MASTER

ESTIMATED INCREMENTAL COSTS FOR NRC LICENSEES
TO IMPLEMENT THE US/IAEA SAFEGUARDS AGREEMENT

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ABSTRACT

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A study was recently completed for the U.S. Nuclear Regulatory Commission (NRC) by the Pacific Northwest Laboratory (PNL) to identify the incremental cost of implementing the US/IAEA safeguards treaty agreement to eligible NRC licensees. Sources for the study were cost estimates from several licensees who will be affected by the agreement and cost analyses by PNL staff.

The initial cost to all eligible licensees to implement the agreement is estimated by PNL to range from \$1.9 to \$7.2 million. The annual cost to these same licensees for the required accounting and reporting activities is estimated at \$0.5 to \$1.5 million. Annual inspection costs to the industry for the limited IAEA inspection being assumed is estimated at \$80,000 to \$160,000.

INTRODUCTION

At the request of the U.S. Nuclear Regulatory Commission (NRC), members of the Pacific Northwest Laboratory (PNL) staff performed a brief investigation regarding the cost impact of implementing the United States/International Atomic Energy Agency (IAEA) safeguards agreement. This agreement is in the form of a treaty currently awaiting Senate action. The objective of this analysis was to develop an estimate of the cost impact to eligible NRC licensees for complying with proposed regulations and to provide the estimate to NRC's Office of Nuclear Material Safety and Safeguards (NMSS). The scope of the study encompasses all of those nuclear activities in the U.S. that are included on the eligibility list of the agreement and that are licensed by NRC. The study considered only incremental costs in terms of complying with the proposed rule, i.e., those costs that are in addition to the licensee's costs for complying with current U.S. requirements. The incremental impact that revisions to Parts 40, 50, 70, 150 and 170 take, which stem from the proposed 10 CFR Part 75 and are necessary to remove conflicting regulations, were included in the cost estimates per se. The technical approach for achieving the objective was to:

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- Identify the affected licensee facilities and select candidate facilities for obtaining cost estimates.
- Develop the safeguards requirements for implementing the proposed rule that would be in addition to current NRC requirements, i.e., the incremental requirements.
- Identify the source of licensees' costs for each type of facility for the incremental requirements.
- Consolidate these costs for each type of facility into appropriate categories.

This brief study was performed between December 11, 1978 and January 19, 1979. During this period the PNL staff interacted closely with members of the NRC/NMSS staff in order to insure the timely completion of the study. Since this study was conducted over a very short period of time, it should not be considered an in-depth cost analysis for implementing the US/IAEA safeguards agreement. The authors attempted to identify the impact and to estimate costs within the short time that was available. We believe that we were able to bracket the cost impact to the affected U.S. nuclear industry and that additional study would only narrow the range of the various cost estimates.

The PNL staff thanks the licensees who participated in this study for their cooperation, helpfulness and prompt response in providing cost estimates. The authors assume responsibility for collecting the data, developing the various ranges, and projecting the industry-wide costs. This report ~~was~~ reviewed by the licensees who participated in the study, who ~~had~~ the opportunity to indicate any areas where the authors might have overlooked a cost impact.

SUMMARY AND CONCLUSIONS

The costs developed by PNL in this study result from reviewing and consolidating estimates provided by more than 20 NRC licensees representing ten facility types. Some estimates of expected costs for annual inspections by IAEA were developed by PNL staff based on their familiarity with IAEA inspection practices. In the case of reactors, the range of costs estimated for the licensee of a single facility was projected into an industry-wide cost range.

The incremental costs for implementing the IAEA safeguards agreement are separated into (1) implementation of the IAEA safeguards requirements, a one-time cost that all eligible NRC licensees can expect, (2) an annual accounting-reporting cost which again all eligible NRC licensees can expect in varying amounts, and (3) an annual inspection cost which only a few of the eligible NRC licensees can expect during any one year. Table 1

lists the cost estimates for each of the ten types of licensed facilities. The range of estimates summed in the three cost categories--implementation, accounting-reporting, and inspection--is expected to include the total costs of all eligible NRC licensees in complying with the US/IAEA safeguards program.

The total one-time implementation cost estimate ranges from \$1.9 to \$7.2 millions, annual accounting-reporting costs from about \$0.5 to \$1.4 millions, and annual inspection costs for those few licensees involved each year from \$0.08 to \$0.16 million per year. Figure 1 projects these results in bar graph form.

The rather wide ranges of cost estimates in these totals result from both variations within facility types and uncertainties of using relatively few samples to establish average costs from which to make extended projections.

Table 2 lists the costs by facility type. The number of facilities reporting in each of the ten types is shown in Column 2. Six licensees for commercial power reactors out of 42 licensees for the 68 reactors currently operating were contacted and responded. The range of their estimated costs is shown in the next three columns. The last three columns in this table tabulate the range of costs expected for the majority of these licensees as developed by PNL. Note that estimates were obtained from licensees for all fuel fabrication facilities in the U.S. (low enriched, high enriched, and plutonium).

