

December 15, 1998

SECY-98-289

FOR: The Commissioners

FROM: William D. Travers /s/  
Executive Director for Operations

SUBJECT: PROPOSED AMENDMENTS TO 10 CFR PARTS 21, 50, AND 54  
REGARDING USE OF ALTERNATIVE SOURCE TERMS AT  
OPERATING REACTORS

PURPOSE:

To obtain Commission approval to publish a proposed rule to amend 10 CFR Parts 21, 50, and 54 to provide for the use of alternative source terms at operating reactors. This proposed rule is in response to the staff requirements memorandum dated September 4, 1998 (SECY-98-158).

SUMMARY:

This paper and the accompanying attachments present, for Commission approval, a proposed rule to amend 10 CFR Parts 21, 50, and 54. These amendments present requirements and acceptance criteria for the use of a revised source term as an alternative to the TID-14844 source term by operating reactors. Operating reactors would have the option to continue to use the TID-14844 source term, or could use an approved alternative, such as that given in NUREG-1465, *Accident Source Terms for Light-Water Nuclear Power Plants*. This action would allow interested licensees to pursue cost beneficial licensing actions to reduce unnecessary regulatory burden without compromising the margin of safety of the facility.

The amendment also makes conforming changes to eliminate the need for exemptions from certain requirements in 10 CFR 50.34(f) and from the dose criterion in 10 CFR Part 50, Appendix A, GDC-19, by applicants for construction permits, combined operating licenses, or design certifications, after January 10, 1997.

Contact: Stephen F. LaVie, NRR  
(301) 415-1081

BACKGROUND:

In the staff requirements memorandum (SRM) dated September 4, 1998 (SECY-98-158), the Commission approved, with comments, the staff's proposed rulemaking plan for implementation of the revised source term at operating reactors. This SRM directed the staff to send a draft rule to the Commission by December 15, 1998.

Included in this package are the Federal Register notice for the proposed rule (Attachment 1), the proposed Regulatory Analysis (Attachment 2), the proposed Environmental Assessment (Attachment 3), draft congressional letters (Attachment 4), and a draft public announcement (Attachment 5).

DISCUSSION:

In the SRM dated February 12, 1997, the Commission approved the staff's approach, described in SECY-96-242 dated November 25, 1996, to allow the revised source term to be used at operating reactors. The Commission directed the staff to commence rulemaking upon completion of the new source term rebaselining and to present the Commission with a rulemaking plan. SECY-98-158 forwarded this rulemaking plan for Commission review and approval. The rulemaking plan contained suggested language for the proposed rule. In the SRM, the Commission directed the staff to expedite the rulemaking process and to send a draft rule to the Commission by December 15, 1998. This paper presents the requested proposed rule for Commission consideration. This rulemaking is being tracked as Item VI.J in the August 25, 1998, Executive Director for Operations (EDO) response to issues raised within the Senate authorization context and July 17, 1998, stakeholder meeting.

As directed by the SRM, the NRC staff placed a copy of the draft proposed rulemaking package in the Public Document Room on October 19, 1998, the date that the copy was sent to the Advisory Committee on Reactor Safeguards (ACRS).

The proposed rule differs from the suggested rule language in the rulemaking plan. A explanation of the changes follows:

1. The proposed new section to Part 50 was referred to as Section 50.95. It was determined that this proposed section would be more appropriately located as Section 50.67. All cross-references to Section 50.95 have been changed to Section 50.67.
2. The definition of the term *source term* was moved from the proposed new section to the existing Section 50.2.
3. The Requirements paragraph in the new Section 50.67 was revised to change the analysis reference from the implied loss of coolant accident to "...an evaluation of the consequences of applicable design basis accidents previously analyzed in the safety analysis report..." The revised language is more consistent with the staff's intent and practice. The revised language also provides for selective implementation by requiring only the applicable design basis accident (DBA) analyses.
4. Proposed conforming changes have been included for Sections 50.65 and 54.4, in addition to the Section 21.3 and 50.49 changes identified previously. These sections will be amended to reflect the relocation of accident dose criteria from Section 100.11 to Section 50.67.
5. The language of the proposed addition to Part 50, Appendix A, GDC-19, was revised to clarify the relationship of the 0.05 Sv (5 rem) total effective dose equivalent (TEDE) dose criterion to the existing requirements in GDC-19.

The proposed amendments are described in detail in the attached Federal Register notice (Attachment 1). The proposed rulemaking will

- allow holders of operating licenses issued before January 10, 1997 (the effective date of the 10 CFR Part 100 amendment), to voluntarily revise the current accident source term used in their DBA radiological analyses by requesting a license amendment,

- provide accident dose criteria of 0.25 Sv (25 rem) TEDE at the boundary of the exclusion area for any 2-hour period and 0.25 Sv (25 rem) TEDE at the outer boundary of the low population zone for the duration of the accident, for analyses based upon the revised source term,
- provide a control room habitability dose criterion of 0.05 Sv (5 rem) TEDE for the duration of the accident, for analyses based upon the revised source term,
- move these dose values from Part 100 to Part 50,
- maintain the current requirements for those operating reactors that continue to use the TID-14844 source term, and
- eliminate the need for exemptions from certain requirements in Section 50.34(f) and Part 50, Appendix A, GDC-19 by applicants after January 10, 1997 for construction permits, combined operating licenses, or design certifications, by removing explicit references to TID-14844 in Section 50.34, and by providing a control room habitability dose criterion of 0.05 Sv (5 rem) TEDE for the duration of the accident.

A Regulatory Analysis (Attachment 2) was prepared to evaluate the value/impact of the proposed rulemaking. This analysis concludes that the public health and safety and the common defense and security would continue to be adequately protected if the proposed rulemaking were implemented. The analysis qualitatively determined that the potential values associated with the revised source term are substantial enough to justify the rulemaking.

An Environmental Assessment (Attachment 3) was performed and it was determined that the proposed amendments, if adopted, would not be a major Federal action significantly affecting the quality of the human environment. An environmental impact statement is not required. The actual accident sequence and progression is not changed; it is the regulatory assumptions regarding the accident that will be affected by the change. The use of an alternative source term alone cannot increase the core damage frequency (CDF) or the large early release frequency (LERF) or actual offsite or onsite radiation doses. An alternative source term could be used to justify changes in the plant design that might have an impact on CDF or LERF or might increase offsite or onsite doses. These potential changes are subject to existing requirements in the Commission's regulations and the associated potential for accident radioactivity releases to the environment would be maintained at the same magnitude. Thus, the protection of public health and safety is not decreased.

The NRC staff has determined that the backfit rule, 10 CFR 50.109, does not apply to this proposed regulation, and, therefore, a backfit analysis is not required for this proposed regulation. These amendments do not involve any provisions that would impose backfits as defined in 10 CFR 50.109(a)(1). This proposed regulation amends the Commission's regulations by establishing alternate requirements that may be voluntarily adopted by licensees.

Resources to develop and implement this rulemaking are budgeted at a total of less than 2 FTE (1.5 FTE from NRR and 0.16 FTE from all other offices).

No Agreement State implementation problems are expected because the proposed rulemaking

affects only the licensing and operation of nuclear power plants that are regulated by the NRC under Part 50, "Domestic Licensing of Production and Utilization Facilities."

COORDINATION:

The Office of the General Counsel has no legal objections to this paper. The Office of the Chief Financial Officer has reviewed this Commission paper for resource implications and has no objection. The Office of the Chief Information Officer has reviewed this proposed rule for information technology and information management implications and concurs in it. The Office of Management and Budget has approved an NRC determination that the information collection burden associated with the proposed rule was insignificant. The NRC staff does not intend to coordinate this Rulemaking Plan with the Agreement States since this rulemaking is only applicable to licensees regulated by the NRC in accordance with Part 50. The ACRS and CRGR have been briefed on this proposed rule and no objection to it being published for public comment was made.

RECOMMENDATION:

That the Commission

1. Approve the notice of proposed rulemaking for publication (Attachment 1)
2. Certify that this rule, if promulgated, will not have a negative economic impact on a substantial number of small entities to satisfy the requirements of the Regulatory Flexibility Act, 5 U.S.C. 605(b).
3. Note
  - a. The proposed rulemaking would be published in the Federal Register for a 75-day public comment period;
  - b. The draft Regulatory Analysis will be available in the Public Document Room (Attachment 2);
  - c. The draft Environmental Assessment and a draft finding of no significant impact have been prepared (Attachment 3);
  - d. The Chief Counsel for Advocacy of the Small Business Administration will be notified of the Commission's determination, pursuant to the Regulatory Flexibility Act (5 U.S.C. 605(b)), that this proposed rule will not have a significant economic effect on a substantial number of small entities;
  - e. The appropriate Congressional committees will be informed (Attachment 4);
  - f. A public announcement will be issued (Attachment 5); and
  - g. Copies of the Federal Register Notice of Proposed Rulemaking will be distributed to all Commission power reactor licensees. The notice will be sent to other interested parties upon request.

William D. Travers  
Executive Director  
For Operations

- Attachments:
1. Federal Register Notice of Proposed Rulemaking
  2. Draft Regulatory Analysis
  3. Draft Environment Assessment and Draft Finding of No Significant Impact
  4. Draft Congressional Letters
  5. Draft Public Announcement

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\*indicates prior concurrence

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<b>NAME</b>	SLaVie		REmch		CMiller		RSanders*		JRoe		SCollins	
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<b>NAME</b>	WTravers											
<b>DATE</b>	/ /98											

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# **Attachment 1**

## **Federal Register**

### **Notice of Proposed Rulemaking**

NUCLEAR REGULATORY COMMISSION

10 CFR Parts 21, 50, and 54

RIN 3150 - AG12

Use of Alternative Source Terms at Operating Reactors

**AGENCY:** Nuclear Regulatory Commission.

**ACTION:** Proposed Rule.

**SUMMARY:** The Nuclear Regulatory Commission (NRC) is proposing to amend its regulations to allow holders of operating licenses for nuclear power plants to voluntarily replace the traditional source term used in design basis accident analyses with alternative source terms. This action would allow interested licensees to pursue cost beneficial licensing actions to reduce unnecessary regulatory burden without compromising the margin of safety of the facility. The NRC is also proposing to amend its regulations to revise certain sections to conform with the final rule published on December 11, 1996 (61 FR 65157).

**DATES:** The comment period expires on *[publishing + 75 days]*. Comments received after this date will be considered, if it is practical to do so, but the NRC is able to assure consideration only for comments received on or before this date.

**ADDRESSES:** Mail written comments to: Secretary, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, Attention: Rulemakings and Adjudications Staff, Mail Stop O16C1.

Deliver comments to: One White Flint North, 11555 Rockville Pike, Rockville, Maryland, 20852, between 7:30 am and 4:15 pm on Federal workdays.

You may also submit comments via the NRC's interactive rulemaking web site,



“Rulemaking Forum,” through the NRC home page (<http://www.nrc.gov>). This site enables people to transmit comments as files (in any format, but WordPerfect version 6.1 is preferred), if your web browser supports that function. Information on the use of the Rulemaking Forum is available on the website. For additional assistance on the use of the interactive rulemaking site, contact Ms. Carol Gallagher, telephone: 301-415-5905; or by Internet electronic mail to [cag@nrc.gov](mailto:cag@nrc.gov).

Certain documents related to this rulemaking, including comments received and the environmental assessment and finding of no significant impact may be examined at the NRC Public Document Room, 2120 L Street, NW. (Lower Level), Washington, DC. These same documents also may be viewed and downloaded electronically via the interactive rulemaking website established by NRC for this rulemaking.

**FOR FURTHER INFORMATION CONTACT:** Mr. Stephen F. LaVie, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; telephone: 301 415-1081; or by Internet electronic mail to [sfl@nrc.gov](mailto:sfl@nrc.gov).

**SUPPLEMENTARY INFORMATION:**

- I. Background
- II. Objectives
- III. Alternatives
- IV. Section-by-Section Analysis
- V. Future Regulatory Action
- VI. Referenced Documents
- VII. Finding of No Significant Environmental Impact; Availability
- VIII. Paperwork Reduction Act Statement
- IX. Regulatory Analysis

X. Regulatory Flexibility Certification

XI. Backfit Analysis

### **I. Background**

A holder of an operating license (i.e., the licensee) for a light-water power reactor is required by regulations issued by the NRC (or its predecessor, the U.S. Atomic Energy Commission, (AEC)) to submit a safety analysis report that contains assessments of the radiological consequences of potential accidents and an evaluation of the proposed facility site. The NRC uses this information in its evaluation of the suitability of the reactor design and the proposed site as required by its regulations contained in 10 CFR Parts 50 and 100. Section 100.11, which was adopted by the AEC in 1962 (27 FR 3509, April 12, 1962), requires an applicant to assume (1) a fission product release from the reactor core, (2) the expected containment leak rate, and (3) the site meteorological conditions to establish an exclusion area and a low population zone. This fission product release is based on a major accident that would result in substantial release of appreciable quantities of fission products from the core to the containment atmosphere. A note to § 100.11 states that Technical Information Document (TID) 14844, "Calculation of Distance Factors for Power and Test Reactors," may be used as a

source of guidance in developing the exclusion area, the low population zone, and the population center distance.

The fission product release from the reactor core into containment is referred to as the “source term” and it is characterized by the composition and magnitude of the radioactive material, the chemical and physical properties of the material, and the timing of the release from the reactor core. The accident source term is used to evaluate the radiological consequences of design basis accidents (DBAs) in showing compliance with various requirements of the NRC’s regulations. Although originally used for site suitability analyses, the accident source term is a design parameter for accident mitigation features, equipment qualification, control room operator radiation doses, and post-accident vital area access doses. The measurement range and alarm setpoints of some installed plant instrumentation and the actuation of some plant safety features are based in part on the accident source term. The TID-14844 source term was explicitly stated as a required design parameter for several Three Mile Island (TMI)-related requirements.

