SESSION XII

REGULATION

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CHAIRMAN: J. T. Collins

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OPENING REMARKS OF SESSION CHAIRMAN:

On behalf of the program committee, I would like to welcome you to the 12th session entitled "Regulation." I venture to say that it would be hard to attend any kind of a national meeting at which we failed to hear something on regulation and I'm sure that we won't disappoint you this afternoon. I think it's also safe to say that there's a number of people at this conference and in industry who feel that our nuclear industry is overregulated. On the other hand, there are other people who are looking for additional guidance; who are looking for more specific regulations. One could construe from that that we are damned if we do and damned if we don't. We're not going to discuss the merits of either.

The speakers this afternoon will take up the subject of implementation of standards used in the design of air cleaning systems. We will then discuss with you some recent developments pertaining to guides and regulations applicable to nuclear power reactors. Then we'll talk about some of our experience in some recent regulations.

USE OF ANSI N-509 IN DESIGN AND LICENSING OF NUCLEAR AIR CLEANING SYSTEMS

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Abstract

American National Standard N-509, "Nuclear Power Plant Air Cleaning Units and Components", has been prepared for ASME by an ad hoc committee* (N45-8.1) of the Subcommittee on Nuclear Power Plant Air and Gas Cleaning Systems (N45-8). After reviewing the background of N-509, the standard is described and its use in design and licensing of nuclear air cleaning systems is discussed.

Background

The American National Standards Subcommittee on Nuclear Power Plant Air and Gas Cleaning Systems (N45-8) was formed to develop standards for testing standby gas treatment systems. At its first meeting, on July 20 and 21, 1971, the charter of the N45-8 Subcommittee was expanded to cover air and gas cleaning systems for all types of nuclear power plants. The subcommittee was organized into four (4) working groups to prepare the following standards:

N45-8.1 - Requirement for Purge and Post-Accident Gas Treatment Systems External to Primary Containments.

N45-8.2 - Requirements for Recirculating Purge and Post-Accident Gas Treatment Systems (Inside Containment).

N45-8.3 - Testing Programs for Nuclear Gas Treatment Systems.

N45-8.4 - Requirements for Condenser Off-Gas Treatment Systems.

The initial organization of the N45-8 Subcommittee, its progress, and descriptions of the first two standards to be prepared by the N45-8.1 and N45-8.3 Ad Hoc Committees were presented at the 12th AEC Air Cleaning Conference [1]. Soon thereafter the titles of the four proposed standards were revised as shown in the forward of American National Standards N-509 (ANSI N-509).

Subsequently it was recognized that the basic requirements for the two types of air cleaning systems included in the N45-8.1 and N45-8.2 areas are the same in all but a few respects. The scope of the standard to be prepared by N45-8.1 was revised to incorporate requirements for both types of systems and N45-8.2 was deleted.

* Ad Hoc Committee on Nuclear Power Plant Air Cleaning Units and Components (N45-8.1), C. A. Thompson, Chairman

The N-509 Standard has been prepared for the American Society of Mechanical Engineers (ASME) under the American National Standard Nuclear Technical Advisory Board (NTAB). ANSI N-509, Draft 9, was approved by the N45-8.1 Ad Hoc Subcommittee and the N45-8 Subcommittee in December, 1975, and forwarded to ASME for approval and printing. The standard was approved by the ASME Committee on Nuclear Power Codes and Standards with minor comments to be incorporated in a future addendum. The standard was to be published by ASME in July, 1976, but has been delayed several months for final ANSI approval.

Description of Standard

The scope, basic concepts, organization, and special features of ANSI N-509 are described next.

Scope

The N-509 Standard includes requirements for the design, construction, and testing of the units and components which make up Engineering Safety Features (ESF) and other high efficiency air and gas cleaning systems used in nuclear power plants. The standard identifies and establishes minimum requirements for filters, adsorbers, moisture separators, air heaters, filter housings, dampers, fans, motors, ducts, and other components. It also establishes requirements for operability, maintainability, and testability. Testing provisions are specified to verify the adequacy of the unit and component design and to assure proper fabrication, installation, and system performance in accordance with specification requirements. This includes acceptance testing, including minimum acceptance criteria, in accordance with ANSI N-510, which was prepared by the companion N45-8.3 Ad Hoc Committee [2].

Limitations of the Standard. The standard does not cover functional design or sizing of complete air cleaning systems or include requirements for redundancy or integration of individual units into the complete air cleaning systems. It does not apply to Boiling Water Reactor condenser off-gas systems or cover requirements for containment isolation valves, recombiners, or ordinary heating, ventilating, and air conditioning.

Basic Concepts

The N45-8.1 Committee incorporated several basic concepts during the preparation of N-509. Included in these basic concepts are safety classification; requirements, recommendations, and options; and systems, units, and components.

ESF and Non-ESF Systems. The consensus of the committee was that the basic requirements for units and components which comprise both Engineered Safety Features and other high efficiency air and gas cleaning systems used in nuclear power plants require essentially the same level of quality. In addition, components and units for ESF systems have other requirements which are related to the safety function; for example, seismic requirements, electrical motor qualifications, and isolation requirements. In general, most portions of the standard apply to both ESF and non-ESF systems. Specific requirements for ESF units and components are identified and, where practical, appear in separate paragraphs of the standard.

Requirements, Recommendations and Options. The basic purpose of the standard is to provide minimum requirements which are mandatory for all units and components which meet the standard. In addition, the committee felt it desirable to include non-mandatory recommendations which, if followed, will further improve the quality of the units and components. For both mandatory minimum requirements and recommended practices, in a number of instances several options are available to the user of the standard.

Systems, Units and Components. One of the early decisions of the N45-8.1 Committee was that it was necessary to limit its scope in order to prepare a usable standard in a reasonable period of time. Since no comprehensive standard for air cleaning systems and components was available, it appeared to be a very large undertaking to provide as a first effort a standard having such comprehensive coverage. It was therefore decided to limit the scope of the inital standard to components, i.e., to exclude system requirements. Even though complete air cleaning systems were excluded from the scope of the standard, many of the components are normally assemblied into a single housing which comprises a major portion or subdivision of complete air cleaning system. This led to the definitions of air cleaning systems, air cleaning unit, and components as given in Section 3 of N-509. As defined therein, an air cleaning unit is an assembly of components which comprise a single subdivision of a complete air cleaning system, including all components necessary to achieve the air cleaning function of that subdivision. A unit includes the housing plus all internal components installed therein. An air cleaning system consists of one or more units and associated external components required to convey air from one or more intake points through any combination of filters and adsorbers to one or more points of discharge. The term air cleaning unit thus became a basic concept in the N-509 standard.

Organization

An outline of the N-509 Standard is presented in Table I. This table is essentially an abbreviated table of contents of the standard and shows its principal portions. The major sections of the standard are those covering functional design, component requirements, acceptance testing, and the appendix covering test canisters.

Functional Design. Section 4 of the standard, covering functional design, includes those functional requirements of a unit and the principal components comprising an air cleaning system. Since N-509 does not provide complete system requirements, Paragraph 4.2 requires that the user of the standard specify the values of a number of design parameters normally developed by the system designer. These parameters are referenced throughout the standard in the requirements for units and components. Other functional requirements include the size or installed capacity of the unit as determined by the HEPA filters and adsorbers, design pressure considerations, maintainability criteria, monitoring requirements, adsorber radioactive decay cooling requirements, testability criteria, and pressure boundary leakage criteria.

Components. The largest portion of the N-509 standard is made up of the requirements of the several types of components, which are listed in Table I. In addition to design and testing requirements for each type of component, the standard provides requirements for drawings and documentation for most components. The component requirements incorporate or invoke by reference existing standards wherever possible. New criteria have been added where suitable existing standards were not found to be available. In particular, the criteria for housings, dampers, ducts, and test canisters were found to be unavailable and were developed during the preparation of N-509.

Acceptance Testing. Paragraph 8.5 of the standard provides requirements for acceptance tests to be made in accordance with the procedures of ANSI N-510 and provides the miminum acceptance criteria which must be satisfied by each of the applicable tests of ANSI N-510.

Test Canisters. Paragraph 4.11 of the standard, covering testability requirements, requires sufficient test canisters as described in Appendix A of the standard or other means of obtaining samples of used adsorbent to be installed in the adsorber system to provide a representative determination of the response of the adsorbent to the service environment over the predicted life of the adsorbent. General requirements for the test canisters are covered in Paragraph 4.11. Appendix A provides specific requirements for several test canister installation types. These include individual test canisters which are installed in the adsorber mounting frame and test canisters which are installed in a modified flat bed or deep bed adsorber cell.

Special Features

Several of the special features of the N-509 Standard are highlighted next.

Definition of Batch and Lot. The terms batch and lot have been used with different meanings by different people in the air cleaning industry. Late in the development of the standard, it was found necessary to provide specific definitions of both lot and batch, particularly in reference to adsorbent, in order to properly specify the qualification requirements for adsorbents. It is anticipated that the definition of these terms in the N-509 standard will become the standard definitions of the nuclear air cleaning industry. This could resolve long-standing confusion in the exact meaning of these terms as used by different persons.