The estimates in Table 2 are projected in Figures 2 through 4. Figure 2 compares the implementation costs per facility for each of the ten types of facilities. The data obtained from each licensee are shown as single points. The bar represents a range within which the implementation costs of most facilities can be expected; this is a PNL estimate based on the data received, the indicated certainty of the reply from the licensee, and PNL's own review. There is a wide variation in anticipated implementation costs among power reactors. The single high estimate was due mostly to high costs this licensee believed would result from modifying his computer

TABLE 1. Estimated Total Costs to Eligible NRC Licensed Facilities

Type of Facility	Number of Facilities Eligible ^(a)	Implementation (\$K)	Accounting/Reporting Costs (\$K/Yr)	Costs for Inspected Facilities	
				Potential Number Inspected ^(d)	IAEA Inspection Costs (\$K/Yr)
Commercial Power Reactors:					
Operating	42/26 ^(b)	340-2360	204-340	2	8-12
Operational Within 2 Years	5/16 ^(b)	105-410	42-105	1	2-3
Research & Test Reactors	56	280-1680	56-280	0	0
LEU Fuel Fabrication	5/1 ^(c)	265-550	90-210	2	20-40
HEU Fuel Fabrication	2	220-400	40-100	1	20-40
Pu Fuel Fabrication	1	75-100	25-50	1	20-40
R&D Facilities	3	90-150	6-15	1	1-3
Other Nuclear Activity	7	70-350	7-140	0	0
Irradiated Fuel Storage	2	20-40	0-2	1	3-6
Source Material	8	400-1200	80-200	1	5-20
Totals	174	1865-7240	550-1442	10	79-164

(a) This is the number of single and multiple facilities on the U.S. eligible list (see Appendix E).

(b) Numerator represents first reactor at a site; denominator represents additional reactors at the same site. Implementation cost for additional reactors at the same site is assumed to range from \$5K to \$10K per reactor.

(c) The second LEU fuel fabrication facility at Combustion Engineering is estimated by them to have 30% of the implementation cost of their first LEU fuel fabrication facility.

(d) PHL assumed ten facilities under full IAEA safeguards in any one year, arbitrarily distributed as shown.

ONE TIME COSTS, $\$10^6$

ANNUAL ACCOUNTING-REPORTING COSTS, $\$10^6/\text{YR}$

ANNUAL INSPECTION COSTS, $\$10^6/\text{YR}$

FIGURE 1. Total Costs to U.S. Industry (Minimum and Maximum Cost Projections Developed by PNL)

**TABLE 2. Estimated Incremental Cost Per Facility of
Implementing IAEA Safeguards in U.S. Facilities**

Type of Facility	Number of Facilities Reporting ^(a)	Estimated Cost of Implementation (\$K)					
		Licensee Data Ranges			PNL Estimate Ranges		
		Implementation	Accounting/ Reporting Costs/Year	Inspection Costs/Year	Implementation	Accounting/ Reporting Costs/Year	Inspection Costs/Year
Commercial Power Reactors:							
Operating	6	4.2-375.0 ^(b)	0.0-67.5 ^(b)	0.0-127.5 ^(b)	5-50/10 ^(c)	3-5	4-6
Operational Within 2 Years	3	21.0-30.8	2.0-27.5	2.0-34.0	5-50/10 ^(c)	2-5	2-3
Research & Test Reactors ^(d)	7	3.4-50.4	0.3-8.4	2.7-11.2	5-30	1-5	2-5
LFO Fuel Fabrication	5/1	55.9-168.0	7.5-45.8	21.3-60.0	50-100/120 ^(e)	15-35	10-20
HFO Fuel Fabrication ^(f)	2	112.5-196.8	7.0-175.7	14.1-70.3	110-200	20-50	20-40
Pu Fuel Fabrication	1	86.7	37.5	3.0	75-100	25-50	20-40
R&D Facilities	1	39.1	2.7	10.8	30-50	2-5	1-3
Other Nuclear Activity	1+2	2.8-65.0	0.7-18.8	2.8	10-50	1-20	1-4
Irradiated Fuel Storage	1	15.0	0	3.8	10-20	0-1	3-6
Source Material ^(g)	2/1	75.0-192.0	10.0-24.0	6.0-30.0	50-150	10-25	5-20

(a) Full cost data was obtained for 29 eligible licensed facilities; partial cost data was obtained for two NRC licensed facilities, shown by the /1 symbol. The +2 indicates that cost data was obtained from two non-eligible licensees to help in determining ranges, but their costs are not included in the industry-wide licensee costs given in Table 1.

(b) HTGR costs are projected by the licensee to be noticeably higher than conventional LWR costs; however, the range of PNL estimates is based entirely on LWR's since there is only one HTGR.

(c) The maximum implementation cost at commercial power reactors is affected by the number of reactors built at the same site. The \$50K represents maximum costs for the first reactor at each site, while \$10K represents maximum costs for any additional reactors at the same site.

(d) Usually includes laboratories and nuclear materials in addition to the reactor facility.

