985	1,130	810	1,940
1986	1,220	750	1,970
1987	1,310	680	1,990
1988	1,410	630	2,040
10 Year Cum.	11,550	11,000	22,550

¹Aggregate of development, operations, data preparation, and existing systems labor cost estimates.

²Aggregate of alternative equipment and existing systems costs.

³Total labor and total computer costs.

Note: All costs measured in 1978 dollars.

TABLE 5.17
PARTIAL ISIS TOTAL COSTS ESTIMATES SUMMARY

	Annual Total Costs for 1985 \$(000)	5 Year Cum. Total Costs 1979-83 \$(000)	10 Year Cum. Total Costs 1979-88 \$(000)
ISIS ALT 1	1,260	8,970	15,350
ISIS ALT 2	1,560	10,480	18,400
ISIS ALT 3	1,850	12,540	21,920
ISIS ALT 4	2,080	13,680	24,310
ISIS ALT 5	2,940	17,700	32,700
ISIS ALT 6	3,200	19,550	35,720
SGCG	1,940	12,670	22,550

Note: All costs measured in 1978 dollars.

6.0 COMPARISON AND CONCLUSIONS

Costs have been presented for each of the alternatives considered in the cost/benefit analysis. Benefits associated with each alternative were discussed in terms of standard reports, percent ad hoc capability available, and other less quantifiable benefits such as data reliability and integrated systems.

In section 6.1, two comparisons are made. The first compares the estimated costs of each integrated system alternative with the estimated costs incurred if the data in support of equivalent capability were not integrated. The second compares the "total cost" of each alternative and the estimated cost of not having an integrated data base (the NO-ISIS cost). If the capability addressed in each alternative were comparable, the cost comparison would be sufficient. In lieu of comparing equivalent capability, the benefits derived from each alternative are necessary in drawing valid conclusions.

Section 6.2 presents the conclusions reached as a result of the comparisons.

6.1 COMPARISON OF ALTERNATIVES

The first comparison is that of the estimated cost of each ISIS alternative vs. its equivalent NO-ISIS cost. For each integrated system alternative, four cost elements were identified:

- o NRC Personnel
- o Equipment and Operations
- o Development
- o Existing System Phase-Out

For the NO-ISIS automated alternative, existing system phase out costs do not apply. The NO-ISIS manual alternative addresses NRC personnel, equipment and operations costs.

The second comparison addresses "total cost." The "total cost" of an integrated system alternative is the estimated cost for the alternative plus the additional NO-ISIS cost of satisfying the remainder of the information requirements. By estimating "total cost" for each alternative, as nearly equivalent capabilities as possible are compared. Thus, the cost of the integrated system alternatives may be compared one with another, as well as with the estimated cost of not having any of the data integrated (NO-ISIS).

Section 6.1.1 presents a summary of the labor and operating costs for each of the alternatives. Sections 6.1.2 and 6.2.3 compare the estimated costs for ISIS versus NO-ISIS alternatives.

6.1.1 Labor and Operating Cost Summary

Labor includes both NRC and contractor personnel. NRC effort is of two types. One is the collection and analysis of data prior to entering it into the automated system. The second is the manual data collection, analysis, manipulation, and maintenance required for that data not automated. Hardware and software support staffs necessary to operate the system are assumed to be contractor.

Table 6.1 presents 5- and 10-year summary totals for both NRC and contractor labor. Note that the total NO-ISIS automated NRC labor estimate is larger than the total ISIS (Alternative 6). This is due to duplicate effort for similar data maintained in more than one data base.

Table 6.2 presents a 5-year equipment and operations cost summary for each of the alternatives. Note that this includes costs associated with operating existing systems.

6.1.2 ISIS VS. "Equivalent" NO-ISIS

Figures 6.1-6.7 compare 5-year system costs for each ISIS alternative and its equivalent NO-ISIS cost. The 5-year cost to NRC of integrating the capability defined for the given alternative is compared with the estimated 5-year cost of providing nearly equivalent capability without an integrated system.

In Figure 6.1, the capability represented is in support of the material accounting function. This means that in the NO-ISIS situations, the equipment and operations costs are those projected for the current material accounting systems. The additional costs in the NO-ISIS automated alternative are due to upgrades that would be required to NMMSS to make the resultant capability more equivalent to that of the integrated system alternative. In the NO-ISIS manual alternative, this additional capability was assumed to be provided manually. Note that whether or not an integrated system is built, the equipment and operating costs would be about the same. That is, after the period of development, the annual operating costs would include neither development costs, nor the cost of operating existing systems that would be phased out after development of the integrated system.

Figures 6.2-6.7 are presented in the same manner. Note that the NO-ISIS manual costs increase quickly. This is because less of the capability addressed is currently automated, and must be provided solely by manual effort. The equipment and operations cost for the NO-ISIS manual alternative remains constant. The manual effort cost estimates represent the cost to NRC of satisfying its safeguards information requirements if no new automated information capability is developed.

Tables 6.3 and 6.4 compare the benefits realized by the ISIS and NO-ISIS alternatives.

6.1.3 ISIS VS. Total NO-ISIS

Figures 6.8-6.9 provide a somewhat different way of viewing the estimated cost of an alternative. Previously, the cost of providing a small portion of the total required capability was considered. Here, "total cost" is being addressed, consistent with the underlying assumption that all requirements must somehow be satisfied. Although capability is made as equal as possible in all alternatives, the benefits as discussed in Tables 6.3 and 6.4 are important in measuring the total capability received.