The NRC’s methods for calculating accident doses, as described in Regulatory Guide 1.3, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors”; Regulatory Guide 1.4, “Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors”; and NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants,” were developed to be consistent with the TID-14844 source term and the whole body and thyroid dose guidelines stated in § 100.11. In this regulatory framework, the source term is assumed to be released immediately to the containment at the start of the postulated accident. The chemical form of the radioiodine released to the containment atmosphere is assumed to be predominantly elemental, with the remainder being small fractions of particulate and organic iodine forms. Radiation doses are calculated at the exclusion area boundary (EAB) for the first 2-hours and at the low population zone (LPZ) for the assumed 30-day duration of the accident. The whole body dose comes

primarily from the noble gases in the source term. The thyroid dose is based on inhalation of radioiodines. In analyses performed to date, the thyroid dose has generally been limiting. The design of some engineered safety features, such as containment spray systems and the charcoal filters in the containment, the building exhaust, and the control room ventilation systems, are predicated on these postulated thyroid doses. Subsequently, the NRC adopted the whole body and thyroid dose criteria in Criterion 19 of 10 CFR Part 50, Appendix A. (36 FR 3255, February 20, 1971)

The source term in TID-14844 is representative of a major accident involving significant core damage and is typically postulated to occur in conjunction with a large loss-of-coolant accident (LOCA). Although the LOCA is typically the maximum credible accident, NRC experience in reviewing license applications has indicated the need to consider other accident sequences of lesser consequence but higher probability of occurrence. Some of these additional accident analyses may involve source terms that are a fraction of those specified in TID-14844. The DBAs were not intended to be actual event sequences, but rather, were intended to be surrogates to enable deterministic evaluation of the response of the plant engineered safety features. These accident analyses are intentionally conservative in order to address known uncertainties in accident progression, fission product transport, and atmospheric dispersion. Although probabilistic risk assessments (PRAs) can provide useful insights into system performance and suggest changes in how the desired defense in depth is achieved, defense in depth continues to be an effective way to account for uncertainties in equipment and human performance. The NRC's policy statement on the use of PRA methods (60 FR 42622) calls for the use of PRA technology in all regulatory matters in a manner that complements the NRC's deterministic approach and supports the traditional defense-in-depth philosophy.

Since the publication of TID-14844, significant advances have been made in understanding the timing, magnitude, and chemical form of fission product releases from severe nuclear power plant accidents. Many of these insights developed out of the major research efforts started by the NRC and the

nuclear industry after the accident at Three Mile Island (TMI). In 1995, the NRC published NUREG-1465, "Accident Source Terms for Light-Water Nuclear Power Plants," which utilized this research to provide more physically based estimates of the accident source term that could be applied to the design of future light-water power reactors. The NRC sponsored significant review efforts by peer reviewers, foreign research partners, industry groups, and the general public (request for public comment was published in 57 FR 33374).

The information in NUREG-1465 presents a representative accident source term ("revised source term") for a boiling-water reactor (BWR) and for a pressurized-water reactor (PWR). These revised source terms are described in terms of radionuclide composition and magnitude, physical and chemical form, and timing of release. Where TID-14844 addressed three categories of radionuclides, the revised source terms categorize the accident release into eight groups on the basis of similarity in chemical behavior. Where TID-14844 assumed an immediate release of the activity, the revised source terms have five release phases that are postulated to occur over several hours, with the onset of major core damage occurring after 30 minutes. Where TID-14844 assumed radioiodine to be predominantly elemental, the revised source terms assume radioiodine to be predominantly cesium iodide (CsI), an aerosol that is more amenable to mitigation mechanisms.

For DBAs, the NUREG-1465 source terms are comparable to the TID-14844 source term with regard to the magnitude of the noble gas and radioiodine release fractions. However, the revised source terms offer a more representative description of the radionuclide composition and release timing. The NRC has determined (SECY-94-302, dated December 1994) that design basis analyses will address the first three release phases — coolant, gap, and in-vessel. The ex-vessel and late in-vessel phases are considered to be unduly conservative for design basis analysis purposes. These latter releases could only result from core damage accidents with vessel failure and core-concrete interactions. The estimated frequencies of such scenarios are low enough that they need not be considered for the purpose of meeting the requirements of § 100.11 or, as proposed herein, § 50.67.

The objective of NUREG-1465 was to define revised accident source terms for regulatory application for future light water reactors. The NRC's intent was to capture the major relevant insights available from severe accident research to provide, for regulatory purposes, a more realistic portrayal of the amount of the postulated accident source term. These source terms were derived from examining a set of severe accident sequences for light water reactors (LWRs) of current design. Because of general similarities in plant and core design parameters, these results are considered to be applicable to evolutionary and passive LWR designs. The revised source term has been used in evaluating the Westinghouse AP-600 standard design certification application. (A draft version of NUREG-1465 was used in evaluating Combustion Engineering's (CE's) System 80+ design.)

The NRC considered the applicability of the revised source terms to operating reactors and determined that the current analytical approach based on the TID-14844 source term would continue to be adequate to protect public health and safety, and that operating reactors licensed under this approach would not be required to reanalyze accidents using the revised source terms. The NRC also concluded that some licensees may wish to use an alternative source term in analyses to support operational flexibility and cost-beneficial licensing actions. The NRC initiated several actions to provide a regulatory basis for operating reactors to voluntarily amend their facility design bases to enable use of the revised source term in design basis analyses. First, the NRC solicited ideas on how an alternative source term might be implemented. In November 1995, the Nuclear Energy Institute (NEI) submitted its generic framework, Electric Power Research Institute Technical Report TR-105909, "Generic Framework for Application of Revised Accident Source Term to Operating Plants." This report and the NRC response were discussed in SECY-96-242 (November 1996). Second, the NRC initiated a comprehensive assessment of the overall impact of substituting the NUREG-1465 source terms for the traditionally used TID-14844 source term at three typical facilities. This was done to evaluate the issues involved with applying the revised source terms at operating plants. SECY 98-154 (June 1998) described the conclusions of this assessment. Third, the NRC accepted license amendment requests

related to implementation of the revised source terms at a small number of pilot plants. Experience has demonstrated that evaluation of a limited number of plant-specific submittals improves regulation and regulatory guidance development. The review of these pilot projects is currently in progress. Insights from these pilot plant reviews will be incorporated into the regulatory guidance that will be developed in conjunction with this rulemaking. Fourth, the NRC initiated an assessment on whether rulemaking would be necessary to allow operating reactors to use an alternative source term. The proposed rule and the supporting regulatory guidance that will be developed as part of this rulemaking have resulted from this assessment. The NRC plans to issue the supporting regulatory guidance for public comment on the same day as it publishes the final rule.

This proposed rulemaking for use of alternative source terms is applicable only to those facilities for which a construction permit was issued before January 10, 1997, under 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities." The regulations of this part are supplemented by those in other parts of Chapter 1 of Title 10, including Part 100, "Reactor Site Criteria." Part 100 contains language that qualitatively defines a required accident source term and contains a note that discusses the availability of TID-14844. With the exception of § 50.34(f), there are no explicit requirements in Chapter 1 of Title 10 to use the TID-14844 accident source term. Section 50.34(f), which addresses additional TMI-related requirements, is only applicable to a limited number of construction permit applications pending on February 16, 1982, and to applications under Part 52.

An applicant for an operating license is required by § 50.34(b) to submit a final safety analysis report (FSAR) that describes the facility and its design bases and limits, and presents a safety analysis of the structures, systems, and components of the facility as a whole. Guidance in performing these analyses is given in regulatory guides. In its review of the more recent applications for operating licenses, the NRC has used the review procedures in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (SRP). These review procedures reference or provide acceptable

assumptions and analysis methods. The facility FSAR documents the assumptions and methods actually used by the applicant in the required safety analyses. The NRC's finding that a license may be issued is based on the review of the FSAR, as documented in the Commission's safety evaluation report (SER). By their inclusion in the FSAR, the assumptions (including the source term) become part of the design basis\* of the facility. From a regulatory standpoint, the requirement to use the TID-14844 source term is expressed as a licensee commitment (typically to Regulatory Guide 1.3 or 1.4) documented in the facility FSAR, and is subject to the requirements of § 50.59.

In January 1997 (61 FR 65157), the NRC amended its regulations in 10 CFR Parts 21, 50, 52, 54, and 100. That regulatory action produced site criteria for future sites; presented a stable regulatory basis for seismic and geologic siting and the engineering design of future nuclear power plants to withstand seismic events; and relocated source term and dose requirements for future plants into Part 50. Because these dose requirements tend to affect reactor design rather than siting, they are more appropriately located in Part 50. This decoupling of siting from design is consistent with the future licensing of facilities using standardized plan designs, the design features of which will be certified in a separate design certification rulemaking. This decoupling of siting from design was directed by Congress in the 1980 Authorization Act for the NRC. Because the revised criteria would not apply to operating reactors, the non-seismic and seismic reactor site criteria for operating reactors were retained as Subpart A and Appendix A to Part 100, respectively. The revised reactor site criteria were added as Subpart B in Part 100, and revised source term

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\* As defined in 10 CFR Part 50.2, *design bases* means that information which identifies the specific functions to be performed by a structure, system, or component of a facility, and the specific values or ranges of values chosen for controlling parameters as reference bounds for design. These values may be (1) restraints derived from generally accepted "state of the art" practices for achieving functional goals, or (2) requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals. The NRC considers the accident source term to be an integral part of the design basis because it sets forth specific values (or range of values) for controlling parameters that constitute reference bounds for design.



and dose requirements were moved to § 50.34. The existing source term and dose requirements of Subpart A of Part 100 will remain in place as the licensing bases for those operating reactors that do not elect to use an alternative source term.

In relocating the source term and dose requirements for future reactors to § 50.34, the NRC retained the requirements for the exclusion area and the low population zone, but revised the associated numerical dose criteria to replace the two different doses for the whole body and the thyroid gland with a single, total effective dose equivalent (TEDE) value. The dose criteria for the whole body and the thyroid, and the immediate 2-hour exposure period were largely predicated by the assumed source term being predominantly noble gases and radioiodines instantaneously released to the containment and the assumed “single critical organ” method of modeling the internal dose used at the time that Part 100 was originally published. However, the current dose criteria, by focusing on doses to the thyroid and the whole body, assume that the major contributor to doses will be radioiodine. Although this may be appropriate with the TID-14844 source term, as implemented by Regulatory Guides 1.3 and 1.4, it may not be true for a source term based on a more complete understanding of accident sequences and phenomenology.

The postulated chemical and physical form of radioiodine in the revised source terms is more amenable to mitigation and, as such, radioiodine may not always be the predominant radionuclide in an accident release. The revised source terms include a larger number of radionuclides than did the TID-14844 source term as implemented in regulatory guidance. The whole body and thyroid dose criteria ignore these contributors to dose. The NRC amended its radiation protection standards in Part 20 in 1991 (56 FR 23391), replacing the single, critical organ concept for assessing internal exposure with the TEDE concept that assesses the impact of all relevant nuclides upon all body organs. TEDE is defined to be the deep dose equivalent (for external exposure) plus the committed effective dose equivalent (for internal exposure). The deep dose equivalent (DDE) is comparable to the present whole body dose; the committed effective dose equivalent (CEDE) is the sum of the products of doses (integrated over a 50-year period) to selected body

organs resulting from the intake of radioactive material multiplied by weighting factors for each organ that are representative of the radiation risk associated with the particular organ.

The TEDE, using a risk-consistent methodology, assesses the impact of all relevant nuclides upon all body organs. Although it is expected that in many cases the thyroid could still be the limiting organ and radioiodine the limiting radionuclide, this conclusion cannot be assured in all potential cases. The revised source terms postulate that the core inventory is released in a sequence of phases over 10 hours, with the more significant release commencing at about 30 minutes from the start of the event. The assumption that the 2-hour exposure period starts immediately at the onset of the release is inconsistent with the phased release postulated in the revised source terms. The proposed rule would extend the future LWR dose criteria to operating reactors that elect to use an alternative source term.

An accidental release of radioactivity can result in radiation exposure to control room operators. Normal ventilation systems may draw this activity into the control room where it can result in external and internal exposures. Control room designs differ but, in general, design features are provided to detect the accident or the activity and isolate the normal ventilation intake. Emergency ventilation systems are activated to minimize infiltration of contaminated air and to remove activity that has entered the control room. Personnel exposures can also result from radioactivity outside of the control room. However, because of concrete shielding of the control room, these latter exposures are generally not limiting. The objective of the control room design is to provide a location from which actions can be taken to operate the plant under normal conditions and to maintain it in a safe condition under accident conditions. General Design Criterion 19 (GDC-19), "Control Room," of Appendix A to 10 CFR Part 50 (36 FR 3255), establishes minimum requirements for the design of the control room, including a requirement for radiation protection features adequate to permit access to and occupancy of the control room under accident conditions. The GDC-19 criteria were established for judging the acceptability of the control room design for protecting control room operators under postulated design basis accidents, a significant concern being the potential increases in offsite doses that

might result from the inability of control room personnel to adequately respond to the event.

The GDC-19 criteria are expressed in terms of whole body dose, or its equivalent to any organ. The NRC did not revise the criteria when Part 20 was amended (56 FR 23391) instead deferring such action to individual facility licensing actions (NUREG/CR-6204). This position was taken in the interest of maintaining the licensing basis for those facilities already licensed. The NRC is proposing to replace the current GDC-19 dose criteria for future reactors and for operating reactors that elect to use an alternative source term with a criterion expressed in terms of TEDE. The rationale for this revision is similar to the rationale, discussed earlier in this preamble, for revising the dose criteria for offsite exposures.

On January 10, 1997 (61 FR 65157), the NRC amended 10 CFR Parts 21, 50, 52, 54, and 100 of its regulations to update the criteria used in decisions regarding power reactor siting for future nuclear power plants. The NRC intended that future licensing applications in accordance with Part 52 utilize a source term consistent with the source term information in NUREG-1465 and the accident TEDE criteria in Parts 50 and 100. However, during the final design approval (FDA) and design certification proceeding for the Westinghouse AP-600 advanced light-water reactor design, the NRC staff and Westinghouse determined that exemptions were necessary from §§ 50.34(f)(2)(vii), -(viii), -(xxvi), and -(xxviii) and 10 CFR Part 50, Appendix A, GDC-19. This rule would eliminate the need for these exemptions for future applicants under Part 52 by making conforming changes to Part 50, Appendix A, GDC-19 and § 50.34.

## **II. Objectives**

The objectives of this proposed regulatory action are to —

1. Provide a regulatory framework for the voluntary implementation of alternative source terms as a change to the design basis at currently licensed power reactors, thereby enabling potential cost-beneficial licensing actions while continuing to maintain existing safety margins and defense in depth.
2. Retain the existing regulatory framework for currently licensed power reactor

licensees who choose not to implement an alternative source term, but continue to comply with their existing source term.

3. Relocate source term and dose requirements that apply primarily to plant design into 10 CFR Part 50 for operating reactors that choose to implement an alternative source term, and

4. Implement conforming changes to § 50.34(f) and Part 50, Appendix A, GDC-19 to eliminate the need for exemptions for future applicants under Part 52.

### **III. Alternatives**

The first alternative considered by the NRC was to continue using current regulations for accident dose criteria and control room dose criteria. This is not considered to be an accept-able alternative. As discussed in the statements of consideration for the final siting rule (61 FR 65157, 65159), the NRC determined that dose criteria expressed in terms of whole body and thyroid doses were inconsistent with the use of new source terms not based upon TID-14844. With regard to the exclusion area dose guideline, the NRC had previously determined (*id.* at 65160) that the dose criterion applies to the 2-hour period resulting in the maximum dose.

