DRAFT

COMMISSION ACTION PAPER

FOR: The Commissioners

FROM: Harold R. Denton, Director
Office of Nuclear Reactor Regulation

THRU: Executive Director for Operations

SUBJECT: ACCIDENT CONSIDERATIONS UNDER NEPA

PURPOSE: To obtain a decision on a proposed Statement of Interim Policy

BACKGROUND: In SECY 79-594, "Class 9 Accident Considerations" dated October 31, 1979, the staff indicated that it intended to develop for Commission consideration a policy statement regarding accident considerations, including Class 9 accidents, for NEPA reviews.

The proposed Statement of Interim Policy contained herein (Enclosure 3) is the staff's response to the Commissioner's request in its Memorandum and Order dated September 14, 1979, "In the Matter of Offshore Power Systems," to "Provide us with its recommendations on how the interim guidance of the Annex might be modified, on an interim basis and until rulemaking on this subject is completed, to reflect developments since 1971 and to accord more fully with current staff policy in this area; . . ." (The Annex referenced in the foregoing was published on December 1, 1971 by the AEC as a proposed annex to 10 CFR Part 50, Appendix D, a rulemaking proceeding which has not yet been completed. A copy of the proposed Annex is included as Enclosure 1.)

DISCUSSION OF ALTERNATIVES AND DECISION CRITERIA: The staff has considered four alternatives the first being the alternative of no change. The second would be redefinition of Classes 8 and 9 accidents but retaining the position that Class 9's (as redefined) represent too low a risk to warrant consideration. The third alternative would eliminate the proposed Annex and its accident classification system entirely and replace it with policy guidance to continue to consider accidents on a case by case basis. The fourth would eliminate the proposed Annex and require the development of a generic treatment of the subject. These alternatives are discussed in sequence below.

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DISCUSSION:
(continued)

1. No Change

This alternative has the advantage that there would be very little impact on staff resources at a time when resources are strained. (Approximately one man-day of effort has been required to prepare the Plant Accident section for each EIS that has been issued over the past several years.) A principal argument against this alternative would be that it subject the NRC to (continued) severe criticism for failure to take steps to come to grips with a significant issue of substantial public interest, viz., Class 9 accidents. These criticisms began with public comments received on the proposed Annex (Enclosure 2) and have continued through the years as comments on numerous draft and final Environmental Statements, as well as being the subject of contentions in many licensing proceedings.

2. Redefining Class 8 and Class 9 Accidents

The staff has considered the possibility of enlarging the scope of definition of Class 8 accidents to include, for example, TMI-2 type accidents that must now be considered credible. This option would retain the concept that there would remain a residual but smaller Class 9 grouping of extremely low risk accidents that need not be considered. It would have the advantage of maintaining a semblance of continuity with past practice.

However, Class 8 accidents have heretofore been identified as design basis accidents that are factored into safety reviews. Action Plans (NUREG-0660) currently in preparation reflect a need to enlarge the scope of accident considerations in safety reviews to encompass degraded core cooling and core melt events and to undertake rulemaking to establish the scope and nature of future requirements. It is not possible at this time therefore, to establish or define a precise boundary of a design basis envelope that would permit a clear redefinition of an accident class beyond this boundary.

3. Discontinue Classification Groupings and Utilize Probabilistic Risk Assessment

This option would involve the withdrawal of the proposed Annex, termination of the rulemaking, and would replace it with interim policy guidance. It would have the following advantages:

DISCUSSION:
(continued)

- It would remove an often interpreted proscription against considerations of a vaguely defined grouping of accidents (Class 9).

- It would respond positively to criticisms of past NRC practices in Environmental Impact Statements,

- It would produce a more objective analysis of accident risks and thus more clearly respond to the requirements of NEPA,

- It would continue the practice of considering accident risks on a plant/site specific basis,

- It would be consistent with ongoing safety related activities in the areas of siting policy, plant design and operational safety and emergency preparedness, and

- It would reemphasize that it is the NRC's responsibility to assess the environmental risk of accidents under NEPA, rather than the applicant's. (This option would remove the "defacto" requirement for applicant's to address accident risks in their Environmental Reports.)

On the other side of the ledger, arguments against adoption of this option would include the following:

- More staff effort would be required to prepare the accident risk sections of Environmental Impact Statements. (See Enclosure 4.)

- It may raise questions as to the validity of past NEPA decisions.

- It may be construed, in part, as contrary to the Commission's policy statement on the reliability of the conclusions of WASH-1400.

4. Generic Treatment of Accident Risks

This option would involve the development of a generic statement on accident risks which could subsequently be referenced on a case by case basis but would probably have to be supplemented with some site specific information and analysis. Adoption of this option would be tantamount to a judgment that there are substantial similarities of accident risks among nuclear power plants and site to site variations are relatively minor adjustments to the quantification of risk. A generic treatment would present the opportunity for analysis in greater depth and detail than may be practical on a case by case basis.

DISCUSSION: (continued)

WASH-1400, as published, cannot be considered an acceptable statement in this regard but taken in conjunction with subsequent improvements and developments to resolve some of its shortcomings, would logically be the starting point for the development of such a generic statement.

Substantial staff resources and a few years would be necessary to produce an acceptable generic treatment.

RECOMMENDATION: The staff recommends the adoption of the third alternative and the publication of the proposed Federal Register Notice, Enclosure 3. The Commission should note that this action, which relates to NEPA responsibilities, is not reflected in the Action Plans (NUREG-0660) currently in preparation by the Staff. If this recommendation is adopted therefore, Commission guidance is requested as to the priority that should be given to the task of implementing the guidance on the first case to which it would apply. A value-impact analysis is given in Enclosure 4.