6.2 CONCLUSIONS

The results of this cost/benefit analysis indicate the following:

- o If NRC does not implement any new automated safeguards information capability, the cost to satisfy its safeguards information requirements in the mid-1980's may be two to three times more than the cost of implementing an integrated safeguards information system now. The cost for additional NRC personnel constitutes the primary reason for the increased cost.
- o Significant benefits to NRC management are achievable only through system integration and integrated control of safeguards information. New automated but not integrated safeguards information capability will not realize these benefits.
- o Annual operating costs in the mid-1980's for ISIS are less than the operating costs for non-integrated alternatives considered. The five year cumulative costs for ISIS are higher than comparable costs for the automated but non-integrated approach primarily because of the costs of operating existing systems during the ISIS development period.
- o Cost savings identified for the automated but non-integrated alternative should be interpreted as maximum savings possible. Actual costs incurred in implementing this non-integrated alternative may exceed the conservative costs estimated for the purpose of this analysis.
- o The full ISIS can be easily implemented in phases. Incremental capabilities can be developed and operated without jeopardizing the flexibility to fully expand the system later. Phasing ISIS enhances the flexibility of the integrated system to adjust to evolving safeguards information needs.
- o A pilot program representing a minimum cost commitment to NRC can be implemented and operated to demonstrate the benefits to NRC of an integrated information system. NRC can initially select those portions which address the most immediate and well defined safeguards information problems facing NRC today.

The ISIS alternative recommended by the SGCG in their report to the Executive Director of Operations provides the benefits of integrated safeguards information. The SGCG recommendation addresses the most pressing NRC needs. The recommended alternative provides NRC management significant benefits by integrating and controlling safeguards data. The SGCG recommendation requires a minimum cost commitment by NRC. The results of this cost/benefit analysis fully support the SGCG recommendation to begin the initial implementation of an integrated safeguards information system (ISIS).

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TABLE 6.1
ESTIMATED LABOR COSTS
\$(000)

Alternative	5 Yr. NRC Labor Costs ¹	5 Yr. Contractor Labor Costs ²	10 Yr. NRC Labor Costs ¹	10 Yr. Contractor Labor Costs ²
ISIS ALT 1	165	3,329	170	7,225
ISIS ALT 2	209	3,834	279	8,508
ISIS ALT 3	209	5,077	279	10,614
ISIS ALT 4	480	5,958	1,060	12,246
ISIS ALT 5	1,347	7,093	4,004	14,224
ISIS ALT 6	1,350	7,349	4,013	14,480
SGCG	470	4,955	1,045	10,492
NO-ISIS Automated	1,495	6,101	4,588	10,255
NO-ISIS Manual	49,550	0	123,948	0

¹Data preparation costs (excludes existing system labor).

²Development and operational labor costs.

Note: All costs measured in 1978 dollars.

TABLE 6.2
 FIVE YEAR EQUIPMENT AND OPERATIONS SUMMARY
 \$(000)

<u>Alternative</u>	<u>Existing Equipment Costs¹</u>	<u>New Equipment Costs</u>	<u>Operations Costs²</u>	<u>Total 5 Year Equipment And Operations Costs</u>
ISIS ALT 1	2,273	3,195	1,959	7,427
ISIS ALT 2	2,273	4,150	2,176	8,599
ISIS ALT 3	2,273	4,967	2,801	10,041
ISIS ALT 4	2,273	4,967	3,186	10,426
ISIS ALT 5	2,273	6,970	3,617	12,860
ISIS ALT 6	2,273	8,576	3,617	14,466
SGCG	2,273	4,967	2,801	10,041
NO-ISIS Automated	5,062	-	4,847	9,909
NO-ISIS Manual	5,062	-	-	5,062

¹Existing systems defined as NMMSS, SSRS, IPELTS, and planned upgrades to same.

²Includes current "existing system" labor.

Note: All cost measured in 1978 dollars.

TABLE 6.3
BENEFITS OF ISIS AND NO-ISIS ALTERNATIVES

<u>Alternative</u>	<u>% of Total Standard Reports</u>	<u>% of Data Base</u>	<u>% of Ad Hoc Capability²</u>
ISIS ALT 1	33%	73%	0% ³
ISIS ALT 2	49%	79%	0% ³
ISIS ALT 3	49%	79%	42%
ISIS ALT 4	64%	82%	62%
ISIS ALT 5	88%	100%	91%
ISIS ALT 6	100%	100%	100%
SGCG ¹	60%	80%	0% ³
NO-ISIS Automated	100% ⁴	-	0% ³
NO-ISIS Manual	86% ⁴	-	Minimal

¹Safeguards coordinating group recommended alternative.

²Estimated based on number of relationships supported by data base.

³Cost of ad hoc capability not included in estimates.

⁴Percentage indicates that some information on each report is available.

TABLE 6.4
COMPARISON OF BENEFITS
OF ISIS VS. NO-ISIS

	<u>ISIS</u>	<u>NO-ISIS AUTOMATED</u>	<u>NO-ISIS MANUAL</u>
1. INTEGRATION & CONTROL			
A. Integration of Data	Yes	No	No
B. NRC Control of Data	Yes	No	No
C. Office/Individual Control	No	Yes	Yes
D. Office Ownership of Data	Yes	Yes	Yes
2. CAPABILITY			
A. Computer Facility Required	Yes	No	No
B. Ad Hoc Reporting	Full	Partial	Minimal
C. Interactive Capability	Yes	Yes	No
D. Overnight Turn-Around	Yes	Partial	Minimal
E. All Information Requirements Satisfied	Yes	No	No
3. RESPONSIVENESS			
A. Timely Data	Yes	Yes	No
B. User-Oriented System	Yes	Yes	No
C. Data Access Via System	Yes	Yes	No
D. Selective Data Requests	Yes	Yes	No
4. RELIABILITY			
A. All Offices Use Same Data	Yes	No	No
B. Reduces Data Conflicts	Yes	Partial	No
C. Reduces Data Redundancy	Yes	No	No
5. EFFICIENCY			
A. Reduced Input Data Load	Yes	No	No
B. Reduced Data Security Program	Yes	No	No
C. Learn Only One System	Yes	No	No
D. Efficient Use of NRC Personnel	Yes	No	No
6. INSIGHT			
A. Completeness of Data	Yes	No	No
B. Data Availability and Location	Yes	No	No
C. Correlate Safeguards Information	Yes	Partial	No
D. Understanding of Safeguards Data Problems	Yes	Partial	No
E. Identifies Potential Safeguards Problems	Yes	Partial	No