The second alternative considered by the NRC was the replacement of the existing guidelines in § 100.11 and the existing criteria in 10 CFR Part 50 Appendix A, GDC-19 with revised dose criteria. This is not considered to be a desirable alternative because the provisions of the existing regulations form part of the licensing bases for many of the operating reactors. Therefore, these provisions must remain in effect for operating reactors that do not implement an alternative source term. In addition, this alternative would also be inconsistent with the NRC's philosophy of separating plant siting criteria and dose requirements.

The approach of establishing the requirements for use of alternative source terms in a new section to Part 50 while retaining the existing regulations in Part 100 Subpart A and Part 50 Appendix A

GDC-19 was chosen as the best alternative.

The NRC considered alternatives with regard to providing regulatory guidance to support the new section to Part 50. The first option was to issue no additional regulatory guidance. This option was not considered to be acceptable because in the absence of clear regulatory guidance, licensee efforts in preparing applications and the NRC staff review of submitted applications, could be hindered by differences in interpretations and technical positions. This could result in the inefficient use of licensee and staff resources, could cause licensing delays, and lead to less uniform and less consistent regulatory implementation.

The second option was to replace the existing regulatory guides that address the radiological consequences of accidents with new revisions. This is not considered to be an acceptable choice because the provisions of the existing regulatory guides form part of the licensing bases for many of the operating reactors. Therefore, these provisions must remain in effect for those operating reactors that do not implement an alternative source term. The third option was to issue a new regulatory guide on the implementation of alternative source terms that would include revised assumptions and acceptable analysis methods for each design basis accident, in a series of appendices. The approach of issuing a new regulatory guide was determined to be the best option. To provide review guidance for the NRC staff, a new section on design basis radiological analyses using alternative source terms would be added to the Standard Review Plan.

#### **IV. Section-by-Section Analysis**

##### *A. Section 50.2*

The general “definitions” section for Part 50 would be supplemented by adding a definition of *source term* for the purpose of § 50.67. In NUREG-1465, the *source term* is defined by five

projected characteristics: (1) magnitude of radioactivity release, (2) radionuclides released, (3) physical form of the radionuclides released, (4) chemical form of the radionuclides released, and (5) timing of the radioactivity release. Although all five characteristics should be addressed in applications proposing the use of an alternative source term, there may be technically justifiable applications in which all five characteristics need not be addressed. The NRC intends to allow licensees flexibility in implementing alternative source terms consistent with maintaining a conservative, clear, logical, and consistent plant design basis. The regulatory guide that supports this proposed rule will contain guidance on an acceptable basis for defining the characteristics of an alternative source term.

*B. Section 50.67(a)*

This paragraph would define the licensees that may seek to revise their current radiological source term with an alternative source term. The proposed rule is applicable only to holders of nuclear power plant operating licenses that were issued under 10 CFR Part 50 before January 10, 1997. The proposed rule would not require licensees to revise their current source term. The NRC considered the acceptability of the TID-14844 source term at current operating reactors and determined that the analytical approach based on the TID-14844 source term would continue to be adequate to protect public health and safety, and that operating reactors licensed under this approach should not be required to reanalyze design basis accidents using a new source term. The proposed rule does not explicitly define an alternative source term. In lieu of an explicit reference to NUREG-1465, Footnote 1 to the proposed rule identifies the significant characteristics of an accident source term. The regulatory guide that will be issued to support this proposed rule will identify the NUREG-1465 source terms as acceptable alternatives to the source term in TID-14844, and will provide implementation guidance. This approach would provide for future revised source terms, if they are developed, and would allow licensees to propose additional alternatives for NRC consideration.

*C. Section 50.67(b)(1)*

This paragraph of § 50.67 would state the information that a licensee must submit as part of a license amendment application to use an alternative source term. Because of the extensive use of the accident source term in the design and operation of a power reactor and the potential impact on postulated accident consequences and margins of safety of a change of such a fundamental design assumption, the NRC has determined that any change to the design basis to use an alternative source term should be reviewed and approved by the NRC in the form of a license amendment. Changes to the source term, by itself, would ordinarily constitute a no significant hazards consideration. In addition, generic analyses performed by the NRC staff in support of this proposed rule have indicated that there are potential changes to the facility as documented in the FSAR which would constitute a no significant hazards consideration. However, such determinations would have to be made for each proposed change based upon facility-specific evaluations. The procedural requirements for processing a license amendment are given in §§ 50.90 through 50.92.

The NRC's regulations provide a regulatory mechanism for a licensee to effect a change in its design basis in § 50.59. That section allows a licensee to make changes to the facility as described in the final safety evaluation report (FSAR) without prior NRC approval, unless the proposed change is deemed to involve an unreviewed safety question (USQ), or involves a change to the technical specifications incorporated into the facility license. If a USQ is determined to exist or if a change to the technical specifications is involved, the licensee must request NRC approval of the change using the license amendment process detailed in § 50.90. The criteria for determining that a USQ is involved appear in § 50.59. Significant to this proposed rule is the criterion that a USQ would exist if the proposed change resulted in an increase in consequences of an accident or malfunction. In many applications, alternative source terms may reduce the postulated consequences of the accident or malfunction. For this reason, the NRC determined that the regulatory framework of § 50.59 does not provide assurance that this change in the design basis would be



recognized by the licensee as needing review by the NRC staff. After a licensee has been authorized to substitute an alternative source term in its design basis, subsequent changes to the facility that involve an alternative source term may be processed under § 50.59 or § 50.90, as appropriate. However, a subsequent change to the source term itself could not be implemented under § 50.59; in all cases a change to the source term must be made through a license amendment.

The proposed rule would require the applicant to perform analyses of the consequences of applicable design basis accidents previously analyzed in the safety analysis report and to submit a description of the analysis inputs, assumptions, methodology, and results of these analyses for NRC review. Applicable evaluations may include, but are not limited to, those previously performed to show compliance with § 100.11, § 50.49, Part 50 Appendix A GDC-19, § 50.34(f), and NUREG-0737 requirements II.B.2, II.B.3, III.D.3.4. The regulatory guide that supports this proposed rule will provide guidance on the scope and extent of analyses used to show compliance with this rule and on the assumptions and methods used therein. It is not the NRC's intent that all of the design basis radiological analyses for a facility be performed again as a prerequisite for approval of the use of an alternative source term. The NRC does expect that the applicant will perform sufficient evaluations, supported by calculations as warranted, to demonstrate the acceptability of the proposed amendment.

*D. Sections 50.67(b)(2)(i), -(ii), -(iii)*

These subparagraphs would contain the three criteria for NRC approval of the license amendment to use an alternative source term. A detailed rationale for the use of 0.25 Sv (25 rem) TEDE as an accident dose criterion and the use of the 2-hour exposure period resulting in the maximum dose for future LWRs is provided at 61 FR 65157. The same considerations that formed the basis for that rationale are similarly applicable to operating reactors that elect to use an alternative source term. The NRC believes that it is technically appropriate and logical to extend the philosophy of decoupling of design and siting, and the dose

criteria established for future LWRs to operating reactors that elect to use an alternative source term.

The NRC is proposing to replace the current GDC-19 dose criteria for operating reactors that elect to use an alternative source term with a criterion of 0.05 Sv (5 rem) TEDE for the duration of the accident. This criterion would be included in § 50.67 rather than GDC-19 in order to co-locate all of the dose requirements associated with alternative source terms. The bases for the NRC's decision are: first, that the criteria in GDC-19 and that in the proposed rule are based on a primary occupational exposure limit. Second, the language in GDC-19: "5 rem whole body, or its equivalent to any part of the body" is subsumed by the definition of TEDE in § 20.1003 and by the 0.05 Sv (5 rem) TEDE annual limit in § 20.1201(a). Although the weighting factors stated in § 20.1003 for use in determining TEDE differ in magnitude from the weighting factors implied in the 0.3 Sv (30 rem) thyroid criteria used for showing compliance with GDC-19, these differences are the result of improvement in the science of assessing internal exposures and do not represent a reduction in the level of protection. Third, as discussed earlier, the use of TEDE in conjunction with alternative source terms has been deemed appropriate and necessary. Fourth, the use of TEDE for the control room dose criterion is consistent with the use of TEDE in the accident dose criteria for offsite exposure.

The NRC is not including a "capping" limitation, an additional requirement that the dose to any individual organ not be in excess of some fraction of the total as provided for routine occupational exposures. The bases for the NRC's decision are: first, that this non-inclusion of a "capping" limitation is consistent with the final rule published in January 10, 1997 (61 FR 65157), with regard to doses to persons offsite. Second, the use of 0.05 Sv (5 rem) TEDE as the control room criterion does not imply that this would be an acceptable exposure during emergency conditions, or that other radiation protection standards of Part 20, including individual organ dose limits, might not apply. This criterion is provided only to assess the acceptability of design provisions for protecting control room operators under postulated DBA conditions. The DBA conditions assumed in these analyses, although credible, generally do not represent actual accident sequences but are specified as conservative surrogates to create bounding conditions for assessing the

acceptability of engineered safety features. Third, § 20.1206 permits a once-in-a-lifetime planned special dose of five times the annual dose limits. Also, Environmental Protection Agency (EPA) guidance sets a limit of five times the annual dose limits for workers performing emergency services such as lifesaving or protection of large populations. Considering the individual organ weighting factors of § 20.1003 and assuming that only the exposure from a single organ contributed to TEDE, the organ dose, although exceeding the dose specified in § 20.1201(a), would be less than that considered acceptable as a planned special dose or as an emergency worker dose. The NRC is not suggesting that control room dose during an accident can be treated as a planned special exposure or that the EPA emergency worker dose limits are an alternative to GDC-19 or the proposed rule. However, the NRC does believe that these provisions offer a useful perspective that supports the conclusion that the organ doses implied by the proposed 0.05 Sv (5 rem) criterion can be considered to be acceptable due to the relatively low probability of the events that could result in doses of this magnitude.

Although the dose criteria in the proposed rule would supersede the dose criteria in GDC-19, the other provisions of GDC-19 remain applicable.

*E. 10 CFR Part 50, Appendix A, GDC-19*

GDC-19 would be changed to include the TEDE dose criterion for control room design for applicants for construction permits, design certifications, and combined operating licenses that submitted applications after January 10, 1997 (the effective date of the 1996 rulemaking adopting the TEDE criterion), and for those licenses using an alternative source term under § 50.67. The proposed change to GDC-19 addresses the use of alternative source terms at operating reactors and a deficiency identified in the regulatory framework for early site permits, standard design certifications, and combined licenses under Part 52. Sections 52.18, 52.48, and 52.81 establish that applications filed under Part 52, Subparts A, B, and C, respectively, will be reviewed according to the standards given in 10 CFR Parts 20, 50, 51, 55, 73, and 100 to the extent that those standards are technically relevant to the proposed design. Therefore, GDC-19 is

pertinent to applications under Part 52. The final rule published on January 10, 1997 (61 FR 65157), established accident TEDE criteria (in § 50.34) for applicants under Part 52 but did not change the existing control room whole body (or equivalent) dose criterion in GDC-19. Thus, exemptions from the dose criteria in the current GDC-19 were necessary in the design certification process for the Westinghouse AP-600 advanced LWR in order to use the 0.05 Sv (5 rem) TEDE criterion deemed necessary for use with alternative source terms. Exemptions would arguably be necessary for future applicants for construction permits, design certifications, and combined operating licenses. This proposed change would eliminate the need for these exemptions.

*F. Sections 21.3, 50.2, 50.49(b)(1)(i)(C), 50.65(b)(1), and 54.4(a)(1)(iii)*

These sections would be revised to conform with the relocation of accident dose criteria from § 100.11 to § 50.67 for operating reactors that have amended their design bases to use an alternative source term.

*H. Section 50.34*

A new footnote to § 50.34 would be added to define what constitutes an accident source term. This new footnote is identical to the existing footnote 1 to § 100.11, and is being added to provide for consistency between Parts 50 and 100.

*I. Sections 50.34(f)(2)(vii), -(viii), -(xxvi) and -(xxviii)*

These paragraphs would be revised to replace an explicit reference to the “TID-14844 source term” with a more general reference to “accident source term.” These changes potentially affect two classes of applicants. The first affected class is facilities that obtain combined licenses under Part 52. Section 52.47(a)(ii) states that applications for combined licenses must contain, *inter alia*, “demonstration of

compliance with any technically-relevant portions of the Three Mile Island requirements set forth in § 50.34(f).” Section 50.34(f) contains several references to the TID-14844 source term. These references would be modified to delete the reference to TID-14844. This would make it clear that applicants for combined licenses would not use the TID-14844 source term but would use the source term in the referenced design certification, or a source term that is justified in the combined license application.

The second affected class is the small subset of plants that had construction permits pending on February 16, 1982. With the proposed change, these plants could use either the TID-14844 source term or an alternative source term in their operating license applications.

## **V. Future Regulatory Action**

The NRC is developing the following regulatory guides and Standard Review Plan sections to provide prospective applicants with the necessary guidance for implementing the proposed regulation. The draft guide and draft Standard Review Plan section will be issued to coincide with the publication of the final regulations that would implement this proposed rulemaking. A notice of availability for these materials will be published in the Federal Register at a future date.

1. Draft Guide DG-1081, "Alternative Radiological Source Terms for Evaluating the Radiological Consequences of Design Basis Accidents at Boiling and Pressurized Water Reactors."

This guide is expected to present regulatory guidance on the implementation of an alternative source term at an operating reactor. The guide is expected to address issues involving limited or selective implementation of an alternative source term and probabilistic risk assessment (PRA) issues related to plant modifications based on an alternative source term, and to provide guidance on the scope and extent of affected DBA radiological analyses and associated acceptance criteria. The guide is expected to include

revised assumptions and methods for each affected DBA in a series of appendices. These appendices will supersede the guidance in Regulatory Guides 1.3, 1.4, 1.25, and 1.77, and will supplement guidance in Regulatory Guide 1.89 for those facilities using an alternative source term.

2. Standard Review Plan Section, 15.0.1, "Radiological Consequence Analyses Using Alternative Source Terms."

This SRP section presents guidance to NRC staff in the review of the adequacy of licensee submittals requesting approval for use of an alternative source term.

## **VI. Referenced Documents**

Copies of NUREG-0737, NUREG-0800, NUREG-1465, and NUREG/CR-6204 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Mail Stop SSOP, Washington, DC 20402-9328. Copies also are available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161. A copy also is available for inspection and copying for a fee in the NRC Public Document Room, 2120 L Street, NW (Lower Level), Washington, DC.

Copies of issued regulatory guides may be purchased from the Government Printing Office (GPO) at the current GPO price. Information on current GPO prices may be obtained by contacting the Superintendent of Documents, U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20402-9328. Issued guides also may be purchased from the National Technical Information Service (NTIS) on a standing order basis. Details on this service may be obtained by writing NTIS, 5826 Port Royal Road, Springfield, VA 22161.