COORDINATION:

Harold R. Denton, Director
Office of Nuclear Reactor Regulation

Enclosures:
1. Proposed Annes to Appendix D, 10 CFR Part 50
2. Public Comment on proposed Annex
3. Proposed Federal Register Notice
4. Value-Impact Analysis of Recommended Alternative

PART 50 DOMESTIC LICENSING OF PRODUCTION AND UTILIZATION FACILITIES

PROPOSED RULE MAKING

36 FR 22851
Published 12/1/71
Comment Period expires 12/31/71

Consideration of Accidents in Implementation of the National Environmental Policy Act of 1969

The Atomic Energy Commission has under consideration amendments to Appendix D of its regulation 10 CFR Part 50, Licensing of Production and Utilization Facilities, an "Interim Statement of General Policy and Procedure: Implementation of the National Environmental Policy Act of 1969 (Public Law 91-190)." The proposed amendments would, by the addition of an annex to Appendix D, specify certain standardized accident assumptions to be used in Environmental Reports submitted by applicants for construction permits or operating licenses for nuclear power reactors pursuant to Appendix D.[1] The accident assumptions and other provisions of the proposed amendments would also be applicable to AEC draft and final Detailed Statements.

The Commission invites written comments or suggestions from all interested persons on the proposed amendments set forth below as well as on the treatment of the probabilities of the accidents.

The Commission expects that the provisions of the proposed amendments will be useful as interim guidance until such time as the Commission takes further action on them.

Pursuant to the Atomic Energy Act of 1954, as amended, and section 553 of title 5 of the United States Code, notice is hereby given that adoption of the following amendments to 10 CFR Part 50 is contemplated. All interested persons who desire to submit written comments or suggestions for consideration in connection with the proposed amendments should send them to the Secretary of the Commission, U.S. Atomic Energy Commission, Washington, D.C. 20545, Attention: Chief, Public Proceedings Branch, within 30 days after publication of this notice in the FEDERAL REGISTER. Copies of comments received may be examined in the Commission's Public Document Room, 1717 H Street NW., Washington, DC.

1. A sentence is added at the end of paragraph 4, of section A of Appendix D to read as follows:

APPENDIX D—INTERIM STATEMENT OF GENERAL POLICY AND PROCEDURE: IMPLEMENTATION OF THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969 (PUBLIC LAW 91-190)

* * * * *

A. *Basic procedures.*

* * * * *

4. * * * The Environmental Report required by paragraph 1 shall also include a discussion of accidents, based on the assumptions set forth in the annex to this appendix.

* * * * *

2. An annex is added to Appendix D to read as follows:

ANNEX

DISCUSSION OF ACCIDENTS IN APPLICANTS' ENVIRONMENTAL REPORTS: ASSUMPTIONS

This Annex requires certain assumptions to be made in discussion of accidents in Environmental Reports submitted pursuant to Appendix D by applicants[1] for construction permits or operating licenses for nuclear

[1] In conjunction with the revision of Appendix D on Sept. 9, 1971 (36 F.R. 18071), there was transmitted to applicants for licenses to construct or operate nuclear power plants, and made available to the public, a document dated Sept. 1, 1971, entitled "Scope of Applicant's Environmental Reports with Respect to Transportation, Transmission Lines and Accidents." This document was a supplement to the guidance provided to license applicants in the "Draft AEC Guide to the Preparation of Environmental Reports for Nuclear Power Plants," dated Feb. 19, 1971, also made available to the public.

See next page for footnote 2.

power reactors.[1]

Postulated accidents are discussed in another context in applicants' safety analysis reports. The principal line of defense is accident prevention through correct design, manufacture, and operation, and a quality assurance program is used to provide and maintain the necessary high integrity of the reactor system. Deviations that may occur are handled by protective systems to place and hold the plant in a safe condition. Notwithstanding all this, the conservative postulate is made that serious accidents might occur, in spite of the fact that they are extremely unlikely, and engineered safety features are installed to mitigate the consequences of these unlikely postulated events.

In the consideration of the environmental risks associated with the postulated accidents, the probabilities of their occurrence and their consequences must both be taken into account. Since it is not practicable to consider all possible accidents, the spectrum of accidents, ranging in severity from trivial to very serious, is divided into classes.

Each class can be characterized by an occurrence rate and a set of consequences.

Standardized examples of classes of accidents to be considered by applicants in preparing the section of Environmental Reports dealing with accidents are set out in tabular form below. The spectrum of accidents, from the most trivial to the most severe, is divided into nine classes, some of which have subclasses. The accidents stated in each of the eight classes in tabular form below are representative of the types of accidents that must be analyzed by the applicant in Environmental Reports; however, other accident assumptions may be more suitable for individual cases. Where assumptions are not specified, or where those specified are deemed unsuitable, assumptions as realistic as the state of knowledge permits shall be used, taking into account the specific design and operational characteristics of the plant under consideration.

For each class, except Classes 1 and 9, the environmental consequences shall be evaluated as indicated. Those classes of accidents, other than Classes 1 and 9, found to have significant adverse environmental effects shall be evaluated as to probability, or frequency of occurrence, to permit estimates to be made of environmental risk or cost arising from accidents of the given class.

Class 1 events need not be considered because of their trivial consequences.

Class 8 events are those considered in safety analysis reports and AEC staff safety evaluations. They are used, together with highly conservative assumptions, as the design-basis events to establish the performance requirements of engineered safety features. The highly conservative assumptions and calculations used in AEC safety evaluations are not suitable for environmental risk evaluation, because their use would result in a substantial overestimate of the environmental risk. For this reason, Class 8 events shall be evaluated realistically. Consequences predicted in this way will be far less severe than those given for the same events in safety analysis reports where more conservative evaluations are used.