TABLE 6.4 (continued)

	<u>ISIS</u>	<u>NO-ISIS AUTOMATED</u>	<u>NO-ISIS MANUAL</u>
7. USABILITY			
A. Greater Familiarity With Safeguards Data Availability	Yes	No	No
B. Establish Common Terminology	Yes	No	No
C. Data in Computer Compatible Format	Yes	Yes	No
8. CREDIBILITY			
A. Increased Public Awareness	Yes	No	No

15217

NOTE: Cost estimates represent capabilities as nearly equal as possible. For a detailed comparison of benefits, see Table 6.4.

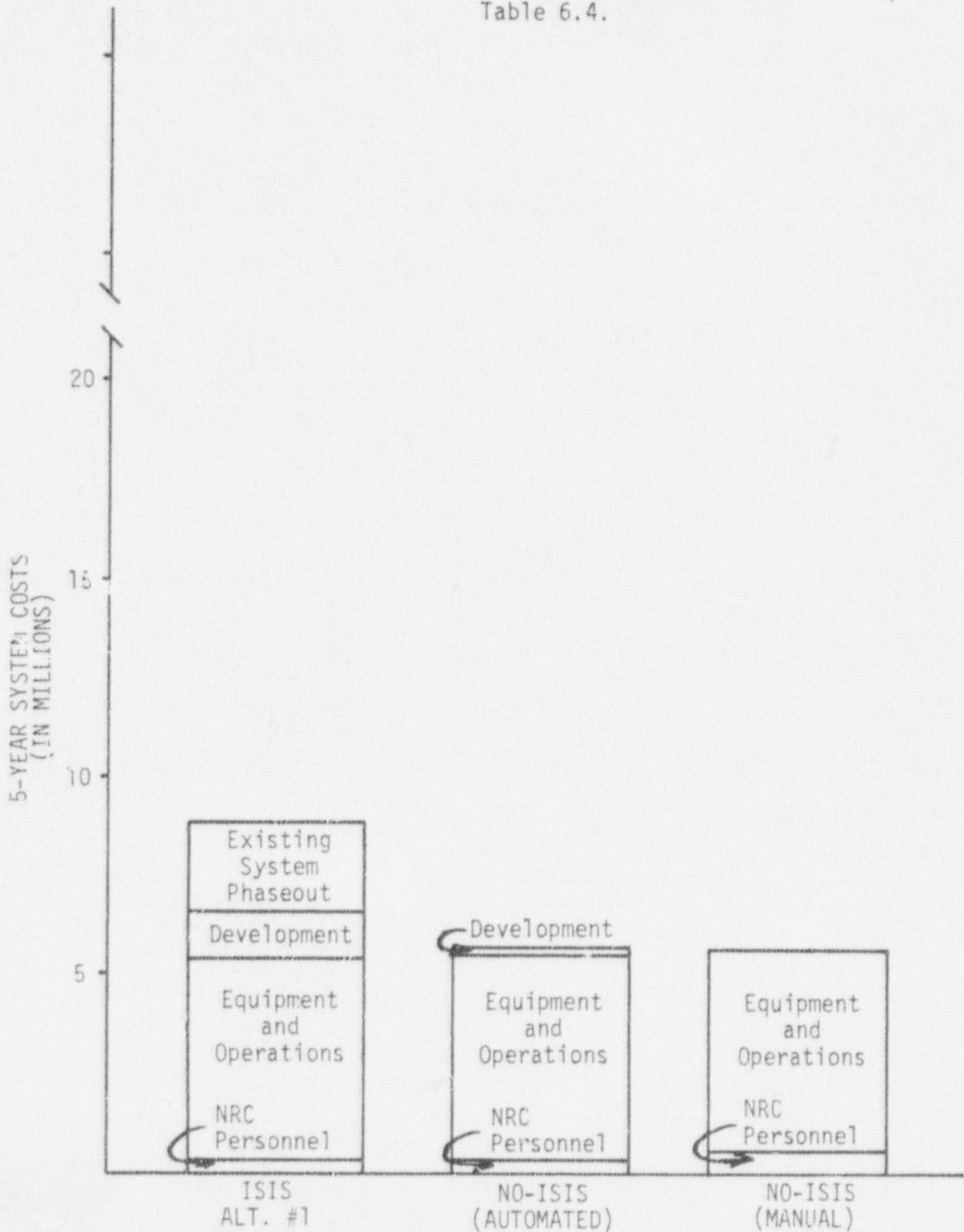


FIGURE 6.1
COMPARISON OF FIVE-YEAR CUMULATIVE COSTS FOR
ISIS ALTERNATIVE 1 VS CORRESPONDING NO-ISIS

NOTE: Cost estimates represent capabilities as nearly equal as possible. For a detailed comparison of benefits, see Table 6.4.