Pressure Boundary Leakage. The criteria for leakage across the pressure boundary of any portion of an air cleaning system includes three distinct types of requirements as listed in Paragraph 4.12 of the standard. These are air cleaning effectiveness requirements, health physics requirements, and duct and housing quality requirements. In any particular case, any one of these three requirements may determine the allowable leakage. Paragraph 4.12 requires that the lowest value as determined by each of these three items shall be used as the allowable leakage. This, in turn, will determine the type of duct construction, for example, welded or non-weld However, ducts for ESF systems and all housings are to be welded.

The definition of and criteria for each of the three types of pressure boundary leakage requirements are given in Paragraph 4.12. As discussed therein, the ultimate measure of air cleaning effectiveness is the reduction in concentration of airborne radioactivity in the contained space or in the effluent released to the off-site atmosphere. Health physics requirements concern limiting plant personnel exposure due to contaminated out-leakage from ducts or housings to dose values established by codes, regulations, or other accepted standards. Duct and housing quality requirements provide a minimum acceptable level of workmanship. Examples providing methods of determining the allowable leakage for the requirements of Paragraph 4.12 are provided in Appendix B.

Dampers and Ducts. Due to lack of existing standards for these components, the committee developed completely new criteria and requirements for both dampers and ducts. These new requirements are given in Paragraphs 5.9 and 5.10 of the N-509 Standard, respectively. Dampers are classified by function, configuration, construction, and leakage class. Recommended damper configurations and minimum requirements for construction and leakage are given in Table 5-2 of the standard and maximum permissible damper leak rates are provided in Table 5-3.

In addition to the specific design requirements given for ducts in Paragraph 5.10 of the standard, the air leakage test requirements discussed above and given in Paragraph 4.12 of the standard were derived as a result of preparation of the criteria for ducts.

Use of N-509 in Design

When designing total air cleaning systems for nuclear power plants, it is intended that the requirements of ANSI N-509 be specified for the units and components which comprise the system. N-509 is intended to be used in all phases of design, manufacturing, storage, installation, erection, and in-place testing of units and components used in nuclear power plants to reduce and minimize concentrations of airborne radioactive materials in normally occupied portions of the plant and in airborne effluents from the plant.

In addition to application to systems handling radioactive contaminated air, N-509 is also intended for use in purging and cleanup systems handling contaminated atmospheres which are rich in nitrogen and/or hydrogen.

Specifications

The primary use of N-509 will be in preparing specifications for the design, purchase, manufacturing, storage, installation, erection, and in-place testing of units and components which comprise nuclear air cleaning systems for nuclear power plants. The distinction between standards and specifications should be carefully noted at this point. The N-509 Standard includes mandatory minimum requirements and recommendations. Design and procurement specifications, on the other hand, include additional specific information and requirements for particular applications.

Specifications include special requirements of the purchaser in addition to minimum requirements covered in the standard, specify those recommendations and options of the standard which are to be incorporated, and provide system design and size parameters for all equipment being specified. Normally, specifications also include detailed shipping information and data sheets, purchase terms, agreements, contract forms, and price information to be completed by the potential vendor. In addition, specifications for units and components of ESF systems include seismic and quality assurance requirements to be followed for equipment supplied.

Specifications which require the use of ANSI N-509 or portions thereof are normally prepared for complete nuclear air cleaning systems. Therefore, the values of the design parameters required by Paragraph 4.2 of N-509 are to be included in the specification along with other general system requirements. It is also not unusual for one design specification to provide requirements for a number of nuclear air cleaning systems.

ESF and Non-ESF Specifications. As discussed earlier, the same basic quality is required for both ESF and non-ESF nuclear air cleaning systems, units, and components. The majority of the mandatory minimum requirements and of the recommendations of N-509 apply to both types of design. However, due to the additional requirements normally imposed upon ESF systems, including seismic design and analysis, quality assurance, and other requirements peculiar to ESF systems, units, and components, it is normal practice to include only ESF or non-ESF equipment in any particular design or procurement specification. It is the intent of the N45-8 Subcommittee that N-509 requirements and recommendations be invoked in specifications for both ESF and non-ESF systems, units and components. Specifications for ESF equipment would invoke these requirements while specifications for non-ESF equipment would normally exclude these requirements.

Invoking N-509 Requirements. The use of N-509 can materially reduce specification writing and result in uniform, high quality, readily maintainable and testable systems. Long-range price reduction can be expected to result from the use of uniform requirements in specifications if N-509 requirements are utilized by the majority of purchasers of this type of equipment.

The specification or requisition for a system "in accordance with ANSI N-509" would be accepted by the suppliers and would produce a good system; however, since N-509 includes requirements specifically for ESF units and components, contains recommendations which are not mandatory requirements, and also contains various options which must be selected by the user, a proper specification or requistion should require conformance to specific paragraphs of N-509. Alternately, the specificaton could require conformance to all portions of ANSI N-509, including all recommendations contained therein. In either case, it would be necessary to delineate in the specification which options were to be followed for the equipment to be supplied.

The specification should also include quality assurance requirements, seismic design and analysis requirements, data sheets for each component to be supplied to be completed by the selected vendor, and the values of the system design parameters required by Paragraph 4.2 of the standard. Although either method of using N-509 could be utilized, it appears preferable for the specification to require conformance with a list of specific paragraphs of N-509 including delineation of recommendations and options which are to be followed for the equipment to be supplied to that specification.

It would also be possible to use material requsitions or other short forms or purchasing requests which required conformance to specific paragraphs of N-509 and provided data sheets, standard purchaser quality assurance and seismic design attachments or specifications, and the values of the design parameters required by Paragraph 4.2 of N-509; thereby eliminating entirely the use of a formal specification. However, in general, requirements beyond the minimum requirements and recommendations of N-509 will also be necessary. For example, additional requirements are imposed by NRC licensing documents such as Regulatory Guide 1.52 for ESF systems and Branch Technical Position ETSB No. 11-2 for non-ESF systems. Thus short specifications invoking specific paragraphs of N-509 are preferred.

N-509 can also be used by architect/engineers and utilities which design their own systems in preparing standard specifications for their company's use. Such standard specifications would then be used for all equipment purchased for all future projects of that entity. This would even further simplify and standardize the preparation of specifications and the manufacture of units and components for nuclear air cleaning systems.

Manufacturing

In the future, incorporation of the requirements of N-509 by most purchasers will result in product lines which meet standard minimum requirements by all manufacturers supplying this type of equipment. The use of standard specifications by major architect/engineers and utilities would provide further savings and opportunity for even broader standardization of product lines of the suppliers. Standardization of component testing requirements incorporated in N-509 and the requirements for standard design drawings and design reports included in the standard would provide further savings for the suppliers. Supplier quality control programs meeting the requirements of N-509 should be acceptable to the majority of purchasers. Minimum requirements for packing and shipping would also be standardized by the majority of suppliers of this type of equipment.

Storage, Installation and Erection

It is possible for high quality, properly specified, designed and manufactured equipment to be rendered ineffective by improper storage, installation and erection procedures during the construction or modification of a nuclear power plant. Therefore, design specifications should require that all units and components be handled in conformance with the Sections 6, 7, and 8 of ANSI N-509. This will further assure the proper performance of high quality equipment supplied and installed in accordance with N-509 and avoid rejection with associated delays and costly replacement of components damaged or otherwise rendered unuseful by improper storage, installation, and erection.

In-Place Testing

In-place acceptance testing as specified by Paragraph 8.5 of ANSI N-509 should be required by design specifications for installation of nuclear air cleaning systems, units, and components during construction or modification of nuclear power plants. Such equipment should meet the criteria for acceptance specified in Paragraph 8.5 of the standard in order to assure that the installation or modification of the system equipment is adequate to allow the system to perform its intended function. Systems and equipment which fail to meet the criteria specified in Paragraph 8.5 should be repaired and retested until the criteria are met prior to accepting the system for operation.

Use of N-509 in Licensing

The N-509 Standard, as well as the companion N-510 Standard, is intended to be referenced in specifying licensing committments and requirements. The participation of the Nuclear Regulatory Commission (NRC) in preparation of N-509 and limitations adopted to the scope of the standard assure compatability with the Commission's licensing requirements. The utilization of standards prepared by industry in licensing applications and their subsequent review and approval by the NRC should minimize the areas of potential disagreement between the applicant and the Commission. Reference to portions of these standards in Revision 1 to NRC Regulatory Guide 1.52 and in NRC Branch Technical Position ETSB No. 11-2, and committment to requirements of the standards in licensing application documents are described.

Compatibility with Licensing Requirements

From the beginning of the committee activity, it was the intent to develop standards which users, suppliers, and the NRC can utilize to assure the maintaining of high efficiency nuclear air and gas treatment systems. It was believed that the availability of such standards would simplify and expedite the licensing process for nuclear power plants. In order to assure that this objective was met, at all stages of the development of the N-509 Standard as well as the companion N-510 Standard, the NRC (formerly the Atomic Energy Commission - AEC) was represented on the committee. The participation of these members of the Commission in the standard development effort helped to identify and resolve conflicts between the resulting standard and regulatory recommendations and guidelines which otherwise might have existed.

