NUCLEAR REGULATORY COMMISSION

10 CFR Part 140

Criteria for an Extraordinary Nuclear Occurrence

AGENCY: Nuclear Regulatory Commission.

ACTION: Proposed rule.

SUMMARY: The Nuclear Regulatory Commission (NRC) is considering amending its regulations to revise the criteria for an "extraordinary nuclear occurrence" (ENO). If a nuclear incident were found by the Commission to be an "extraordinary nuclear occurrence," several legal defenses would be waived including the necessity of persons with damage claims to prove negligence. The proposed changes are designed to simplify the administrative criteria used by the Commission in making an ENO determination and to avoid the problems encountered by the Commission in applying the existing criteria to the accident at the Three Mile Island nuclear plant (TMI). These proposed changes will affect applicants for and holders of NRC licenses for production and utilization facilities and other persons indemnified as to such facilities.

DATE: The comment period expires on August 7, 1985. Comments received after that date will be considered if it is practical to do so, but assurance of consideration cannot be given unless the comments are filed on or before that date.

ADDRESSES: All interested persons who desire to submit written comments or suggestions in connection with this proposed rule should send them to the Secretary of the Commission, U.S. Nuclear Regulatory Commission, Washington, DC 20555, Attention: Docketing and Service Branch. Copies of all documents received may be examined and copied in the Commission's Public Document Room at 1717 H Street NW., Washington, DC.

FOR FURTHER INFORMATION CONTACT: H.T. Peterson, Office of Nuclear Regulatory Research, U.S. Nuclear Regulatory Commission, Washington, DC 20555, Telephone (301) 427-4578.

SUPPLEMENTARY INFORMATION:

I. Background

In the event of a nuclear incident, claims for injuries or damages can be brought against the plant licensee and other parties considered responsible for the incident. The Price-Anderson provisions of the Atomic Energy Act (AEA) of 1954, as amended, (section 170) provide a system of private insurance and electric utility funds totaling over $560 million to pay pay public liability claims. One of the principal obstacles to a claimant's recovery for injuries or damages could be the necessity for the claimant to prove negligence on the part of the defendants or the absence of contributory negligence on the part of the claimant. Congress attempted to remove this obstacle in 1966 by amending the Price-Anderson Act to require the waiver of certain defenses by an indemnified person when the nuclear accident magnitude "triggered" the ENO criteria.

When the Commission determines that a nuclear incident is an "extraordinary nuclear occurrence" within the meaning of the Act and the Commission's regulations, the waiver of defenses provisions contained in the insurance policies and indemnity agreements implementing the Price-Anderson system are activated. As provided by section 170n(1) of the Atomic Energy Act of 1954, as amended, the waived defenses include:

(i) Any issue or defense as to the conduct of the claimant or fault of persons indemnified,

(ii) Any issue or defense, as to charitable or governmental immunity, and

(iii) Any issue or defense based on any statute of limitation if suit is instituted within three years from the date on which the claimant first knew, or reasonably could have known, of his injury or damage and the cause thereof, but in no event more than twenty years after the date of the nuclear incident.

The waivers of defenses, once triggered by an ENO determination by the Commission, relieve the claimant of having to prove negligence by a defendant and of having to disprove defenses such as contributory negligence. Whether or not an ENO is declared, however, a claimant would still have to prove: (a) Personal injury or damage, (b) amount of monetary loss, and (c) the causal link between the claimant's loss and the radioactive material released.

The term "extraordinary nuclear occurrence" is defined by section 11(j) of the Atomic Energy Act as follows:

The term "extraordinary nuclear occurrence" means any event causing a discharge or dispersal of source, special nuclear, or byproduct material from its intended place of confinement in amounts offsite, or causing radiation levels offsite, which the Commission determines to be substantial, and which the Commission determines has resulted

or probably will result in substantial damages to persons offsite or property offsite.

This provision clearly calls for a two-pronged determination: (a) Substantial offsite release or substantial offsite radiation, and (b) actual or prospective substantial offsite damages. This section also requires the Commission to "establish criteria in writing" for application of these tests to specific events.

The Commission's present regulations were established in 1968 (33 FR 15998) and are found in 10 CFR 140.84 and 140.85. Consistent with the statutory definition, for the Commission to determine that there has been an ENO, the Commission must find that both substantial releases of radioactive materials or substantial offsite doses *and* substantial injury or substantial damages have occurred (both Criterion I and Criterion II must be met). The language of the regulation, especially that related to Criterion I, is rather technical and precise.

Criterion I

Criterion I relates to whether there has been a substantial discharge or dispersal of radioactive material offsite, or whether there has been a substantial level of radiation offsite. Criterion I calls for such a finding when radioactive material is released from its intended place of confinement or radiation levels occur offsite and *either* of the following findings are also made:

a. That one or more persons offsite were, could have been, or might be exposed to radiation or to radioactive material, resulting in a dose or in a projected dose in excess of one of the levels in the following table:

TABLE I.—TOTAL PROJECTED RADIATION DOSES

Critical organ	Dose (rems)
Thyroid	30
Whole body	20
Bone Marrow	20
Skin	60
Other organs or tissues	30

In measuring or projecting doses, exposures from the following types of radiation shall be included:

(1) Radiation from sources external to the body;