(e) One licensee is expected to have significantly higher costs in reprogramming his accounting computer than the other licensees. The \$120K maximum implementation cost applies in this one case only. The \$100K maximum implementation cost applies in the other four cases.

(f) Includes several additional facilities such as minor LFO fuel fabrication and research and test reactors.

(g) The lower end of the PNL range estimate occurs because several licensees are relatively small.

TYPE OF FACILITY

COMMERCIAL POWER REACTORS:

OPERATING

OPERATIONAL WITHIN TWO YEARS

RESEARCH AND TEST REACTORS

LEU FUEL FABRICATION

HEU FUEL FABRICATION

Plu FUEL FABRICATION

R&D FACILITIES

OTHER NUCLEAR ACTIVITIES

IRRADIATED FUEL STORAGE

SOURCE MATERIAL

• LICENSEE'S ESTIMATE

— LICENSEE'S ESTIMATE WITH RANGE SUPPLIED BY LICENSEE

— PNL ESTIMATE OF RANGE OF PROBABLE COSTS

FIGURE 2. Implementation Costs Per Facility (One Time)

TYPE OF FACILITY

COMMERCIAL POWER REACTORS:

OPERATING

OPERATIONAL WITHIN TWO YEARS

RESEARCH AND TEST REACTORS

LEU FUEL FABRICATION

HEU FUEL FABRICATION

Pu FUEL FABRICATION

R&D FACILITIES

OTHER NUCLEAR ACTIVITIES

IRRADIATED FUEL STORAGE

SOURCE MATERIAL

• LICENSEE'S ESTIMATE

— LICENSEE'S ESTIMATE WITH RANGE SUPPLIED BY LICENSEE

— PNL ESTIMATE OF RANGE OF PROBABLE COSTS

FIGURE 3. Annual Accounting/Reporting Costs Per Facility

TYPE OF FACILITY

COMMERCIAL POWER REACTORS:

OPERATING

OPERATIONAL WITHIN TWO YEARS

RESEARCH AND TEST REACTORS

LEU FUEL FABRICATION

HEU FUEL FABRICATION

Pu FUEL FABRICATION

R&D FACILITIES

OTHER NUCLEAR FACILITIES

IRRADIATED FUEL STORAGE

SOURCE MATERIAL

• LICENSEE'S ESTIMATE

— PNL ESTIMATE OF RANGE OF PROBABLE COSTS

FIGURE 4. Annual Inspection Costs Per Facility

controlled material inventory program. A rather wide range of cost estimates also exists among licensees of source materials. The uncertainty in amount of additional materials management and reporting to be required for source material resulted in this range of estimates.

The range of implementation and annual costs for university research reactors is estimated to be lower than for power reactors and in the same range as industrial research and test reactors. However, the licensees at universities pointed out that these similar costs will make up a significantly larger percent of their total annual budgets. For the industrial sites this is not as likely to be the case.

Figure 3 shows the annual accounting and reporting costs from Table 2 per facility, and estimates of annual costs under the anticipated IAEA inspection program are shown by facility in Figure 4.

The range of major costs to the eligible NRC licensees, i.e., the implementation and the annual costs, are compared by facility type in Figure 5. Inspection costs are a small fraction of these costs and are not included. Initially the implementation costs will be the major cost, with the licensees for power and test reactors being the major source. This is due to the large number of NRC licensed power and test reactors. However, over the long run, the reporting/accounting costs will be greater than the implemental costs. The likely total cost is expected to be considerably less than the maximum of the range indicated by the bar, which is an extremely conservative estimate. Using this wide range assumes both that most of the costs per reactor facility may be at the low end (\$10K, see Table 2), and also that these costs could mostly be at the high end (\$50K) (see Table 5).

The wide range of cost estimates to eligible NRC licensees for Source Material to implement the proposed regulation results in part from uncertainty of possible changes in material accounting and reporting requirements. The current annual costs to licenses of Source Material are now minimal.

(a) NUMERATOR REPRESENTS FIRST REACTOR AT A SITE; DENOMINATOR REPRESENTS ADDITIONAL REACTORS AT THE SAME SITE.

(b) NUMERATOR REPRESENTS THE 5 LEU FABRICATION FACILITIES WITH GENERALLY SIMILAR ECONOMIC CONSIDERATIONS; DENOMINATOR REPRESENTS THE ONE FACILITY EXPECTED TO INCURE A COST BENEFIT DUE TO ITS BEING THE SECOND OF TWO LEU FABRICATION FACILITIES OWNED BY A SINGLE COMPANY INVOLVED IN IMPLEMENTATION OF IAEA SAFEGUARDS.

FIGURE 5. Total Costs (PNL) to U.S. Industry by Facility Type

DISCUSSION

The following sections describe the / of the study: that is, how the questionnaire was developed, which premises and assumptions to utilize, how licensees were selected, and how uniform costs and projections resulted.