The occurrences in Class 9 involve sequences of postulated successive failures more severe than those postulated for the design basis for protective systems and engineered safety features. Their consequences could be severe. However, the probability of their occurrence is so small that their environmental risk is extremely low. Defense in depth (multiple physical barriers), quality assurance for design, manufacture, and operation, continued surveillance and testing, and conservative design are all applied to provide and maintain the required high degree of assurance that potential accidents in this class are, and will remain, sufficiently remote in probability that the environmental risk is extremely low. For these reasons, it is not necessary to discuss such events in applicants' Environmental Reports.

Furthermore, it is not necessary to take into account those Class 8 accidents for which the applicant can demonstrate that the probability has been reduced and thereby the calculated risk to the environment made equivalent to that which might be hypothesized for a Class 9 event.

Applicants may substitute other accident class breakdowns and alternative values of radioactive material releases and analytical assumptions, if such substitution is justified in the Environmental Report.

Accident Assumptions

TABLE OF CONTENTS

Accident

1.0 Trivial incidents.
2.0 Small releases outside containment
3.0 Radwaste system failures.
- 3.1 Equipment leakage or malfunction.
- 3.2 Release of waste gas storage tank contents.
- 3.3 Release of liquid waste storage tank contents.

4.0 Fission products to primary system (BWR).
- 4.1 Fuel cladding defects.
- 4.2 Off-design transients that induce fuel failures above those expected.

5.0 Fission products to primary and secondary systems (PWR).
- 5.1 Fuel cladding defects and steam generator leaks.
- 5. Off-design transients that induce fuel failure above those expected and steam generator leak.
- 5. Steam generator tube rupture.

6.0 Refueling accidents.
- 6.1 Fuel bundle drop.
- 6.2 Heavy object drop onto fuel in core.

7.0 Spent fuel handling accident.
- 7.1 Fuel assembly drop in fuel storage pool.
- 7.2 Heavy object drop onto fuel rack.
- 7.3 Fuel cask drop.

8.0 Accident initiation events considered in design basis evaluation in the safety analysis report.
- 8.1 Loss-of-coolant accidents.
- 8.1(a) Break in instrument line from primary system that penetrates the containment.
- 8.2(a) Rod ejection accident (PWR).
- 8.2(b) Rod drop accident (BWR).
- 8.3(a) Steamline breaks (PWRs outside containment).
- 8.3(b) Steamline breaks (BWR).

Accident Assumptions

ACCIDENT—1.0 TRIVIAL INCIDENTS

These incidents shall be included and evaluated under routine releases in accordance with proposed Appendix I.[3]

ACCIDENT—2.0 SMALL RELEASE OUTSIDE CONTAINMENT

These releases shall include such things as releases through steamline relief valves and small spills and leaks of radioactive materials outside containment. These releases shall be included and evaluated under routine releases in accordance with proposed Appendix I.

ACCIDENT—3.0 RADWASTE SYSTEM FAILURE

3.1 *Equipment leakage or malfunction* (includes operator error).

(a) Radioactive gases and liquids: 25 percent of average inventory in the largest storage tank shall be assumed to be released.

(b) Meteorology assumptions—χ/Q values are to be 1/10 of those given in AEC Safety Guide No. 3 or 4.[3]

(c) Consequences should be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

3.2 *Release of waste gas storage tank contents* (includes failure of release valve and rupture disks).

(a) 100 percent of the average tank inventory shall be assumed to be released.

(b) Meteorology assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 3 or 4.

(c) Consequences should be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

3.3 *Release of liquid waste storage tank contents.*

(a) Radioactive liquids—100 percent of the average storage tank inventory shall be assumed to be spilled on the floor of the building.

(b) Building structure shall be assumed to remain intact.

(c) Meteorology assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 3 or 4.

(d) Consequences should be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

ACCIDENT—4.0 FISSION PRODUCTS TO PRIMARY SYSTEM (BWR)

4.1 *Fuel cladding defects.*

Releases from these events shall be included and evaluated under routine releases in accordance with proposed Appendix I.

4.2 *Off-design transients that induce fuel failures above those expected* (such as flow blockage and flux maldistributions).

(a) 0.02 percent of the core inventory of noble gases and 0.02 percent of the core inventory of halogens shall be assumed to be released into the reactor coolant.

(b) 1 percent of the halogens in the reactor coolant shall be assumed to be released into the steam.

(c) The mechanical vacuum pump shall be assumed to be automatically isolated by a high radiation signal on the steamline.

(d) Radioactivity shall be assumed to carry over to the condenser where 10 percent of the halogens shall be assumed to be available for leakage from the condenser to the environment at 0.5 percent/day for the course of the accident (24 hours).

(e) Meteorology assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 3 dated November 2, 1970.

(f) Consequences should be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

[1] Preliminary guidance as to the content of applicants' Environmental Reports was provided in the Draft AEC Guide to the Preparation of Environmental Reports for Nuclear Power Plants dated Feb. 19, 1971, a document made available to the public as well as to the applicant. Guidance concerning the discussion of accidents in environmental reports was provided to applicants in a Sept. 1, 1971, document entitled "Scope of Applicants' Environmental Reports with Respect to Transportation, Transmission Lines and Accidents," also made available to the public.

[2] Although this annex refers to applicants' Environmental Reports, the current assumptions and other provisions thereof are applicable, except as the content may otherwise require, to AEC draft and final Detailed Statements.

[3] 36 F.R. 11113, June 8, 1971.

[4] Copies of such Guide(s), dated Nov. 2, 1970, are available at the Commission's Public Document Room, 1717 H Street NW., Washington, DC, and on request to the Director, Division of Reactor Standards, U.S. Atomic Energy Commission, Washington, D.C. 20545.

ACCIDENT—5.0 FISSION PRODUCTS TO PRIMARY AND SECONDARY SYSTEMS (PRESSURIZED WATER REACTOR)

5.1 *Fuel cladding defects and steam generator leak.*

Releases from these events shall be included and evaluated under routine releases in accordance with proposed Appendix I.