(2) Radioactive material that may be taken into the body from air or water; and

(3) Radioactive material that may be taken into the body from its occurrence in food or on terrestrial surfaces.

or

b. (1) Surface contamination of at least a total of any 100 square meters of offsite property has occurred as a result of a release of radioactive material from a production or utilization facility and such contamination is characterized by levels of radiation in excess of one of the values listed in column 1 or column 2 of the following table, *or*

(2) Surface contamination of any offsite property has occurred as the result of a release of radioactive material in the course of transportation and such contamination is characterized by levels of radiation in excess of one of the values in column 2 of the following table:

TABLE II.—TOTAL SURFACE CONTAMINATION LEVELS [1]

Type of emitter	Column 1	Column 2
	Offsite property contiguous to site; owned or leased by a person with whom an indemnity agreement is executed.	Other offsite property
Alpha emission from transuranic isotopes.	3.5 microcuries per square meter.	0.35 microcuries per square meter.
Alpha emission from isotopes other than transuranic isotopes.	35 microcuries per square meter.	3.5 microcuries per square meter.
Beta or gamma emission.	40 millirads/hour at 1 cm. (measured through not more than 7 milligrams per square centimeter of total absorber).	4 millirads/hour at 1 cm. (measured through not more than 7 milligrams per square centimeter of total absorber).

[1] The maximum levels (above background), observed or projected, 8 or more hours after initial deposition.

If Criterion I is satisfied, Criterion II must then be applied.

Criterion II

Criterion II is satisfied if *any* of the following findings is made:

(1) The event has resulted in the death or hospitalization, within 30 days of the event, of five or more people located offsite showing objective clinical evidence of physical injury from exposure to the radioactive, toxic, explosive, or other hazardous properties of source, special nuclear, or byproduct material; *or*

(2) $2,500,000 or more of damage offsite has been or will probably be sustained by any one person, or $5 million or more of such damage in total has been or will probably be sustained, as the result of such event; *or*

(3) $5,000 or more of damage offsite has been or will probably be sustained by each of 50 or more persons, provided that $1 million or more of such damage in the aggregate has been or will probably be sustained, as the result of such events.

The term "damage" refers to damage arising out of or resulting from the radioactive, toxic, explosive, or other hazardous properties of source, special nuclear, or byproduct material, and shall be based upon estimates of one or more of the following:

(1) Total cost necessary to put affected property back into use,

(2) Loss of use of affected property,

(3) Value of affected property where not practical to restore to use,

(4) Financial loss resulting from protective actions such as evacuation appropriate to reduce or avoid exposure to radiation or to radioactive materials.

II. Problems in Application

The accident at the Three Mile Island Nuclear Power Station, Unit 2, on March 29, 1979 uncovered several problems in applying the existing ENO criteria in 10 CFR 140.84 and 140.85. The Commission's determination that the accident at TMI was not an "extraordinary nuclear occurrence" was published in the Federal Register on April 23, 1980 (45 FR 27590). This determination was based in part on NRC staff report NUREG-0637, "Report to the Nuclear Regulatory Commission from the Staff Panel on the Commission's Determination of an Extraordinary Nuclear Occurrence (ENO)", dated January 1980. This report is available for inspection in the Commission's Public Document Room at 1717 H Street NW., Washington, DC. A single copy of the report NUREG-0637 may be obtained free upon request from the Nuclear Regulatory Commission, Publication Services Section, Washington, DC 20555.

Basically, there are problems with the existing ENO criteria. These problems are:

1. Several of the dose criteria for "substantial releases" in the present regulation were formulated in part to be consistent with the then effective Protective Action Guides. Since 1968 proposed Protective Action Guides have been reformulated at lower dose levels.

2. The current Criterion II for "substantial injury" requires objective clinical evidence of radiation injury. However, tests for evidence of such injury are not necessarily conclusive proof of radiological injury. For example, psychological stress can manifest some physical symptoms similar to those associated with acute radiation injury.

3. Monetary damages in Criterion II were difficult, if no impossible, to

evaluate accurately in a timely manner. For example, in the ENO determination for the Three Mile Island Accident, compensation costs such as payments for evacuation were evaluated and tabulated. However, many damages, such as diminution of property values and business losses, required court adjudication before the proper compensation could be awarded.

III. Proposed Criteria

The Commission is proposing for comment three different options for determining whether an accident was an extraordinary nuclear occurrence. The first and second options retain the structure of the existing criteria and contain explicit criteria for both substantial releases and substantial damages. These options employ estimates of offsite doses and ground contamination as indicators of substantial releases but have separate criteria for substantial damages. These two options also seek to avoid the measurement problems encountered in applying the present criteria for "substantial damages" by focusing the criteria on costs which can be readily counted or estimated. The first two options differ in that the Commission is proposing alternative wording of these criteria for public comment.

The Commission is also interested in obtaining public comments on a third option for defining an ENO. This third option represents a new and arguably more simplified approach to arrive at ENO criteria which could be readily evaluated following a nuclear accident. This option focuses on establishing that a major release of radioactive materials has occurred with concomitant high offsite radiation levels or contamination. It does not require that doses to individuals be evaluated, nor does it require that property damage estimates or evacuation characteristics be evaluated. Further, this criterion for substantial releases does not require the NRC staff to evaluate exposure conditions such as occupancy time or building shielding factors for actual or hypothetical individuals and, consequently, would simplify the data collection and analysis following an accident. Thus, this option may be viewed as more straight forward than the other option. It allows for direct measurement of discharge of material or radiation levels, and by virtue of the strong causal relation between release of radionuclides and damages, it defines, by direct measurement, the conditions under which the Criterion II requirement of substantial damages is met. Therefore, its intent is that procedural barriers to a rapid determination should be minimized.