FIGURE 6.2

COMPARISON OF FIVE-YEAR CUMULATIVE COSTS FOR
ISIS ALTERNATIVE 2 VS CORRESPONDING NO-ISIS

15219

NOTE: Cost estimates represent capabilities as nearly equal as possible. For a detailed comparison of benefits, see Table 6.4.

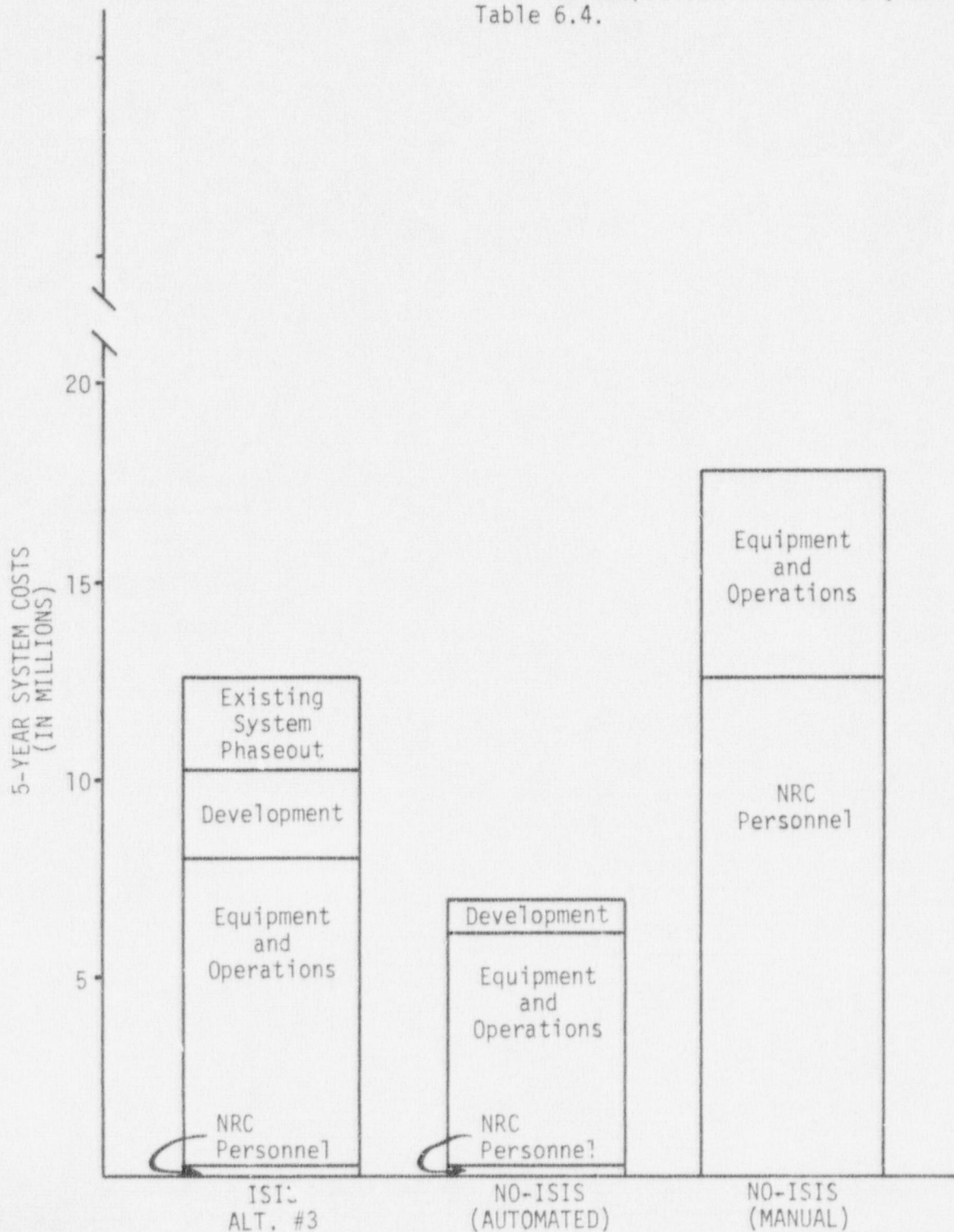


FIGURE 6.3
COMPARISON OF FIVE-YEAR CUMULATIVE COSTS FOR
ISIS ALTERNATIVE 3 VS CORRESPONDING NO-ISIS

NOTE: Cost estimates represent capabilities as nearly equal as possible. For a detailed comparison of benefits, see Table 6.4.



FIGURE 6.4
COMPARISON OF FIVE-YEAR CUMULATIVE COSTS FOR ISIS ALTERNATIVE 4 VS CORRESPONDING NO-ISIS 15221

NOTE: Cost estimates represent capabilities as nearly equal as possible. For a detailed comparison of benefits, see Table 6.4.

