

ENCLOSURE D

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ENCLOSURE "D"

VALUE/IMPACT STATEMENT ON AMENDMENTS OF 10 CFR PART 34

This value/impact statement first gives an overview of the radiation overexposure problem in industrial radiography. Then the individual amendments of 10 CFR Part 34 are discussed.

Industrial radiography accounts for more than two-thirds of the overexposures reported by all NRC licensees greater than 5 rems to the whole body or 75 rems to the extremities and almost 90% of the overexposures greater than 25 rems to the whole body and 375 rems to the extremities (Table 1).

Table 1. Overexposures to external radiation reported by NRC licensees in the last 7 years

Year	Total Overexposures (1.25 or 3 rem whole body or 18.75 rem extremity)		Overexposures greater than 5 rem whole body or 75 rem extremity		Overexposures greater than 25 rem whole body or 375 rem extremity	
	All Licensees	Radiography	All Licensees	Radiography	All Licensees	Radiography
1971	57	24	11	9	3	3
1972	59	21	12	6	3	3
1973	65	24	12	7	2	2
1974	103	29	13	5	2	1
1975	39	13	2	2	1	1
1976	52	20	14	14	4	4
1977	54	8	4	3	2	1
Total	429	139 (32%)	68	46 (68%)	17	15 (88%)

These overexposures in Table 1 resulted in six cases of radiation burns on the hands, one case of which left a scar on a finger.

At the same time, the estimated total collective dose to the industrial radiography worker population is less than one-half of that for power reactor personnel and about one-third of that for medical workers (Table 2).

Table 2. Total radiation dose to workers in 1975 for licensees with the highest totals**

Type of Licensee	Total dose (man-rems)	Number of workers with measurable doses	Average dose (rems)
Medical*	27,000	102,000	0.26
Power Reactors	21,270	28,034	0.76
INDUSTRIAL RADIOGRAPHY*	9,300	15,500	0.60

* For both NRC and Agreement State licensees, estimated by multiplying NRC figures for total dose and number of workers by 2 for medical and by 3 for industrial radiography. The number of workers reported for radiography exceeds the total number of radiographers (estimated at 9000) because it includes persons monitored who were not radiographers (i.e., coworkers, supervisors, etc.)

** Source: "Occupational Radiation Exposure at NRC Licensed Facilities - 1975," Walter S. Cool, NUREG-0419, 1978. Data are based on voluntary reporting by licensees for 1975. Such voluntary reporting was not requested for other years.

626 099

Likewise, the average radiation dose to workers is higher for five other categories of NRC-licensed workers than for radiographers (Table 3).

Table 3. Average radiation dose to workers with measurable doses for licensees with the highest average doses - 1975**

Type of licensee	Average dose (rems)
Unencapsulated SNM	1.54
Waste disposal, burial	1.26
Power reactors	0.76
Fuel storage	0.69
Byproduct manufacture & distribution	0.64
Industrial Radiography	0.60

** Walter S. Cool, op. cit.

Some statements on the severity of the radiation overexposures experienced by NRC licensed industrial radiography since 1971 are in order:

1. There have been no deaths, near-deaths, or illnesses due to acute effects of radiation in industrial radiography licensed by NRC. The radiation overexposures experienced have not been life threatening due to the acute effects of radiation.

2. There has been no loss of limb due to extremity doses received in industrial radiography. Since 1971 radiation burns on hands were visible in six instances. In five cases the burns healed fully. In one case there was a scar on a fingertip. (Note, however, that there have been more severe cases among NRC licensees prior to 1971, among Agreement State licensees, and in foreign countries.) The conclusion is that while industrial radiography sources can, and occasionally have, caused serious injuries to extremities, there has been no loss of limb among NRC licensees over the last eight years (including 1978). Few other industries can point to as little loss of limb, and many other industries have records which are very poor by comparison.

3. Since the acute effects of radiography overexposures (i.e., loss of life or limb) are minimal the hazard of radiation overexposures to the whole body must be considered to be its effect in causing cancer or genetic defects much the same as radiation doses within regulatory limits. Since overexposure incidents account for only a few percent of the total collective dose received by radiographers (about 100 man-rems/year vs. 3000 man-rems/year, they account for only a few percent of the risk from cancer or genetic defects. With respect to total risk to all workers or average risk to a worker, industrial radiography presents less risk than some other classes of licensees (Tables 2 and 3).