Option 1

Criterion I is a mechanism for determining that a substantial release of radioactive material or radiation offsite has occurred. Currently Criterion I specifies a 20-rem (0.2-sievert)* whole body dose to one person offsite with higher values for specific organs. The proposed regulation would lower these levels to a 5-rem whole body dose with correspondingly lower organs doses. This proposed modification has been selected to be numerically consistent with Protective Action Guides proposed by the Enivronmental Protection Agency[1] and those issued by the Food and Drug Administration.[2] This ensures that any nuclear accident which would have warranted protective actions will be found to involve a substantial release of radioactive materials which satisfy the first condition for an ENO determination.

The proposed dose levels for Criterion I, which would define levels of "substantial releases or substantial offsite doses" for screening purposes, are in the range of the occupational dose limits and hence could be regarded as too low to be viewed as being "substantial." However, these doses criteria are substantially above the doses to the general public expected from normal operation of NRC-licensed facilities as limited by § 20.105 of 10 CFR Part 20 and, in that sense, constitute criteria for "substantial releases."

The words "* * * one or more persons offsite were, could have been or might be exposed * * *" in the current criterion would be replaced with the proposed words: "* * * one or more persons offsite were or will probably be exposed * * *" This proposal will remove the necessity to evaluate highly improbable "might have been" conditions in favor of conditions which would be more likely to occur.

The surface contamination levels in Criterion I will not be changed as those levels are consistent with proposed emergency response levels. The existing procedures in § 140.84(b) are inexpensive and can be performed rapidly. Although more sophisticated measurement techniques are available and specific radionuclide levels could be measured, the existing simpler tests provide adequate indication of contamination levels for an ENO determination.

Criterion II, which defines substantial damages, would be changed extensively. Instead of the present criterion based upon the total monetary worth of damages or clinical evidence of radiation injury, the proposed Criterion II for the amount of damages represents items for which information is readily available within the time frame for an ENO determination. For each of the monetary requirements, the total valuation is assumed to be equivalent to a loss of $2.5 million. This value is in the present ENO criterion as the amount of loss to a single individual which would constitute an ENO. The Commission no longer believes it necessary or useful to specify different amounts of monetary damages depending upon the number of people affected.

Criterion II (1) accounts for human injury. One alternative that the Commission is considering would replace the current criterion for clinical injury to 5 or more people with a requirement that 5 or more receive radiation doses which are in the range that would produce symptoms of "radiation sickness." For the purpose of this evaluation, clinical findings of radiation injury in the current criteria would not be required, only a showing that five or more people received doses in excess of 100 rads (1 Gy).* This is expressed in rads because the unit of dose equivalent (rem or sievert) requires a dose quality factor (QF) be used. In the range of doses which could cause acute injury such as the 100-rem (1-sievert) dose, the appropriate quality factor is dependent upon the specific biological end point.

In evaluating the doses for defining "substantial injury", the Commission intends that the methodology used for the evaluations be realistic rather than overly conservative. Parameters and models used in Regulatory Guide 1.109[3] are suitable for this purpose to the extent that they apply to accident conditions.

In this proposal, the present monetary values for property damage in the

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* A sievert (Sv) is the SI unit of dose equivalent: 1 Sv = 100 rem; 1 rem-centisievert (1 cSV) or 0.01 sievert.

[1] Environmental Protection Agency, "Manual of Protective Action Guides and Protective Actions for Nuclear Incidents" EPA Report EPA-520/1-75-001 (Revised June 1980).

[2] Food and Drug Administration "Accidental Radioactive Contamination of Human Food and Animal Feeds; Recommendation for State and Local Agencies," published in the Federal Register on October 22, 1982 (47 FR 47073).

* Gray is the SI unit of absorbed dose. 1Gy = 100 rads; 1 rad = 0.01 gray.

[3] 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". Available from Director, Division of Technical Information and Document Control, USNRC, Washington, DC 20555.

existing Criterion II would be replaced by things that could be readily counted or estimated within a relatively short time following an accident, such as tax assessments, numbers of people unemployed, and numbers of people evacuated. In Criterion II (2), the assessed value of property requiring decontamination is used as an index of damage. Criterion II (3) is based upon an assumed loss (to the person directly affected and others) of $100 per person-day of lost employment. In Criterion II (4) a cost of $25 per person-day for evacuees is used to arrive at the number of evacuees equivalent to the $2.5 million loss.

Option #2—Commissioner Asselstine's Proposals

Commissioner Asselstine has proposed alternatives to criteria for defining substantial releases and for specifying substantial injury. In Criterion I, in place of the change proposed in Option #1 for redefining substantial releases, Commissioner Asselstine would prefer that, instead of the present Part 140 wording: * * * one or more persons were, could have been or might be exposed * * *," the text would read:

"* * * a person or persons on or near any site boundary throughout the duration of the accident * * *"

This permits the Commission to make the ENO evaluation based upon the estimated dose to an individual who possibly was at or near the site boundary throughout the course of the accident. As was the case with Option #1, this proposal also eliminates the uncertain "might have been" condition and employs the proposed revised dose criteria.