Copies of SECY-94-302, SECY-96-242, SECY-98-154, TID14844, and TR-105909 are available for inspection and copying for a fee at the NRC Public Document Room, 2120 L Street, NW.

(Lower Level), Washington, DC.

## **VII. Draft Finding of No Significant Environmental Impact: Availability**

The NRC has determined under the National Environmental Policy Act of 1969, as amended, and the NRC's regulations in Subpart A of 10 CFR Part 51, that this regulation is not a major Federal action significantly affecting the quality of the human environment and, therefore, an environmental impact statement is not required. This proposed rule would allow operating reactors to replace the traditional TID-14844 source term with a more realistic source term based on the insights gained from extensive accident research activities. The actual accident sequence and progression would not be changed; it is the regulatory assumptions regarding the accident that would be affected by the change. The use of an alternative source term alone cannot increase the core damage frequency (CDF) or the large early release frequency (LERF) or actual offsite or onsite radiation doses. An alternative source term could be used to justify changes in the plant design that might have an impact on CDF or LERF or that might increase offsite or onsite doses. These potential changes are subject to existing requirements in the NRC's regulations. Thus, the level of protection of public health and safety provided in NRC regulations would not be decreased by this proposed rule. The proposed rule would not affect non-radiological plant effluents and has no significant environmental impact.

As discussed above, the determination of the environmental assessment is that there would be no significant offsite impact on the public from this action. However, the general public should note that the NRC welcomes public participation. Also, the NRC has committed itself to complying in all its actions with Executive Order #12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," dated February 11, 1994. In accordance with that executive order, the NRC has determined that there are no disproportionately high and adverse impacts on minority and low income parties. In the letter and spirit of E.O. 12898, the NRC is requesting public comments on any environmental justice

considerations or questions that the public thinks may be related to this proposed rule, but that somehow were not addressed. The NRC uses the following working definition of environmental justice: *Environmental justice* means the fair treatment and meaningful involvement of all people, regardless of race, ethnicity, culture, income, or educational level with respect to the development, implementation and enforcement of environmental laws, regulations, and policies. Comments on any aspect of the environmental assessment, including environmental justice, may be submitted to the NRC as indicated under the ADDRESSES heading.

The draft environmental assessment and the draft finding of no significant impact on which this determination is based are available for inspection at the NRC Public Document Room, 2120 L Street NW. (Lower Level), Washington, DC. Single copies of the environmental assessment and finding of no significant impact are available from Mr. Stephen F. LaVie, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory NRC, Washington, DC 20555-0001, telephone: 301-415-1081, or by Internet electronic mail to [sfl@nrc.gov](mailto:sfl@nrc.gov).

### **VIII. Paperwork Reduction Act Statement**

This proposed rule increases the burden on licensees by requiring that when seeking to revise their current accident source term in design basis radiological consequence analyses, they apply for an amendment under § 50.90. The public burden for this information collection is estimated to average 609 hours per request. Because the burden for this information collection is insignificant, Office of Management and Budget (OMB) clearance is not required. Existing requirements were approved by the Office of Management and Budget, approval number 3150-0011.

#### Public Protection Notification

If an information collection does not display a currently valid OMB control number, the



NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

## **IX. Regulatory Analysis**

The Commission has prepared a regulatory analysis on this regulation. Interested persons may examine a copy of the regulatory analysis at the NRC Public Document Room, 2120 L Street NW. (Lower Level), Washington, DC. Single copies of the analysis are available from Mr. Stephen F. LaVie, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, telephone: 301-415-1081, or by Internet electronic mail to [sfl@nrc.gov](mailto:sfl@nrc.gov).

## **X. Regulatory Flexibility Certification**

As required by the Regulatory Flexibility Act of 1980, 5 U.S.C. 605(b), the Commission certifies that this regulation will not have a significant economic impact on a substantial number of small entities. This proposed regulation will affect only the licensing and operation of nuclear power plants. The companies that own these plants do not fall within the definition of "small entities" found in the Regulatory Flexibility Act or within the size standards established by the NRC (April 11, 1995; 60 FR 18344).

## **XI. Backfit Analysis**

The NRC has determined that the backfit rule in 10 CFR 50.109, does not apply to this proposed regulation and that a backfit analysis is not required for this proposed regulation because these amendments do not involve any provisions that would impose backfits as defined in 10 CFR 50.109(a)(1). This proposed

regulation amends the NRC's regulations by establishing alternate requirements that may be voluntarily adopted by licensees.

### **List of Subjects**

#### *10 CFR Part 21*

Nuclear power plants and reactors, Penalties, Radiation protection, Reporting and recordkeeping requirements.

#### *10 CFR Part 50*

Antitrust, Classified information, Criminal penalties, Fire protection, Intergovernmental relations, Nuclear power plants and reactors, Radiation protection, Reactor siting criteria, Reporting and recordkeeping requirements.

10 CFR Part 54

Administrative practice and procedure, Age-related degradation, Backfitting, Classified information, Criminal penalties, Environmental Protection, Nuclear power plants and reactors, Reporting and recordkeeping requirements.

For the reasons noted in the preamble and under the authority of the Atomic Energy Act of 1954, as amended, the Energy Reorganization Act of 1974, as amended; and 5 U.S.C. 552 and 553, the NRC is proposing the following amendments to 10 CFR Parts 21, 50, and 54:

**PART 21 — REPORTING OF DEFECTS AND NONCOMPLIANCE**

1. The authority citation for Part 21 continues to read as follows:

AUTHORITY: Sec. 161, 68 Stat. 948, as amended, sec. 234, 83 Stat. 444, as amended, sec. 1701, 106 Stat. 2951, 2953 (42 U.S.C. 2201, 2282, 2297f); secs. 201, as amended, 206, 88 Stat. 1242, as amended, 1246 (42 U.S.C. 5841, 5846).

Section 21.2 also issued under secs. 135, 141, Pub. L. 97 - 425, 96 Stat. 2232, 2241 (42 U.S.C. 10155, 10161).

2. Section 21.3 is amended by revising paragraph (1)(i)(C) of the definition of *Basic Component* to read as follows:

**§ 21.3 Definitions.**

As used in this part:

*Basic component.*

(1)(i) \* \* \*

(C) The capability to prevent or mitigate the consequences of accidents

which could result in potential offsite exposures comparable to those referred to in

§§ 50.34(a)(1), 50.67(b)(2), or § 100.11 of this chapter, as applicable.

\* \* \* \* \*

**PART 50 — DOMESTIC LICENSING OF PRODUCTION AND  
UTILIZATION FACILITIES**

3. The authority citation for Part 50 continues to read as follows:

AUTHORITY: Secs. 102, 103, 104, 105, 161, 182, 183, 186, 189, 68 Stat. 936, 937, 938, 948, 953, 954, 955, 956, as amended, sec. 234, 83 Stat. 444, as amended (42 U.S.C. 2132, 2133, 2134, 2135, 2201, 2232, 2233, 2236, 2239, 2282); secs. 201, as amended, 202, 206, 88 Stat. 1242, as amended, 1244, 1246 (42 U.S.C. 5841, 5842, 5846).

Section 50.7 also issued under Pub. L. 95-9601, sec. 10, 92 Stat. 2951 (42 U.S.C. 5851). Section 50.10 also issued under secs. 101, 185, 68 Stat. 955 as amended (42 U.S.C. 2131, 2235), sec. 102, Pub. L. 91-9190, 83 Stat. 853 (42 U.S.C. 4332). Sections 50.13, 50.54(dd), and 50.103 also issued under sec. 108, 68 Stat. 939, as amended (42 U.S.C. 2138). Sections 50.23, 50.35, 50.55, and 50.56 also issued under sec. 185, 68 Stat. 955 (42 U.S.C. 2235). Sections 50.33a, 50.55a and Appendix Q also issued under sec. 102, Pub. L. 91-9190, 83 Stat. 853 (42 U.S.C. 4332). Sections 50.34 and 50.54 also issued under sec. 204, 88 Stat. 1245 (42 U.S.C. 5844). Sections 50.58, 50.91, and 50.92 also issued under Pub. L. 97-9415, 96 Stat. 2073 (42 U.S.C. 2239). Section 50.78 also issued under sec. 122, 68 Stat. 939 (42 U.S.C.

2152). Sections 50.80-50.81 also issued under sec. 184, 68 Stat. 954, as amended (42 U.S.C. 2234). Appendix F also issued under sec. 187, 68 Stat. 955 (42 U.S.C 2237).

4. Section 50.2 is amended by revising paragraph (1)(iii) of the definition of *Basic component* and by adding in alphabetical order the definition for *Source term* to read as follows:

**§ 50.2 Definitions.**

As used in this part,

\* \* \* \* \*

*Basic component* \* \* \*

(1) \* \* \*

(iii) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to those referred to in §§ 50.34(a)(1), 50.67(b)(2), or § 100.11 of this chapter, as applicable.

\* \* \* \* \*

*Source term* refers to the magnitude and mix of radionuclides released from the reactor core to the reactor containment, their physical and chemical form, and the timing of their release.

\* \* \* \* \*

5. Section 50.34 is amended by revising paragraphs (f)(2)(vii), (viii), (xxvi), and (xxviii), and adding new Footnote 11 to read as follows:

**§ 50.34 Contents of applications; technical information.**

- \* \* \* \* \*
- (f) \* \* \*
- (2) \* \* \*

(vii) Perform radiation and shielding design reviews of spaces around systems that may, as a result of an accident, contain accident source term<sup>(11)</sup> radioactive materials, and design as necessary to permit adequate access to important areas and to protect safety equipment from the radiation environment. (II.B.2)

(viii) Provide a capability to promptly obtain and analyze samples from the reactor coolant system and containment that may contain accident source term<sup>(11)</sup> radioactive materials without radiation exposures to any individual exceeding 5 rems to the whole body or 50 rems to the extremities. Materials to be analyzed and quantified include certain radionuclides that are indicators of the degree of core damage (e.g., noble gases, radioiodines and cesiums, and nonvolatile isotopes), hydrogen in the containment atmosphere, dissolved gases, chloride, and boron concentrations. (II.B.3)

- \* \* \* \* \*

(xxvi) Provide for leakage control and detection in the design of systems outside containment that contain (or might contain) accident source term<sup>(11)</sup> radioactive materials following an accident. Applicants shall submit a leakage control program, including an initial test program, a schedule for re-testing these systems, and the actions to be taken for minimizing leakage from such systems. The goal is to minimize potential exposures to workers

and public, and to provide reasonable assurance that excessive leakage will not prevent the use of systems needed in an emergency. (III.D.1.1)

\* \* \* \* \*

(xxviii) Evaluate potential pathways for radioactivity and radiation that may lead to control room habitability problems under accident conditions resulting in an accident source term<sup>(11)</sup> release, and make necessary design provisions to preclude such problems. (III.D.3.4)

\* \* \* \* \*

<sup>11</sup> The fission product release assumed for these calculations should be based upon a major accident, hypothesized for purposes of site analysis or postulated from considerations of possible accidental events, that would result in potential hazards not exceeded by those from any accident considered credible. Such accidents have generally been assumed to result in substantial meltdown of the core with subsequent release of appreciable quantities of fission products.

\* \* \* \* \*

6. Section 50.49 is amended by revising paragraph (b)(1)(i)(C) to read as follows:

**§ 50.49 Environmental qualification of electric equipment important to safety for nuclear power plants.**

\* \* \* \* \*

(b) \* \* \*

(1) \* \* \*

(i) \* \* \*

(C) The capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the guidelines in §§ 50.34(a)(1), 50.67(b)(2), or §100.11 of this chapter, as applicable.

\* \* \* \* \*

7. Section 50.65 is amended by revising paragraph (b)(1) to read as follows:

**§ 50.65 Requirements for monitoring the effectiveness of maintenance at nuclear power plants.**

\* \* \* \* \*

(b) \* \* \*

(1) Safety-related structures, systems and components that are relied upon to remain functional during and following design basis events to ensure the integrity of the reactor coolant pressure boundary, the capability to shut down the reactor and maintain it in a safe shutdown condition, or the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposure comparable to the guidelines in §§ 50.34(a)(1), 50.67(b)(2), or §100.11 of this chapter, as applicable.

\* \* \* \* \*

8. Part 50 is amended to add § 50.67, a new section, to read as follows:



**§ 50.67 Accident source term.**

(a) *Applicability.* The requirements of this section apply to all holders of operating licenses issued prior to January 10, 1997, who seek to revise the current accident source term used in their design basis radiological analyses.

(b) *Requirements:* (1) A licensee who seeks to revise its current accident source term in design basis radiological consequence analyses shall apply for a license amendment under § 50.90. The application shall contain an evaluation of the consequences of applicable design basis accidents<sup>(1)</sup> previously analyzed in the safety analysis report.

(2) The NRC may issue the amendment only if the applicant's analysis demonstrates with reasonable assurance that:

(i) An individual located at any point on the boundary of the exclusion area for any 2-hour period following the onset of the postulated fission product release, would not receive a radiation dose in excess of 0.25 Sv (25 rem)<sup>(2)</sup> total effective dose equivalent (TEDE).

(ii) An individual located at any point on the outer boundary of the low population zone, who is exposed to the radioactive cloud resulting from the postulated fission product release (during the entire period of its passage), would not receive a radiation dose in excess of 0.25 Sv (25 rem) total effective dose equivalent (TEDE).

(iii) Adequate radiation protection is provided to permit access to and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 0.05 Sv (5 rem) total effective dose equivalent (TEDE) for the duration of the accident.

<sup>1</sup> The fission product release assumed for these calculations should be based upon a major accident, hypothesized for purposes of design analyses or postulated from considerations of possible

accidental events, that would result in potential hazards not exceeded by those from any accident considered credible. Such accidents have generally been assumed to result in substantial meltdown of the core with subsequent release of appreciable quantities of fission products.

<sup>2</sup> The use of 0.25 Sv (25 rem) TEDE is not intended to imply that this value constitutes an acceptable limit for emergency doses to the public under accident conditions. Rather, this 0.25 Sv (25 rem) TEDE value has been stated in this section as a reference value, which can be used in the evaluation of proposed design basis changes with respect to potential reactor accidents of exceedingly low probability of occurrence and low risk of public exposure to radiation.

9. Part 50, Appendix A, General Design Criterion 19, is amended to read as follows:

**Appendix A to Part 50 — General Design Criteria for Nuclear Power Plants**

\* \* \* \* \*

*Criterion 19 — Control room.* A control room shall be provided from which actions can be taken to operate the nuclear power unit safely under normal conditions and to maintain it in a safe condition under accident conditions, including loss-of-coolant accidents. Adequate radiation protection shall be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 rem whole body, or its equivalent to any part of the body, for the duration of the accident.