626 101

The Nature of Radiography Overexposures

To estimate the value of the recommended amendments in terms of reducing overexposures, all reported radiography overexposures of greater than 5 rems whole body dose or 75 rems extremity dose for the years 1971 through 1977 were studied. There were 46 people overexposed during those seven years in a total of 42 overexposure incidents reported. In four cases it was not possible to determine what happened; the discussion below concerns the other 38 incidents.

Radiography overexposure accidents generally happen in three parts. First, the source is left exposed when it should not be. Second, a required radiation survey to assure proper radiation levels is omitted or inadequately done. Third, the source is not secured in its shielded position. In almost all devices the source securing mechanism cannot be operated if the source assembly is not in the shielded position. All three of these failures are usually necessary for an overexposure to occur.

The reasons for the source being left exposed are shown in Table 4.

Table 4. Reasons for source being exposed in 38 radiography overexposure incidents

Radiographer forgets to retract source.....	7
Source jams in guide tube.....	7
Source disconnects from control cable.....	3
Radiographer does not fully retract source into the safe shielded position.....	10
With two sources and controls present, the radiographer exposes the second source instead of retracting the first source.....	3
Source moves out of shielded position after survey.....	3
Operator confuses "in" and "out".....	1
Other miscellaneous.....	4

It is interesting to look at the role of equipment failure. The exposure devices involved in jammed sources were an Automation Industries 100A, Newport News I-30/NN250-1, Automation Industries 100, Technical Operations 533, Radionics PGO-30, Technical Operations 446, and an unknown model. No pattern is evident.

The disconnects were with a Technical Operations 553, a Gamma Industries Century, and an Automation Industries (unknown model). Again, no pattern is evident.

The situation of not fully retracted sources can be caused by operator error or by the source jamming or catching at the entrance of the device. In four cases, a Technical Operations 533 was used; in one case, a Technical Operations 660; in one case, a Gamma Industries Century; in one case, a Simco-Testing DU-100P. In three cases, no device model could be determined. In none of these cases, however, was a device malfunction positively identified as a contributing factor in causing the source not to be fully retracted.

In summary, the malfunction rate of radiographic exposure devices is low, and no design defect leading to repeated overexposure incidents can be identified.

The secondary causes of overexposure are shown in Table 5. By far the most prevalent cause is the failure of the radiographer to perform the survey after each exposure. This survey is clearly required by § 34.43(b). A variation of "no survey" is the incomplete survey where the radiographer does not survey the front of the device or the guide tube.

626 103

Table 5. Reasons that radiographers did not discover an exposed source in 38 overexposure incidents

No survey performed.....	23
Incomplete survey.....	5
Failure to lock device before moving.....	3
Radiographer realized problem but did not handle the emergency situation properly.....	3
Broken survey meter.....	2
Other miscellaneous.....	2

The amendments in Enclosure "A" of this paper are discussed below primarily in terms of their value for reducing overexposures.

626 104

AMENDMENT 1

Statement: Amend § 34.11 to specify that the currently required licensee's internal inspection program would have to be conducted at intervals not to exceed three months and that records of the inspections would have to be kept for two years.

Comment: It is current licensing practice not to issue radiography licenses unless the licensee commits to internal inspections at a minimum frequency of quarterly.

The licensee's flexibility in running its internal inspection program would be reduced. A quarterly frequency might not be appropriate for the needs of all licensees. For example, some licensees whose radiography is performed onsite now perform daily walk-throughs to check radiographer performance and do not produce written records sufficient to meet the requirements of the proposed regulation. Thus, in those cases, the proposed regulation would add a burdensome recordkeeping requirement.

Value: Specifying a fixed frequency will reduce licensing correspondence on this matter.

Records of the inspection would be useful to both the licensee and to IE inspectors.