An alternative criterion for defining substantial injury has been proposed by Commissioner Asselstine. This alternative represents a change from using acute injury, such as in the present criterion for "objective clinical evidence of radiation injury" to five people or the death of the five people, or using a high dose to a few exposed individuals such as the 100-rem (1 sievert) dose to five people proposed in Option #1. Option #2 would use a requirement that a 100,000 person-rem (1,000 person-sieverts) collective dose delivered to the population within fifty miles as only indication of the potential impact of the accident on the surrounding population. This is consistent with findings that the latent effects of a serious nuclear accident could far outweigh the observable acute affects.

The proposed changes to the criteria for substantial damage are those proposed in Option #1.

Option #3—Commissioner Bernthal's Proposal

The rule presented as Options #1 and #2 resemble the existing ENO criteria in 10 CFR Part 140, Subpart E in several respects. The proposed organization is similar in that separate criteria are retained for substantial releases and doses and for substantial injury or damage. Both sets of criteria require the evaluation of doses to people. This might require that data on occupancy times, food comsumption, and movement be collected for those people living in the immediate vicinity of the facility or accident site. Both Option #1, Option #2, and the existing criteria require enumeration and valuation of damages. Although these options restrict the damages that the Commission must consider to those which can be more readily evaluated, the time and effort required for such an analysis could still be large. Moreover, damage costs or values could be required for property other than taxable property such as municipal utilities, churches, and schools. Although Option #1 and Option #2 would rectify a number of the problems with the existing ENO criteria, they do not represent a radical departure from them and fail to solve totally the problems associated with evaluation of damages.

The statutory definition of an ENO permits the Commission to make a definition that an ENO has occurred if there have been substantial releases of radioactive materials or substantial offsite doses which have resulted or will probably result in substantial injury or substantial damages. The current criteria and the revisions proposed above place more emphasis on releases of radioactive materials "which have resulted" in substantial injury or damage and thus require a detailed enumeration of such injuries or damages as have occurred. Option #3 proposed by Commissioner Bernthal suggests a different approach to decide whether a nuclear accident is an extraordinary nuclear occurrence in that it emphasizes the "will probably result" aspect in dealing with substantial injury or damages. Rather than requiring enumeration and evaluation of actual damages and identification of actual injuries, the Option #3 simplifies the Commission's task to identifying those conditions which could lead to injury or damages.

The ENO criteria in Option #3 depart from the two-tiered approach which first requires a finding that substantial releases (or doses) occurred and then determining that substantial injury or damages resulted. Instead, one set of criteria is given for the magnitude of releases and doses that the Commission believes will satisfy the conditions for both substantial releases and will probably result in injury or substantial damages.

A principal basis of an ENO determination is that an event occurred which released radioactive materials in such quantities that the event is clearly "extraordinary" compared to normal operation. This provides the threshold level to ensure that the waivers of defenses and other legal provisions of the Price-Anderson amendments of 1966 are not activated as a result of minor expected operational occurrences. Options #1 and #2 and the present criteria for substantial release set this threshold at a low level to provide a "trigger" for identifying events which might be classed extraordinary nuclear occurrences. Section 140.81(a) of 10 CFR Part 140 clearly states that the present criterion is below that where substantial injury or damage would result. This is also true for the proposed revisions especially as the numerical criterion for substantial releases is less than in the existing Part 140.

For Option #3, a release of radioactive materials which results in doses or dose rates offsite of a magnitude equal to or greater than the proposed criterion will suffice to demonstrate that substantial releases of offsite doses have occurred and that substantial damage will probably occur. Enumeration of actual damages is not required to satisfy the criterion. Based upon the experience with the ENO determination for the Three Mile Island accident, this simplification would be of great value to a prompt ENO determination. The Commission believes that such simplification warrants the issuance of this novel proposal for public comment.

Of the three conditions associated with Option #3, Conditions (a) and (b) apply primarily to accidents at commercial light-water reactors. Condition (a) applies to surface contamination which would result from deposited radioactive materials from serious accidents releasing particulates or semi-volatile materials. Condition (a) is considered a threshold for damage requiring extensive decontamination. Damage requiring interdiction or damage resulting in significant harm to people (early injuries, early deaths and latent effects) is considered well above this threshold and, therefore, is adequately covered by this condition. Condition (b) uses a 24-hour integrated dose of 10 rad (0.1 gray) as a measure of the dose which could be received by an

individual from releases including those from accidents from which only the noble gases are released. This dose criterion does not use the dose received by a specific individual or group of individuals. Rather, it is the dose which could have been received during the duration of the accident. The values of these conditions were selected to be far above doses or exposure rates which could occur from normal operation under existing radiation protection standards.

Commissioner Bernthal's proposal (Option #3) relies on the "will probably occur" aspect of the statutory ENO definition. It should be noted that this option would trigger the waivers of defenses and other resultant actions of an affirmative ENO determination without first having to establish that substantial injuries or damages have actually occurred. The criterion in Option #3 should ensure that an affirmative ENO determination will be reached in any situation which would give rise to substantial injury or damage, and, conversely, that it would be difficult to exceed the criterion in situations where accident consequences were minor. This should provide the threshold intended by the ENO concept.