Equipment at appropriate locations outside the control room shall be provided (1) with a design capability for prompt hot shutdown of the reactor, including necessary instrumentation and controls to maintain the unit in a safe condition during hot shutdown, and (2) with a potential capability for subsequent cold shutdown of the reactor through the use of suitable procedures.

Applicants for construction permits under this part or a design certification or combined license under Part 52 of this chapter who apply on or after January 10, 1997, or holders of operating licenses using an alternative source term under § 50.67, shall meet the requirements of this criterion, except that with regard to control room access and occupancy, adequate radiation protection shall be provided to ensure that radiation exposures shall not exceed 0.05 Sv (5 rem) total effective dose equivalent (TEDE) as defined in § 50.2 of this chapter for the duration of the accident.

\* \* \* \* \*

**PART 54 — REQUIREMENTS FOR RENEWAL OF OPERATING LICENSES  
FOR NUCLEAR POWER PLANTS**

10. The authority citation for Part 54 continues to read as follows:

AUTHORITY: Secs. 102, 103, 104, 161, 181, 182, 183, 186, 189, 68 Stat. 936, 937, 938, 948, 953, 954, 955, as amended, sec. 234, 83 Stat. 1244, as amended (42 U.S.C. 2132, 2133, 2134, 2135, 2201, 2232, 2233, 2236, 2239, 2282); secs 201, 202, 206, 88 Stat. 1242, 1244, as amended (42 U.S.C. 5841, 5842), E.O. 12829, 3 CFR, 1993 Comp., p. 570; E.O. 12958, as amended, 3 CFR, 1995 Comp., p. 333; E.O. 12968, 3 CFR, 1995 Comp., p. 391.

11. Section 54.4 is amended by revising paragraph (a)(1)(iii) to read as follows:

**§ 54.4 Scope.**

(a) \* \* \*

(1) \* \* \*

(iii) The capability to prevent or mitigate the consequences of accidents which could

result in potential offsite exposures comparable to those referred to in §§ 50.34(a)(1), 50.67(b)(2), or 100.11 of this chapter, as applicable.

\* \* \* \* \*

Dated at Rockville, Maryland, this    the day of January 1999.

For the Nuclear Regulatory Commission.

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Annette Vietti-Cook,  
*Secretary of the Commission.*

# **Attachment 2**

**Draft**

## **Regulatory Analysis**

**REGULATORY ANALYSIS  
REVISION OF 10 CFR PARTS 21, 50, AND 54**

**Use of Alternative Source Terms at Operating Reactors**

**I. STATEMENT OF PROBLEM**

This regulatory analysis addresses a proposed rule that will revise 10 CFR Parts 21, 50, and 54. This rulemaking was initiated to enable holders of power reactor operating licenses issued before January 10, 1997, to voluntarily amend their facility design basis to replace the current accident source term in design basis radiological consequence analyses with an alternative source term. Although this proposed rule is based on the accident source terms presented in NUREG-1465, *Accident Source Terms for Light-Water Nuclear Power Plants*, which will be endorsed by the NRC staff in a proposed regulatory guide, the rule will refer to *alternative source term* to enable the use of a future alternative to NUREG -1465. (In this analysis, *revised source terms* refers to NUREG-1465.) This rule also incorporates proposed conforming revisions to 10 CFR Part 50 to eliminate the need for certain exemptions from Part 50 requirements for future applicants under Part 52. In addition to future applicants under Part 52, the proposed conforming change to §50.34(f) affects the small class of applicants that had a construction permit or manufacturing license pending on February 16, 1982. This proposed change would allow this small class of applicants to use an alternative to the TID-14844 source term in showing compliance with §50.34(f).

This regulatory analysis is presented in two parts, corresponding to the two considerations stated above.

**A. Use of Alternative Source Terms at Operating Reactors**

1. Background

a. Accident Source Term

A holder of an operating license (licensee) for a light-water power reactor was required by regulations issued by the NRC (or its predecessor, the U.S. Atomic Energy Commission) to submit a safety analysis report in support of its license application that assessed the radiological consequences of potential accidents and evaluated the proposed facility site. The NRC staff used this information in its evaluation of the suitability of the reactor design and the proposed site as required by 10 CFR Parts 50 and 100. Section 100.11 requires an applicant to assume (1) a fission product release from the core, (2) the expected containment leak rate, and (3) the site meteorological conditions to establish an exclusion area and a low population zone. A footnote to §100.11 provides guidance that the fission product release be based on a major accident that would result in substantial release of appreciable quantities of fission products from the core to the containment atmosphere. A note to §100.11 references Technical Information Document (TID) 14844, *Calculation of Distance Factors for Power and Test Reactors*, published in 1962 by the U.S. Atomic Energy Commission, as a source of guidance and as a point of departure for addressing site-specific considerations. This fission product release, known as the TID-14844 accident source term, was used to evaluate the radiological consequences of design basis accidents (DBAs) to determine compliance with various requirements in 10 CFR Parts 50 and 100 in all of the operating reactors licensed to date. Although originally

used for site suitability analyses, the accident source term is a design parameter for accident mitigation features, equipment qualification, control room operator radiation doses, and post-accident vital area access doses. The TID-14844 source term was explicitly stated as a required design parameter for several Three Mile Island (TMI)-related requirements. The NRC considers the accident source term an integral part of the design basis because it was a significant input to a large portion of the plant design.

The NRC staff's methods for calculating accident doses, as described in Regulatory Guide 1.3, *Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Boiling Water Reactors*, and Regulatory Guide 1.4, *Assumptions Used for Evaluating the Potential Radiological Consequences of a Loss of Coolant Accident for Pressurized Water Reactors*, and in the Standard Review Plan, were developed to be consistent with the TID-14844 source term and the whole body and thyroid dose guidelines stated in §100.11. In that regulatory framework, the source term is assumed to be released immediately to the containment at the start of the postulated accident. The chemical form of the radioiodine released to the containment atmosphere is assumed to be predominantly elemental with small fractions of particulate and organic iodine forms.

Radiation doses are calculated at the exclusion area boundary (EAB) for the first 2-hours and at the low population zone (LPZ) for the assumed 30-day duration of the accident. The whole body dose comes primarily from the noble gases in the source term. The thyroid dose is based on inhalation of radioiodines. In analyses performed to date, the thyroid dose has generally been limiting. The design of some engineered safety features, such as containment spray systems and containment, ventilation exhaust, and control room charcoal filters, are predicated on these postulated thyroid doses. This regulatory framework has provided a consistent analytical approach for evaluating the spectrum of potential consequences from DBAs.

Since the publication of TID-14844, significant advances have been made in understanding the timing, magnitude, and chemical form of fission product releases from severe nuclear power plant accidents. Many of these insights developed out of the major research effort started by the NRC and the industry after the accident at TMI. In 1995, the NRC published NUREG-1465, which utilized this research to provide more physically based estimates of accident source terms that could be applied to the design of future light-water power reactors. In NUREG-1465, the NRC staff provides a representative accident source term for a boiling-water reactor (BWR) and for a pressurized-water reactor (PWR). These source terms are described in terms of radionuclide composition and magnitude, physical and chemical form, and timing of release. Where TID-14844 addressed three categories of radionuclides, the revised source terms categorize the accident release into eight groups based on similarity of chemical behavior. Where TID-14844 assumed an immediate release of the activity, the revised source terms have five release phases that are postulated to occur over several hours, with the onset of major core damage occurring after 30 minutes.

Where TID-14844 assumed radioiodine to be predominantly elemental, the revised source terms assume radioiodine to be predominantly cesium iodide (CsI), an aerosol that is more amenable to mitigation mechanisms. For DBAs, the NUREG-1465 source terms are comparable to the TID-14844 source term with regard to the magnitude of the noble gas and radioiodine release fractions. However, the revised source terms present a more representative description of the radionuclide composition and release timing. In SECY-94-302, *Source Term-Related Technical and Licensing Issues Pertaining to Evolutionary and Passive Light-Water-Reactor Designs*, the NRC staff determined that the first three phases (coolant, gap, and early in-vessel) are appropriate for design basis evaluations.

The NRC staff initiated several actions to provide a regulatory basis for operating reactors to voluntarily amend their facility design bases to enable use of alternative source terms in design basis analyses. First, the NRC staff solicited information on how such source terms might be implemented. In November 1995, the Nuclear Energy Institute (NEI) submitted its generic framework (Electric Power Research Institute Technical Report TR-105909, *Generic Framework for Application of Revised Accident Source Term to Operating Plants*). This report and the NRC response were discussed in SECY-96-242 (November 1996). Second, the NRC staff initiated a comprehensive assessment of the overall impact of substituting the NUREG-1465 source terms for the TID-14844 source term at two typical facilities. This was done to evaluate the issues involved with applying this revised source terms at operating plants. SECY- 98-154 (June 1998), described the conclusions of this assessment. Third, the NRC staff accepted license amendment requests related to implementation of these revised source terms at a small number of pilot plants. The staff is currently reviewing these pilot projects. Insights from these pilot plant reviews will be incorporated into the regulatory guidance that will be developed in conjunction with this rule. Fourth, the NRC staff initiated an assessment on whether rulemaking would be necessary to allow operating reactors to use alternative source terms. The proposed rule described herein and the supporting regulatory guidance that will be developed as part of this rulemaking have resulted from this assessment. The NRC staff plans to issue the supporting regulatory guidance for public comment on the same date as it publishes the final rule.

#### b. Accident Dose Criteria and Control Room Dose Criteria

In Part 50, Appendix A, GDC-19, the NRC staff presents radiation dose criteria that are used to assess the suitability of the plant design with regard to maintaining control room habitability during DBAs. In §100.11, the NRC staff presents radiation dose guidelines that are used to assess the suitability of the plant design with regard to offsite exposures during design basis events. The dose guidelines for the whole body and the thyroid and the immediate 2-hour exposure period were largely predicated by the assumed source term being predominantly noble gases and radioiodines instantaneously released to the containment and the assumed "single critical organ" method of modeling the internal dose used when Part 100 was originally published. However, the current dose guidelines, by focusing on doses to the thyroid and the whole body, assume that radioiodine will be the major contributor to doses. Although this may be appropriate with the TID-14844 source term, it may not be true for source terms based on a more complete understanding of accident sequences and phenomenology. The postulated chemical and physical form of radioiodine in the revised source terms is more amenable to mitigation and, as such, radioiodine may not always be the predominant radionuclide in an accident release. The revised source terms assume a larger number of radionuclides than did the TID-14844 source term as implemented in regulatory guidance. The whole body and thyroid dose guidelines ignored these contributors to dose.

In the period since these regulations were issued, there have been significant developments in the principles and scientific knowledge underlying standards for radiation dose limitation and assessment. These developments include not only updated scientific information on radionuclide uptake and metabolism, but also reflect changes in the basic philosophy of radiation protection. In 1991, the NRC staff revised 10 CFR Part 20, *Standards for Protection Against Radiation*, to reflect these developments. The accident dose guidelines in §100.11 and GDC-19, were not changed when Part 20 was revised because the requisite revision to the licensing basis of each operating power reactor was not warranted. The standards in Part 20 include the dose quantity, *total effective dose equivalent* (TEDE), which is defined as the deep dose equivalent (for external exposure) plus the committed effective dose equivalent (for internal exposure). The deep dose equivalent (DDE) is comparable to the present whole body dose. The committed effective dose equivalent (CEDE) is the sum of the products of doses (integrated over a 50-year period) to selected body organs resulting from the



intake of radioactive material multiplied by weighting factors for each organ that are representative of the radiation risk associated with the particular organ. The TEDE, using a risk-consistent methodology, assesses the impact of all relevant nuclides upon all body organs. It is expected that the thyroid could still be the limiting organ and that radioiodine could still be the limiting radionuclide, and that the current whole body and thyroid guidelines could provide adequate protection; however, this conclusion cannot be assured in all potential cases. The NRC staff recommended in SECY-96-242 that dose guidelines expressed in terms of TEDE be required if a licensee elects to use a revised source term. In a staff requirements memorandum dated February 12, 1997, the Commission directed the NRC staff to incorporate TEDE in this proposed rulemaking.

The dose guideline for the EAB in §100.11 is specified with a 2-hour exposure period commencing immediately following the onset of the fission product release. This exposure period was predicated, in part, on the traditional source term assumption that the activity would be immediately available for release at the onset of the accident. The combination of these two assumptions resulted in the maximum postulated dose. The revised source terms postulate a release that occurs in phases, with the significant release starting after about 30 minutes and continuing for about 90 minutes (through the early in-vessel phase only). Because of this, an exposure period starting at the onset of the fission product release may not represent the limiting case. The NRC staff recommended in SECY-96-242 that dose guidelines expressed in terms of the worst 2-hour dose be considered if a licensee elects to use the revised source terms. In a staff requirements memorandum dated February 12, 1997, the Commission directed the NRC staff to incorporate the worst 2-hour dose in this proposed rulemaking.

## 2. Existing Regulatory Framework

### a. Accident Source Term

The proposed rule for implementation of alternative source terms is applicable only to facilities that obtained an operating license, under 10 CFR Part 50, before January 10, 1997. The regulations in this part are supplemented by those in other parts of Chapter 1 of Title 10, including Part 100. Part 100 contains language that qualitatively defines a required accident source term and contains a note to Section 100.11 that discusses the availability of TID-14844. However, this note did not mandate the use of TID-14844. With the exception of §50.34(f), that addresses additional TMI-related requirements, there are no explicit provisions in Title 10 requiring the use of the TID-14844 accident source term. Section 50.34(f) is only applicable to a limited number of construction permit and manufacturing license applications pending on February 16, 1982, and to applications under Part 52.

Regulatory Guides 1.3 and 1.4 specify the methods and assumptions acceptable to the NRC staff for assessing the consequences of design basis loss of coolant accidents (LOCAs) as required by §100.11. These regulatory guides provide guidance involving accident source terms, much of which is derived from TID-14844. Other guides specify accident source terms either directly or by reference to Regulatory Guides 1.3 and 1.4. None of these guides, however, explicitly refers to TID-14844. The NRC publishes regulatory guides to describe methods acceptable to the NRC staff for implementing specific parts of the NRC's regulations. Because compliance with these guides is not required, applicants are permitted to propose alternatives for NRC staff consideration. Although NRC staff licensing reviews have been based on Regulatory Guides 1.3 and 1.4, the option for a licensee to propose alternatives has been and remains a possible regulatory mechanism to implement a source term other than the one in TID-14844.