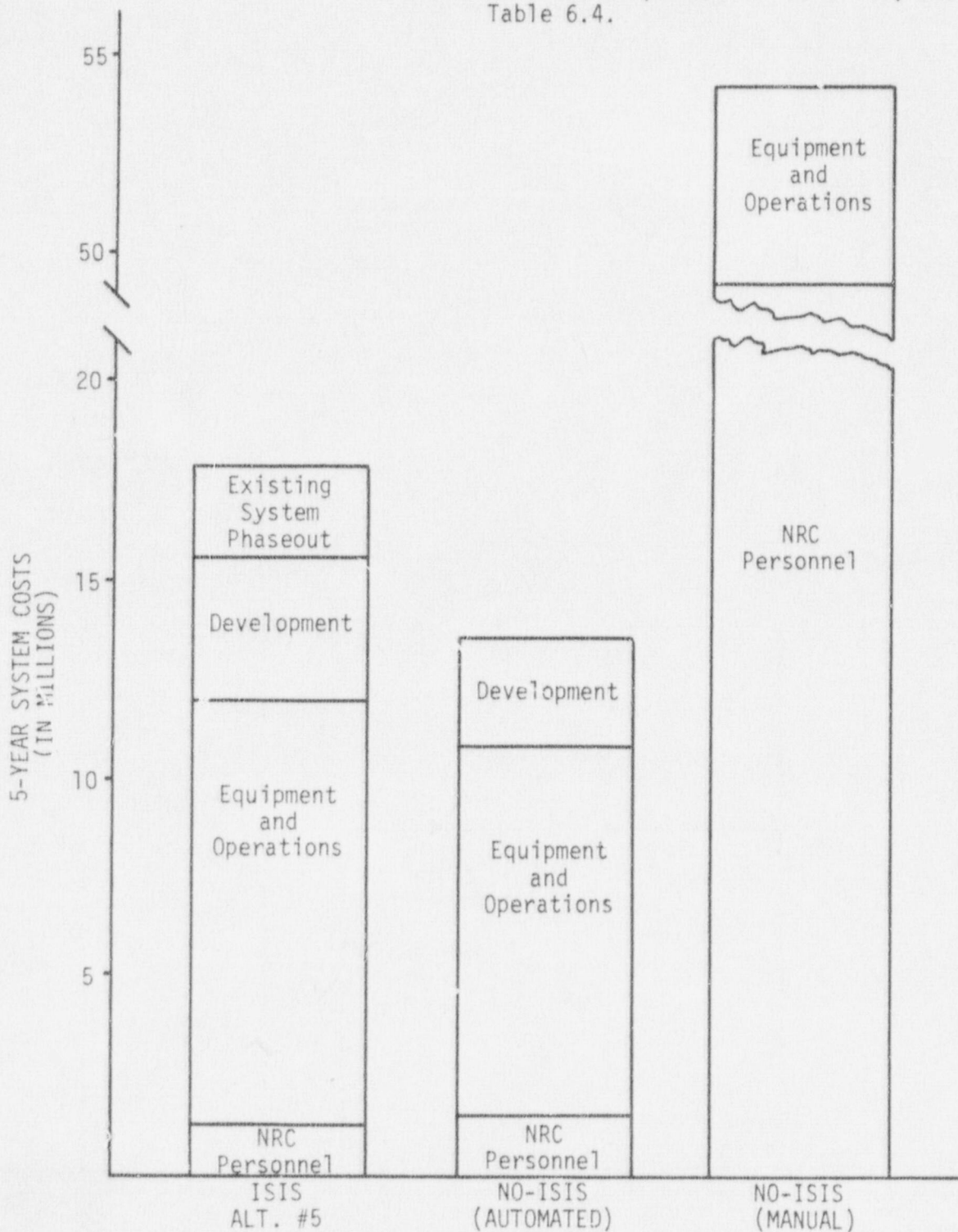


FIGURE 6.5
COMPARISON OF FIVE-YEAR CUMULATIVE COSTS FOR
ISIS ALTERNATIVE 5 VS CORRESPONDING NO-ISIS

NOTE: Cost estimates represent capabilities as nearly equal as possible. For a detailed comparison of benefits, see Table 6.4.