METHOD

The determination of impacts on licensees due to the proposed rule for implementing IAEA safeguards was made by the following four-step process:

1. The incremental impacts were identified by carefully reviewing the proposed 10 CFR 75 and comparing it to the existing regulations. The identified cost impacts were separated into categories established in an earlier preliminary study on expected impacts of a US/IAEA safeguards requirement on eligible NRC licensees.⁽¹⁾ In that study four cost categories were identified which were expanded into six for the licensees to consider in this study. These six were reduced to three in the tables and figures.
2. A questionnaire was prepared for collecting data from selected licensees. It was based on the six categories of incremental cost impact derived in Step 1. A set of premises and assumptions was also developed during these two steps for the licensees to utilize in responding to the questionnaire. These were intended to clarify the proposed safeguards requirements and assist those licensees contacted in their cost estimation process.
3. After an initial contact by telephone, the questionnaire was sent to 25 licensees representing the ten types of licensed facilities to be included in the scope of this study (see Appendix A).
4. The responses received from the licensees were consolidated and the results were analyzed and combined by the PNL staff into a summary of the ranges of estimated cost impacts.

DEVELOPMENT OF QUESTIONNAIRE

The questionnaire was developed from studies of the proposed rule for implementing IAEA safeguards in the U.S.⁽²⁾ and the existing regulations as given in 10 CFR 40, 50 and 70. Other information pertaining to both the intent of the US/IAEA safeguards agreement and current NRC licensing and inspection practices was also available.⁽³⁻²³⁾ Needed information not on hand was supplied by the sponsor. In addition, the PNL safeguards staff was able to draw upon previous experience from studies for the NRC and DOE in material control and accounting methodology, and inspection and inventory verification strategies.⁽²⁴⁻²⁸⁾ The questionnaire was organized around six principal sources of cost for licensees:

1. Preparation and review of the Design Information Questionnaire (DIQ), an IAEA questionnaire for eligible licensee facilities to complete and submit within a specified time.
2. Review of the Facility Attachment (FA), an agreement between the IAEA and the licensee as approved by NRC that identifies facility specific reporting, accounting and inspection procedures.
3. Revision of the accounting and records systems to accommodate IAEA information requirements.
4. Implementation of the revised accounting, records, and reporting systems.
5. Accounting for material and issuing the required periodic and special reports.
6. Participation in IAEA inspections if designated.

The first four categories are one-time or nonrepetitive costs and have been collectively identified as the single implementation cost in the preceding tables and figures. The fifth is a repetitive or operational cost. The sixth category is a cost item only during the period that the facility is subject to full safeguards inspection.

A further breakdown or clarification of each of these six categories was given in the questionnaire. to identify most of the specific tasks or activities required of licensees for the purpose of obtaining comparable estimates of costs from several different licensees. For example, the preparation of the installation information package would probably involve (1) drafting the material in the IAEA format (most if not all of the information, data and drawings could usually be selected from the material previously prepared for the NRC in the license application), (2) receiving one or more site visits or inspections by NRC and IAEA personnel for verification of the installation information, (3) preparing a request and justification for separate treatment of proprietary or sensitive information, if necessary, and (4) responding to NRC requests for additional or clarifying information and redrafting the final package. Similar detail was provided for the remainder of the questionnaire to help assure that all were responding throughout to essentially the same requirements and to guide those licensees not familiar with the proposed rule, 10 CFR 75.

PREMISES AND ASSUMPTIONS

The premises and assumptions that provided part of the basis for the cost estimates were derived from the same sources of information used to develop the questionnaire.

As the study progressed and additional contacts were made with NRC staff members and other contractor personnel, further clarification of IAEA impacts was possible. When any new information was obtained that would affect cost impacts appreciably, the PNL staff made estimates of the affects and adjusted the data appropriately. In several cases it was possible to discuss the issue with licensee personnel in the context of their specific cost estimates.

The principal premises and assumptions affecting cost impacts can be summarized as follows:

- Installation information (DIO) must be prepared by each licensee on the U.S. eligible list. This DIO will be reviewed for approval by the NRC and IAEA. Each licensee submitting a DIO can expect a

site visit by the IAEA to verify DIQ information. Any separate treatment of sensitive information must be identified by each licensee and negotiated with the NRC.

- The NRC will assist in the preparation of a Facility Attachment (FA) with IAEA for each licensee on the U.S. eligible list, with consultation from the licensee. The licensee will review the draft FA, and may negotiate the FA terms with the IAEA. The substantive issues of the agreement will be between the licensee and the IAEA with the NRC assuring similar conformance among licensees.
- All licensees on the U.S. eligible list come under 10 CFR 75 reporting requirements, except that the advance notification required pursuant to §§75.43-45 applies only to those installations designated by the IAEA for full safeguards inspection. [Our interpretation of §75.43 is that advance notification will be required for:
 - (a) Exports of nuclear material exceeding one effective kilogram to any non-nuclear weapon state within any period of 90 days.
 - (b) Imports of nuclear material exceeding one effective kilogram within any period of 90 days if the material is under IAEA safeguards in the exporting country.
 - (c) Transfer of nuclear material to U.S. installations not on the U.S. eligible list, except for small quantities in the form of samples containing less than 0.01 effective kilogram per sample.]*
- Generally NRC and IAEA will coordinate inspections to avoid duplicate efforts. In particular they will coordinate inventory verifications to coincide with the scheduled physical inventory of the licensee. However, some mismatch of schedules can be expected to occur occasionally.