An applicant for an operating license is required by §50.34 to submit a final safety analysis report (FSAR) that describes the facility and its design bases and limits, including a safety analysis of the site and facility. Guidance in performing these analyses is given in regulatory guides. In its review of the more recent applications for operating licenses, the NRC staff has used the review procedures in NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants* (SRP). These review procedures reference or provide acceptable assumptions and analysis methods. Although compliance with the SRP is not required, in practice, many applicants adhere to the guidance in the interest of facilitating NRC staff review. Operating license applications docketed after May 17, 1982, are required in §50.34(g) to contain an evaluation of the facility for conformance with the SRP. The facility FSAR documents the assumptions and methods actually used by the applicant in the required safety analyses. The NRC staff's finding that a license may be issued is based on the review of the FSAR, as documented in the safety evaluation report (SER). Through inclusion in the FSAR, these assumptions (including source term) and the licensee's methods of evaluation become part of the design basis of the facility.

Thus, from a regulatory standpoint, the requirement to use the TID-14844 source term is a licensee commitment (typically expressed as a commitment to Regulatory Guide 1.3 or 1.4) documented in the facility FSAR. The licensee may effect a change in its licensing basis, including the FSAR, by applying for an amendment to its license under §§50.90–50.92, or on its own volition within the provisions of §50.59. Because of the extensive use of the accident source term in the design and operation of a power reactor, and because of the potential impact on postulated accident consequences and margins of safety of a change in such a fundamental design assumption, the NRC has concluded that an alternative source term should be implemented by a license amendment under §§50.90–50.92.

#### b. Accident Dose Criteria and Control Room Dose Criteria

The accident dose guidelines for operating reactors licensed before January 10, 1997, are presented in §100.11. These guidelines are expressed in terms of whole body and thyroid dose. Two guidelines are provided. The first is for the EAB for the 2-hour period immediately following the onset of radioactivity release. The second is for the LPZ for the duration of the event. General Design Criterion 19 (GDC-19), *Control Room*, of Appendix A to 10 CFR Part 50, establishes minimum requirements for the design of the control room, including a requirement for radiation protection features adequate to permit access to and occupancy of the control room under accident conditions. The GDC-19 criteria are expressed in terms of 0.05 Sv (5 rem) whole body dose, or its equivalent to any organ. SRP Section 6.4, *Control Room Habitability Systems*, contains guidance that defines *equivalent* as 0.3 Sv (30 rem) to the thyroid and 0.3 Sv (30 rem) to the skin.

In January 1997, the NRC amended its regulations in 10 CFR Parts 21, 50, 52, 54, and 100 to (1) provide site criteria for future sites and (2) relocate source term and dose requirements for future plants into §50.34. The guidelines of §100.11 remain in place as the licensing basis for operating reactors licensed before January 10, 1997. In relocating the source term and dose requirements for future reactors to §50.34, the NRC retained the requirements for the EAB and the LPZ, but revised the associated numerical dose guidelines to replace the two different doses for the whole body and the thyroid gland with a single, total effective dose equivalent (TEDE) value. The dose guideline for the EAB was expressed in terms of the 2-hour period that yielded the maximum dose. The NRC did not, at that time, amend the control room dose criterion in GDC-19.

In a staff requirements memorandum dated February 12, 1997, the Commission directed that the

amended dose guidelines be made applicable to operating plants choosing to use a revised source term. Therefore, an alternative source term cannot be implemented without a modification of the accident dose criteria and the GDC-19 criteria. It is this needed modification that makes the proposed rule necessary.

## **B. Conforming Changes for Part 52**

Part 52 governs the issuance of early site permits, standard design certifications, and combined licenses for nuclear power facilities. Part 52 is used in conjunction with applicable requirements of Part 50. The TMI-related requirements in §50.34(f) were specifically incorporated by reference in §52.47(a)(ii). This incorporation by reference is necessary because §50.34(f) limits applicability to specifically identified facilities for which an application for a construction permit was pending on February 16, 1982. The NRC staff expects that future plants will use the revised source terms, or an approved alternative, in supporting safety analyses. Because §§50.34(f)(2)(vii), -(viii), -(xxvi), and -(xxviii) contain specific references to the TID-14844 source term, these sections need to be revised. The control room habitability criteria in GDC-19 were incorporated by reference in §52.47(a)(i). This criterion is expressed in terms of whole body dose or its equivalent to any part of the body rather than in terms of TEDE. Exemptions from these requirements were necessary for the Westinghouse AP-600 final design approval and design certification. The proposed rule would address changes to these affected sections in order to avoid the need for exemptions for subsequent applicants under Part 52.

The conforming changes to §50.34(f) would also be applicable to the small subset of specifically listed applicants that had a construction permit application pending on February 16, 1982. The NRC does not expect these applications to be pursued further. However, should one of these applications be reactivated, the applicant would, in effect, be given the option of using an approved alternative to the TID-14844 source term.

## **II. OBJECTIVE OF PROPOSED RULE**

### **A. Use of Alternative Source Terms at Operating Reactors**

The objective of this proposed regulatory action is to set up a regulatory framework for the voluntary implementation of alternative source terms as a change to the design basis at currently licensed power reactors, thereby enabling potential cost-beneficial licensing actions while continuing to maintain existing safety margins and defense in depth.

This would be accomplished by

- Providing revised accident dose criteria and control room habitability dose criteria that are consistent with the characteristics of the revised source terms and that reflect updated scientific information on radionuclide uptake and metabolism, and also reflect current radiation protection standards; and

- Requiring submittal of a license amendment that contains an evaluation of the consequences of applicable design basis accidents previously analyzed in the safety analysis report.

Because conformance to the proposed rule is voluntary and would not constitute a backfit, the licensing bases for operating reactors that do not adopt an alternative source term must remain in the regulation. Therefore, the proposed rule is designated as a new section, §50.67, applicable to operating reactors licensed before January 10, 1997, that are proposing to use an alternative source term. The existing requirements in Part 100 and GDC-19 are maintained for operating reactors that continue to use the TID-14844 source term.

The NRC staff will prepare a regulatory guide and an SRP section in support of this rule. The drafts of these guidance documents will be issued for public comment at the time the final rule is published (September 1999).

## **B. Conforming Changes for Part 52**

The objective of this proposed regulatory action is to eliminate the need for applicants under Part 52 to request exemptions from certain of the NRC's regulations. The need for these exemptions was identified during the Westinghouse AP-600 advanced reactor design certification proceeding.

This would be accomplished by

- Explicit references to the *TID-14844 source term* in §50.34(f) would be revised to read *accident source term*. A footnote would be added to define an accident source term in generic terminology (similar language to the corresponding footnote in Part 100).
- GDC-19 will be revised to incorporate a revised dose criterion that is applicable only to applicants for construction permits under this part, or a design certification or combined license under 10 CFR Part 52 who apply on or after January 10, 1997. The current dose criterion would remain in effect for those operating reactors that continue to use the TID-14844 source term.

## **III. ALTERNATIVE APPROACHES**

### **A. Use of Alternative Source Terms at Operating Reactors**

The no-action alternative of retaining the existing accident source term was not considered in the development of the proposed rulemaking. In SECY-96-242, the NRC staff made recommendations to the Commission on how the revised source terms could be implemented at operating reactors. The staff requirements memorandum on SECY-96-242 directed the NRC staff to (1) complete the re-baselining study, (2) complete pilot plant evaluations, (3) commence rulemaking, and (4) include the TEDE terminology and the worst 2-hour methodology.

The first alternative considered by the NRC was to continue using current regulations for accident

dose criteria and control room dose criteria. This is not considered to be an acceptable alternative. The NRC had previously determined in the January 1997 Part 50 and Part 100 final rule that dose guidelines expressed in terms of whole body and thyroid doses were inconsistent with the use of the revised source terms. With regard to the EAB dose

guideline, the NRC also determined that the dose guideline applies to that 2-hour period resulting in the maximum dose.

The second alternative considered by the NRC was to replace the existing guidelines in §100.11 and the existing criteria GDC-19 with revised dose criteria. This is not considered to be an acceptable alternative because the provisions of the existing regulations form part of the licensing bases for many of the operating reactors. Therefore, these provisions must remain in effect for operating reactors that do not implement an alternative source term. In addition, this rulemaking alternative would also be inconsistent with the NRC's philosophy of separating plant siting criteria and dose requirements. The approach of establishing the requirements for use of alternative source terms in a new section to Part 50 while retaining the existing regulations in Part 100 Subpart A and GDC-19 was chosen as the best rulemaking alternative.

The NRC considered alternatives with regard to providing regulatory guidance to support the new section to Part 50. The first alternative was to issue no additional regulatory guidance. This was not considered to be acceptable alternative because, in the absence of clear regulatory guidance, licensee efforts in preparing applications, and the NRC staff review of submitted applications, could be hindered by differences in interpretations and technical positions. This could result in the inefficient use of licensee and NRC staff resources, could cause licensing delays, and could lead to less uniform and less consistent regulatory implementation. The second alternative was to replace the existing regulatory guides that address accident radiological consequences with new revisions. This was not considered to be an acceptable alternative because the provisions of the existing regulatory guides form part of the licensing bases for many of the operating reactors. Therefore, these provisions must remain in effect for operating reactors that do not implement an alternative source term. The third alternative was to issue a new regulatory guide on the implementation of the revised source terms that would include revised assumptions and acceptable analysis methods for each design basis accident in a series of appendices. The approach of issuing a new regulatory guide was chosen as the best alternative. To provide review guidance for the NRC staff, a new section on design basis radiological analyses using alternative source terms would be added to the Standard Review Plan.

## **B. Conforming Changes for Part 52**

Because these revisions are conforming changes for a rule issued earlier, the no-action alternative was not considered to be acceptable. No reasonable alternative was identified for the necessary §50.34(f) revisions. The reference to TID-14844 needs to be removed.

With regard to a revised control room dose criterion, the revised criterion could have been implemented by changing Part 52 (that cross-references Part 50), by a changing §50.34(a), or by changing GDC-19. A change to GDC-19 was found to be the simplest and clearest approach and, therefore, was considered to be the acceptable alternative.

## **IV. EVALUATION OF VALUES AND IMPACTS**

The NRC has determined that the public health and safety and the common defense and security would continue to be adequately protected if the proposed rule is implemented. The NRC has

qualitatively determined that the potential values associated with the revised source terms are substantial enough to justify the rule. This proposed rule is voluntary for operating

reactors. (The conforming changes for Part 52 will be mandatory for future applicants.) The basis for these conclusions is discussed in the sections to follow.

## **A. Use of Alternative Source Terms at Operating Reactors**

### **1. Values**

This proposed rule would allow operating reactors to voluntarily replace the traditional TID-14844 source term with a source term that is based on the insights gained from extensive accident research activities. The accident source term is a design parameter for accident mitigation features, equipment qualification, control room operator radiation doses, and post-accident vital area access doses. The design of some engineered safety features, such as containment spray systems and containment, ventilation exhaust, and control room charcoal filters, is largely predicated on the radiation doses postulated using these source terms. It is expected that an alternative source term, with its improvements in the understanding of chemical/physical form and release timing, could be used to effect reductions in operational and maintenance requirements associated with some of these systems. These reductions would have economic benefit.

The implementation of an alternative source term does not, in itself, have economic value. It is the modifications to the facility structures, systems, components, and procedures, enabled by an alternative source term that give rise to the associated values and impacts. Because this is a voluntarily action on the part of the licensee, it is expected that licensees will not pursue applications of an alternative source term unless it is perceived to be in their benefit to do so. Because of this conclusion and the large number of possible applications varying in scope and extent, the NRC has not performed quantitative value-impact analyses. In 1996, NEI informally polled the industry to determine how often and for what uses licensees might apply the NUREG-1465 source terms. Although the poll was informal and does not constitute any commitment to act, the results of the poll indicate the level of interest in the proposed rule. The responses received represented 43 operating power reactors. Of these, 41 reactors plan to use the revised source terms to pursue plant modifications. Anticipated applications includes the following:

- change in allowable containment and ECCS leak rates (24 plants)
- change in isolation valve actuation timing (31 plants)
- simplification of filtration units (27 plants)
- change in mitigation system actuation timing (22 plants)
- change in equipment qualification (2 plants)

There is an expectation that many of the alternative source term applications may provide concomitant improvements in overall safety and in reduced occupational exposure, as well as economic benefits. Because of the wide range of possible applications and the voluntary nature of this rule, it is not reasonable to quantify possible outcomes. Reductions in occupational exposures may be realized



through reductions in maintenance efforts associated with maintaining unnecessarily limiting leakage, timing, or filtration requirements. Improvements in overall safety may be realized through reduced emergency diesel generator loading, improved containment ventilation system performance due to removal of filter media, and closer synchronization of mitigation feature actuation with the onset of major fission product release, to provide just three examples. There may be improvements in safety margins realized due to the upgrading of analysis assumptions, methods, and acceptance criteria.

It is believed that the proposed rule would result in an improvement in the allocation of resources both for the NRC and for industry. The industry would be allowed to propose applications of alternative source terms that could reduce unnecessary or ineffective requirements in the facility design basis. Limited resources could be diverted to safety issues of greater significance.

## 2. Costs

Since the implementation of an alternative source term is a voluntarily action on the part of the licensee, licensees are not expected to pursue applications of an alternative source term unless it is perceived to be in their benefit to do so. Because of this conclusion and the large number of possible applications varying in scope and extent, the NRC has not performed quantitative value-impact analyses.

## 3. Impacts

It is difficult to determine with exactitude the actual impacts of the proposed rule since it does not mandate or approve any *specific* source term as a substitute to TID-14844. However, to provide some idea of the potential impact, the NRC assumed for purposes of this regulatory analysis that a licensee would seek to replace the traditional TID-14844 source term with a source term that is based on the NUREG-1465 source terms. Using NUREG-1465, the actual accident sequence and progression are not changed; it is the regulatory assumptions regarding the accident that will be affected by substituting the alternative source term. Use of an alternative source term alone cannot increase the core damage frequency (CDF) or the large early release frequency (LERF) or actual offsite or onsite radiation doses. (Although *actual* doses would not increase, analysis results may show an increase in some *postulated* doses because additional radionuclides will be considered and dose modeling will be more comprehensive.) The accident source terms are used in analyses performed to assess the adequacy of the plant design to contend with a DBA in order to ensure adequate defense in depth and adequate safety margins.

An alternative source term could be used to justify changes in the plant design that could have an impact on CDF or LERF or that could increase offsite or onsite doses. These potential changes are subject to existing requirements in the NRC's regulations. The supporting regulatory guide for this rule will discuss the need for an evaluation of the impacts of an alternative source term implementation, including consideration of reductions in defense in depth, safety margins, or both. Consistent with Regulatory Guide 1.174, *An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Current Licensing Basis*, the draft guide will indicate that PRA insights may have to be considered if the proposed changes to the design basis are not addressed in currently approved NRC staff positions.