The restriction of the scope of the N-509 Standard to units and components further aided in eliminating differences which might have resulted between industry and Commission members of the committee. The regulatory recommendations and guidelines contain many system requirements as well as component requirements. It was believed that by restricting the scope of this standard to units and components, an industry accepted standard could most quickly be prepared which would be compatible and consistent with the regulatory recommendations. Furthermore, other standards activities, such as those covered by the American Nuclear Society, already included nuclear air cleaning system requirements in their scope. It was decided that a standard covering only units and components would be useful in meeting the licensing objectives and would serve as a useful standard for incorporation by reference in system standards produced by other committees. Subsequent revisions of the regulatory guides and establishment of branch technical positions have incorporated by reference certain portions of the requirements for units and components covered in the N-509 standard.

Revision 1 to Regulatory Guide 1.52

Revision 1 to NRC Regulatory Guide 1.52 was issued for comment in July, 1976[3]. In addition to incorporating requirements of the ANSI N-509 and N-510 standards, the revised Regulatory Guide contains a number of other revisions to the original issue of the guide. Among these other revisions are changes to the title and scope of Regulatory Guide 1.52 to limit its application to Engineered Safety Features (ESF) systems. In addition to general reference to the N-509 and N-510 standards, the major revisions to the Regulatory Guide making reference to portions of N-509 include qualification of new carbon, carbon sampling in accordance with Appendix A, leakage rate testing of system housings and duct work, and required documentation. Table II provides a summary of portions of ANSI N-509 and N-510 required by Revision 1 to Regulatory Guide 1.52.

ETSB No. 11-2

NRC Branch Technical Position No. 11-2, "Design, Testing and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light Water - Cooled Nuclear Power Reactor Plants", dated 11/24/75, is the non-ESF counterpart of NRC Regulatory Guide 1.52[4] Many of the recommendations of ETSB No. 11-2 are very similar to those of Regulatory Guide 1.52, but several are somewhat less restrictive. Like Revision 1 to Regulatory Guide 1.52, this Branch Technical Position incorporates requirements of both ANSI N-509 and N-510.

The Branch Technical Position incorporates a large number of recommendations by reference to particular paragraphs of N-509. ETSB No. 11-2 recommends conformance to the criteria given in N-509 for the following items: instrumentation for monitoring and alarm; housing and duct leakage; quality of HEPA filters; heaters; component mounting frames; filter housings, including floors, doors, electrical conduits and drains; ductwork; adsorber cells, including arrangement and documentation; system fans, including mounting and ductwork connections; dampers; accessability and maintainability; provisions for test probes; and carbon samples meeting the requirements of Appendix A of the standard. A summary comparing sections of ESTB No. 11-2 with portions of ANSI N-509 and N-510 required by the Branch Technical Position is given in Table III.

Licensing Applications

It is intended that applicants preparing licensing documents such as Preliminary and Final Safety Analysis Reports (PSAR, FSAR) commit to meeting requirements given in N-509 and N-510. Revision 2 of the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants requires information for habitability systems for the control room, ESF filter systems for fission product removal and control systems, and air conditioning, heating, cooling and ventilating systems used for normal operation (non-ESF) in Sections 6.4, 6.5.1 and 9.4, respectively. Implementation of the requirements and recommendations of ANSI N-509 and N-510 should be included in these sections of the SARs submitted to the NRC, both by direct reference to the standards (both general and particular paragraphs) and indirectly by incorporating the guidelines and recommendations of Regulatory Guide 1.52, Revision 1, and Branch Technical Position ETSB No. 11-2.

Use in Other Standards and Other Applications

The ANSI N-509 Standard is expected to be incorporated in standards prepared by other organizations having scopes which include nuclear air cleaning systems requirements for use in both nuclear power plants and other applications, e.g., research facilities, hot cells, fuel reprocessing plants, fuel fabrication plants, and radioactive waste facilities. The N-509 Standard, as well as its companion N-510 Standard, may be used directly in applications other than nuclear power plants by incorporating its requirements in the design and licensing of such facilities. In addition, regulatory guides and requirements for facilities other than nuclear power plants may incorporate the requirements of these standards.

An example of the use of ANSI N-509 in more general standards for air cleaning systems for nuclear power plants is the proposed ANSI N-276, "BWR Containment Ventilation Systems", which is being prepared by the ANS-50 Committee. This standard acknowledges and makes reference to ANSI N-509. It is expected that in the future, additional standards will be prepared by the American Nuclear Society and other organizations which incorporate N-509 requirements.

Updating of N-509

The ANSI/N45-8 Subcommittee has been reorganized under the ASME "Accredited Organization Method" for preparing American National Standards. This new ASME Committee on Air and Gas Treatment Equipment will be one of several committees under the recently reorganized ASME Committee on Nuclear Power Codes and Standards. This committee, in turn, reports to the ASME Policy Board on Codes and Standards. Other committees included under the Committee on Nuclear Power Codes and Standards are Operation and Maintenance, Quality Assurance, Qualification Testing, Sections III and XI of the Boiler and Pressure Vessel Code, and Mechanical Equipment. Organizational meetings of the Air and Gas Treatment Equipment Committee were held February 26 and May 6, 1976.

The ANSI N-509 and N-510 standards now fall under the custody of the ASME Committee on Air and Gas Treatment Equipment. This committee will prepare subsequent issues and revisions to the N-509 and N-510 Standards as appropriate, which will then be reissued by ASME.

References

1. F. D. Leckie and C. A. Thompson, "ANSI/N45-8 Nuclear Gas Systems Treatment Standards", Proceedings of the 12th AEC Air Cleaning Conference, CONF-720823, Vol. 2, pp. 848-856, (1972).

2. American National Standard - Reactor Plants and Their Maintenance, "Testing of Nuclear Air Cleaning Systems", ANSI N-510-1975, The American Society of Mechanical Engineers (1975).

3. Regulatory Guide 1.52, "Design, Testing and Maintenance Criteria for Engineered Safety Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants", Revision 1, June, 1976, U. S. Nuclear Regulatory Commission (1976).

4. NRC Branch Technical Position ETSB No. 11-2, "Design, Testing and Maintenance Criteria for Normal Ventialation, Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Reactor Plants", U. S. Nuclear Regulatory Commission (1975).

Table I

Outline of standard ANSI N-509

1. SCOPE

2. APPLICABLE DOCUMENTS

3. TERMS AND DEFINITIONS

4. FUNCTIONAL DESIGN
4.1 General
4.2 Design Parameters
4.3 Size (Installed Capacity) of Unit
4.4 Environmental Design Conditions
4.5 Structural Load Requirements
4.6 Design Pressures
4.7 Maintainability Criteria
4.8 Monitoring of Operational Variables
4.9 Adsorbent Radioactive Decay Heat Cooling
4.10 Insulation
4.11 Testability
4.12 Pressure Boundary Leakage

5. COMPONENTS
5.1 HEPA Filters
5.2 Adsorbers
5.3 Prefilters
5.4 Moisture Separators
5.5 Heaters
5.6 Filter Housing
5.7 Fan
5.8 Fan Motors
5.9 Dampers
5.10 Ducts

6. PACKAGING, SHIPPING, AND STORAGE OF COMPONENTS

7. INSTALLATION AND ERECTION

8. QUALITY ASSURANCE INCLUDING ACCEPTANCE TESTING

APPENDIX A. SAMPLING METHODS TO DETERMINE PERFORMANCE DEGRADATION RATES OF ADSORBENTS

APPENDIX B. PROCEDURE TO DETERMINE TEST UNIT LEAKAGE FOR DUCTS AND HOUSINGS

APPENDIX C. FIELD OBSERVATION CHECKLIST

Table II

Summary of ANSI N-509 and N-510 sections required
by NRC Regulatory Guide 1.52, Revision 1

Reg. Guide 1.52 Position	Subject	N-509 Section(s)	N-510 Section(s)
C.2.1	Testing and acceptance criteria	4.11, 8.5	All
C.5	Visual inspection	-	5
C.5.a	Flow distribution test	-	8
C.5.b	DOP testing of HEPA filters	-	10
C.5.c	Freon testing of adsorbers	-	12
C.6.b	Carbon samples	Appendix A	-
C.6.c	Detailed test procedures	4.11, 8.5	All
Table I	New activated carbon tests	5.2.3	-

Table III

Summary of ANSI N-509 and N-510 sections required by
NRC Branch Technical Position ETSB No. 11-2

ETSB No. 11-2 Position	Subject	N-509 Section(s)	N-510 Section(s)
B.2.c	Local instrumentation	4.8.1	-
B.2.g	Housing and duct leakage rate	4.12	6
B.3.a	Heaters	5.5	-
B.3.b	HEPA filter design	5.1	-
B.3.c	Component mounting frames	5.6.3	-
B.3.e	Unit filter housings	5.6	-
B.3.f	Ductwork	5.10	-
B.3.h	Adsorber cells	5.2	-
B.3.i	Fan and motor	5.7, 5.8	-
B.3.1	Dampers	5.9	-
B.4.b	Accessibility and maintenance	4.7	-
B.4.d	Permanent test probe parts	4.11	-
B.5.a	Visual inspection	-	5
B.5.b	Air flow distribution	-	8
B.5.c	In-place HEPA DOP test	-	10
B.5.d	Refrigerent testing of adsorbers	-	12
B.6.b	Carbon samples	Appendix A	-

DISCUSSION

PALMER: Why was the standard (ANSI N-509) taken away from the ANSI organization for updating, etc.? I don't understand that.