*A slight variation of this assumption (in error) was provided to the licensees responding to this inquiry.

- Physical inventories for special nuclear material will not be required at a greater frequency than currently required by the NRC. Physical inventories for source material will not be required more frequently than once a year.
- A material balance report submission will follow each physical inventory.
- Licensees will not be assessed fees for inspections by the IAEA.
- The NRC will not assess a license modification fee upon the implementation of Part 75.
- Reimbursements by the IAEA, if any, for costs associated with inspections will not be considered in this study as a significant factor in cost impacts on the licensees.
- Usually a single material balance area (MBA) for the entire installation will suffice for R&D and power reactor installations, while the IAEA is expected to require no more than three MBA's for any nuclear materials manufacturing facility.
- The frequency of inspector visits to the facility for inspection purposes varies with the type of activity and quantity and type of nuclear material on hand.

SELECTION OF LICENSEES CONTACTED

Ten types of NRC licensed facilities from the 13 on the current list of eligible facilities, as provided for in Article 1(b) of GOV/1806, 27 August 1976, Jan 78 Rev. 1, were assigned for this study. These ten types are identified in Tables 1 and 2. Reprocessing Plants and Burial Grounds were specifically excluded from this study by the sponsor, and commercial nuclear power reactors under early construction were judged unlikely to be included for safeguards reviews in the immediate future.

From the list of eligible licensees a number were selected for soliciting cost information. Selection of licensees in the different categories was based on the following:

- All licensees who had participated in the Voluntary Facility Attachment Development Plan.
- From three to seven licensees in each of the three reactor categories.
- All licensees in each fuel fabrication category (LEU, HEU and plutonium).
- From one to three licensees in the remaining four categories that had fewer than nine licensees each.

DEVELOPMENT OF COSTS

Charge-Out Rates

To permit a uniform compilation of cost data from many sources, consistent charge-out rates for a man-month were utilized for both professional and nonprofessional staff time when we were given only man-months of effort. These rates are given in Table 3. Monthly charge-out rates are based on actual working time of 10.6 months per year, assuming an average of a two week vacation, 10 holidays and 10 other absence days per year. The rates were developed with the aid of the PNL accounting staff and are consistent with most of the data received from industrial licensees. When the charge-out rates differed appreciably from licensee values, the reason appeared to be primarily differences in applying indirect costs to staff labor costs. Hence, costs were developed in this study using similar charge-out rates for like facilities.

TABLE 3. Charge-Out Rates Relative to an Annual Cost of \$80K for Industrial Professional Manpower

	<u>Industry</u>		<u>University</u>	
	<u>Professional</u>	<u>Non-Professional</u>	<u>Professional</u>	<u>Non-Professional</u>
Annual	80K	40K	60K	30K
Monthly	7.5K	3.75K	5.6K	2.8K

Different salary levels between regions of the U.S. were ignored. However, university costs were calculated at 75% of the industrial costs because salaries and indirect costs of university staff are lower than those for industrial staff.

IAEA Inspection Costs for Licensees

The PNL staff made independent estimates of the cost to licensees of IAEA safeguards inspections. The cost ranges given in Table 4 are based on the expected number of man-days of IAEA inspection effort per year for each type of facility and the assumption that the ratio of licensee to inspection staff effort will be 1.25. Some additional cost was added for installation of surveillance equipment at reactors, but all other costs are covered by the staff time estimates. The average man-days per year of onsite inspection by IAEA personnel for the various facility types are given in Table 4. They are based on the estimated current level of inspection effort at similar facilities in other countries and were derived from information given in References 7 and 29, and from estimates by PNL staff members who have considerable familiarity with current IAEA inspection practices. The licensee staff effort ratio associated with inspections was based on the assumption that there will be some preparation and follow-up effort by the licensee for at least one annual inventory verification. At least one of the licensee's professional staff would be expected to accompany each inspector at the facility as an escort and to answer questions and otherwise facilitate inspector access to records and facilities.

There is considerable uncertainty about how the IAEA will conduct inspections in the U.S. PNL has assumed that inspections of U.S. facilities will be comparable to inspections of similar facilities in other countries, but other assumptions are possible. For example, the IAEA might use U.S. facilities to develop and demonstrate new techniques or to train new inspectors. However, the principle of "equal treatment" makes it likely that the burdens imposed on facilities will not be greatly different in different countries.

For the near future, budgetary and manpower constraints in IAEA suggest that inspection effort per facility will not increase much above current levels. In the long run, however, it is likely that inspection effort will increase gradually, especially in sensitive facilities.