IV. Petition for Rulemaking

In a petition (PRM-140-1) to the NRC, the Public Citizens Litigation Group and Critical Mass Energy Project requested that the accident at the Three Mile Island Nuclear Station Unit No. 2 be found to be an ENO. This portion of the petition was considered as part of the ENO determination already initiated by the Commission. The Commission later determined (as published in the Federal Register on April 23, 1980 [45 FR 27590]) that the Three Mile Island Accident was not an ENO as defined in the Atomic Energy Act and the Commission's regulations.

The petitioners also requested that the Commission make the criteria for determination of an ENO more in line with the intent of Congress. Notice of receipt of the petition and a request for public comment were published in the Federal Register on August 28, 1979 (44 FR 50419). One public comment was received regarding the ENO criteria. The commenter, an official of a nuclear utility, believed that the current criteria for determining an ENO are reasonable. The commenter stated that Congress intended that the waiver of defenses be limited to incidents resulting in significant injury or loss and that the current criteria are consistent with this. The commenter also believed that lowering the threshold for an ENO would lead to higher premiums for insurance coverage and could at some point endanger the availability of insurance coverage.

The Commission believes that the existing ENO criteria are consistent with the Atomic Energy Act definition of an ENO. However, based upon the experience during the Three Mile Island ENO determination, the Commission is proposing revised ENO criteria which are more practicable than the present regulation. Because the proposed regulations revise the standards against which an ENO determination will be made, the PCLG-CMEP petition for revised ENO criteria is granted in part.

The Commission believes that none of the proposed criteria will affect insurance premiums. During the 1966 Congressional hearings on the ENO, representatives of the insurance industry testified [4] that experience with claims would be the principal determinant of insurance premiums and that institution of the waivers of defenses would not be expected to have any effect on premiums.

The proposed modifications to the ENO criteria would not have changed the outcome of the ENO decision for the Three Mile Island accident. That accident would not have exceeded the proposed dose criteria or the surface contamination criteria and, consequently, would not have been found to be an ENO under existing or any of the proposed regulations.

Additional Comments of Commissioner Bernthal

Although the proposed criteria for an ENO in Option 1 are improvements to those currently in Part 140, substantial problems remain, problems that would be largely eliminated by the inherent simplicity of Option 3. The basis of Option 3 is the definition of two simple, objective dose measurements that directly satisfy the requirement of Criterion I; i.e., they are a measure of "Substantial Discharge of Radioactive Material or Substantial Radiation Levels Offsite." Moreover, these two measures are sufficiently correlated with "Substantial Damages to Persons Offsite or Property Offsite" (the definition of Criterion II) that there is no need for further considerations in order to satisfy Criterion II. For the special case of release of radionuclides that produce little or no gamma radiation, Option 3 here incorporates, with minor clarifying modifications, the relevant part of the existing rule.

In justifying this approach, it is useful first to consider some of the specific problems in Option 1. Second, the characteristics of damages to people and property must be considered, in order to establish what constitutes "substantial" damages. Finally, analyses which correlate "substantial damages" with the measures of radionuclide release recommended here will be discussed.

Option 1 of the proposed Part 140 rule is evidently complicated, and unnecessarily so. Demonstrating that the criteria for an ENO have been met may be difficult under Option 1, and the proposed rule itself suffers from inconsistences. For example, with reference to:

A. Criterion I (Defined as "Substantial Discharge of Radioactive Material or Substantial Radiation Levels") Part (a):

- In order to "measure" Part (a), one must be able to track two paths: the path of the persons at risk and the path of the plume of radionuclides. It is the intersection of these two paths that will determine the dose to persons, but the two pathways may never be known well enough to make a reliable determination of dose. (Doses cannot be measured after the fact.)
- It is doubtful one would know the compositions of the plume (radioactive cloud) in terms of radionuclides, particle sizes, and chemistry, sufficiently well to rely on them for calculating the critical parameters, i.e., damage to human beings and the dose to specific human organs.
- Since persons must actually be exposed to meet this criterion (e.g., 15 rems (0.15 sieverts) to the thyroid), it is a measure of exposure and possible damage (cf. Criterion II), not a measure of discharge or radiation level. Must people be present before a discharge or radiation level threshold can be established? [This problem is also addressed in the proposed revision to Criterion I(a) found in Option 2, but the problem of identifying the intersection of the two pathways remains.]

B. Criterion I Part (b)(1):

- For nuclear power plants, the breakdown into two alpha-emission groups is unnecessary.
- It is not clear whether *each* of the 100 square meters must be contaminated in excess of those levels in the table, or whether there need only be *some* contamination evident over 100 contiguous square meters. In the latter case, a single localized pocket or object of radioactivity could cause the criteria for an ENO to be met, even though the

[4] Testimony of D.C. Thomas with E.A. Lowie, R. Fisher, L. Senger, W.M. Smith and J.H. Merritt, "Proposed Amendments to Price-Anderson Act Relating to Waiver of Defenses," Hearings before the Joint Committee on Atomic Energy, 89th Congress, June, 1966. Superintendent of Documents, GPO 1966, page 120.

median and modal contamination per square meter might be very low.