THOMPSON: This is a reorganization of the entire ASME committee structure and I have some brief comments on it in my paper. Let me refer to it to list the other committees that are included. The ASME committee on Nuclear Power Codes and Standards has incorporated a number of standards areas from ANSI and other organizations relating to nuclear power plants. Included under this committee are a number of other committees, including the committee on Operation and Maintenance, Quality Assurance, which would be the old N-45-2, Qualification Testing, Sections III and XI of the Boiler and Pressure Vessel Code, Mechanical Equipment, and theAir and Gas Treatment Equipment Committee. Beyond that, I can't give you much additional information but I hope it gives a partial answer to your question.

COLLINS: Is Jim Fish in the audience? Perhaps he could further clarify this matter.

FISH: N-45 was a committee that functioned under the chairmanship of Saul Bernstein of Wisconsin Power. That committee was finally terminated about one week ago. Under the new "Accredited Organization Method", the Nuclear Power Code and Standards Committee, of which we are a part, has picked up the air and gas treatment activity.

R. A. BROWN: If the ANSI standard has been made compatible with the Regulatory Guide, why do we need both?

THOMPSON: Perhaps I should defer comment inasmuch as we have two Nuclear Regulatory Commission members who will speak after me, but I will attempt an answer. I believe it is correct that NRC likes to be able to reference acceptable industry standards when these provide an acceptable degree of conservative design, testing, and operation to meet safety requirements.

R. A. BROWN: Then perhaps in your paper you should have said that the Regulatory Guide was compatible with the standard you established rather than your standard being compatible with the Regulatory Guide.

THOMPSON: We have worked closely with the Regulatory Commission on this standard and we have made every attempt to make the two viewpoints compatible I guess it is not really a question of which came first, the chicken or the egg, because Regulatory Guide 1.52 was there first. We didn't want to disagree in any areas without good reason. There were some recommendations for revisions to the Regulatory Guide that were made by the committee, and some of these are, indeed, reflected in Revision 1.

RECENT DEVELOPMENTS IN NRC GUIDELINES FOR ATMOSPHERE CLEANUP SYSTEMS

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Abstract

The Nuclear Regulatory Commission (NRC) maintains the policy of updating when necessary, its published guidance for the design of engineered safety feature (ESF) and normal ventilation systems. The guidance is disseminated by means of issuing new, or revisions to, existing Regulatory Guides, Standard Review Plans, Branch Technical Positions and Technical Specifications. NRC guidance is updated only when a strong technical basis exists, resulting from standards development, research developments, the determination of additional review areas that are found to be needed based on operating reactor experience, or the review of Safety Analysis Reports.

Since the 13th Air Cleaning Conference two years ago, NRC has added to and changed many of its guidelines for atmosphere cleanup systems. This paper will discuss a revised Regulatory Guide, new Technical Specifications and new Standard Review Plans with Branch Technical Positions for atmosphere cleanup systems.

Regulatory Guide 1.52, "Design, Testing and Maintenance Criteria for Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants," was issued in July 1973. Since that time, NRC has received numerous comments from industry on the regulatory positions contained in the guide. During this period, NRC has participated in numerous meetings with various segments of the nuclear industry (utilities, architect-engineers, filtration system vendors and private consultants) concerning the positions set forth in this guide. Revision 1 to Regulatory Guide 1.52 reflects comments received from the industry, latest state-of-the-art technology, operating experience and the requirements set forth in recently issued ANSI Standards N510-1975, "Testing of Nuclear Air Cleaning Systems," and ANSI N509 (draft), "Nuclear Power Plant Air Cleaning Units and Components".

Technical Specifications for ESF filter systems that require a variety of in-place tests for these systems have been issued to all operating reactors and those utilities receiving operating licenses. Standard Review Plan 11.3, "Gaseous Waste Systems," was issued December 22, 1975 and contains Branch Technical Position (BTP) Effluent Treatment Systems Branch (ETSB) No. 11-2, "Design, Testing and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Reactor Plants". BTP ETSB 11-2 outlines NRC guidance for normal ventilation exhaust systems that are designed to meet the "as low as is reasonably achievable" guidelines of Appendix I to 10 CFR Part 50, and contains NRC positions with respect to review procedures for HEPA filters for particulate removal and charcoal adsorption units for low-concentration radioiodine removal.

This paper will discuss the major comments received from the nuclear industry since the guide was issued in July 1973, NRC's experience in implementing the guide in recent license applications, status of operating plants in meeting the guidelines and NRC's continuing assessment of operating data and laboratory tests to assure that the guide reflects the latest technology.

I. Introduction

New and revised guidance for the design of atmosphere cleanup systems to be installed in commercial nuclear power facilities have appeared from various sectors of the nuclear industry in the last two years. Industry standards, research accomplishments, developments in operating experience, and new regulations have all impacted on this occurrence. The Nuclear Regulatory Commission (NRC) has made its contributions in the form of a revised Regulatory Guide, Standard Review Plans, Branch Technical Positions and Technical Specifications. This paper will discuss (1) Revision 1 to Regulatory Guide 1.52, "Design, Testing, and Maintenance Criteria for Engineered Safety Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants,"[1] (2) Technical Specifications for engineered safety feature (ESF) filter systems, and (3) Branch Technical Position (BTP) Effluent Treatment Systems Branch (ETSB) No. 11-2, "Design, Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."[2]

II. Revision 1 to Regulatory Guide 1.52

Since Regulatory Guide 1.52[3] was issued in July 1973, NRC has received numerous comments on its contents. These comments have been received in various forms, including official submittals to the Advisory Committee on Reactor Safeguards, informal conversations, and scheduled meetings, and have been received from consultants, utilities, architect-engineers, filtration system vendors and other governmental agencies. Revision 1 has considered every comment received.

Many of the changes to Regulatory Guide 1.52 are minor clarifications. These changes will not be discussed here, but will be available for your review in the near future when the revised Guide is issued for public comment. The issuance of the revised Guide will be noted in the Federal Register, and information will be included pertaining to its availability. A 60-day comment period will follow, after which the NRC staff will consider all comments received and incorporate any applicable comments into the final version of Revision 1. However, once the draft of Revision 1 is issued for public comment, it may be referenced in license applications.

One of the major proposed changes to the Guide pertains to provisions to preclude possible iodine desorption and adsorbent autoignition that may result from radioactivity induced heat and the associated temperature rise. Previously, water sprays were considered necessary to inhibit adsorber fires. The proposed change would allow a single-failure proof low flow air bleed system to prevent any temperature rise. This means of cooling has been shown acceptable by various analyses,[4] including computer simulation.[5]

Experience with water sprays has shown their susceptibility to inadvertent activation (thus inhibiting the carbon from further usefulness as an adsorbent), and the possibility of the spray resulting in re-volatilization of adsorbed iodine.[6] A suitable low flow airbleed system may be obtained by cross-connections or redundant fans. The single failure criterion applies to the fans, cross-connections and heaters (to assure that any air bleed is at a maximum relative humidity of 70%).

A second major change is concerned with bypassing of any cleanup components during testing. Previously, temporary bypassing of banks of components was needed to prevent the test agents from contaminating the high efficiency particulate air (HEPA) filters or carbon adsorbers. Laboratory tests have shown such precautions to be unnecessary.[7, 8]

The third major change concerns utilization of two industry standards that were issued since July 1973. ANSI N510-1975, "Testing of Nuclear Air-Cleaning Systems,"[9] describes methods for field-testing of nuclear air cleaning systems. Sections of ANSI N510-1975 incorporated in Revision 1 to Regulatory Guide 1.52 include a visual inspection of filter trains, air flow distribution testing, in-place dioctyl phthalate (DOP) leak testing of HEPA filter banks, in-place halogenated hydrocarbon refrigerant leak testing of adsorber banks, and laboratory testing of adsorbent. ANSI N509-Draft 9 (November 1975), "Nuclear Power Plant Air Cleaning Units and Components,"[10] covers requirements for the design, construction, and testing of units and components which make up high efficiency air and gas cleaning systems used in nuclear power plants. Sections of ANSI N509-Draft 9 incorporated in Revision 1 to Regulatory Guide 1.52 include guidance on how to obtain representative used carbon samples, qualification of new carbon to be installed in ESF filter systems, and documentation. Mr. Thompson has just completed a discussion of the use of this standard in the design and licensing of nuclear air cleaning systems.[11]

The fourth major change to the Guide is concerned with in-place testing frequency. The Guide as now issued recommends in-place testing simply on a calender frequency, with no consideration for how long the filter system might actually have been in operation and degrading. The proposed change recommends in-place testing (1) initially, (2) at least once per operating cycle if in a standby status or after every 720 hours of filter system operation, and (3) following painting, fire, or chemical release in any ventilation zone communicating with the system that could contaminate the HEPA filters or carbon adsorbers. This testing frequency verifies that the system has been installed properly, that undue aging or weathering has not occurred, and that contamination of the filter system components has not occurred after painting, fire or chemical release. A testing frequency of 720 hours may seem unduly restrictive for those systems used for any normal plant ventilation, but is considered necessary to verify that poisoning or weathering of the carbon adsorbent has not occurred. A review of the available degradation data for in-service carbon [12-22] supports this testing frequency, when the uncertainties in the reactor site, the filter system location, and the contaminants the filter system will experience, are considered.