Impact: Most licensees now audit on a 3-month basis but a minority do not. Thus, this rule would have no impact for perhaps 80%-90% of licensees. Some of the others would have to conduct inspections more frequently, and some would be required to provide more documentation.

AMENDMENT 2

Statement: Amend § 34.22 to require securing the source in its shielded position in each radiographic exposure device each time the source is returned to the shielded position.

Comment: Securing the source could prevent subsequent personnel overexposure due to inadvertent movement of a source into an unshielded position after being retracted into its shielded position. NMSS does not issue a license for radiography unless the applicant's operating procedures provide for such security of the source. Securing the source requires a few moments of the radiographer's time.

Three of the 38 overexposure incidents can be directly attributed to a failure to lock the exposure device. In addition to which if devices which could not be locked without the source being in the shielded position were used, the inability to lock the device would be a positive indication that the source was not safely stored.

Value: Securing the source would have directly prevented 3 of the 38 overexposure incidents. In addition, in most of the other overexposure incidents, securing the source, which can be as simple as pushing down a lock mechanism or turning a knob, would have provided the radiographer with a positive indication that the source was not in the safe shielded position.

Impact: Little. Most licensees already secure the source routinely. For others, the act would take only a few seconds of effort. This would be negligible compared with the time the radiation survey takes.

AMENDMENT 3

Statement: Amend § 34.28 to require that radiographic exposure devices, storage containers, and source changers be checked for obvious damage each day before use and comprehensively inspected and maintained each quarter.

Comment: This amendment represents good practice in most situations. A quarterly frequency is in agreement with most manufacturer's recommendations and with current licensing practice. Specifying a fixed frequency reduces flexibility and quarterly maintenance would not be necessary in all cases. A device used at moderate frequency in a clean laboratory would need maintenance at a less frequent interval than one used under field conditions. Also there is no good reason to perform maintenance on an exposure device that had not been used during the previous quarter.

In 4 instances in which the source jammed in the guide tube an inspection of the device could have disclosed an operating problem. In the remaining 3 cases the guide tube was kinked or damaged during the operations.

Value: Provide explicit statement of good practice (daily check) and inspectable maintenance program and assure that problems are identified before they occur.

Impact: Quarterly maintenance is fairly common practice. Some additional maintenance would be required.

AMENDMENT 4

Statement: Add a new § 34.29 and a definition in § 34.2 to require that permanent radiographic installations have an alarm that would warn anyone entering the high radiation area that entry is being attempted while the source is exposed.

Comment: Thirteen of the 46 people overexposed were overexposed in permanent installations. In 3 instances an alarm device had been installed and was either ignored or disconnected. This alarm requirement very likely would have prevented most of the other 10 overexposures.

Value: Effective reduction in the number of overexposures in permanent radiographic installations.

Impact: \$1,000 to \$2,000 per installation, including installation costs, plus \$100/yr to test and maintain. Many installations already have this alarm.

AMENDMENT 5

Statement: Amend § 34.31 to require that both radiographers and radiographers' assistants demonstrate understanding of their training by receiving written (or oral for assistants) and field examinations on the required subjects.

Comment: Both written and field examinations are appropriate for demonstrating understanding of the required training by radiographers.

Value: Provide a basis for determining the competency of radiographers and their assistants and for an inspectable record of training.

Impact: Almost none. Records of tests are generally kept already.

AMENDMENT 6

Statement: Amend § 34.43 to state that the presently required radiation surveys of radiographic exposure devices after each exposure include surveys of source guide tubes where readily accessible.

Comment: A survey of the guide tube is an effective way to show that the source is in the shielded position. Radiation levels at the radiographic exposure device can be near normal when the source is at the far end of the guide tube.

A very careful survey of the device itself including circling the device fully and waiting for the meter to respond completely, is also sufficient to establish that the source is in its fully shielded position. Five overexposures were caused because surveys were not complete enough to locate the source.

Value: Explicit statement of good practice.

Impact: Small. Operating procedures usually include such a survey.

AMENDMENT 7

Statement: Add a new description of "personal supervision" to § 34.44 to require that a radiographer supervising an assistant must be physically present at the site where sealed sources are being used and watching the assistant when the assistant uses radiographic exposure devices, sealed sources or related source handling tools, or radiation survey instruments to determine that the source has returned to its shielded position following an exposure.