C. Criterion II (Defined as "Substantial Damages to Persons Offsite or Property Offsite") Part (1):

• This is the only criterion for substantial radiation damage to persons, and the threshold is very high. Consider, for example, that the exposure of 5,000 people to 80 rads (0.8 grays) each would still fall below the threshold criterion for radiation damage to persons.

• If four persons were exposed to 600 rads each (6 grays) (lethal dose), the criterion would not be met.

D. Criterion II Part (2):

• The valuation itself of taxable property could be time-consuming and cumbersome, and leaves open the question of how one would quickly establish the value of items other than taxable property (e.g., cemeteries, municipal sewer systems, churches). The ENO finding must be made within a reasonable period of time.

E. Criterion II Part (3):

• An "Employment Loss" criterion could act as a disincentive for employees to return to work or for employers to require return to work. In any case, such numbers may in practice be difficult to measure.

F. Criterion II Part (4):

• This criterion depends more on the declaration of a general emergency than on damage to persons. There may well be declarations of general emergencies (with accompanying evacuation) without any release of radionuclides. The criterion could act as an incentive (or disincentive) to declaring a general emergency. There could also be an incentive to stay away from home in order to contribute to the threshold for waiving defenses.

In summary, it seems clear that Option 1 is so flawed as to call into question its practicality and applicability in any realistic circumstance. On the other hand, to demonstrate the suitability of an alternative, Option 3, it is important to establish a realistic definition of "substantial damages" to persons and property, and to relate that definition to a readily measurable radiological release.

Radiological releases from nuclear power plants under accident conditions are expected to fall into two categories: (1) Releases characterized by a mix of particulates, volatiles, and gases; and (2) releases consisting principally of noble gases (Xe, Kr). For the first category, significant contamination of property would very likely be evident and dominant long before direct health effects are determined to be present and would therefore represent a conservative and early indicator of harm.

Literature[1] on the subject suggests a hierarchy of "damage thresholds" that can be reasonably correlated with dose rates in the case of property, and with integrated doses in the case of persons. For example, the literature suggests readily measurable criteria as follows, in order of increasing severity: (1) Damage not requiring decontamination, such as that to milk and crops; (2) damage requiring decontamination; (3) damage requiring interdiction; i.e., physical isolation and exclusion of the public from contaminated areas for an indefinite period of time; (4) early injuries; and finally, (5) early fatalities.

Latent (cancer) fatalities or genetic effects are not included in such a tabulation because neither has a "threshold"; both are normally treated in a probabilistic fashion. Moreover, the incidence of these important latent health effects is characterized by doses well above the threshold for decontamination. The first item (milk and crops), on the other hand, involves relatively low cost damages (e.g., contaminated milk and crops are purchased and disposed of) and having costs that are unambiguous (e.g., the cost of buying milk and disposing of it can be clearly documented). Thus, there is little reason to set the threshold of "significant" damage this low.

On the other hand, costs become much more significant when decontamination becomes necessary. Decontamination may involve repaving roads, putting new roofs on homes, and deep plowing of farm lands and/or soil removal. Such costs very quickly would escalate to many millions of dollars—certainly "significant" as defined in this proposed rule. Costs involved in interdiction are still higher. Thus, a reasonable threshold to establish "significant damages" to property for ENO purposes is that level of damage which requires decontamination.

The remaining question is whether the "decontamination threshold" for significant damage correlates with an easily measurable dose-rate or integrated dose. As a guideline, studies[2] have proposed that decontamination should be required if the integrated dose over 30 years is expected to be greater than about 25 rem (0.25 sieverts). For a representative mix of radionuclides such as that expected to be released in an accident, such an integrated long-term dose would be indicated by 10 millirad/hr (0.10 milligray/hr) measured at 1 meter from the ground surface within a few hours after the release. Dose rates substantially higher than this would require interdiction, and could lead to significant latent and genetic effects and even risk of early injury or death.

Of course, the relation between the damage measures described above and the doses at various offsite locations are a function of variables such as meteorological conditions, plume characterizations, population distribution, and isotopic mixes of radionuclides. Specifically, studies show that:

1. Surface contamination dose rate is a good general dose measure—it correlates well with damage measures.

2. For a wide variation of accident conditions, the postulated decontamination threshold dose rate of 10 millirad/hr (0.10 milligray/hr) covers cases where costs of decontamination would be significant (i.e., at least a few million dollars).

3. For virtually all conceivable accident conditions, the threshold rate of 10 millirad/hr (0.10 milligray/hr) would envelop interdiction and all health effects (cancers, genetic effects and early casualties). The exception is the case of release of noble gases only. This case is addressed in category 2, described below.

4. TMI-2 accident releases resulted in surface contamination dose rates well below the 10 millirad (0.10 milligray/hr) threshold.

5. Accidents characterized by containment building failure (other than basemat melt-through) all are expected to result in peak surface dose rates well above 10 millirad/hr (0.10 milligray/hr).

6. Accidents characterized by no containment building failure all are expected to result in peak surface dose rates well below 10 millirad/hr (0.10 milligray/hr).