Some of the minor changes proposed to Regulatory Guide 1.52 include (1) allowing 1500 cubic feet per minute HEPA filters, (2) deleting the recommendation for provisions to replace contaminated filter trains as an intact unit, (3) leak testing in accordance with ANSI N510-1975, with acceptance criteria as outlined in ANSI N509-Draft 9, and (4) elimination of any reference to non-ESF atmosphere cleanup systems.

III. ESF Atmosphere Cleanup System Technical Specifications

Regulatory Guide 1.52 contains a section entitled "In-Place Testing Criteria." Although a utility commits to this testing program when the plant is being designed, site-specific Technical Specifications are needed to ensure that an adequate in-place testing program is being followed. Thus, Technical Specifications to cover the in-place testing of ESF atmosphere cleanup systems have been developed. These specifications reflect the proposed changes to Regulatory Guide 1.52 and have been issued to approximately 75% of the 58 reactor units licensed to operate to date (the remainder of the operating reactors are in the process of revising their Technical Specifications accordingly). The Technical Specifications are also part of the Standard Technical Specifications being issued to applicants seeking an operating license.

As previously discussed, the Technical Specifications for ESF atmosphere cleanup systems require in-place testing (1) initially, (2) at least once per operating cycle if in a standby status or after every 720 hours of filter system operation, and (3) following painting, fire, or chemical release in any ventilation zone communicating with the system that could contaminate the HEPA filters or carbon adsorbers. This testing frequency is considered appropriate to assure that, if called upon after a design basis accident, the ESF atmosphere cleanup system could perform its intended function in reducing the release of gaseous radioactive materials to the environment or protecting the control room operator. The Technical Specifications contain Surveillance Requirements, which outline surveillance testing (with procedures and acceptance criteria), to demonstrate that a limiting condition of operation (which require that a system either be in an operable status or steps are taken to return the system to operable status or the reactor is shut down), are not violated. Bases are also included which supply the justification for and reasoning behind the Technical Specifications.

The Technical Specifications for ESF atmosphere cleanup systems contain requirements to periodically check (1) pressure drop across the HEPA filters and carbon adsorbers, (2) air distribution across the HEPA filters and carbon adsorbers, (3) automatic initiation of the filter trains, (4) operability of heaters, (5) fan capacity, (6) leak tightness of the HEPA filter bank, (7) leak tightness of the carbon adsorber bank, and (8) removal capability of the carbon adsorbent for radioiodine by laboratory testing. If these requirements are not satisfied, the Technical Specifications allow a period of time to return the filter train to operable status, or the reactor is to be shut down. Guidance is given in the bases for returning the filter train to operable status, by indicating that replacement HEPA filters and carbon adsorbent should be qualified according to Regulatory Guide 1.52.

IV. Branch Technical Position ETSB No. 11-2

Standard Review Plans (SRP) are prepared for the guidance of the staff reviewer of the Office of Nuclear Reactor Regulation, NRC, who performs the detailed safety review of applications to construct or operate a nuclear power plant. The application of the SRP should improve the quality and uniformity of staff reviews, and present a well-defined base for evaluation of proposed changes in the scope and requirements of reviews. The SRP also serve to implement Nuclear Reactor Regulation policy on making information about regulatory matters widely available and to improve communication and understanding of the staff review process by interested members of the public and the nuclear power industry. SRP 11.3 is entitled "Gaseous Waste Management Systems."(23) Attached to this SRP is Branch Technical Position (BTP) Effluent Treatment Systems Branch (ETSB) No. 11-2, "Design, Testing and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Reactor Plants." This BTP offers design guidance for particulate filtration and radioiodine adsorption units included in ventilation exhaust systems to reduce the quantities of gaseous radioactivity released from building or containment atmospheres during normal operation. In some instances, these ventilation exhaust systems will be necessary to satisfy the "as low as is reasonably achievable" criterion as expressed in Appendix I to 10 CFR Part 50(24) issued May 1975. Mr. Collins will discuss this regulation and its impact shortly.(25) This paper will discuss the major positions set forth in BTP ETSB No. 11-2; copies of SRP 11.3 containing the entire position paper are available as NUREG-75/087 through the National Technical Information Service in Springfield, Virginia.

BTP ETSB No. 11-2 indicates that an atmosphere cleanup system installed in a normal ventilation exhaust system should consist of the following components: heater for humidity control, HEPA filters for particulate removal, iodine adsorbers, fans for air movement, and associated ducts, dampers and instrumentation. The system need not be redundant, nor seismic Category I, but should be limited to a volumetric flow rate of 30,000 cubic feet per minute per train. Instrumentation should be provided to monitor pressure drops and flow rates. Draft standard ANSI N509 is referenced for qualification of heaters and HEPA filters, and for the design of component mounting frames, filter housings (including floors and doors), electrical conduits, drains, ductwork, adsorber cells (including arrangement and documentation), the system fan (including mounting and ductwork connections), dampers, test probes, and samplers to obtain representative carbon samples for laboratory testing. Standard ANSI N510-1975 is referenced for in-place testing of the air flow distribution to the HEPA filters and carbon adsorbers, leak-tightness of the HEPA filter banks, and leak-tightness of the carbon adsorber banks. In-place testing is recommended initially and at intervals not to exceed 18 months thereafter (during scheduled shutdowns is acceptable). During each in-place test, a representative sample of carbon is removed for laboratory testing. Guidance for performing this laboratory testing is presented in the BTP, and physical properties for new activated carbon to be installed in the adsorber units whenever used carbon does not pass the laboratory test is outlined.

BTP ETSB No. 11-2 is written in the same format as Regulatory Guide 1.52: the first section of the document contains technical positions, or one acceptable method of designing the system, then the second section of the document indicates the removal credit for various radioactive species that will be assigned the filter system if the positions in the first section of the document are satisfied. Table 2 of BTP ETSB No. 11-2 indicates that normal ventilation exhaust systems operating outside of containment and controlling the relative humidity to 70% will be assigned removal efficiencies for radioiodine of 70%, 90% and 99% when the bed depth of activated carbon is 2, 4 and 6 inches, respectively. Radioactive particulate matter will be assumed to be removed at an efficiency of 99%. Naturally, these removal efficiencies are based on the premise that all of the positions in the first section of BTP ETSB No. 11-2 are satisfied, and the inplace test program is followed and all test results are acceptable. Also, these removal efficiencies are the expected average removal efficiencies for the 30-year operating life of the plant.

The NRC welcomes, and solicits, any comments or supporting data for any of the above positions. Comments on BTP ETSB No. 11-2 should be forwarded to Director, Office of Nuclear Reactor Regulation, U. S. Nuclear Regulatory Commission, Washington, D.C. 20555.

V. Conclusion

This paper has discussed three NRC documents published in the last two years that present the NRC positions on atmosphere cleanup systems. Revision 1 to Regulatory Guide 1.52 and the Technical Specifications that implement part of the Regulatory Guide are concerned with ESF atmosphere cleanup systems; Branch Technical Position ETSB No. 11-2 is concerned with normal ventilation exhaust systems. This new guidance has been issued due to the adoption of two industry standards, research accomplishments, developments in operating experience, and new regulations. Comments or data impacting on any of these documents are invited. These comments, together with future developments in the field of atmosphere cleanup at nuclear power reactors will be considered, and, when necessary and a strong technical basis exists, NRC will revise existing guidance or publish additional guidance relating to atmosphere cleanup systems in commercial nuclear power reactors.

References

1. USNRC Regulatory Guide 1.52 (Rev. 1), "Design, Testing and Maintenance Criteria for Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants," (to be issued for comment).

2. Branch Technical Position Effluent Treatment Systems Branch No. 11-2, "Design, Testing and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants," NUREG 75/087, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants - LWR Edition," September 1975.

3. USNRC Regulatory Guide 1.52, "Design, Testing and Maintenance Criteria for Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants," June 1973.

4. Final Safety Analysis Report, Florida Power and Light Company, St. Lucie, Unit No. 1, Docket 50-355, pp. 6.2-117, 118.

5. E. A. Bernard and R. W. Zavadoski, "The Calculation of Charcoal Heating in Air Filtration Systems," 13th AEC Air Cleaning Conference, Conf-740807, August 12-15, 1974.

6. Letter, Director, Naval Research Laboratory to Director, Atomic Energy Commission, Division of Waste Management and Transportation, "Influence of Solvent Vapors and of Water Flooding on Methyl Iodide Trapping by Charcoal," January 8, 1975.

7. Letter, C. H. Ice, Director, Savannah River Laboratory, Atomic Energy Division, to N. Stetson, Manager, Savannah River Operations Office, U. S. Atomic Energy Commission, DPST-74-495-TL, October 10, 1974.

8. A. H. Dexter, A. G. Evans and L. R. Jones, "Confinement of Airborne Radioactivity Progress Report: January-December 1974, Savannah River Laboratory DP-1390, October 1975.

9. ANSI N510-1975, "Testing of Nuclear Air Cleaning Systems," American National Standard Institute.

10. Draft Standard ANSI N509 (Draft 9-November 1975), "Nuclear Power Plant Air Cleaning Units and Components," American National Standards Institute.

11. C. A. Thompson, "Use of ANSI N509 in Design and Licensing of Nuclear Air Cleaning Systems," 14th ERDA Air Cleaning Conference, August 2-4, 1976 (to be published).