The Commission directed the NRC staff to assess the impacts of implementing the NUREG-1465 source terms at operating reactors. The results of this study were presented to the Commission in SECY-98-154, *Results of the Revised (NUREG-1465) Source Term Re-Baselining for Operating Reactors*. The major areas examined were the effect on individual offsite and control room dose, the effect on doses used in equipment environmental qualification, and the effect of potential modifications that might be enabled by the revised source terms. The study also assessed the margin afforded by the revised source terms in comparison to assessments performed using the integrated severe accident assessment code, MELCOR. The study indicated that the impact of implementing the revised source terms at operating reactors will produce lower postulated doses in the majority of cases. The NRC intends to address the exceptions in the regulatory guidance that will be developed to support the proposed rule and in the processing of the individual license amendments. The MELCOR best estimate analyses indicated that the design basis dose calculations using the revised source term continue to have a substantial margin (a factor of two or greater). The study also indicated that many of the plant systems that are likely to be considered for modification are not involved in risk significant sequences and are, therefore, not likely to have a substantial offsite risk impact using a measure such as LERF. At the present time, the only approved alternative to the TID-14844 source term is that in NUREG-1465. The NRC expects that any future proposed alternative source term will be subjected to the same level of scrutiny as was used in approving NUREG-1465.

On the basis of these considerations, the NRC concludes that approval of an alternative source term based upon NUREG-1465 would not involve a significant increase in the probability or consequences of accidents previously analyzed, nor would it create a new or different type of accident or result in a significant reduction in safety margin.

The NRC does not intend to approve any source term that is not of the same level of quality as NUREG-1465, or that has not had the extensive peer review as did NUREG-1465. Any alternative source term is expected to provide the same level of protection as does NUREG-1465. Thus, the NRC concludes that this rule itself is unlikely to have any significant impact on public health and safety and will continue to provide reasonable assurance of adequate protection.

#### 4. Backfit Considerations

The NRC has determined that the backfit rule, 10 CFR 50.109, does not apply to this proposed regulation, and, therefore, a backfit analysis is not required because these amendments do not involve any provisions that would impose backfits as defined in 10 CFR 50.109(a)(1). The proposed §50.67 amends the NRC's regulations by establishing alternate requirements that may be voluntarily adopted by operating reactors licensed before January 1997 that have adopted, or are proposing to adopt, an alternative source term.

#### 5. Impacts on Other Programs, Other Agencies

The proposed rule would not affect Federal, State, or local Government agencies, or Agreement State licensees because the rule would affect only the licensing and operation of nuclear power plants that are regulated by the NRC under Part 50. Within the NRC, the cognizant office is the Office of Nuclear Reactor Regulation, which is sponsoring this proposed rule. No other NRC office is affected by this proposed rule.

## **B. Conforming Changes for Part 52**

### 1. Values

The proposed conforming changes would eliminate the need for future applicants under Part 52 to apply for exemptions from certain paragraphs in §50.34(f) and GDC-19. This would eliminate the costs associated with preparing and processing an exemption request. By eliminating the need for exemptions, the integrity of the regulations would be maintained.

### 2. Costs

Because the conforming changes would eliminate the need for future applicants under Part 52 to apply for exemptions from certain paragraphs in §50.34(f) and GDC-19, it is expected that costs would be reduced, not increased.

### 3. Impacts

Because these are conforming changes for regulations already promulgated, there could be no significant increase in the probability or consequences of accidents previously analyzed, nor would a new or different type of accident be created, nor would there be a significant reduction in safety margins.

The proposed conforming changes to §50.34(f) would also be applicable to the small subset of specifically listed applicants that had a construction permit application pending on February 16, 1982. The NRC does not expect these applications to be pursued further. However, if one of these applications would be re-activated, the applicant would be given the option of using an approved alternative to the TID-14844 source term. If an affected applicant chose to use an alternative source term, the impact discussion and conclusions above for the proposed §50.67 would apply.

### 4. Backfit Considerations

The NRC has determined that the backfit rule, 10 CFR 50.109, does not apply to this proposed regulation and, therefore, a backfit analysis is not required for this proposed regulation because these amendments would not involve any provisions that would impose backfits as defined in 10 CFR 50.109(a)(1).

- The proposed changes to §50.34(f), by removing the explicit reference to TID-14844, would allow future applicants under Part 52 to use an alternative source term without the need for seeking exemptions, and would allow the small class of applicants for which a construction permit or manufacturing license was pending on February 16, 1982, to use an approved alternative to the TID-14844 source term in showing compliance with §50.34(f). With the exception of the Westinghouse AP-600 final design approval process, there are no pending Part 52 applications. (Westinghouse requested an exemption from the affected paragraphs in §50.34(f) to use the revised source term.)

- The proposed change to GDC-19, would require future applicants under Part 50 or Part 52 after January 10, 1997, to show compliance with the 0.05 Sv (5 rem) TEDE dose criterion. There are no applicants in this status at the present time.

#### 5. Impacts on NRC Staff, Other Programs, and Other Agencies

The proposed rule would not affect Federal, State, or local Government agencies, or Agreement State licensees, because the rule would only affect the licensing and operation of nuclear power plants that are regulated by the NRC under Part 50. Within the NRC, the cognizant office is Nuclear Reactor Regulation, which is sponsoring this proposed rule. No other NRC office is affected by this proposed rule.

### **V. DECISION RATIONALE**

#### **A. Use of Alternative Source Terms at Operating Reactors**

The decision to create a new section in Part 50, i.e., §50.67, and to include the following provisions: the need for a license amendment, the accident dose criteria in §50.34(a)(1)(ii), and the 0.05 Sv (5 rem) TEDE dose criterion for the control room was based on the following rationale:

- a. The objective of providing a regulatory framework for the voluntary implementation of alternative source terms as a change to the design basis at currently licensed power reactors would enable potential cost-beneficial licensing actions and continue to maintain existing safety margins and defense in depth.
- b. The need for accident dose criteria and control room habitability dose criteria that are consistent with the characteristics of the revised source term and that reflect updated scientific information on radionuclide uptake and metabolism, and current radiation protection standards.
- c. The provision that an alternative source term be implemented in a facility's design basis by a license amendment, which addresses the NRC staff concern that the current language of §50.59 could be interpreted as allowing this change without prior approval. (The NRC is currently considering changes to §50.59. The approach taken in §50.67 is not inconsistent with the proposed language in §50.59.)
- d. The results of the NRC staff re-baselining study that did not identify any significant concerns related to implementation of the revised source term.
- e. The NRC philosophy of separating plant siting from plant design, as evidenced by the January 1997 Part 50 and Part 100 final rule.
- f. The need to maintain the existing licensing basis for the operating reactors that continue to use the TID-14844 source term.

## B. Conforming Changes for Part 52

The decision to address needed conforming changes to Part 50 and to include the 0.05 Sv (5 rem) TEDE dose criterion for the control room was based on the following rationale:

- a. The desire to eliminate the need for exemptions from compliance with the affected sections.
- b. The need for control room habitability dose criteria that are consistent with the characteristics of the revised source term and that reflect updated scientific information on radionuclide uptake and metabolism, and current radiation protection standards.

## VI. IMPLEMENTATION

In the interest of facilitating stakeholder participation in this rule and allowing interested licensees to proceed with the development of applications, the Commission decided to separate development of the proposed rule from the proposed draft guide and SRP section. This regulatory analysis addresses only the proposed rule. The following are the major milestones:

Proposed rule to the Commission	12/15/98
Final rule, draft guide, draft SRP section to the Commission	7/30/99
Final guide, SRP section to the Commission	1/24/00

Because this is a voluntary rule for operating reactors, there would be no effective date or required schedule for implementation on the part of licensees. No backfit would be involved.

The proposed rule language is provided in the *Federal Register* notice for which this regulatory analysis applies. The accident dose criteria and the control room dose criteria in the proposed rule are readily quantifiable and enforceable. These guidelines and criteria are performance based, i.e., the proposed rule does not prescribe how to meet the requirement.

## VII. REFERENCES

1. *Accident Source Terms for Light-Water Nuclear Power Plants*, NUREG-1465, February 1995
2. *Calculation of Distance Factors for Power and test Reactor Sites*, Technical Information Document (TID) 14844, March 1962
3. *Results of the Revised (NUREG-1465) Source Term Re-Baselining for Operating Reactors*, SECY-98-154, June 1998

4. *Amendments to 10 CFR Parts 50, 52, and 100, and Issuance of New Appendix S to Part 50*, SECY-96-118, May 1996
5. *Use of the NUREG-1465 Source Term at Operating Reactors*, SECY-96-242, November 1996

# **Attachment 3**

**Draft**

**Environmental Assessment**

**DRAFT**  
**ENVIRONMENTAL ASSESSMENT**  
**REVISION OF 10 CFR PARTS 21, 50, AND 54**

The Nuclear Regulatory Commission (NRC) is proposing to amend its regulations to allow the holders of operating licenses at currently operating reactors to voluntarily amend their design bases to replace the current accident source term with a revised source term from NUREG-1465, *Accident Source Terms for Light-Water Nuclear Power Plants*.

**Identification of Action**

The NRC is proposing to amend 10 CFR Part 50 by adding a new section, §50.67, to address the use of alternative accident source terms. Section 50.67 would apply to all holders of operating licenses issued before January 10, 1997, that seek to amend their facility design basis to replace the current accident source term with an alternative source term on or after the publication date of the final regulation. These licensees would be required by §50.67 to evaluate the radiological consequences of the design basis accidents previously analyzed in the safety analysis report, and to request a license amendment under §50.90. Acceptance criteria for the accident radiological consequence analyses appear in §50.67. These criteria are accident dose guidelines for evaluation of releases of radioactivity to the environment and the resulting exposures to persons offsite, and dose criteria for plant personnel occupying the control room during postulated accidents.

The proposed rule amends a current regulation by establishing alternate requirements that licensees may voluntarily adopt. The NRC concluded that the existing analytical approach based on the current source term continues to be adequate to protect public health and safety; therefore, the NRC does not intend to backfit the alternative source terms or the changes in accident dose guidelines and control room habitability criteria on operating power reactors. Because the proposed revision to the regulation would not constitute a backfit, the bases for existing nuclear power plants must be preserved. For this reason, the current accident dose guidelines in §100.11 and the current control room habitability criteria of Appendix A to 10 CFR Part 50 would remain in effect for those licensees that do not apply for the use of an alternate source term.



The NRC is also proposing to amend 10 CFR Part 50 by revising 10 CFR Part 50, Appendix A, GDC-19 to use a dose criterion based on total effective dose equivalent. The revised criterion, which would be an alternative to the current dose criterion in GDC-19, is applicable only to applicants for construction permits under this part, or applicants for a design certification or combined license under 10 CFR Part 52, that apply on or after January 10, 1997, or holders of operating licenses using an alternative source term.

## **Need for the Action**

### Use of Alternative Source Terms

Current operating light-water reactors were licensed, in part, on the basis of safety analyses that used fission product release assumptions presented in the Technical Information Document (TID) 14844, *Calculation of Distance Factors for Power and Test Reactor Sites* (1962). Although initially applied to the evaluation of proposed reactor sites, these fission product release assumptions, known collectively as the “source term,” have been used in several regulatory applications related to light-water reactors. This source term was a key input to many of the design analyses associated with currently operating reactors and is a significant component of the design basis for these facilities. During the period since the publication of TID-14844, significant advances have been made in understanding the timing, magnitude, physical form, and chemical form of fission product releases from severe nuclear power plant accidents. In 1995, the NRC published NUREG-1465, *Accident Source Terms for Light-Water Nuclear Power Plants*, which utilized these source term insights to produce revised estimates of the accident source term. These source terms are described in terms of radionuclide composition and magnitude, physical and chemical form, and timing of release. For design basis accident assessments, the NUREG-1465 source terms are comparable to the TID-14844 source term with regard to the magnitude of the noble gas and radioiodine release fractions. However, the revised source terms provide a more representative description of the radionuclide composition and release timing.

The objective of NUREG-1465 was to define revised accident source terms for regulatory application for future light water reactors. The NRC’s intent was to capture the major relevant insights available from severe accident research to provide, for regulatory purposes, a more realistic portrayal of the amount of the postulated accident source term. These source terms were derived from

examination of a set of severe accident sequences for light water reactors of current design. Because of general similarities in plant and core design parameters, these results are considered to be applicable to evolutionary and passive LWR designs. The NRC considered the applicability of the revised source terms to operating reactors and determined that the current analytical approach based on the TID-14844 source term would continue to be adequate to protect public health and safety and that operating reactors licensed under this approach would not be required to reanalyze design basis accidents using the revised source terms. The NRC also concluded that some licensees may wish to use alternative source terms in analyses to support operational flexibility and cost-beneficial licensing actions. These actions could reduce unnecessary regulatory burden.

In January 1997, the NRC amended its regulations in 10 CFR Parts 21, 50, 52, 54, and 100 (61 FR 65157). That regulatory action provided siting criteria for future sites and relocated source term and dose requirements for future plants into Part 50. Because these dose requirements tend to affect reactor design rather than siting, they are more appropriately located in Part 50. Because the revised criteria would not apply to operating reactors, the non-seismic and seismic reactor site criteria for operating reactors were retained as Subpart A and Appendix A to Part 100, respectively. The revised reactor site criteria were added as Subpart B in Part 100, and revised source term and dose requirements were relocated to §50.34. The existing source term and dose requirements of Subpart A of Part 100 would remain in place as the licensing bases for those operating reactors that do not elect to use an alternative source term. The NRC retained the requirements for the exclusion area and the low population zone, but revised the associated numerical dose guidelines to replace the two different doses for the whole body and the thyroid gland with a single, total effective dose equivalent (TEDE) value.

The dose guidelines for the whole body and thyroid, and for the immediate 2-hour exposure period, were largely predicated by the assumed source term being predominantly noble gases and radioiodines instantaneously released to the containment and the assumed “single critical organ” method of modeling the internal dose used at the time that Part 100 was originally published. However, the current dose guidelines, by focusing on doses to the thyroid and whole body, assume that the major contributor to doses would be radioiodine. Although this may be appropriate with the TID-14844 source term, it may not be true for a source term based on a more complete understanding of accident sequences and phenomenology. The postulated chemical and physical forms of radioiodine in the revised source terms are more amenable to mitigation and, as such, radioiodine may

not always be the predominant radionuclide in an accident release. The revised source terms include a larger number of radionuclides than did the TID-14844 source term as implemented in regulatory guidance. The whole body and thyroid dose guidelines ignore these contributors to dose. The TEDE, using a risk-consistent methodology, assesses the impact of all relevant nuclides upon all body organs. Although it is expected that, in many cases, the thyroid could still be the limiting organ and radioiodine the limiting radionuclide, this conclusion cannot be assured in all potential cases.