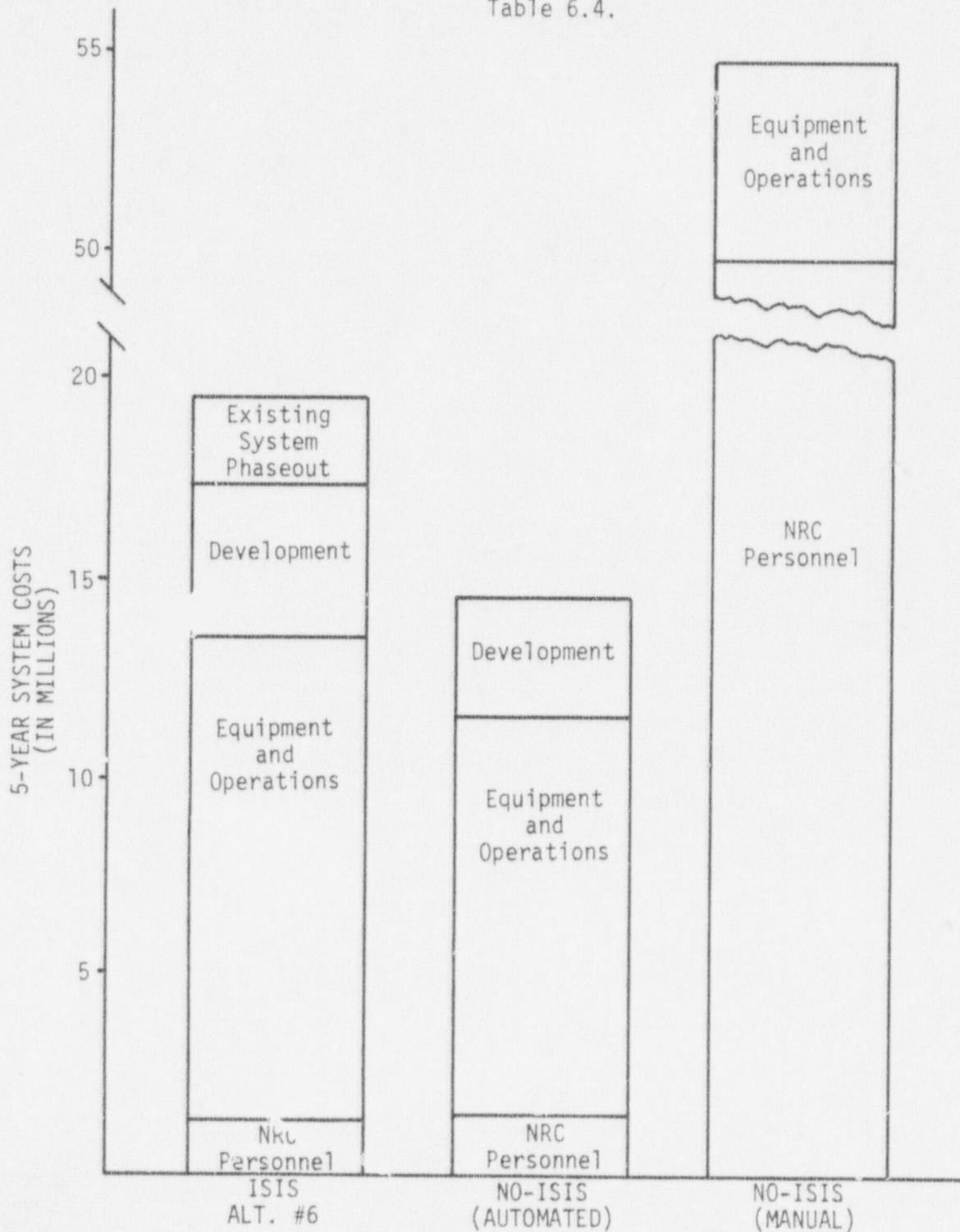


FIGURE 6.6
COMPARISON OF FIVE-YEAR CUMULATIVE COSTS FOR
ISIS ALTERNATIVE 6 VS CORRESPONDING NO-ISIS

15223

NOTE: Cost estimates represent capabilities as nearly equal as possible. For a detailed comparison of benefits, see Table 6.4.

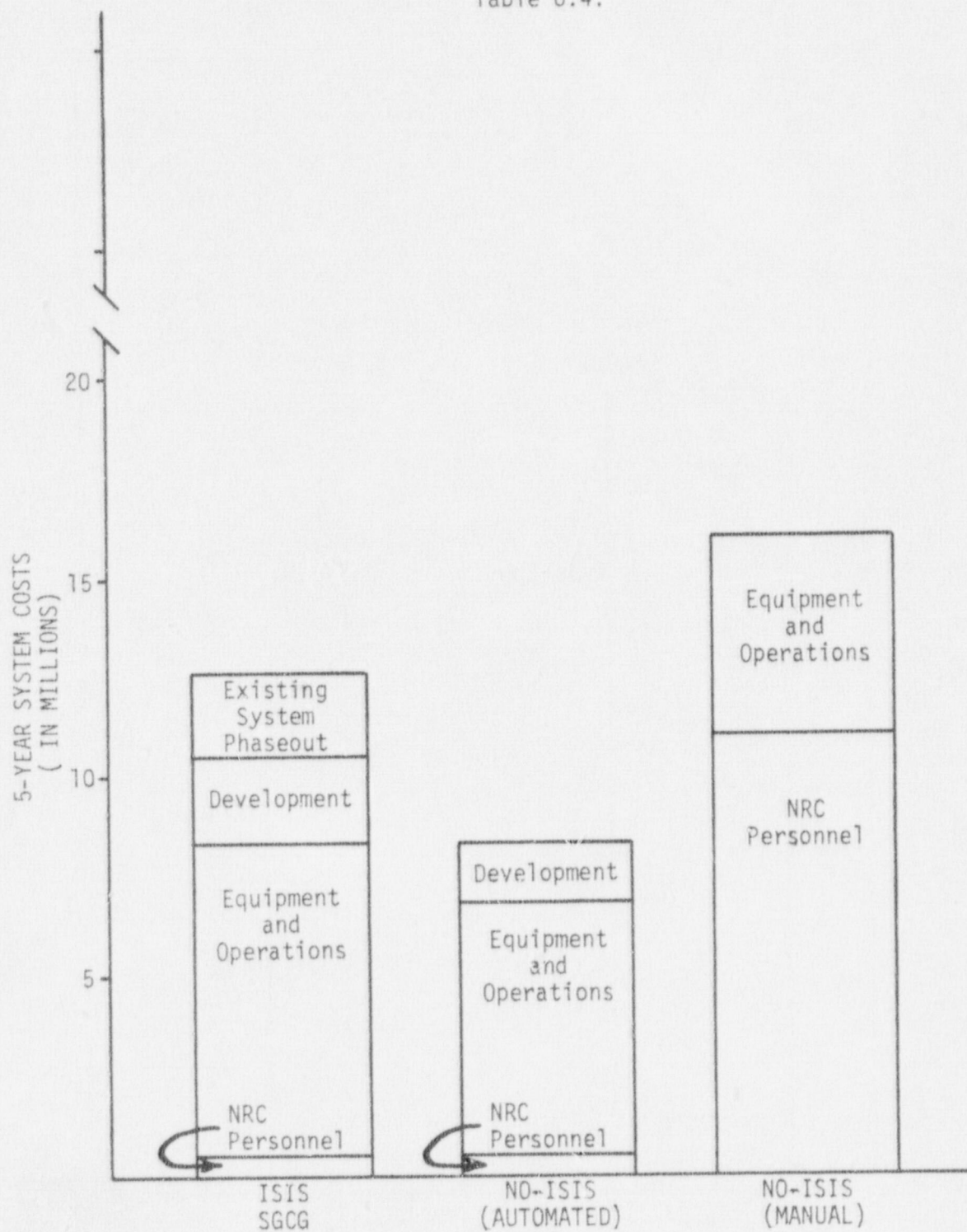


FIGURE 6.7
COMPARISON OF FIVE-YEAR CUMULATIVE COSTS FOR
SGCG-RECOMMENDED ALTERNATIVE VS CORRESPONDING NO-ISIS

15224

NOTE: Cost estimates represent capabilities as nearly equal as possible. For a detailed comparison of benefits, see Table 6.4.