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14. Akley, R. D., et al., Aging, Weathering, and Poisoning of Impregnated Charcoals Used for Trapping Radioiodine, ORNL-TM-2860, March 1970.

15. Davis, R. J., et al., Long-Term Effects on Radioiodine Trapping by Charcoals, 12th AEC Air Cleaning Conference, CONF-720823, August 28-31, 1972.

16. Hesbol, R., et al., Iodine Filter Testing in Sweden, Seminar on Iodine Filter Testing, Karlsruhe, December 1973.

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18. Wilhelm, J. G., Testing of Iodine Filter Systems Under Normal and Post-Accident Conditions, 12th AEC Air Cleaning Conference, CONF-720823, August 28-31, 1972.

19. Letter, Ralph B. Sewell, Consumers Power Company Nuclear Licensing Administrator, to R. A. Purple, NRR, June 18, 1975, Palisades Plant In-Place Filter Systems, Docket No. 50-255, License DPR-20.

20. Bennett, E. C., et al., Evaluation of Weathered Impregnated Charcoals for Retention of Iodine and Methyl Iodide, DUN-7985, June 1972.

21. Bennett, E. C., et al., Evaluation of Weathered Impregnated Charcoals for Retention of Iodine and Methyl Iodide, UNI-39, July 1973.

22. Bennett, E. C., et al., Evaluation of Weathered Impregnated Charcoals for Retention of Iodine and Methyl Iodide, UNI-251, August 1974.

23. Standard Review Plan 11.3, "Gaseous Waste Management Systems," USNRC NUREG-75/087, September 1975.

24. Appendix I to Title 10 of the Code of Federal Regulations, Part 50, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low As Is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents."

25. J. T. Collins, "The Impact of Appendix I to 10 CFR Part 50 on Atmosphere Cleanup Systems," 14th ERDA Air Cleaning Conference, August 2-4, 1976 (to be published).

DISCUSSION

SHERMAN: What, in your opinion, would constitute an acceptable indication of total integrated running time up to 720 hours?

BELLAMY: If I understand the question correctly, my answer will be a timing device on the filter system. It should be initiated whenever the filter system is seeing air through the carbon and automatically stopped whenever the air flow through the carbon is eliminated.

DEMPSEY: Every two years, the Europeans come to this Conference and tell us the advantages of their well-used in-place testing procedures using methyl iodide 131. Would this technique be accepted by NRC as an alternate to the sampling and laboratory test now required if we demonstrated its efficiency?

BELLAMY: I would say, if the usefulness is demonstrated and knowledgeable health physicists on the NRC staff make a decision that it is not detrimental to the tests, or the filter system, or to any of the operating personnel, I would say we would seriously consider it.

THOMPSON: I have noticed that the credit for removal efficiencies for radioiodine for non-ESF units given in Branch Technical Position ETSB No. 11-2 are lower than the comparable values for ESF filter units. Normally, operating units discharge effluents indicating performance in excess of values for ESF credit. Discharges from normally operating units are monitored and recorded. They also have alarms and activate closure of inlet dampers if the release exceeds preset values for any reason, including sudden changes in filter efficiency. Could you comment on this?

BELLAMY: My first comment would be that the bottom line in the use of normal ventilation exhaust systems is conformance or nonconformance with the environmental technical specifications for the plant. The numbers in the branch technical position are based on a very limited number of laboratory tests on filters that are operating continuously. A realistic assessment of these data leads me to conclude that the efficiencies that I would use, and that are in the branch technical position, are the ones that would be expected over the 30-year operating life of a plant. I would like to indicate that we are available to review all other data that anybody might have to support these numbers and I would like to do so.

COLLINS: Let me make a further comment. The purpose of the branch technical position was to permit the staff to make an evaluation for license processing. It was not intended as an operating guide, i.e., as to what we would expect from a plant under normal operating conditions once it had been licensed. The staff needed to set forth some criteria as to how we would base our source term calculations and what would be considered as expected releases from the plant. Therefore, we set forth these numbers and they are a little different from what we put forth in 1.52. We hope that additional data will come to us on the normal releases from ventilation systems that we do not now have in our possession. As Ron Bellamy said, if anybody has better data than we have, we would be very happy to look at them.

WILHELM: From a first glance at the revision of the Regulatory Guide, I read that after some service in the nuclear power plant, the filter should be tested in-place again. Because I know that the in-place test is a Freon test, I just can't make up my mind what this test should show. In Europe, especially in Germany, we get an impression that in-place tests are very expensive and do not tell much. If you use methyl iodide, the numbers you get are questionable because you won't have the same humidity condition and so on. Would it not be wise to use the money to test more charcoal, the charcoal itself, than to test the whole filter system by the in-place test? Then you can detect the event which loaded the filter with water, or with solvent, or with some other stuff.

BELLAMY: We have received that comment from other sources and it will be included and considered before the final revision.

COLLINS: Let me add an additional comment to the one that Ron Bellamy alluded to. In the development of our revision of 1.52, as many of you in this room know, a subject that received more discussion than anything else was the 720 hours. Ron Bellamy and I spent a lot of time, together with some of our other people, analyzing all of the data that were available to us. At the conclusion of our evaluation, we convinced ourselves that the available information would not support a change in that number. In January or February of this year, we sent letters to 54 operating reactors asking for their test data. Up to today, we have received seven responses. Of the seven responses we have received, two of them contained sufficient data for us to continue our evaluation. If industry wants us to change the numbers, I think industry has to be a little more responsive to us. We can only set forth numbers based on available data. We can't make it up. So if you're operating a reactor and you haven't responded, we certainly encourage you to do so.

THE IMPACT OF APPENDIX I TO 10 CFR PART 50 ON ATMOSPHERE CLEANUP SYSTEMS*

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Abstract

On December 3, 1970, the Atomic Energy Commission published new sections 50.34a and 50.36a of 10 CFR Part 50 specifying design and operating requirements for nuclear power reactors to keep levels of radioactivity in effluents "as low as is reasonably achievable". The amendments provided qualitative guidance but not numerical criteria for determining when design objectives and operations meet the specified requirements.

On April 30, 1975, the Nuclear Regulatory Commission announced its decision in the rulemaking proceedings concerning the numerical guides for design objectives and limiting conditions for operation to meet the criterion "as low as is reasonably achievable" for radioactive material in light-water-cooled nuclear power reactor effluents. The Commission noted in the Statement of Considerations that the new rule, if met, provided one acceptable method of establishing compliance with the "as low as is reasonably achievable" requirement of sections 50.34a and 50.36a.

In adopting the new rule, the Commissioners expressed the opinion that Appendix I should guide the NRC staff and other interested persons in the use of appropriate calculational procedures for applying the numerical guides for design objectives. The Commissioners further stated that compliance with the rule should be demonstrated by calculational procedures based on models and data that will not substantially underestimate the actual exposure of an individual through appropriate pathways all uncertainties being considered together.

In addition to the numerical design objectives, applicants are required to include in their radwaste systems all items of reasonably demonstrated technology that when added to the system sequentially and in order of diminishing cost-benefit return can with a favorable cost-benefit ratio effect reduction in dose to the population reasonably expected to be within 50 miles of the reactor.

On September 4, 1975, the Nuclear Regulatory Commission published in the Federal Register (Volume 40, Number 172) amendments to Appendix I to 10 CFR Part 50. The amendments provide persons who have filed applications for construction permits which were docketed on or after January 2, 1971 and prior to June 4, 1976 the option of dispensing with the cost-benefit analysis required by Section II.D of Appendix I if the proposed or installed radwaste systems and equipment satisfy the Guides on Design Objectives for Light-Water-Cooled Nuclear Power Reactors proposed in the Concluding Statement of Position of the Regulatory Staff in Docket Number RM-50-2, dated February 20, 1974. Because the criterion proposed by the staff in the rulemaking hearing; namely 5 curies/yr/reactor for liquid effluents, excluding tritium and dissolved gases, 1 curie/yr/reactor of radioiodine-131, and 5 mrem annual whole body dose to individuals at or beyond the site boundary from all pathways of exposure, has led to the proposed or actual installation of radwaste systems and equipment to reduce expected effluent releases to low levels, the

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application of the $1000 per man-rem criterion specified in Section II.D to plants designed to proposed Appendix I is unlikely to result in radwaste equipment augmentation.

This paper will discuss dose design objectives in Appendix I to 10 CFR Part 50 for gaseous effluents from light-water-cooled nuclear power plants, the need for a cost-benefit analysis for certain proposed facilities, one acceptable method for performing a cost-benefit analysis, and the cost of ventilation equipment considered by the staff in its evaluation. The cost-benefit analysis will be used to show when additional radwaste equipment will be required.

I. Introduction

Part 50.34a of Title 10 of the Code of Federal Regulations (10 CFR Part 50.34a) requires the release of radioactive materials in liquid and gaseous effluents from nuclear power reactors to be "as low as is reasonably achievable" (ALARA)*. The term "as low as is reasonably achievable" as used in this context means "as low as is reasonably achievable taking into account the state of technology, and the economics of improvements in relation to the benefits to the public health and safety, and in relation to the utilization of atomic energy in the public interest".