Comment: In order to permit licensees to begin training individuals in the actual use of radiographic equipment at an early point in their training, the NRC staff requires minimal training to qualify as a radiographer's assistant. Typically, a few hours of instruction are sufficient and the radiographer's assistant is qualified to do critical work only while being watched by the radiographer. An assistant works in that capacity for a period of 3 to 6 months. Assistants with months of experience may not always require this degree of supervision.

Value: Mistakes due to inexperience could be avoided. In 3 of the 38 overexposure incidents an improper retraction of a source or an improper survey of the exposure device by an unwatched assistant caused the overexposure.

Impact: Many of the licensees that use assistants now provide this degree of supervision and this change would have little effect. For the remainder, this change would reduce the usefulness of assistants.

AMENDMENT 8

Statement: Amend Appendix A of Part 34 to include study of typical radiography accidents which have occurred. The NRC staff will provide suitable study material. Also amend Appendix A to require training in any radiographic equipment inspection

and maintenance that the radiographer will be required to perform.

Value: If radiographers were aware of the mistakes that others have made they would be less likely to repeat these mistakes. If a radiographer will be expected to inspect and maintain radiographic equipment, he should be trained to do so.

Impact: Will add a couple of hours to the training of each radiographer.

CONCLUSIONS

For the typical licensee the impact of these amendments should be quite small. The amendments to some extent serve to codify what is already common practice in much of the industry and what the NRC generally requires by way of license condition. In this respect the amendments should serve to make licensing easier for both the applicant and the NRC staff by making NRC safety requirements more explicit.

Several of the amendments should improve safety. Alarm requirements for permanent radiographic installations should improve safety at facilities not already having such alarms. The requirement that management audits be conducted at a quarterly frequency should serve to increase management attention to safety at some companies where audits are conducted less frequently. The requirement describing surveys of exposure devices after radiographic exposures should upgrade survey procedures for some licensees. The increased supervision required for radiographers' assistants should reduce the number of accidents involving inexperienced assistants. The requirement to instruct radiographers in accident case histories should help them avoid similar accidents.

The cost of these amendments to licensees should be minimal. Many licensees would need to make no changes at all in their operations. For others the cost of upgrading their safety should not significantly affect the cost of their operations. These amendments of Part 34 call for small but important changes in operating procedures.

ENCLOSURE E

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626 111

ENCLOSURE "E"

RECORDKEEPING JUSTIFICATION ANALYSIS

This analysis discusses recordkeeping requirements contained in amendments of 10 CFR Part 34 (Enclosure "A"). The analysis covers (1) need for the records, (2) cost to the licensee in maintaining the records, (3) alternatives to the recordkeeping, (4) value/impact assessment of the recordkeeping, and (5) sources of information outside NRC. The recordkeeping requirements are discussed below by section of the regulations.

A. Maintaining records of the licensee's quarterly internal inspection program required in § 34.11.

- (1) Need: Section 34.11 requires licensees to perform a quarterly inspection or audit of the performance of their radiographers. The purpose of the inspection is to make management assure that the radiographers are working safely. It has been observed repeatedly that where licensee management does not monitor the safety performance of radiographers, they will have a high accident rate. The records of the inspections will aid NRC inspectors in establishing that a genuine internal inspection was made. The records will be used by the licensee to keep track of deficiencies that were uncovered so that they can be

corrected. IE strongly stated that NRC inspectors require these records to determine that a bonafide internal inspection was made. Records of past inspections will also be used by the licensee in his current inspections to make sure that previously noted deficiencies no longer exist.

- (2) Cost: A report on the radiographer's performance may take from 5 minutes, using a standard checklist, to one hour or more if a report is written. An average of 30 minutes per radiographer is assumed. At 4 times per year for an estimated 3000 radiographers, a total recordkeeping cost of 6000 man-hours is expected.
- (3) Alternatives: This is the only record on the performance of each individual radiographer. Relying on memory to remember the outcome of an internal inspection would not seem adequate either to the licensee or to NRC inspectors. A written record is also an effective means of informing upper management of the results of the internal inspection.
- (4) Value/impact assessment: The records provide inspectable evidence that an important management function has been performed. They are thus very valuable in assuring that the internal inspections are done. Maintaining a record of such an activity would appear to be well worth the cost. The records would also be valuable to the licensee in performing employee evaluations.