For the second category of release, that of only noble gas release, there is no lasting ground contamination and the

[1] a. Food and Drug Administration, Emergency Protective Action Guides, Federal Register, Vol 47, #205, October 22, 1982, [47 FR 47073].

b. U.S. Nuclear Regulatory Commission, "Reactor Safety Study—An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants," WASH-1400 (NUREG-75/014), Appendix 6, October 1975.

c. Recommendations of the International Commission on Radiological Protection, Report #9, September 1965.

d. Federal Radiation Council Staff Report #5, 1964, "Background for Development of Radiation Protection Standards."

e. Medical Research Council of Great Britain, 1975, "Criteria for Controlling Radiation Doses to the Public after Accidental Escapes of Radioactive Material," Her Majesty's Stationary Office.

[2] a. Ibid. [2] b.

b. U.S. Nuclear Regulatory Commission, "Overview of the Reactor Safety Study Consequence Model" (NUREG-0340), October 1977.

damage to persons as a consequence of plume exposure dominates. An appropriate threshold dose for damage in this case can be as low as 10 rads (0.10 gray) integrated over 24 hours, since a noble gas plume passage is highly likely to be concluded within a few hours. This dose can be considered substantial since it is twice the value that triggers Protective Action as established by the FDA and the EPA.

Key to the entire approach suggested here is the fact that the proposed threshold surface contamination dose rate can be easily measured and confirmed by NRC shortly after an accident; the integrated dose would be monitored by the network of 40–50 TLD's located at each reactor site. (Needless to say, adequate dosimetry equipment in the vicinity of nuclear power plants is essential.)

For completeness, Criterion (c) has been included to cover the special cases where a radionuclide release might *not* involve significant gamma radiation, but might instead produce surface contamination by alpha and/or beta radiation emitters. Such hypothetical releases will be limited to events that might be associated with transportation of nuclear materials, operation of certain non-power plant reactor facilities, or operation of certain other special production and utilization facilities. Criterion (c) in Option 3 is taken directly from 10 CFR 140.84(b)(2) with minor clarifying modifications. The footnotes in that part of the existing rule have also been omitted because they are subject to misinterpretation and appear to be unnecessary.

In summary, radionuclide releases are sufficiently correlated with expected damage from such releases to establish a causal relationship between Criterion I and "Substantial Damages to Persons Offsite or Property Offsite." Therefore, no Criterion II as such is needed. The expected correlation between Criterion I and "substantial damages" suggests that the advantages to this approach far outweigh the disadvantages.

Paperwork Reduction Act Statement

The proposed rule contains no new information collection requirements and therefore is not subject to the requirements of the Paperwork Reduction Act of 1980 (44 U.S.C. 3501, et seq.).

Regulatory Flexibility Certification

In accordance with the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), the Commission hereby certifies that this rule will not, if promulgated, have a significant economic impact on a substantial number of small entities. This proposed rule could affect NRC licensees of production and utilization facilities and the nuclear liability insurance underwriting pools. The companies that own the production and utilization facilities and the insurance pools do not fall within the definition of a small business found in section 3 of the Small Business Act, 15 U.S.C. 632, or within the Small Business Size Standards set forth in 13 CFR Part 121.

List of Subjects in 10 CFR Part 140

Extraordinary nuclear occurrence, Insurance, Intergovernmental relations, Nuclear materials, Nuclear power plants and reactors, Penalty, Reporting and recordkeeping requirements.

For the reasons set out in the preamble and under the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended, and 5 U.S.C. 553, notice is hereby given that adoption of the following amendments to 10 CFR Part 140 is contemplated.

PART 140—FINANCIAL PROTECTION REQUIREMENTS AND INDEMNITY AGREEMENTS

1. The authority citation for Part 140 is revised to read as follows:

Authority: Secs. 161, 170, 68 Stat. 948, 71 Stat. 576, as amended (42 U.S.C. 2201, 2210); secs. 201, 202, 88 Stat. 1242, as amended, 1244 (42 U.S.C. 5841, 5842).

For the purposes of sec. 223, 68 Stat. 958, as amended (42 U.S.C. 2273); §§ 140.11(a), 140.12(a), 140.13 and 140.13a are issued under sec. 161b, 68 Stat. 948, as amended (42 U.S.C. 2201(b)); and § 140.6 is issued under sec. 161o, 68 Stat. 950, as amended (42 U.S.C. 2201(o)).

Proposed Amendments—Option #1

1. In § 140.84, paragraph (a) is revised to read as follows:

§ 140.84 Criterion I—Substantial discharge of radioactive material or substantial radiation levels offsite.

* * * * *

(a) The Commission finds that one or more of the persons offsite has been or probably will be exposed to radiation or radioactive materials which would result in estimated doses in excess of any one of the levels in the following table:

TABLE 1.—TOTAL PROJECTED COMMITTED RADIATION DOSE

Organ	Dose (rems)	Dose (sieverts)
Total Body	5	0.05
Thyroid	15	0.15
Bone marrow	5	0.05
Bone (surface or mineral)	15	0.15
Skin	50	0.50
Other organs or tissues	10	0.10

Exposures from the following types of sources of radiation shall be included:

(1) Radiation from sources external to the body;

(2) Radiation material that may be taken into the body from its occurrence in air or water;

(3) Radiation material that may be taken into the body from its occurrence in food or on terrestrial surfaces; and

(4) Radiation from sources internal to the body.

* * * * *

2. Section 140.85 is revised to read as follows:

§ 140.85 Criterion II—Substantial damages to persons offsite or property offsite.