Until the publication of Appendix I to 10 CFR Part 50 on April 30, 1975, the means of achieving ALARA was based on criteria set forth in proposed Appendix I dated June 9, 1971, Regulatory Guide 1.42, dated June 1973, Revision 1 to Regulatory Guide 1.42 dated March 1974, and criteria contained in the Concluding Statement of the Regulatory Staff, RM-50-2, dated February 20, 1974. In adopting the new rule, the Commissioners expressed the opinion that Appendix I should guide the NRC staff and other interested persons in the use of appropriate calculational procedures for applying the numerical guides for design objectives. The Commissioners further stated that compliance with the rule should be demonstrated by calculational procedures based on models and data that will not substantially underestimate the actual exposure of an individual through appropriate pathways all uncertainties being considered together. To assist applicants and licensees in this regard, the NRC staff has recently issued five Regulatory Guides (1.109, 1.110, 1.111, 1.112 and 1.113). These guides provide calculational models and parameters acceptable to the staff for calculating average expected releases of radioactive materials in liquid and gaseous effluents from normal operation, dispersion of effluents in the atmosphere and different bodies of water, models and parameters for calculating associated radiation doses to man, and cost-benefit aspects of treating radwaste for purposes of implementing the guidance on design objectives and limiting conditions in Appendix I.

In addition to the individual dose design objectives specified in Section II.A, B and C of Appendix I, Section II.D requires applicants to include in the design of their radwaste systems all items of reasonably demonstrated technology that when added to the system sequentially and in order of diminishing cost-benefit return, can for a favorable cost-benefit ratio, effect reduction in dose to the population reasonably expected to be within 50 miles of the reactor. As an interim measure and until establishment and adoption of better values (or other appropriate criteria) the values of $1000 per total body man-rem and $1000 per man-thyroid-rem (or lesser values as may be demonstrated to be suitable in a particular case) shall be used in the cost-benefit analysis.

*The phrase "as low as practicable" was replaced by "as low as is reasonably achievable" by the Commission on December 19, 1975 (40 FR 58847).

On September 4, 1975, the Commission amended Appendix I to 10 CFR Part 50 to provide persons who have filed applications for construction permits on or after January 2, 1971 and prior to June 4, 1976, the option of dispensing with the cost-benefit analysis if the proposed or installed radwaste systems and equipment described in the preliminary or final safety analysis report and amendments thereto satisfy the Guides on Design Objectives for Light-Water-Cooled Nuclear Power Reactors proposed in the Concluding Statement of Position of the Regulatory Staff in Docket No. RM-50-2, dated February 20, 1974. Because the criterion proposed in RM-50-2 and used by the staff that each plant meet those design objectives has led to the proposed or actual installation of radwaste systems and equipment to reduce to low levels the total radioactivity in effluent releases or expected effluent releases from such plants, the application of the interim value of $1000 per man-rem and $1000 per man-thyroid-rem criterion specified in Section II.D of Appendix I to these or similarly designed plants is unlikely to result in radwaste equipment augmentation.

In support of this amendment, a cost-benefit analysis was performed by the NRC staff of applications filed and reviewed since 1971 in accordance with the criterion set forth in RM-50-2, which showed that for BWRs and PWRs additional radwaste equipment cannot be added for less than $1000/man-rem. Therefore, in general plants which meet these criterion will meet the requirements of Section II.D.

Applications for construction permits filed after June 4, 1976 are required to include in their reactor's radwaste treatment systems all equipment of reasonably demonstrated technology that could be installed to reduce the cumulative dose to the population within a 50 mile radius of the reactor at an interim cost of $1000 per man-rem or $1000 per man-thyroid-rem in addition to any equipment needed to meet the criteria for doses to individuals required by Sections II.A, B and C of Appendix I.

In the case of plants whose applications for construction permits were filed prior to January 2, 1971, Appendix I does not provide specific guidance concerning the need for these plants to perform a cost-benefit analysis to demonstrate that their releases are ALARA. However, Section V.B of Appendix I states that for applications filed prior to January 2, 1971, licensees/applicants shall file with the Commission within 12 months from June 4, 1975 the following:

a. Such information as is necessary to evaluate the means employed for keeping levels of radioactivity in effluents to unrestricted areas as low as practicable, including all such information as is required by paragraph 50.34a(b) and (c) not already contained in his application; and
b. Plans and proposed Technical Specifications developed for the purpose of keeping releases of radioactive materials in unrestricted areas during normal reactor operation, including expected operational occurrences as low as practicable.

In December 1975, some seven months after the Commission adopted Appendix I, the U. S. Court of Appeals in the matter of Peach Bottom, Unit 2, (York Committee for a Safe Environment vs. NRC) handed down a decision indicating that they could not find anywhere in the record a cost-benefit balance as required by Commission regulations 10 CFR Part 20.1 and 10 CFR Part 50.34a. The case has been remanded back to the Commission to perform the required cost-benefit analysis to demonstrate that Peach Bottom meets the ALARA criterion and that adequate consideration is given to the balancing of "health and safety effects, costs, the state of technology and utilization of atomic energy in the public interest", as required by the above regulations. In response to the Court action, the NRC staff is currently performing a generic cost-benefit analysis of augmented radwaste systems for plants whose applications for construction permits were filed prior to January 2, 1971, which includes Peach Bottom, Unit No. 2. We hope to show by this analysis that if the radwaste systems presently installed or proposed for these facilities are capable of meeting the dose and curie design objectives set forth in RM-50-2 additional radwaste equipment cannot be added for less than $1000/man-rem. Plants not electing this option will be required to perform a detailed cost-benefit analysis in conformance with Section II.D of Appendix I.

Table 1 shows a comparison of the annual design objectives set forth in Appendix I adopted by the Commission on April 30, 1975 with those proposed by the staff in the Concluding Statement of Position of the Regulatory Staff in Docket RM-50-2.

II. Discussion

The requirements set forth in Section II.D of Appendix I to 10 CFR Part 50 placed upon both the NRC staff and applicants the task of determining the incremental effects of radwaste additions on a case-by-case basis. To provide a uniform means to determine whether or not additions are needed for individual reactors to satisfy the requirements of Section II.D of Appendix I, the NRC staff prepared and issued Regulatory Guide 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors". It is the objective of this guide to provide an acceptable method of performing the required cost-benefit analysis. The guide provides cost parameters for estimating the costs for the various radwaste treatment equipment items in use or proposed for use at LWRs and a methodology for performing the analysis. The costs presented consider the direct equipment cost and the costs of building space, supportive services, maintenance, interest and operating, as well as other costs generally considered in analyzing capital and operating costs in power plant estimating. The basis for the costs used by the staff are given in Appendix B to this guide. All costs are based on the assumption that the reactor is in design stage and that augmentation of a radwaste system will not involve backfitting of an existing plant. Backfitting costs are determined on a case-by-case basis. Because the Commission did not outline any procedures for including the effects of inflation in the analysis, the NRC staff's analysis is based on 1975 dollars; i.e., neither the costs nor the interim criteria are escalated for the predicted effects of inflation. Since the worth of a man-rem or man-thyroid-rem to the public is subject to the same fluctuations in value as the cost of equipment to reduce radioactive emissions, the staff believes this approach to be reasonable.

The first setp in a cost-benefit analysis of a proposed radwaste system is to calculate the expected releases of radioactive materials in gaseous and liquid effluents for normal operation including anticipated operational occurrences.

Using these release values, the individual doses at the nearest site boundary and the population dose within 50 mile radius are then calculated. For staff analyses, the estimated releases, aquatic and meteorological dispersion characteristics, and dose calculations are based on the methodologies and parameters outlined in Regulatory Guides 1.109, 1.111, 1.112 and 1.113.

Before the cost benefit analysis is initiated, the radwaste systems must be shown to be capable of meeting the individual dose design objectives set forth in Sections II.A, B and C of Appendix I. Population doses are then broken down by release point (i.e., main condenser air ejector in a BWR, waste gas decay tanks in a PWR and building ventilation exhaust systems for both BWRs and PWRs), by principal isotopes (iodine, noble gases and particulates) and into man-rem and man-thyroid-rem.

The next step is to examine the proposed radwaste system and determine locations of potential augments. In the case of a PWR, one could consider the following augments:

a. An additional waste gas decay tank

b. The installation of a HEPA filter downstream of the waste gas decay tanks

c. The installation of charcoal adsorbers and HEPA filters in the containment purge exhaust system

d. The installation of charcoal adsorbers and HEPA filters in the various building ventilation exhaust systems (turbine, auxiliary, fuel storage and radwaste building).

The next step is to determine the overall total body cost assessment and overall thyroid cost assessment. This is accomplished by multiplying the population total body dose (man-rem/yr) by $1000/man-rem and multiplying the population thyroid dose by $1000/man-rem. For example, if the total body dose is 5 man-rem/yr and the population thyroid dose is 20 man-rem/yr, then the overall cost assessment would be $5,000/yr and $20,000/yr respectively. These overall cost assessments represent the maximum benefit that could result from augmenting the system.

If the augmented cost is greater than both of the overall cost assessments, the augment is not cost effective and there is no need to proceed further with the detailed evaluation. If the augmented cost is less than either of the overall cost assessments, the augment is further evaluated by comparing its cost against the specific monetary value of the reduction in dose caused by the augment. For example, if the addition of a charcoal adsorber in the containment purge exhaust system resulted in a reduction in the population thyroid dose of 3 man-rem/yr out of a total of 20 man-rem/yr, the monetary value of that reduction in dose would be 3 man-rem/yr x $1000 = $3000. If the cost of the charcoal adsorber is greater than the monetary value of the dose reduction, the augment is not cost beneficial and the charcoal adsorber is not added. However, if the cost of the charcoal adsorber is less than the monetary value of the dose reduction, the addition of the charcoal adsorber is cost beneficial and would have to be installed to staisfy the regulation.