626 113

- (5) Outside sources of information: Ten of 49 public commenters discussed this amendment, but the comments were primarily that the proposed schedule was too restrictive. No one expressed objection to the recordkeeping requirement.
- B. Records showing that the licensee has performed a quarterly inspection and maintenance of his radiography exposure devices as required in § 34.28.
- (1) Need: This record is a simple log entry or a tag on a radiographic exposure device showing the last maintenance date. The licensee needs these records to keep track of when each of his radiographic devices was last maintained. The NRC inspector needs the records to aid in establishing that the devices are being maintained as required in § 34.28.
- (2) Cost: This requires only noting the date of the maintenance in a logbook or on a tag on the device. It requires an estimated 5 minutes of time for each device 4 times a year. For an estimated 3000 devices in use the recordkeeping burden becomes 1000 man-hours.
- (3) Alternatives: This is the only record of maintenance of each exposure device. Remembering maintenance dates of several pieces of equipment is impossible for most people.

626 114

- (4) Value/impact assessment: The easiest way to know when a device was last maintained is to record the date of its last servicing. This essential fact can be recorded at nominal cost. There does not seem to be any easier way to know that the regulations are being met.
- (5) Outside sources of information: Two of 49 public commenters said this requirement involved too much recordkeeping.
- C. Records of quarterly tests on alarm interlock systems at permanent radiographic installations as required in § 34.29.
- (1) Need: This record is a simple log entry or an entry on a chart at the permanent radiographic installation. The licensee needs a record of when the alarm was last tested for his own use. The NRC inspector needs the records to aid in establishing that the alarms are being maintained as required in § 34.29.
- (2) Cost: This requires only a log book entry or an entry on a chart. The estimated time is 5 minutes per installation 4 times a year. For the estimated 300 installations, the total record-keeping burden becomes 100 man-hours.

626 115

(3) Alternatives: This is the only record of the maintenance of the alarm. The only way to be able to recall this date is to write it down in a suitable log or chart.

(4) Value/impact assessment: The easiest way to know when an alarm was last tested is to write down the date. An essential fact is recorded at nominal cost.

(5) Outside sources of information: None of the public commenters objected to keeping a record of this test.

D. Records of the training of radiographers and radiographers' assistants in § 34.31.

(1) Need: This record consists of filing a copy of the tests a radiographer takes and keeping a record of refresher courses he attends. The records will aid NRC inspectors in verifying that the radiographers have been trained adequately to meet the requirements of § 34.31 and the conditions of the license.

(2) Cost: The cost of filing the tests taken and recording attendance at courses and lectures is estimated to be 5 minutes each once a year for 3000 radiographers. The burden is therefore 250 man-hours per year.

626 116

- (3) Alternatives: In this case a viable alternative might be for the NRC inspector to establish that adequate training has been given by relying solely on questions asked the radiographer about the training he received and testing his knowledge of important areas by asking him some questions on essential subjects. An alternative for radiographers' assistants is not to require that records be kept since the records would prove so little.
- (4) Value/impact assessment: Because of the minimal cost of 250 man-hours per year it does not seem unreasonable to ask that the records be maintained. They provide a valuable resource in establishing how well a radiographer has been trained.
- (5) Outside sources of information: Two commenters thought assistant radiographers should be allowed to take oral examinations with records of the exam date maintained. (This suggestion was adopted.) One comment said it should not be necessary to maintain the records for as long as the person was a radiographer. (The retention period was subsequently limited to 3 years.)

E. Summary.

The total recordkeeping burden on licensees for these amendments is estimated to be 7350 man-hours per year.

ENCLOSURE F

626 118

ENCLOSURE "F"

DRAFT LETTER TO CONGRESSIONAL COMMITTEES

Enclosed for the information of the committee is a notice of amendments of 10 CFR Part 34 of the Nuclear Regulatory Commission regulations dealing with industrial radiography.