5.2 *Off-design transients that induce fuel failure above those expected and steam generator leak* (such as flow blockage and flux maldistributions).

(a) 0.03 percent of the core inventory of noble gases and 0.02 percent of the core inventory of halogens shall be assumed to be released into the reactor coolant.

(b) Average inventory in the primary system prior to the transient shall be based on operation with 0.5 percent failed fuel.

(c) Secondary system equilibrium radioactivity prior to the transient shall be based on a 20 gal./day steam generator leak and a 10 g.p.m. blowdown rate.

(d) All noble gases and 0.1 percent of the halogens in the steam reaching the condenser shall be assumed to be released by the condenser air ejector.

(e) Meteorology assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 4.

(f) Consequences should be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

5.3 *Steam generator tube rupture.*

(a) 15 percent of the average inventory of noble gases and halogens in the primary coolant shall be assumed to be released into the secondary coolant.

The average primary coolant activity shall be based on 0.5 percent failed fuel.

(b) Equilibrium radioactivity prior to rupture shall be based on a 20 gallon per day steam generator leak and a 10 g.p.m. blowdown rate.

(c) All noble gases and 0.1 percent of the halogens in the steam reaching the condenser shall be assumed to be released by the condenser air ejector.

(d) Meteorology assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 4.

(e) Consequences should be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

ACCIDENT—6.0 REFUELING ACCIDENTS

6.1 *Fuel bundle drop.*

(a) The gap activity (noble gases and halogens) in one row of fuel pins shall be assumed to be released into the water. (Gap activity is 1 percent of total activity in a pin.)

(b) One week decay time before the accident occurs shall be assumed.

(c) Iodine decontamination factor in water shall be 500.

(d) Charcoal filter efficiency for iodines shall be 99 percent.

(e) A realistic fraction of the containment volume shall be assumed to leak to the atmosphere prior to isolating the containment.

(f) Meteorology assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 3 or 4.

(g) Consequences should be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

6.2 *Heavy object drop onto fuel in core.*

(a) The gap activity (noble gases and halogens) in one average fuel assembly shall be assumed to be released into the water. (Gap activity shall be 1 percent of total activity in a pin.)

(b) 100 hours of decay time before object is dropped shall be assumed.

(c) Iodine decontamination factor in water shall be 500.

(d) Charcoal filter efficiency for iodines shall be 99 percent.

(e) A realistic fraction of the containment volume shall be assumed to leak to the atmosphere prior to isolating the containment.

(f) Meteorology assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 3 or 4.

(g) Consequences should be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

ACCIDENT—7.0 SPENT FUEL HANDLING ACCIDENT

7.1 *Fuel assembly drop in fuel storage pool.*

(a) The gap activity (noble gases and halogens) in one row of fuel pins shall be assumed to be released into the water. (Gap activity shall be 1 percent of total activity in a pin.)

(b) One week decay time before accident occurs shall be assumed.

(c) Iodine decontamination factor in water shall be 500.

(d) Charcoal filter efficiency for iodines shall be 99 percent.

(e) Meteorology assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 3 or 4.

(f) Consequences shall be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

7.2 Heavy object drop onto fuel rack.

(a) The gap activity (noble gases and halogens) in one average fuel assembly shall be assumed to be released into the water. (Gap activity is 1 percent of total activity in a pin).

(b) 30 days decay time before the accident occurs shall be assumed.

(c) Iodine decontamination factor in water shall be 500.

(d) Charcoal filter efficiency for iodines shall be 99 percent.

(e) Meteorology assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 3 or 4.

(f) Consequences should be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

7.3 Fuel cask drop.

(a) Noble gas gap activity from one fully loaded fuel cask (120 day cooling) shall be assumed to be released. (Gap activity shall be 1 percent of total activity in the pins).

(b) Meteorology assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 3 or 4.

(c) Consequences should be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

ACCIDENT—8.0 ACCIDENT INITIATION EVENTS CONSIDERED IN DESIGN BASIS EVALUATION IN THE SAFETY ANALYSIS REPORT

8.1 *Loss-of-coolant accidents.*

Small pipe break (6" or less)

(a) Source term—The average radioactivity inventory in the primary coolant shall be assumed (This inventory shall be based on operation with 0.5 percent failed fuel).

(b) Filter efficiencies shall be 95 percent for internal filters and 99 percent for external filters.

(c) 50 percent building mixing for boiling water reactors shall be assumed.

(d) For the effects of Plateout, Sprays, Decontamination Factor in Pool, and Core Sprays the following reduction factors shall be assumed:

For pressurized water reactors—0.05 with chemical additives in sprays, 0.2 for no chemical additives.

For boiling water reactors—0.2.

(e) A realistic building leak rate as a function of time shall be assumed.

(f) Meteorology Assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 3 or 4.

(g) Consequences should be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

Large pipe break

(a) Source term—The average radioactivity inventory in the primary coolant shall be assumed (This inventory shall be based on operation with 0.5 percent failed fuel), plus release into the coolant of:

For pressurized water reactors—2 percent of the core inventory of halogens and noble gases.

For boiling water reactors—0.2 percent of the core inventory of halogens and noble gases.

(b) Filter efficiencies shall be 95 percent for internal filters and 99 percent for external filters.

(c) 50 percent building mixing for boiling water reactors shall be assumed.

(d) For the effects of Plateout, Containment Sprays, Core Sprays (values based on 0.3 percent of halogens in organic form) the following reduction factors shall be assumed:

For pressurized water reactors—0.05 with chemical additives in sprays, 0.2 for no chemical additives.

For boiling water reactors—0.2.

(e) A realistic building leak rate as a function of time and including design leakage of steamline valves in BWRs shall be assumed.

(f) Meteorology Assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 3 or 4.