The revised source terms postulate that the core inventory is released in a sequence of phases over several hours, with the more significant release commencing at about 30 minutes from the start of the event. The assumption that the 2-hour exposure period starts immediately at the onset of the release is inconsistent with the phased release postulated in the revised source terms. A detailed rationale for the use of 0.25 Sv (25 rem) TEDE as an accident dose guideline and the use of the 2-hour exposure period resulting in the maximum dose for future light water reactors (LWRs) is provided at 61 FR 65157. The considerations that formed the basis for that rationale are also applicable to operating reactors that elect to use the revised source term. The NRC believes that it is technically appropriate and logical to extend the dose guidelines, established for future LWRs using the revised source term to operating reactors that elect to use the same revised source term.

The NRC determined that, for use with the revised source terms, accident dose guidelines and control room habitability should be expressed in terms of TEDE, and that the 2-hour exposure period should be based on the 2-hour period that yields the maximum dose. The proposed §50.67 incorporates these acceptance criteria.

#### Conforming Change to GDC-19

The proposed change to GDC-19 is not related to the use of alternative source terms at operating reactors but is included to address a deficiency identified in the regulatory framework for early site permits, standard design certifications, and combined licenses under Part 52. Sections 52.18, 52.48, and 52.81 establish that applications filed under Part 52 Subparts A, B, and C, respectively, would be reviewed according to the standards given in 10 CFR Parts 20, 50, 51, 55, 73, and 100 to the extent that those standards are technically relevant to the proposed design. Therefore, GDC-19 is pertinent to applications under Part 52. The recent Part 100 rulemaking (61 FR 65157) established accident TEDE guidelines (in §50.34) for applicants under Part 52, but did not establish a revised control room

dose criterion. Therefore, exemptions from the dose criterion in the current GDC-19 were necessary in the design certification process for the Westinghouse AP-600 advanced light water reactor in order to use the 0.05 Sv (5 rem) TEDE criterion deemed necessary for use with the revised source terms. The proposed change would eliminate the need for exemptions by future applicants under Part 52. The proposed change would also be applicable to future applications under Part 50 that are filed on or after January 10, 1997.

### **Environmental Impacts of the Action**

The implementation of an alternative source term at an operating power reactor would replace the traditional TID-14844 source term with a source term that would be based on the insights gained from extensive accident research activities. The actual accident sequence and progression are not changed; it is the regulatory assumptions regarding the accident that would be affected by substituting an alternative source term. Use of an alternative source term alone cannot increase the core damage frequency (CDF) or the large early release frequency (LERF) or actual offsite or onsite radiation doses. (Although *actual* doses would not increase, analysis results may show an increase in some *postulated* doses because additional radionuclides would be considered and dose modeling would be more comprehensive.) The source term is used in analyses performed to assess the adequacy of the plant design to contend with a design basis accident (DBA) in order to ensure adequate defense in depth and adequate safety margins. The alternative source term could be used to justify changes in the plant design that could have an impact on CDF or LERF or that could increase offsite or onsite doses. These potential changes are subject to existing requirements in the NRC's regulations. Thus, the level of protection of public health and safety provided by the NRC's regulations would not be decreased by this proposed rulemaking.

The Commission directed the NRC staff to assess the impacts of implementing the revised source term at operating reactors. The results of this study were presented to the Commission in SECY-98-154, *Results of the Revised (NUREG-1465) Source Term Re-Baselining for Operating Reactors*. The major areas examined included the effect on individual offsite and control room dose, the effect on doses used in equipment environmental qualification, and the effect of potential modifications that might be enabled by the revised source term. The study also assessed the margin afforded by the revised source term in comparison to assessments performed using the integrated severe accident assessment code, MELCOR. The study indicated that the impact of implementing the revised source

term at operating reactors would produce lower postulated doses in the majority of cases. The NRC intends to address the exceptions in the regulatory guidance that will be developed to support the proposed rule and in the processing of the individual license amendments. The best estimate MELCOR analyses indicated that the design basis dose calculations using the revised source terms still have a substantial margin (a factor of two or greater). The study also indicated that many of the plant systems that are likely to be considered for modification are not involved in risk significant sequences and are, therefore, not likely to have a substantial offsite risk impact using a measure such as LERF.

There is an expectation that many of the alternative source term applications may provide concomitant improvements in overall safety and in reduced occupational exposure, as well as economic benefits. In light of the wide range of possible applications and the voluntary nature of this proposed rule, it is not reasonable to quantify possible outcomes. Occupational exposures may be reduced through reductions in maintenance efforts associated with maintaining unnecessarily limiting leakage, timing, or filtration requirements. Overall safety may be improved through (1) reduced emergency diesel generator loading, (2) improved containment ventilation system performance due to removal of filter media, and (3) closer synchronization of accident mitigation feature actuation with the onset of major fission product release. There may be improvements in safety margins realized due to the upgrading of analysis assumptions, methods, and acceptance criteria.

The radiological consequences of DBAs would not be increased by the use of the revised source term. The proposed dose guidelines are comparable, in level of protection, to the existing guidelines. The proposed rule would not affect non-radiological plant effluents and would have no other environmental impact. Therefore, the NRC concludes that there would be no significant non-radiological environmental impacts associated with the amendments to the regulations.

### **Alternatives to the Action**

As required by Section 102(2)(E) of National Environmental Policy Act (NEPA) (42 U.S.C.A. 4332(2)(E)), the NRC staff has considered possible alternatives to the proposed action. Most of the alternatives considered were related to administrative details such as location of the proposed rule and the means of providing regulatory guidance. These alternatives are neutral with regard to environmental impact and will not be considered further. With regard to environmental impacts, the

alternatives can be reduced to (1) retain the existing accident source term, i.e., the no-action alternative, and (2) allow the use of the revised source term.

The first alternative considered by the NRC was to retain the existing accident source term, i.e., the no-action alternative. This was not considered to be an acceptable alternative, because it would preclude the use of an alternative source term by operating reactors and the potential reductions in regulatory burden. This rulemaking alternative would also preclude potential concomitant improvements in overall safety and in reduced occupational exposure. The environmental impact of a postulated DBA would be unchanged. The foreclosure of potential concomitant improvements could prevent some actions that could reduce the risk and/or consequences of accidents. Because it is not possible to predict the source term applications that may voluntarily be proposed by license with any degree of certainty, this aspect is not evaluated further.

The second alternative considered by the NRC was to allow the voluntary use of the revised source term at operating plants, including the use of dose guidelines and dose criteria consistent with the characteristics of the revised source term. This alternative would establish the requirements for use of an alternative source term in a new section to Part 50 while retaining the existing regulations in 10 CFR Part 100 Subpart A and GDC-19. The proposed approach was chosen as the best rulemaking alternative. It is believed that the proposed rule would result in an improvement in the allocation of resources both for the NRC and for industry. The industry would be allowed to propose applications of an alternative source term that could reduce unnecessary or ineffective requirements in the facility design basis. The NRC and the industry stand to gain from having appropriate regulatory requirements and guidance needed to facilitate preparation and NRC staff review of licensee submittals. Limited resources could be diverted to safety issues of greater significance. The environmental impacts of the proposed use of the revised source term were addressed earlier in this assessment and it was concluded that there would be no significant environmental impact. Given the conclusion of no significant impact and the economic benefits that could be achieved, this alternative is clearly superior to the no-action alternative.

### **Alternative Use of Resources**

No alternative use of resources was considered. The proposed rule would apply only to existing operating reactors and the use of an alternative source term for analysis purposes has no impact on

the use of resources. Although this rule also makes conforming changes related to future plant licensing, the environmental impact of the future plant licensing would, by regulation, be assessed as part of the plant licensing.

### **Agencies and Persons Consulted**

The NRC staff developed the proposed rule and this environmental assessment. No outside agencies or consultants were used in developing this assessment. The NRC staff obtained advice from the NRC Advisory Committee on Reactor Safeguards.

### **Conclusion**

The proposed amendments to 10 CFR Parts 21, 50, and 54 to allow the holders of operating licenses at currently operating reactors to voluntarily amend their design bases to replace the current accident source term with an alternative source term, would not have a significant effect on the quality of the human environment.

This conclusion is based on the following:

1. The foregoing environmental assessment.
2. The proposed accident revised source term and the proposed accident dose guidelines were incorporated into the NRC's regulations in Parts 50 and 100 for future plant licensing by a final rulemaking on January 10, 1997. The environmental assessment for that final rule made a finding of no significant impact. Because the proposed rule would be a logical extension of these provisions to operating reactors, a similar finding is appropriate.
3. The revised source term reflects the significant advances that have been made in understanding the timing, magnitude, and chemical form of fission product releases from severe nuclear power plant accidents. This alternative source term provides more physically based estimates of the accident source term. The NRC sponsored significant review efforts by peer reviewers, foreign research partners, industry groups, and the general public (57 FR

33374).

## References

1. *Accident Source Terms for Light-Water Nuclear Power Plants*, NUREG-1465, February 1995
2. *Calculation of Distance Factors for Power and Test Reactor Sites*, Technical Information Document (TID) 14844, March 1962
3. *Results of the Revised (NUREG-1465) Source Term Re-Baselining for Operating Reactors*, SECY-98-154, June 1998
4. *Amendments to 10 CFR Parts 50, 52, and 100, and Issuance of New Appendix S to Part 50*, SECY-96-118, May 1996



# **Attachment 4**

**Draft**

**Congressional Letters**

The Honorable Dan Schaefer, Chairman  
Subcommittee on Energy and Power  
Committee on Commerce  
United States House of Representatives  
Washington, DC 20515

Dear Mr. Chairman:

Enclosed for the information of the Subcommittee are copies of a public announcement and a proposed amendment to 10 CFR Parts 21, 50, and 54. The proposed rule would allow holders of operating licenses at currently operating reactors to voluntarily amend their design bases to replace the current accident source term with the revised source term in NUREG-1465, *Accident Source Terms for Light-Water Nuclear Power Plants*. The NRC is also proposing some changes to various sections of its regulations to conform with revisions implemented earlier.

Since the publication of the current accident source term in 1962, significant advances have been made in understanding the timing, magnitude, and chemical form of fission product releases from severe nuclear power plant accidents. Many of these insights developed out of the major research effort started by the NRC and the industry after the accident at Three Mile Island (TMI). The proposed rule would enable currently licensed power reactors to propose applications of the revised source term that could reduce unnecessary or ineffective requirements in the facility design basis, thereby reducing the regulatory burden. It is believed that the proposed rulemaking would also result in an improvement in the allocation of resources both for the NRC and for industry. Also, there is an expectation that many of the revised source term applications may provide concomitant improvements in overall safety and in reduced occupational exposure, as well as economic benefits.

The NRC staff has determined that the public health and safety and the common defense and security would continue to be adequately protected if the proposed rule is implemented.

Sincerely,

Dennis K. Rathbun, Director  
Office of Congressional Affairs

Enclosure: Public Announcement  
Federal Register Notice

cc: Representative Ralph Hall

The Honorable James N. Inhofe, Chairman  
Subcommittee on Clean Air, Wetlands, Private  
Property and Nuclear Safety  
Committee on Environment and Public Works  
United States Senate  
Washington, DC 20510

Dear Mr. Chairman:

Enclosed for the information of the Subcommittee are copies of a Public Announcement and a proposed amendment to 10 CFR Parts 21, 50, and 54. The proposed rule would allow holders of operating licenses at currently operating reactors to voluntarily amend their design bases to replace the current accident source term with the revised source term in NUREG-1465, *Accident Source Terms for Light-Water Nuclear Power Plants*. The NRC is also proposing some changes to various sections of its regulations to conform with revisions implemented earlier.

Since the publication of the current accident source term in 1962, significant advances have been made in understanding the timing, magnitude, and chemical form of fission product releases from severe nuclear power plant accidents. Many of these insights developed out of the major research effort started by the NRC and the industry after the accident at Three Mile Island (TMI). The proposed rule would enable currently licensed power reactors to propose applications of the revised source term that could reduce unnecessary or ineffective requirements in the facility design basis, thereby reducing the regulatory burden. It is believed that the proposed rulemaking would also result in an improvement in the allocation of resources both for the NRC and for industry. Also, there is an expectation that many of the revised source term applications may provide concomitant improvements in overall safety and in reduced occupational exposure, as well as economic benefits.

The NRC staff has determined that the public health and safety and the common defense and security would continue to be adequately protected if the proposed rule is implemented.

Sincerely,

Dennis K. Rathbun, Director  
Office of Congressional Affairs

Enclosure: Public Announcement  
Federal Register Notice

cc: Senator Bob Graham



# **Attachment 5**

**Draft**

**Public Announcement**

D R A F T

(MEMO ON PROPOSED SECY PAPER)

PROPOSED NRC RULE WOULD PERMIT NUCLEAR POWER PLANTS TO CHANGE  
ACCIDENT ANALYSES OF PUBLIC RADIATION DOSE

The Nuclear Regulatory Commission has proposed amendments to its regulations that would permit nuclear power plant licensees to take advantage of updated research findings on estimated public radiation doses from reactor accidents.

The revised rule would permit them to use what is known as a revised "source term" for the accident analysis on which plant design and operations are based. NRC believes this change could reduce an unnecessary burden on many licensees without compromising public health and safety.



"Source term" is the technical name for the calculation of the speed, magnitude and chemical form in which the radioactive material produced by the atom splitting process in a nuclear reactor would be released from the reactor to the containment if an accident occurred. Nuclear power plants use the source term for analyzing possible accident consequences -- including potential radiation dose to the public from leakage out of the containment into the environment -- and factor that analysis into plant design and operation.

All currently operating nuclear power plants were licensed on the basis of a source term published in 1962 by the Atomic Energy Commission, NRC's predecessor agency. That procedure assumed an immediate release of radioactive materials to the containment during a severe accident, including a substantial amount of radioactive iodine which could cause thyroid cancer. But the experience of the Three Mile Island accident in 1979, in addition to research which followed it, suggests that a release into the containment would not be immediate, but a phased release. Revised source terms published by NRC in 1995 reflected this experience and research.

The proposed rule, which is being issued for public comment, would permit utilities with nuclear power plant operating licenses to replace the 1962-era source term in their licenses with a revised one. It is expected that such a change could cut down on occupational radiation exposures in such activities as the installation of charcoal

filters, maintenance of certain containment isolation valves, and repairs to systems to maintain leak-rate limits which are overly restrictive in the light of the recent research. Cutting back on such unnecessary work also could lead to cost savings. Licensees who wanted to continue with their present source term could do so. The NRC staff's recent approval of the Westinghouse AP 600 advanced reactor design was based in part on the revised source term.

Comments are due 75 days after publication of the proposed rule in a forthcoming edition of the Federal Register. The rule and associated documents also are available for public inspection and copying for a fee at the NRC Public Document Room, 2120 L Street N.W., Washington, DC. The telephone numbers are 202/634-3273 and 800/397-4209.

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