The amendments would require several changes intended to improve radiography safety. Other changes are intended to formalize current licensing practices as regulations.

A public announcement on these amendments to be released by the Commission in the next few days is also enclosed.

Enclosures:

1. Federal Register Notice
2. Public Announcement

ENCLOSURE G

626 120

ENCLOSURE "G"

STATUS OF ACTIONS DEALING WITH INDUSTRIAL RADIOGRAPHY

A previous Commission Paper, SECY-78-57, "Reduction of Radiography Overexposures," discussed five staff actions that could potentially reduce the rate of overexposures among radiographers. This paper would complete one of those actions-amendment of NRC regulations dealing with industrial radiography. The status of the other four actions is given below.*

- (1) Advance notice of proposed rulemaking on design requirements for radiographic exposure devices.

An advance notice of proposed rulemaking was published on March 27, 1978. This notice was approved by the Commission following review of SECY-78-57. Thirty-two public comments were received. In addition, a public meeting on the proposed rules was held on April 18, 1978. The public comments and the meeting revealed extensive divergence of opinion regarding the design requirements. Agreement States expressed opposition to including detailed safety design criteria in the regulations and expressed preference for a regulatory guide in this area. The staff agrees that the detailed design criteria should be

* In a memorandum dated March 20, 1979 (see Enclosure "H"), OPE suggested that this enclosure include the original as well as the present target dates. This has been done, although not all actions in SECY-78-57 provided target dates.

in a regulatory guide, although a brief amendment of the regulations seems necessary to provide a firm regulatory basis for the guide. The staff plans to submit a recommendation to the Commission for such a rule change, accompanied with the draft guide, in late 1979. The original target date for this action was late summer 1978. The reason for the delay is that this work has been given a lower priority than was initially assigned. The staff has studied the overexposure incidents and is not aware of design changes that would significantly decrease the rate of overexposures, although this is not to say that work in this area would not be productive.

(2) Advisability of requiring radiographers to use audible alarm dosimeters.

The performance of audible alarm dosimeters, especially their reliability, has been studied by Battelle-Pacific Northwest Laboratories under contract with the NRC. Their report indicates that certain models of audible alarm dosimeters would be adequately reliable for use by industrial radiographers, although their use would be subject to some limitations. The Health Physics Society Standards Committee (HPSSC) has developed a draft performance standard for these dosimeters. The staff is developing a regulatory guide which will endorse the use of audible alarm dosimeters if they meet the draft HPSSC standard and are used within certain limitations. The draft regulatory guide is scheduled

to be issued in May, 1979. SECY-78-57 did not provide a target date for the guide.

(3) Training programs for radiographers.

The Office of Inspection and Enforcement has recently published a report containing case histories of radiography overexposure accidents (NUREG-0495). The report was published in December, 1978 versus an August, 1978, target date. Instruction in such case histories would be required by one of the amendments of 10 CFR Part 34 contained in Enclosure "A" of this paper.

The development of a standard safety training program for industrial radiographers is underway at the University of Lowell, under NRC contract. The draft program was submitted to NRC in January, 1979, meeting the original target date. The NRC staff will review the program, and it will be revised as necessary. The program will then be published as a draft NUREG report and distributed to radiography licensees and Agreement States for their review and comment. An improved program, based on these comments, will be developed.

(4) Licensing of individual radiographers.

In a letter dated June 24, 1977, The Non Destructive Testing Management Association (NDTMA) suggested to the NRC staff that licensing of individual radiographers by the NRC would improve

safety (1) by assuring a minimum level of competence and (2) by making the individual radiographer responsible for his own actions, making him liable for fines and suspension of his license for violations of NRC regulations and license conditions.

On June 28, 1978, the NDTMA asked NRC to consider their letter to be a petition for rulemaking. The NRC accepted the letter as a petition. A notice on the petition was published in the Federal Register on August 4, 1978, with public comments due by October 3, 1978. Eleven public comments were received, all opposing the petition. The staff is developing a recommended response to the petition which is scheduled to be submitted to the Commission by late 1979. SECY-78-57 provided no target date for this action.

626 124