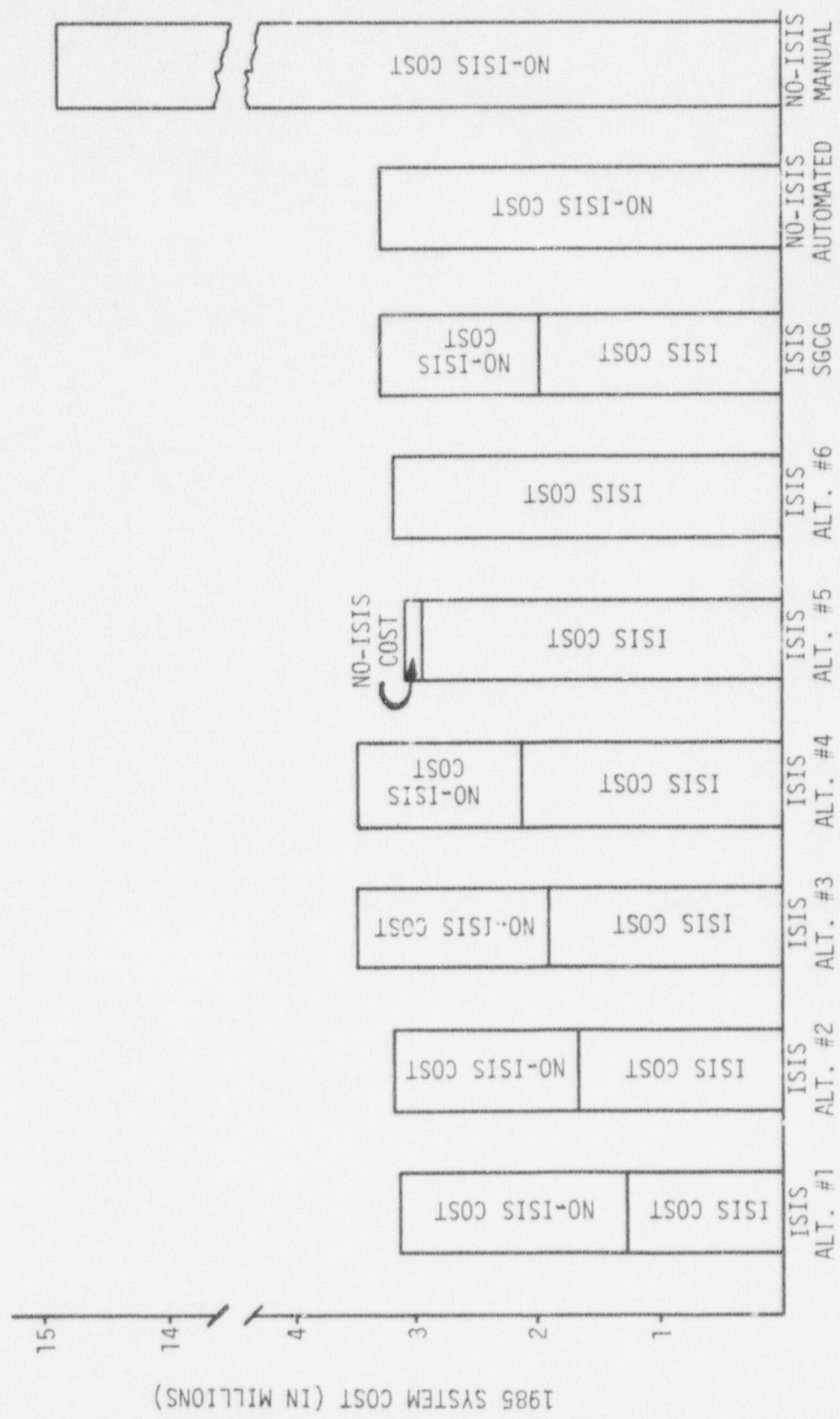


FIGURE 6.8
COMPARISON OF ANNUAL (1985) "TOTAL COSTS" FOR ALTERNATIVES

15225

NOTE: Cost estimates represent capabilities as nearly equal as possible. For a detailed comparison of benefits, see Table 6.4.