(g) Consequences should be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

8.1(a) *Break in instrument line from primary system that penetrates the containment* (lines not provided with isolation capability inside containment).

(a) The primary coolant inventory of noble gases and halogens shall be based on operation with 0.5 percent failed fuel.

(b) Release rate through failed line shall be assumed constant for the four hour duration of the accident.

(c) Chalcoal filter efficiency shall be 99 percent.

(d) Reduction factor from combined plateout and building mixing shall be 0.1.

(e) Meteorology assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 3.

(f) Consequences shall be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

8.2(a) *Rod ejection accident (pressurized water reactor).*

(a) 0.2 percent of the core inventory of noble gases and halogens shall be assumed to be released into the primary coolant plus the average inventory in the primary coolant based on operation with 0.5 percent failed fuel.

(b) Loss-of-coolant accident occurs with break size equivalent to diameter of rod housing (See assumptions for Accident 8.1).

8.2(b) *Rod drop accident (boiling water reactor).*

Radioactive material released.

(a) 0.025 percent of the core inventory of noble gases and 0.025 percent of the core inventory of halogens shall be assumed to be released into the coolant.

(b) 1 percent of the halogens in the reactor coolant shall be assumed to be released into the condenser.

(c) The mechanical vacuum pump shall be assumed to be automatically isolated by high radiation signal on the steamline.

(d) Radioactivity shall be assumed to carry over to the condenser where 10 percent of the halogens shall be assumed to be available for leakage from the condenser to the environment at 0.5 percent/day for the course of the accident (24 hours).

(e) Meteorology assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 3.

(f) Consequences should be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

8.3(a) *Steamline breaks (pressurized water reactors—outside containment).*
Break size equal to area of safety valve throat.

Small break

(a) Primary coolant activity shall be based on operation with 0.5 percent failed fuel. The primary system contribution during the course of the accident shall be based on a 20 gal./day tube leak.

(b) During the course of the accident a halogen reduction factor of 0.1 shall be applied to the primary coolant source when the steam generator tubes are covered; a factor of 0.5 shall be used when the tubes are uncovered.

(c) Secondary coolant system radioactivity prior to the accident shall be based on:
  (a) 20 gallons per day primary-to-secondary leak.
  (b) Blowdown of 10 g.p.m.

(d) Volume of one steam generator shall be assumed to be released to the atmosphere with an iodine partition factor of 10.

(e) Meteorology Assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 4.

(f) Consequences shall be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

Large break

(a) Primary coolant activity shall be based on operation with 0.5 percent failed fuel. The primary system contribution during the course of the accident shall be based on a 20 gal./day tube leak.

(b) A halogen reduction factor of 0.5 shall be applied to the primary coolant source during the course of the accident.

(c) Secondary coolant system radioactivity prior to the accident shall be based on:
  (a) 20 gallons per day primary-to-secondary leak.
  (b) Blowdown of 10 g.p.m.

(d) Volume of one steam generator shall be assumed to be released to the atmosphere with an iodine partition factor of 10.

(e) Meteorology Assumptions—χ/Q values shall be 1/10 of those given in AEC Safety Guide No. 4.

(f) Consequences shall be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

8.3(b) *Steamline breaks (boiling water reactor).*

Small pipe break (of ¼ ft.²)

(a) Primary coolant activity shall be based on operation with 0.5 percent failed fuel.

(b) The main steamline shall be assumed to fail releasing coolant until 5 seconds after isolation signal is received.

(c) Halogens in the fluid released to the atmosphere shall be at 1/10 the primary system liquid concentration.

(d) Meteorology assumptions—χ/Q values shall be 1/10 of those in AEC Safety Guide No. 3.

(e) Consequences shall be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

Large break

(a) Primary coolant activity shall be based on operation with 0.5 percent failed fuel.

(b) Main steamline shall be assumed to fail releasing that amount of coolant corresponding to a 5-second isolation time.

(c) 1/2 the halogens in the fluid exiting the break shall be assumed to be released to the atmosphere.

(d) Meteorology assumptions—χ/Q values shall be 1/10 of those in AEC Safety Guide No. 3.

(e) Consequences shall be calculated by weighting the effects in different directions by the frequency the wind blows in each direction.

ENCLOSURE 2

(In Preparation)

ENCLOSURE 3

PROPOSED F.R. NOTICE

Nuclear Power Plant Accident Considerations
Under the National Environmental Policy Act of 1969

AGENCY: U.S. Nuclear Regulatory Commission

ACTION: Statement of Interim Policy and Termination of Rulemaking Proceeding.

SUMMARY: It has been the policy and practice of the Nuclear Regulatory Commission, and before it, the Atomic Energy Commission to consider the possibilities, probabilities, and potential consequences for the public health and safety of accidents that might occur at nuclear power plants. These considerations have been reflected in criteria for siting, for plant design and operation, for planning to cope with emergencies, and in environmental impact assessments required by the National Environmental Policy Act of 1969 (NEPA). These policies and practices have been severely criticized for their apparent failure to give adequate consideration to the more severe kinds of accidents that are physically possible. Such accidents are commonly referred to as Class 9 accidents, following an accident classification scheme proposed in 1971 for purposes of implementing NEPA.[1] The March 28, 1979 accident at Unit 2 of the Three Mile Island nuclear plant has further emphasized the need for changes in our policies regarding the considerations to be given to serious accidents from an environmental as well as a safety point of view.

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[1] Proposed as an Annex to 10 CFR Part 50, Appendix D, 36 F.R. 22851. The Commission's NEPA-implementing regulations were subsequently (July 18, 1974) revised and recast as 10 CFR Part 51 but at that time the Commission noted that "The proposed Annex is still under consideration . . ." 39 F.R. 26279.

ENCLOSURE 3

PROPOSED F.R. NOTICE

Nuclear Power Plant Accident Considerations
Under the National Environmental Policy Act of 1969

AGENCY: U.S. Nuclear Regulatory Commission

ACTION: Statement of Interim Policy and Termination of Rulemaking Proceeding.