Fuel Fabricator Costs

Both HEU fuel fabricators--Atomics International and General Atomic--

TABLE 4. Assumed IAEA Inspection Effort for Various Types of Facilities

<u>Type of Facility</u>	<u>No. Inventory Verifications Per Year</u>	<u>Man-Days Per Inventory Verification</u>	<u>No. Intermediate^(a) Inspections</u>	<u>Man-Days Per Intermediate Inspection</u>	<u>Total Man-Days Per Year</u>
Operating Power Reactors	1	4	4-6	1	8-10
Power Reactors Under Construction	1	1-2	1	1-2	2-4
Research and Test Reactors	1	1-2	0-1	1-2	2-3
LEU Fabrication	1	10-20	5	3-5	25-45
HEU Fabrication	2	14-20	5	3-4	43-60
Pu (MOX) Fabrication	2	14-20	5	3-4	43-60
R&D Facilities	-	-	-	-	3-4
Irradiated Fuel Storage	1	3-6	4-6	1	7-12
Source Material	1	20-25	4-6	2	25-40

(a) Intermediate inspection means an inspection at which a complete physical inventory is not verified. Intermediate inspections are aimed at inspection of records, verifying transfers of material, and maintaining and checking containment and surveillance devices.

include the costs of their entire operations in their HEU estimates because HEU fuel fabrication is the major part of their cost impact. Atomics International is licensed for HEU fuel fabrication, plus LEU fuel fabrication, Pu fabrication, and a research and test reactor. General Atomic is licensed for HEU fuel fabrication, plus LEU fuel fabrication and two research and test reactors (one a critical facility). Since both licensees gave us their estimates as if all costs were incurred in HEU fuel fabrication without identifying costs from their other operations, the data appear to be overly expensive for HEU fuel fabrication. For developing an industry-wide incremental cost impact, PNL considers this to be quite acceptable, and removed the included facilities from the total number of U.S. facilities so that each NRC licensed facility is accounted for once.

The plutonium fuel fabrication facility at Westinghouse-Cheswick is currently supported by Department of Defense (DOD) funding for all plutonium work. The commercial development facility is essentially dormant except for some low level development work, storage, and occasional shipments. The incremental cost impact for plutonium fuel fabrication contributing to this study was based upon the level of activity conducted for DOD. In addition, the current computer program for the Westinghouse accounting system is used in common between the Cheswick and Columbia facilities. Hence, computer reprogramming costs were arbitrarily apportioned between the two facility estimates. Instead, if Cheswick had been assigned the entire computer cost, the plutonium fuel fabrication implementation cost would have been \$20,000 higher.

ESTIMATING THE TOTAL COST FOR THE U.S.

The range of the total cost for all U.S. facilities of a given type was obtained simply by multiplying the upper and lower cost estimates for a single facility by the number of facilities of that type. This procedure gives rather wide cost ranges where there are a large number of facilities, e.g., reactors (see Columns 3 and 4 in Table 1). These cost ranges are quite conservative because the method allows for the possibility that the average cost per facility may be either very near the lower end or very

near the upper end of the estimated range for a single facility. The authors feel that the average cost is actually more in the central part of the range and that the range of uncertainty for the U.S. reactor totals may be much narrower than given in Figure 1. However, there is no technical basis for making an assumption about the actual distribution of facility costs within the estimated range. If the distribution is not symmetrical, the midpoint of the range would not be an unbiased estimate of the mean.

A similar issue arises in calculating the totals for all nuclear facilities in the U.S. (the bottom line in Table 1). The ranges for the total implementation, reporting and inspection costs were obtained by simply summing the maximum and minimum figures for the ten types.

Within the limited time and scope of this study it was not possible to investigate mathematical/statistical bases that might be available for projecting the range estimate for the typical facility to the total for all facilities. The authors chose not to make an arbitrary assumption about the type of probability distribution to apply to the range estimates. For example, a very simple assumption may be that the distribution of facility costs within the range is normal. Therefore, the mean would be at the midpoint of the range and the distribution is symmetrical. The range could be assumed to be four times the standard deviation. To illustrate, Table 5 presents ranges for implementation costs calculated in this manner for the five most numerous facility types.

TABLE 5. Range of Implementation Costs When a Normal Distribution of Costs Within a Type of Facility is Assumed (\$K)

<u>Facility Type</u>	<u>Estimated Cost Range (From Table 1)</u>	<u>Assumed Mean</u>	<u>Total For All Facilities</u>
Commercial Power Reactors:			
Operating	5-50/10	27.5/7.5	1191-1508
Operational Within Two Years	5-50/10	27.5/7.5	196-318
Research and Test Reactors	5-30	17.5	868-1102
Other Nuclear Facilities	10-50	30	157-263
Source Material	50-150	100	659-941

Finally, all of the inputs from licensees that make up the implementation costs per facility are shown in Figure 6. Here are shown in detail how each of the licensees estimated the components that make up his one-time costs. The several estimates shown at \$0 should perhaps be interpreted as a low dollar estimate rather than zero dollars.