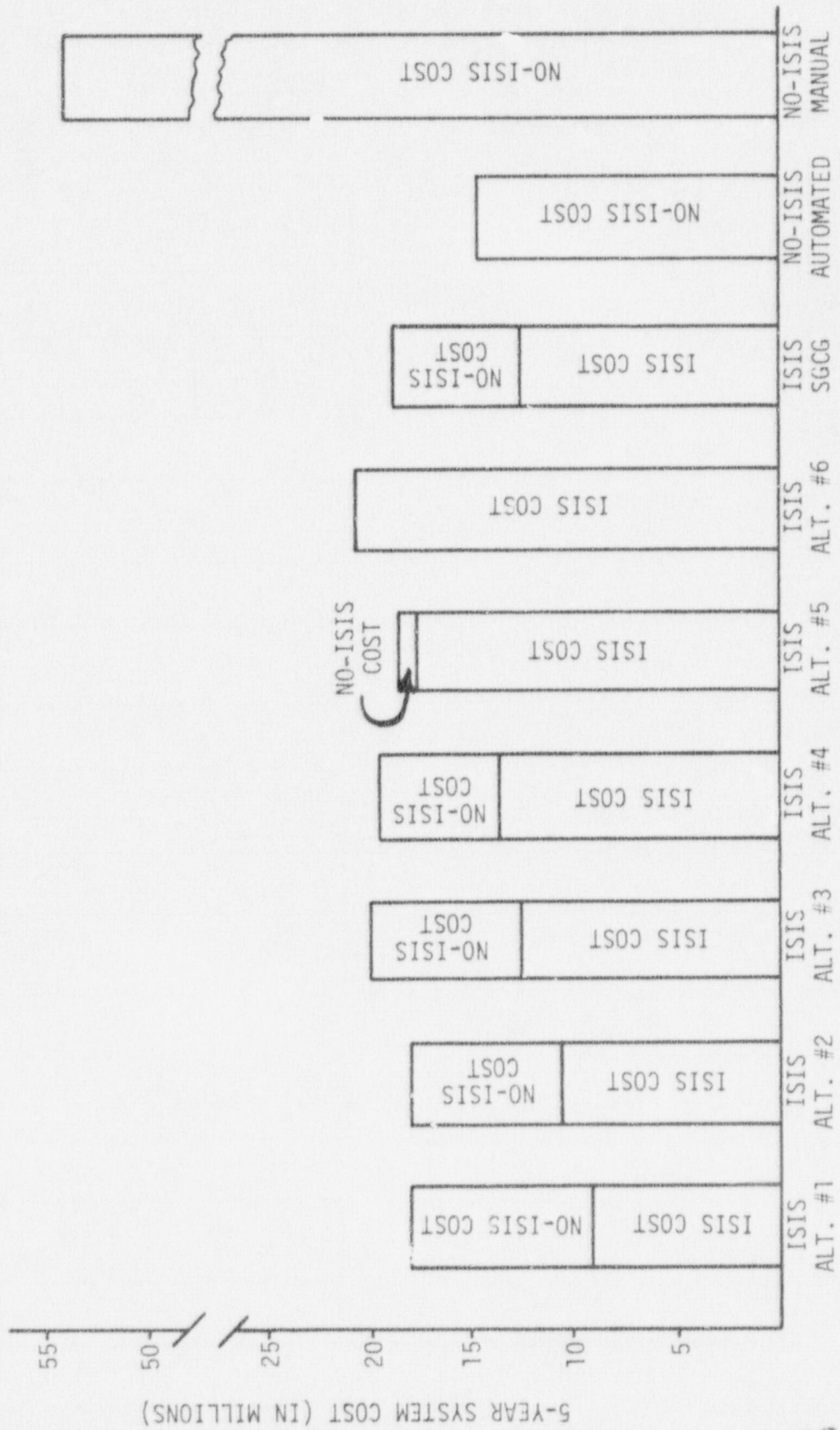


FIGURE 6.9
COMPARISON OF FIVE-YEAR CUMULATIVE "TOTAL COSTS" FOR ALTERNATIVES

15226

NRC FORM 335 (7-77)		U.S. NUCLEAR REGULATORY COMMISSION BIBLIOGRAPHIC DATA SHEET		1. REPORT NUMBER (Assigned by DDC) NUREG/CR-0333	
4. TITLE AND SUBTITLE (Add Volume No., if appropriate) Cost/Benefit Analysis of the Integrated Safeguards Information System (ISIS) Alternatives				2. (Leave blank)	
7. AUTHOR(S)				3. RECIPIENT'S ACCESSION NO.	
9. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) Boeing Computer Services, Co. 7700 Leesburg Pike Suite 201 Falls Church, VA 22043				5. DATE REPORT COMPLETED MONTH YEAR August 1978	
12. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) Division of Safeguards, Fuel Cycle and Environmental Research Office of Nuclear Regulatory Research, USNRC Washington, D.C. 20555				6. (Leave blank)	
13. TYPE OF REPORT Final Report - Technical				7. DATE REPORT ISSUED MONTH YEAR August 1978	
15. SUPPLEMENTARY NOTES				8. (Leave blank)	
16. ABSTRACT (200 words or less) <p>The Offices of Nuclear Regulatory Research and Nuclear Materials Safety and Safeguards initiated a research effort to develop a general design for a comprehensive Integrated Safeguards Information System (ISIS) in March 1977. At the completion of that project in May 1978, the Executive Director of Operations instructed the NRC staff to review the results of the research study and to formulate recommendations as to how NRC should satisfy its safeguards information requirements. To assist the Safeguards Coordinating Group (SGCG) in formulating its recommendations for implementing a safeguards information system, NRC contracted with Boeing Computer Services Company to perform a cost/benefit analysis on seven ISIS alternatives. The results of that cost/benefit analysis are presented here. Five and ten year cost estimates have been developed for the seven alternatives. Costs have been compared with cost estimates for satisfying NRC's safeguards information requirements without an integrated system. Benefits are discussed for each alternative. The results of the analysis indicate that ISIS will provide, at reasonable cost, significant benefits achievable only through an integrated system approach.</p>				10. PROJECT/TASK/WORK UNIT NO. B5714	
17. KEY WORDS AND DOCUMENT ANALYSIS				11. CONTRACT NO. NRC-04-77-065	
17b. IDENTIFIERS/OPEN-ENDED TERMS				13. PERIOD COVERED (Inclusive dates) May 15, 1978-August 15, 1978	
19. AVAILABILITY STATEMENT Unlimited		17a. DESCRIPTORS		14. (Leave blank)	
19. SECURITY CLASS (This report) UNCLASSIFIED		21. NO. OF PAGES 102		20. SECURITY CLASS (This page) UNCLASSIFIED	
22. PRICE \$		15227			

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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