SUMMARY: It has been the policy and practice of the Nuclear Regulatory Commission, and before it, the Atomic Energy Commission to consider the possibilities, probabilities, and potential consequences for the public health and safety of accidents that might occur at nuclear power plants. These considerations have been reflected in criteria for siting, for plant design and operation, for planning to cope with emergencies, and in environmental impact assessments required by the National Environmental Policy Act of 1969 (NEPA). These policies and practices have been severely criticized for their apparent failure to give adequate consideration to the more severe kinds of accidents that are physically possible. Such accidents are commonly referred to as Class 9 accidents, following an accident classification scheme proposed in 1971 for purposes of implementing NEPA.[1] The March 28, 1979 accident at Unit 2 of the Three Mile Island nuclear plant has further emphasized the need for changes in our policies regarding the considerations to be given to serious accidents from an environmental as well as a safety point of view.

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[1] Proposed as an Annex to 10 CFR Part 50, Appendix D, 36 F.R. 22851. The Commission's NEPA-implementing regulations were subsequently (July 18, 1974) revised and recast as 10 CFR Part 51 but at that time the Commission noted that "The proposed Annex is still under consideration . . ." 39 F.R. 26279.

This statement of interim policy announces the withdrawal of the proposed Annex to Appendix D of 10 CFR Part 50 and the termination of the rulemaking proceeding that began with the publication of that proposed Annex on December 1, 1971. It sets forth the reasons for taking this action at this time, including the reasons why further rulemaking is not warranted. It also states the Commission's interim views as to how accident considerations should be factored into NEPA reviews in the future, and notes that this statement of interim policy is taken in coordination with other ongoing safety related activities that are intimately related to accident considerations in the areas of plant design, operational safety, siting policy, and emergency planning.

SUPPLEMENTARY INFORMATION:

Accident Considerations in Past NEPA Reviews

The proposed Annex to Appendix D of 10 CFR Part 50 (hereafter the "Annex") was published for comment on December 1, 1971 by the (former) Atomic Energy Commission. It proposed to specify a set of standardized accident assumptions to be used in Environmental Reports submitted by applicants for construction permits or operating licenses for nuclear power reactors. It also included a system of classifying accidents according to a graded scale of severity and probability of occurrence. Nine classes of accidents were defined ranging from trivial to very serious. It directed that "for each class, except classes 1 and 9, the environmental consequences shall be evaluated as indicated." Class 1 events were not to be considered because of their trivial consequences, whereas in regard to Class 9 events, the Annex stated as follows:

"The occurrences in Class 9 involve sequences of postulated successive failures more severe than those postulated for the design basis for protective systems and engineered safety features. Their consequences could be severe. However, the probability of their occurrence is so small that their environmental risk is extremely low. Defense in depth (multiple physical barriers), quality assurance for design, manufacture, and operation, continued surveillance and testing, and conservative design are all applied to provide and maintain the required high degree of assurance that potential accidents in this class are, and will remain, sufficiently remote in probability that the environmental risk is extremely low. For these reasons, it is not necessary to discuss such events in applicants' Environmental Reports."

A footnote to the Annex stated:

"Although this annex refers to applicant's Environmental Reports, the current assumptions and other provisions thereof are applicable, except as the content may otherwise require, to AEC draft and final Detailed Statements."

During the public comment period that followed publication of the Annex a number of criticisms of the Annex were received. Principal among these were the following:

(1) The philosophy of prescribing assumptions does not lead to objective analysis,

(2) It failed to treat the probabilities of accidents in any but the most general way,

(3) No supporting analysis was given to show that Class 9 accidents are sufficiently low in probability that their consequences in terms of environmental risks need not be discussed.

(4) No guidance was given as to how accident and normal releases of radioactive effluents during plant operation should be factored into the cost-benefit analysis,

(5) The accident assumptions are not generally applicable to gas cooled or liquid metal cooled reactors, and

(6) Safety and environmental risks are not essentially different considerations.

The Commission has not, heretofore, responded to these comments made in late 1971 and early 1972 and has taken no further action on this rule-making except as noted above in 1974 when 10 CFR Part 51 was promulgated. Over the intervening years the accident considerations discussed in

Environmental Impact Statements for proposed nuclear power plants have reflected the guidance of the Annex with few exceptions, as noted below. Typically, the discussions of accident consequences through Class 8 (design basis accidents) for each case have reflected specific site characteristics associated with meteorology (the dispersion of releases of radioactive material into the atmosphere), the actual population within a fifty mile radius of the plant, and some differences between boiling water reactors (BWR) and pressurized water reactors (PWR). Beyond these few specifics, the discussions have reiterated the guidance of the Annex and have relied upon the Annex's conclusion that the probability of occurrence of a Class 9 event is too low to warrant consideration, a conclusion based upon generally stated safety considerations.

With the publication of the Reactor Safety Study (WASH-1400), in draft form in August 1974 and final form in October 1975, the accident discussions in Environmental Impact Statements began to refer to this first detailed study of the risks associated with nuclear power plant accidents, particularly events which can lead to the melting of the fuel inside a reactor.[2] The references to this study were wholly in keeping with the intent and spirit of NEPA "to disclose" relevant information but it is obvious that it did not form the basis for the conclusion expressed in the Annex in 1971 that the probability of occurrence of Class 9 events was too low to warrant their (site specific) consideration under NEPA.

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[2]It is of interest that the Reactor Safety Study never refers to nor uses the term "Class 9 accident" although it is commonly understood as loosely equivalent to a core melt accident.