After the Commission finds that an event has satisfied Criterion I, the Commission will determine that the event has resulted or will probably result in substantial damages to persons offsite or property offsite when any of the following conditions are satisfied:

(a) Five or more people have received a radiation dose equivalent to the whole body or any organ in excess of 100 rads (1 gray) during the course of the accident.

(b) Offsite property having a value of $2,500,000 is contaminated with radioactive materials in excess of the levels in § 140.84(b). The valuation shall be based on market value taking into account the ratio of assessed value/market in each tax assessment jurisdiction.

(c) Employment loss of at least 25,000 person-day had occurred.

(d) Evacuation of at least 100,000 person-days has occurred as a result of an evacuation ordered by a State or local official with the authority to make such an order. For the purpose of this regulation, the evacuation period will end when the evacuation order is rescinded by this or another responsible official and when it is determined that the evacuated area may be reoccupied.

Option #2

1. In Subpart E of 10 CFR Part 140, § 140.84 paragraph (a) is revised to read as follows:

§ 140.84 Criterion I—Substantial discharge of radiocharge material or substantial radiation levels offsite.

* * * * *

(a) The Commission finds that any of the following doses were or could have been received by a person or persons located on or near any site boundary throughout the duration of the accident:

TABLE 1.—TOTAL PROJECTED COMMITTED RADIATION DOSE

Organ	Dose (rems)	Dose (sieverts)
Total Body	5	0.05
Thyroid	15	0.15
Bone marrow	5	0.05
Bone (surface or mineral)	15	0.15
Skin	80	0.80
Other organs or tissues	10	0.10

Exposures from the follwing types of sources of radiation shall be included:

(1) Radiation from sources external to the body;

(2) Radiation material that may be taken into the body from its occurrence in air or water;

(3) Radiation material that may be taken into the body from its occurrence in food or on terrestrial surfaces; and

(4) Radiation from sources internal to the body.

* * * * *

2. Section 140.85 is revised to read as follows:

§ 140.85 Criterion II—Substantial damages to persons offsite or property offsite.

After the Commission finds that an event has satisfied Criterion I, the Commission will determine that the event has resulted or will probably result in substantial damages to persons offsite or property offsite when any of the following conditions are satisfied:

(a) A calculated collective dose of 100,000 person-rem [1,000 person-sieverts] has been delivered within a 50-mile radius during the course of the accident.

(b) Offsite property having a value of $2,500,000 is contaminated with radioactive materials in excess of the levels in § 140.84(b). The valuation shall be based on market value taking into account the ratio of assessed value/market value in each tax assessment jurisdiction.

(c) Employment loss of at least 25,000 person-days has occurred.

(d) Evacuation of at least 100,000 person-days has occurred as a result of an evacuation ordered by a State or local official with the authority to make such an order. For the purpose of this regulation, the evacuation ordered by a State or local official with the authority to make such an order. For the purpose of this regulation, the evacuation period will end when the evacuation order is rescinded by this or another responsible official and when it is determined that the evacuated area may be reoccupied.

Option #3

1. In Subpart E of 10 CFR Part 140: § 140.84 is revised to read as follows:

§ 140.84 Criterion for an Extraordinary Nuclear Occurrence.

The Commission will determine that there has been a substantial release of radiocative material offsite, or that there have been substantial levels of radiation offsite such that substantial injuries or substantial damages have resulted or will probably result when radioactive material is released from its intended place of confinement and, as a result of the event, any of the following conditions is satisfied:

(a) Real and personal property is rendered unfit for its normal use as a result of contamination with radioactive materials at levels which produce gamma exposure rates at 1 meter above the surface equal to or greater than 10 millirads per hour, (0.1 milligray/hr).[1]

(b) The integrated air dose which could be received by an individual, over any 24-hour period exceeds 10 rads (0.1 gray), or

(c) Real and personal property is rendered unfit for its normal use as a result of contamination for each square meter of any 100 square meters (as a minimum) at levels in excess of:

Transuranic Alpha-particle-emitting radionuclides.	0.35 microcuries per square meter (0.013 MBq/m²).*
Non-transuranic alpha-particle emitting radionuclides.	3.5 microcuries per square meter (0.13 MBq/m²).*
Beta-gamma-emitting radionuclides.	4 millirads per hour (0.4 milligray/hr)@ 1 centimeter above the ground.[1]

*Megabecquerel where 1 MBq = 10⁶ Bq and 1 becquerel (Bq) is 1 disintegration per second. A curie is 3.7 x 10¹⁰ Bq or 34,000 MBq.

[1] Measured to exclude very short-lived radionuclides (those having half-lives less than 1 hour) either by measurement at least 8 hours after the cessation of abnormal releases of radioactive materials or by making multiple measurements and compensating or correcting for the contributions from these short-lived radionuclides.

§ 140.85 [Removed]

2. Section 140.85 is removed.

Dated at Washington, DC this 2nd day of April 1985.

For the Nuclear Regulatory Commission.

John C. Hoyle,

Acting Secretary of the Commission.

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[1] Measured to exclude very short-lived radionuclides (those having half-lives less than 1 hour) either by measurement at least 8 hours after the cessation of abnormal releases of radioactive materials or by making multiple measurements and compensating or correcting for the contributions from these short-lived radionuclides.