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TYPE OF FACILITY

COMMERCIAL POWER REACTORS:

OPERATING

OPERATIONAL WITHIN 2 YEARS

RESEARCH AND TEST REACTORS

LEU FUEL FABRICATION

HEU FUEL FABRICATION

Pu FUEL FABRICATION

R&D FACILITIES

OTHER NUCLEAR ACTIVITIES

IRRADIATED FUEL STORAGE

SOURCE MATERIAL

- PREPARE DIQ
- REVIEW AND NEGOTIATE FA
- ◆ REVISE/REPROGRAM RECORDS SYSTEM
- ▲ IMPLEMENT ABOVE SYSTEM
- LICENSEE DATA RANGE

FIGURE 6. Industry Estimated Implementation Cost Detail Per Facility

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APPENDIX A

NRC LICENSEES CONTACTED

Allied Chemical Corporation
Atomics International
Babcock & Wilcox Company (three facilities)
Baltimore Gas & Electric Company
Columbus Laboratories, Battelle Memorial Institute
Combustion Engineering, Inc.
Commonwealth Edison Company (two reactor types: Operating and
Awaiting Operating License)
Exxon Nuclear Company, Inc.
Florida Power & Light Company
General Atomic Company
General Electric Company (two facilities)
Kerr-McGee Nuclear Corporation
Massachusetts Institute of Technology
Oregon State University
Pacific Northwest Laboratory, Battelle Memorial Institute
Pennsylvania State University (two facilities)
Portland General Electric Company
Public Service Company of Colorado
Southern California Edison Company (two reactor types as above)
Tennessee Nuclear Specialists
University of Florida
University of Washington
Washington Public Power Supply System
Washington State University
Westinghouse Electric Corporation (two facilities)

PNL PREMISES AND ASSUMPTIONS FOR IMPLEMENTING 10 CFR 75

1. Incremental IAEA safeguards requirements will be based on the proposed rule 10 CFR 75 published in the May 25, 1978 Federal Register, as compared to current regulations in force: 10 CFR 40, 50, 70 and 150. A revised draft of 10 CFR 75, modified on the basis of public comment, is not available to use in this review.
2. Costs will be broken down into categories representing (a) one-time implementation costs, (b) annual incremental operating costs, and (c) licensee costs associated with IAEA inspections.
3. Installation information (DIO) must be prepared by each licensee on the U.S. eligible list. This DIO must be acceptable to the NRC and IAEA. Each licensee submitting a DIO must be prepared for a site visit by the IAEA to verify DIO information. Any separate treatment of sensitive information must be identified by each licensee and negotiated with the NRC.
4. The NRC will prepare a Facility Attachment (FA) for each licensee on the U.S. eligible list, with consultation from the licensee. The licensee will provide information, review the draft FA, and negotiate the FA terms with the NRC and IAEA.
5. All licensees on the U.S. eligible list come under 10 CFR 75 reporting requirements, except that the advance notification required pursuant to §§75.43-45 is applicable only to those installations designated by the IAEA for inspection programs. [Our interpretation of §75.43 is that advance notification will be required for:
 - (a) Exports of nuclear material exceeding one effective kilogram to any non-member weapon state within any period of 90 days,
 - (b) Imports of nuclear material exceeding one effective kilogram within any period of 90 days if the material is under IAEA safeguards in the exporting country,
 - (c) Transfer of nuclear material to or from U.S. installations not on the U.S. eligible list, except for small quantities in the form of samples containing less than 0.01 effective kilogram per sample.]
6. Generally, NRC and IAEA will coordinate inspections to avoid duplicate efforts. In particular, they will coordinate inventory verifications to coincide with the scheduled physical inventory of the licensee. However, some mismatch of schedules will occasionally occur.
7. Physical inventories will not be required by §75.35 at a greater frequency than currently required by the NRC (§75.35 requires a material balance report submission following every physical inventory).
8. Licensees will not be assessed fees for inspections by the IAEA.
9. No attempt will be made to modify estimated costs for IAEA reimbursement pursuant to §75.47.
10. A single MBA constituting the entire facility will be acceptable for material balance purposes in the case of reactors and many other installations. In the case of parallel process lines or separately operated facilities, such as separate uranium and plutonium laboratories in R&D facilities, it is assumed that there will be separate MBAs.

A-2

A-2

APPENDIX B

SUMMARY OF IMPACTS ON OPERATING REACTORS - FOR PROJECTION PURPOSES

TABLE B.1. Operating Reactors^(a)

Operator	Facility Name	No. of Units	No. of Impacts	
			High	Low
Baltimore Gas & Electric	Calvert Cliffs 1 & 2	2	1	1
Metropolitan Edison	Three Mile Island 1 & 2	2	1	1
Niagara Mohawk Power	Nine Mile Point 1, FitzPatrick	2	1	1
Northeast Utilities	Millstone 1 & 2	2	1	1
Philadelphia Electric	Peach Bottom 2 & 3	2	1	1
Commonwealth Edison	Dresden 1, 2 & 3; Zion 1 & 2, Quad Cities 1 & 2	7	1	6
Indiana & Michigan Electric	Cook 1 & 2	2	1	1
Northern States Power	Monticello; Prairie Island 1 & 2	3	1	2
Wisconsin Electric Power	Point Beach 1 & 2	2	1	1
Carolina Power & Light	Brunswick 1 & 2; Robinson 2	3	1	2
Duke Power Company	Oconee 1, 2 & 3	3	1	2
Florida Power & Light	Turkey Point 3 & 4; St. Lucie 1	3	1	2
Georgia Power Company	Hatch 1 & 2	2	1	1
TVA	Browns Ferry 1, 2 & 3	3	1	2
Virginia Elec. & Power	Surry 1 & 2; North Anna 1	3	1	2
			15	26