The Commission's staff has however identified in certain cases unique circumstances which it felt warranted more extensive and detailed consideration of Class 9 events. One of these was the proposed Clinch River Breeder Reactor Plant (CRBRP), a liquid metal cooled fast breeder reactor very different from the more conventional light water reactor plants for which our safety experience base is much broader. In the Final Environmental Statement for the CRBRP,[3] the staff included a discussion of the consideration it had given to Class 9 events.

In the case of the application by Offshore Power Systems to manufacture floating nuclear power plants, the staff judged that the environmental risks of some Class 9 events warranted special consideration. The special circumstances here are the potentially serious consequences associated with water (liquid) pathways leading to radiological exposures if a molten reactor core were to fall into the water body on which the plant floats. Here the staff emphasized its focus on risk to the environment but did not find that the probability of a core melt event occurring in the first place was essentially any different than for a land based plant. In its Memorandum and Order In the Matter of Offshore Power Systems,[4] the Commission has concurred in the staff's judgment. Thus, the Reactor Safety Study and our experience with these cases has served to refocus our attention on the need to reemphasize that environmental risk entails both probabilities and consequences, a point that while made in the publication of the Annex, was not given adequate emphasis..

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[3] NUREG-0139, February 1977

[4] Docket No. STN 50-437, September 14, 1979

In July 1977 the NRC commissioned a Risk Assessment Review Group "to clarify the achievements and limitations of the Reactor Safety Study." One of the conclusions of this study, published in September 1978, was that "The Review Group was unable to determine whether the absolute probabilities of accident sequences in WASH-1400 are high or low, but believes that the error bounds on those estimates are in general, greatly understated." This and other findings of the Review Group have also subsequently been referred in Environmental Impact Statements, along with a reference to the Commission's policy statement on the Reactor Safety Study in light of the Risk Assessment Review Group Report, published on January 18, 1979. The Commission's statement accepted the findings of the Review Group, both as to its achievements and as to its limitations.

A few Draft Environmental Statements have been published subsequent to the Three Mile Island accident. These relate to conventional land based light water reactor plants and continue to reflect the immediate past practice with respect to accidents at such plants, but noted that the experience gained from the Three Mile Island accident was not factored into the discussion. This omission is attributable to the allocation of staff resources to the safety questions raised by the accident and not to an intent not to rectify the accident discussion in this regard.

This chronicling of our experience with past NEPA reviews of accidents clearly reflects a need for change and we now summarize these and other deficiencies in the Annex which cause us to withdraw it rather than attempt to modify its structure and language.

1. The Annex proscribes consideration of the kinds of accidents (Class 9) that the Reactor Safety Study found dominates the accident risk.

2. The definition of Class 9 accidents in the Annex is not sufficiently precise to warrant its further use in Commission policy, rules and regulations, nor as a decision criterion in agency practice.

3. The Annex's prescription of assumptions to be used in the analysis of the environmental consequences of accidents does not contribute to objective consideration.

4. The thrust of the Annex, insofar as it places emphasis on Environmental Report requirements, inadequately reflects the fact that, under NEPA, it is the NRC's primary responsibility for the assessment of the environmental risk associated with its actions.

Accordingly, the proposed Annex to Appendix D of 10 CFR Part 50, published on December 1, 1971, is hereby withdrawn and shall not hereafter be used by applicants nor by the staff. The classification of accidents proposed in that Annex shall no longer be used. In its place the following interim guidance is given for the treatment of accident risk considerations in NEPA reviews in the future.

Accident Considerations in Future NEPA Reviews

It is the position of the Commission that its Environmental Impact Statements, pursuant to Section 102(c)(i) of the National Environmental Policy Act of 1969, shall include a reasoned consideration of the environmental impacts (risks) that can be associated with accidents at the particular facility or facilities within the scope of each such statement. In the analysis and discussion of such risks approximately equal attention shall be given to the probability of occurrence of releases and to the probability of occurrence of the environmental consequences of those releases. Releases refer to radiation and/or radioactive materials entering environmental exposure pathways including air, water, and ground water.

Events or accident sequences that lead to releases shall include but not be limited to those that can reasonably be expected to occur. In-plant accident sequences that can lead to a spectrum of releases shall be discussed and shall include sequences that can result in inadequate cooling of reactor fuel and to melting of the reactor core. The extent to which events arising from causes external to the plant which are considered possible contributors to the risk associated with the particular plant shall also be discussed. Detailed quantitative considerations that form the basis of probabilistic estimates of releases need not be incorporated in the Environmental Impact Statements but shall be referenced therein. Such references shall include, as applicable, reports on safety evaluations.

The environmental consequences of releases whose probability of occurrence has been estimated shall also be discussed in probabilistic terms. Such consequences shall be characterized in terms of exposures to individuals (Rem) and to population groups (person-Rem). Health and safety risks that may be associated with such exposures shall be discussed in a manner that fairly reflects the current state of knowledge regarding such risks. Economic impacts that might be associated with accident releases of radioactive materials should be discussed qualitatively but need be discussed quantitatively only to the extent that they may enter significantly into the cost-benefit balance.

In promulgating this interim guidance the Commission is aware that there are and will likely remain for some time to come many uncertainties in the application of risk assessment methodologies and it expects that its Environmental Impact Statements will identify major uncertainties in its

probabilistic estimates. On the other hand the Commission believes that the state of the art now is sufficiently advanced that a beginning should now be made in the use of these methodologies in the regulatory process and that such use will represent a constructive and rational forward step in the discharge of its responsibilities.

It is the intent of the Commission in issuing this interim guidance that the staff will initiate revised treatments of accident considerations in its on-going NEPA reviews, i.e., for any case at a licensing stage where a Final Environmental Impact Statement has not yet been issued. For the reasons set forth below we do not expect the staff, independent of on-going safety matters under review, to initiate revised statements of accident considerations for any other cases, unless it first brings such cases to our attention and sets forth the reasons why it believes such revised statements should be considered.