Regulatory Guide 1.110 contains a number of tables which list the direct cost of gaseous system equipment (equipment cost, site labor and site materials), annual operating costs for each item, annual maintenance costs for each item, labor cost correction factors to adjust for geographical labor cost differential, indirect cost factors such as construction facilities, services and equipment, engineering and construction manpower costs, interest during construction, and an allowance for miscellaneous owner's cost during construction. The annual expenses for operation and maintenance consider a baseloaded plant operating at an 80% plant capacity factor. The capital recovery factors given in Regulatory Guide 1.110 are levelized annual changes which account for the cost of borrowed money and the depreciation of assets over a 30-year plant operating life.

III. Regulatory Experience

Following the adoption of the Annex to Appendix I, dated September 4, 1975, all utilities whose applications for construction permits were docketed between January 2, 1971 and the present time, were notified by letter from the NRC staff of the need to provide additional information concerning the means to be employed to meet the guidelines of Appendix I of 10 CFR Part 50. Of the forty-seven utilities (representing 91 reactors) in this category, twenty-eight utilities (55 reactors) have elected to comply with the option to the cost-benefit analysis provided by the September 4 Annex rather than to perform the individual cost-benefit analysis required by Section II.D of Appendix I. Of this number, the staff has completed their evaluation of twenty-one and has shown that all of these facilities have radwaste systems capable of meeting the criteria in RM-50-2, and therefore, meet the requirements of Section II.D of Appendix I.

To date, the utilities that have elected to perform the detailed cost-benefit analysis are Watts Bar, Unit Nos. 1 & 2, Hartsville, Unit Nos. 1 - 4, Phipps Bend, Unit Nos. 1 & 2, Pilgrim, Unit No. 2 and Washington Public Power Supply System (WPPSS), Unit Nos. 3 & 5. The remaining fourteen utilities have not yet decided which way they intend to show conformance with Appendix I. Of those electing the detailed cost-benefit analysis of Section II.D, only the WPPSS evaluation has been completed by the NRC staff.

Based on the staff's evaluation of WPPSS and using a value of $1000 as the worth of a man-rem to be cost effective, gaseous waste treatment system additions beyond those required to meet the individual dose design objectives of Appendix I would not result in an annual cost in excess of $6,800 per year. Similarly, using a value of $1000 as the worth of a man-thyroid-rem to be cost effective, iodine control systems for gaseous waste management systems would not result in an annual cost in excess of $8000 per year to the annual cost of the system required to meet Section II.C of Appendix I. Augmentations that were considered for the gaseous waste management systems for WPPSS were an additional waste gas decay tank for the waste gas processing system, the addition of a charcoal adsorber to the waste gas processing system and the addition of charcoal adsorbers for the turbine building ventilation exhaust system. Annual costs for these systems ranged from $8000/yr to $660,000/yr. No items were found that could be added to the system at an annual cost per unit of dose reduction less than $1000 per man-rem or $1000 per man-thyroid-rem.

Based on the limited experience we have had to date, it appears that in most cases the individual dose design objectives of Sections II.A, B and C of Appendix I will be more limiting than the cost-benefit analysis of Section II.D. From our experience, a number of utilities have been required to add iodine control systems and particulate filters to meet the individual dose design objectives and that any additional augments can be shown not to be cost beneficial.

We have briefly discussed the cost-benefit analysis described in Regulatory Guide 1.110, and we welcome any comments or suggestions you may have concerning the cost parameters or methodology as outlined in this guide.

References

1. Appendix I to Title 10 of the Code of Federal Regulations, Part 50, "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion 'As Low As Is Reasonably Achievable' for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents".

2. Annex to Appendix I, September 4, 1975, "Application of Cost-Benefit Requirements of Appendix I to Certain Nuclear Power Plants."

3. Concluding Statement of Position of the Regulatory Staff (Docket RM-50-2), Public Rulemaking Hearing On: "Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion "As Low As Practicable" for Radioactive Material In Light-Water-Cooled Nuclear Power Reactors," February 20, 1974.

4. Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I", March 1976.

5. Regulatory Guide 1.110, "Cost-Benefit Analysis for Radwaste Systems for Light-Water-Cooled Nuclear Power Reactors", March 1976.

6. Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors", March 1976.

7. Regulatory Guide 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors", April 1976.

8. Regulatory Guide 1.113, "Methods for Estimating Aquatic Dispersion of Liquid Effluents from Routine Reactor Releases for the Purpose of Implementing Appendix I".

9. NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors" (PWR-GALE Code), April 1976.

10. NUREG-0016, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors" (BWR-GALE Code), April 1976.

TABLE 1

ANNUAL DESIGN OBJECTIVES

COMPARISON OF APPENDIX I (MAY 5, 1976) AND
THE STAFF'S PROPOSED APPENDIX I (RM 50-2, FEBRUARY 1974)

			APPENDIX I	RM 50-2
Sec. II.A	Liquid Effluents	(Total Body)	3 Mrem/Reactor	5 Mrem/Site (Total Body or Any Organ)
		(Any Organ)	10 Mrem/Reactor	5 Ci/Reactor[1]
Sec. 11.B.1	Gaseous Effluents	(Air Dose)	10 Mrad γ/Reactor	10 Mrad γ/Site
		(Air Dose)	20 Mrad β/Reactor	20 Mrad β/Site
OR				
Sec. II.B.2	Gaseous Effluents[2]	(Total Body)	5 Mrem/Reactor	5 Mrem/Site
		(Skin)	15 Mrem/Reactor	15 Mrem/Site
Sec. II.C	Iodine and Particulates	(Any Organ)	15 Mrem/Reactor	15 Mrem/Site
				1 Ci/Reactor I-131
Sec. II.D	Cost-Benefit Analysis	(Total Body)	$1000/Man-Rem	
	50 Mile Radius	(Thyroid)	$1000/Man-Rem	

(1) Excluding Tritium and Dissolved Noble Gases.

(2) Higher quantities may be permited if assured that doses to any individual in an unrestricted area will be less than these values.

DISCUSSION

LIPTON: Why was "as low as practicable" changed to "as low as reasonably achievable"?

COLLINS: I really don't know. I think it was a preferred terminology on the part of the commissioners and took in more of the societal factors, along with cost factors. They determined that the later designation more reasonably expressed the term. I think "as low as practicable" was being interpreted sometimes as being "as low as possible" and not "as low as practicable".

LIPTON: You mentioned one thousand dollars per person-rem for the whole body and for the thyroid. Do you think that this will be extended? For example, if you had something that only exposed the lungs, would it be a thousand dollars per lung-rem, and so forth?

COLLINS: In response to that, we met with the commissioners about a month ago to discuss the need to proceed with the thousand dollar per man-rem rulemaking hearing. The commissioners told the staff to expedite the rulemaking hearing and, in our consideration of the scope of that hearing, to consider the cost to all organs.

FORSBERG: You mentioned that the thousand dollar per man-rem had a 50-mile circumference circle. Do you think that this distance will be expanded globally?

COLLINS: Speaking for myself and not for the Nuclear Regulatory Commission, I believe that the number will stick within a 50-mile radius of the reactor.

WATT: In my reading of RN-50-2, I don't remember anything specified regarding a 50-mile limit. Moreover, it would seem that a man-rem, no matter where delivered, should have the same value. It dosen't matter whether you get a man-rem in California or New York. I would, therefore, like to understand a little bit more about the origin of the 50-mile limit that you have mentioned but I do not recall being in RN-50-2.

COLLINS: You are right. RN-50-2 did not have a 50-mile radius and did not have a population dose. RN-50-2 never had a thousand dollar man-rem cost. RN-50-2 had two specific criteria within it. One was a five curie release in liquid effluent and another was a curie of iodine 131 in gaseous effluent. Nowhere in the RN-50-2 concluding statement did the staff mention a thousand dollar man-rem. The reason we did not, in the rulemaking hearing, is because the staff could not come up with a dollar value that it felt was worth one man-rem.

ANON: I got from the NRC a copy of RN-50-2 which, in the summary in the front, I am sure, has one thousand dollar per man-rem as a number.

COLLINS: If you did, then you received a copy of the September 4 amendment to Appendix I which specified the RN-50-2 criteria and it said that if you met your system design, met those releases, that would satisfy Paragraph 2-D which does contain a thousand dollar man-rem.

ANON: I am reasonably sure the document I have does not allude to any other kind of standards. I hope you have a copy here. I would like to straighten it out.

COLLINS: I don't happen to have RN-50-2 with me, but I don't remember seeing that. I am sure what you have is the September 4 amendment, which was published in the Federal Register.

RICHARDSON: The Environmental Protection Agency is also quite interested in this question of dollar value of a man-rem or some other measure for cost benefit balancing. We are also in the process of looking at the question of the appropriate assignment of dollar values to both health impact and measures like a man-rem. I think it is axiomatic that any final determination in this area is going to have to assign different values to different kinds of impacts. Certainly, a lung man-rem is not the same thing as a whole body man-rem.