(a) There are 26 operating reactors owned by utilities already involved with one or more operating reactors. We assume that implementing IAEA safeguards for these 26 reactors will cost considerably less.

There are $58 - 26 = 42$ reactors that will have full one-time costs to assume to implement the US/IAEA safeguards agreement, and 26 reactors that will each have 1/3 to 1/10 the one-time costs of the 42 identified above. All 68 licensed and operating reactors are assumed to have full annual reporting costs.

Up to three reactors during any one year can be expected to be on the inspection list and will have annual inspection costs.

The two reactors at Consumers Power Company were considered as having full costs to each to implement because of their wide geographic separation.

APPENDIX ^S~~E~~

NUMBER OF NRC LICENSEE FACILITIES ON ELIGIBLE LIST

A total of 174 nonduplicated facilities are used in Table 1 of this report to project the estimates of total cost to eligible NRC licensed facilities. The breakdown of the 174 into ten types of facilities is given in Table 1. The procedure used in arriving at 174 nonduplicated facilities when there were 242 entries on the current list of eligible facilities is given below by facility type.

Commercial Power Reactors: Operating

There are 63 entries on the list. Subtract one because Indian Point 1 has been shut down since October 31, 1974 and all fuel is unloaded, with no decision yet on the future. Add six because Cook 2, Davis-Besse 1, Farley 1, Hatch 2, North Anna 1, and Three Mile Island 2 are now operating (reference Nucleonics Week, December 28, 1978). This gives 68 total, of which 42 are the first operating reactors owned by a utility, and 26 are owned by utilities already involved with at least one operating reactor (see also Appendix D).

Commercial Power Reactors: Operational Within Two Years

There are 21 reactors in this category by PNL's estimate, of which five are the first operating reactors owned by a utility, and 16 are owned by utilities already involved with at least one operating reactor (see page D-2, Appendix D).

Commercial Power Reactors: Not Operational for at Least Two Years

There are 48 entries in this category. Although they will eventually incur safeguards costs when they become authorized to possess fuel, this is far enough into the future that they have been excluded from PNL's range estimates of probable cost.

Research and Test Reactors

There are 60 entries on the list. Subtract one for Atomics International and subtract two for General Atomic Company because in both instances their cost estimates for their research and test reactors are already included in their estimates for HEU fuel fabrication facilities. Subtract one of the Babcock & Wilcox Company reactors because their estimate included costs for both of their reactors.

LEU Fuel Fabrication

There are seven entries on the list. Subtract one for General Atomic Company because costs in this category are already included in their estimate for an HEU fuel fabrication facility. Also note that Combustion Engineering, Inc. has two facilities.

HEU Fuel Fabrication

There are two entries in this category.

Pu Fuel Fabrication

There are four entries in this category. Subtract one for Atomics International because costs here are already included in their estimate for an HEU fuel fabrication facility. Subtract two more because Kerr-McGee has no fuel onsite, and Exxon Nuclear is currently inactive.

Reprocessing Plants

There are two entries on the list; however, PNL was asked by NRC to exclude both facilities from the cost estimates.

Research and Development Facilities

There are five entries on the list. Subtract two because costs for Westinghouse Electric Corp. are already included in Pu fuel fabrication, and costs for University of Florida are included in research and test reactors.

Other Nuclear Activity

There are nine entries in this category. Subtract two because costs for Pennsylvania State University and Massachusetts Institute of Technology are already included in their respective estimates for research and test reactors.

Irradiated Fuel Storage

There are two entries in this category.

Source Material

There are eight entries in this category.

Burial Grounds

There are five entries on the list; however, PNL was asked by NRC to exclude these facilities from the cost estimate.

Summary of NRC Licensees Tallied vs. Number on Eligible List

- The following represents a simple balance between the 174 nonduplicated facilities used in the PNL estimates and the 242 entries on the original list of eligible NRC licensed facilities:

- 242 - NRC licensed, eligible facility listing.
- 12 - Deletions where licensee combined multiple facilities together in his estimate, so that each facility would be counted exactly once in the PNL estimate.
- 48 - Deletion of commercial power reactors that won't be operational for at least two years.
- 1 - Deletion of Indian Point 1 power reactor because of its uncertain future status.
- 2 - Deletion of reprocessing plants at NRC request.
- 5 - Deletion of burial grounds at NRC request.

174 - PNL list of nonduplicated facilities.