Applicants for construction permits and operating licenses need not discuss environmental risks associated with accidents in their Environmental Reports submitted hereafter but will be expected to provide such information as the staff may require to perform the foregoing assessments, pursuant to 10 CFR Part 51.20(a) and 51.21.

Related Policy Matters Under Consideration

In addition to its responsibilities under NEPA, the NRC also bears responsibility under the Atomic Energy Act for the protection of the public health and safety from the hazards associated with the use of nuclear energy. Pursuant to this responsibility we note that there are currently a number of on-going activities within the Commission and its staff which intimately relate to the "Class 9 accident" question and

either are the subject of current rulemaking or are candidate subjects for rulemaking.

On December 19, 1979 the Commission issued for public comment[5] a proposed rule which would significantly revise its requirements for emergency planning for nuclear power plants. One of the considerations in this rulemaking was the potential consequences of Class 9 accidents in a generic sense.[6]

In August 1979, pursuant to our request, a Siting Policy Task Force made recommendations to us with respect to possible changes in our reactor siting policy and criteria,[7] currently set forth in 10 CFR Part 100. As stated therein, its recommendations were made to accomplish (among others) the following goal:

> "To take into consideration in siting the risk associated with accidents beyond the design basis (Class 9) by establishing population density and distribution criteria."

This matter is currently before us.

This and other recommendations that have been made as a result of the investigations into the Three Mile Island accident are currently being brought together by the Commission's staff in the form of proposed Action Plans.[8] Among other matters these incorporate recommendations for rulemaking related to degraded core cooling and core melt accidents. We expect to issue decisions on these Action Plans in the near future. The

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[5] 44 F.R. 75167

[6] cf. NUREG-0396, "Planning Basis for the Development of State and Local Government Radiological Emergency Response Plans in Support of Light Water Nuclear Power Plants," November 1978.

[7] NUREG-0625, "Report of the Siting Policy Task Force," August 1979.

[8] Draft NUREG-0660, "Action Plans for Implementing Recommendations of the President's Commission and Other Studies of the TMI-2 Accident," December 10, 1979.

outcome of these decisions may alter our policy guidance set forth above for accident considerations under NEPA. In the meantime, however, it is our policy and intent to devote our major resources to matters which we believe will make existing and future nuclear power plants safer, and to prevent a reoccurrence of the kind of accident that occurred at Three Mile Island.

COMMENT: The Commission intends the interim policy guidance contained herein to be immediately effective. However, the public is invited to submit comments thereon. Written comments or suggestions in connection with this interim statement of policy will be considered if submitted within 90 days from the date of publication. Such comments should be submitted to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, D. C. 20555.

VALUE-IMPACT ANALYSIS

The staff believes that the value in taking the proposed step to improve the rationality and objectivity of the treatment of the radiological risks to the environment due to potential accidents at nuclear power plants has been sufficiently set forth in the discussion of Alternative 3 in the main body of the paper. Further discussion is necessary however, to clarify the staff's conception of the scope and depth of the treatment envisaged for the analysis and discussion of environmental risks of accidents in future Environmental Impact Statements. The primary resource impact of adopting the proposed policy guidance would fall upon the staff.

It is the staff's intent, as noted previously in SECY 79-594, to introduce probabilistic assessments of accident risks that reflect the current state of the art, as that exists at the time of preparation of each Statement. At the present time this would involve releases to the atmosphere as characterized by the release categories identified in WASH-1400 and to the hydrosphere as identified in the Liquid Pathway Generic Study (NUREG-0440). The approach would reflect characteristics specific to classes of plants, BWR's, PWR's, and ice containments representing work which has already been done by the staff. It would also reflect improvements in and the results of a number of studies regarding the consequence model employed, that are responsive to concerns expressed by the ACRS and by the Risk Assessment Review Group. In particular these improvements can now reflect a reasonable, application to site specific circumstances of population distribution, and meteorology. It is important to note that, for light water reactors, the staff does not believe it is necessary, for purposes of implementing the proposed guidance, to embark upon any new research or development tasks.

The guidance, in principal, would also be applicable to other designs, e.g., LMFBR's, but its implementation for such cases would have a significantly greater impact on staff resources. For the near term, this latter impact has not been considered.

It is not the intent of the staff to rely for its judgment on the environmental risks of accidents wholly and exclusively upon assessments that use event tree-fault tree methodology. It is the intent that the discussion also reflect partially quantifiable and qualitative considerations associated with safety reviews and safety requirements that are important contributors to the judgment on risk, but in a more specific and relevant manner to the case under consideration than has been the manner of past practice. The integration of the risk cannot, therefore, be quantitatively definitive.

The staff envisions a treatment that would lend itself to the range of 10 to 15 pages of discussion augmented by a few graphical descriptions of the textual material, and a conclusion as to whether or not it considers that adequate steps have been taken to minimize the impact (risk) to the environment. It is estimated that four man-months of staff effort will be required to produce the first such treatment, and approximately 1 to 2 man-months for subsequent cases. The staff does not envision the need to utilize outside technical assistance to carry this out.

With respect to applicants, it is inherent in the proposed policy guidance that the impact is a beneficial one in the sense that their resources which may otherwise be devoted to the preparation of Environmental Reports with respect to accident risk assessment could now be devoted to safety matters and the actual lessening of risk.

With respect to the public, the staff believes that the primary impact would be an improved degree of confidence in the NRC's decisional process. In this respect the staff believes that the accident impact section of future EIS's should reflect clear and understandable answers to the kinds of questions that citizens near the plant can be expected to be concerned about and in site reference terms or landmarks with which they would be familiar. The staff would expect to acknowledge its awareness of the potential psychological impacts of accidents, referencing the TMI experience and studies, and that emergency preparedness measures under way are more definitively addressing the public's needs for information in this regard, but also noting that such impacts are not quantifiable.

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