POLICY ISSUE
(Notation Vote)

December 18, 2008 SECY-08-0197

FOR: The Commissioners

FROM: R. W. Borchardt
Executive Director for Operations

SUBJECT: OPTIONS TO REVISE RADIATION PROTECTION REGULATIONS AND GUIDANCE WITH RESPECT TO THE 2007 RECOMMENDATIONS OF THE INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

PURPOSE:

The purpose of this paper is to request Commission approval of the staff's recommended option regarding the revision of the U.S. Nuclear Regulatory Commission (NRC) regulations and guidance for radiation protection to address the Recommendations of the International Commission on Radiological Protection (ICRP) in ICRP Publication 103.

SUMMARY:

This paper provides the background and an evaluation of the 2007 recommendations contained in ICRP Publication 103, as they relate to possible implications for the NRC's regulations and guidance for radiation protection. The staff has developed regulatory options of moving, or not moving, towards greater alignment of the NRC regulatory framework with ICRP Publication 103. The staff recommends that the Commission approve the staff taking the next steps towards achieving a greater degree of alignment of NRC's regulations with the recommendations contained in ICRP Publication 103. The staff proposes to immediately begin engagement with stakeholders and interested parties, and initiate development of the technical basis and regulatory analysis information during FY 2009, FY 2010 and FY 2011 for possible revision of 10 CFR Part 20, and 10 CFR Part 50 and Part 50 Appendix I. Because certain materials necessary to finalize the technical basis will not be available until 2011 or later, the staff will provide specific recommendations for initiation of rulemaking once the technical basis has been developed after 2011.

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The Commissioners

The staff recommends that the technical issues identified in this paper will be the starting point for a dialogue with stakeholders and interested parties in order to better understand the impacts of moving towards greater alignment with ICRP Publication 103. Pursuing these discussions before the initiation of rulemaking will facilitate preparation of a more complete catalog of issues, options, and the technical materials needed for a proposed rule. The staff will provide the Commission with the results of the stakeholder and interested party interactions, the recommended scope of rulemaking, and the resources needed at the time it provides specific recommendations for rulemaking.

BACKGROUND:

On April 12, 2002, in a staff requirements memo (SRM) for SECY-01-0148, "Processes for Revision of 10 CFR Part 20 Regarding Adoption of ICRP Recommendations on Occupational Dose Limits and Dosimetric Models and Parameters," the Commission approved the staff's recommendation to not initiate consideration of changes to 10 CFR Part 20 until the ICRP had completed its update of the ICRP recommendations. However, the Commission disapproved the staff's proposal to develop a communications plan and a technical information base that would eventually be necessary for any contemplated rulemaking. ICRP Publication 103 (December 2007) contains the revised recommendations that are the latest in the series published by the ICRP.

10 CFR Part 20 provides the fundamental radiological protection regulatory requirements for NRC licensees. Through the existing compatibility criteria, the Agreement States have certain requirements that are essentially identical to 10 CFR Part 20 for their licensees. The most recent rulemaking to incorporate the recommendations of the ICRP into 10 CFR Part 20 was completed in 1991, and was based primarily on the 1977 recommendations contained in ICRP Publication 26, and the public dose limit later reflected in the 1990 recommendations contained in ICRP Publication 60. Not all the recommendations contained in ICRP Publication 60 were incorporated into 10 CFR Part 20 in 1991 because those recommendations were not available during the public comment period for the proposed rule.

In 1991, some other portions of the regulatory framework (e.g. 10 CFR Parts 32, 50, 51, 61, and 72) were not considered or updated along with 10 CFR Part 20. Those portions not updated were primarily those in which explicit dose criteria were provided, rather than a cross-reference to 10 CFR Part 20. Consequently, the use of radiation protection concepts based on the 1958 recommendations contained in ICRP Publication 1, and the maximum permissible concentrations of radionuclides from ICRP Publication 2 (1959) are still required for some licensed activities. This is particularly the case for 10 CFR Part 50, Appendix I, dealing with effluents for operating power plants, current new reactor applications and early-site permits, and the next generation of nuclear plants. On the other hand, the NRC fuel cycle licensees requested and were authorized, on a case-by-case basis, to conduct licensed activities using the dose methodologies that have been revised by the ICRP since 1990. As a result there are three different generations of recommendations (ICRP Publications 1, 26, and 60), and corresponding methodologies for calculating radiation doses, that comprise various aspects of NRC's regulatory guidance and licensing programs that are in use today by various licensees. The staff notes that this situation is similar for other U.S. Federal agencies and the Agreement States where a similar spectrum of requirements exists.

On June 30, 2008, in SECY-08-0092, "Plans For Review of Radiation Protection Regulations In Light Of the New International Commission on Radiological Protection Recommendations," staff committed to provide the Commission with options in December 2008, for possible revision of the overall regulatory framework and to consider using the recommendations contained in ICRP Publication 103 to modify rulemaking proposals that are being developed.

DISCUSSION:

The radiation protection framework recommended by ICRP Publication 103 is, in most respects, similar to previous recommendations of the ICRP. The framework continues to be based on the fundamental principles of justification of exposures, optimization of protection, and limitation of dose. In particular, the numerical values of dose limits for occupational and public exposure are unchanged from the 1990 recommendations contained in ICRP Publication 60. Enclosure 1 provides a brief synopsis of the ICRP recommendations.

ICRP also assessed new scientific information, and provides new weighting factors for certain tissues and types of radiation and incremental improvements to reflect recent scientific understanding of the intake, distribution, retention, and elimination of radioactive material from the body. The staff recognizes that the ICRP is still in the process of preparing updated dose conversion factors by incorporating the new weighting factors for tissues and types of radiation, and the new metabolic models, and that the updated dose conversion factors will be available in subsequent ICRP publications. ICRP estimates that the computation of dose conversion factors for occupational workers, for the more commonly used radionuclides, will not be available until 2011. Dose conversion factors for members of the public may be available in 2012. A complete set of values, covering all radionuclides, may not be available before 2014. These dates impact the timing of any NRC revision to the radiation protection framework because the dose conversion factors are an essential underpinning for the Appendix B values in 10 CFR Part 20. Furthermore, the revised dose conversion factors are crucial to the completion of computer codes used for implementation of the regulations, including 10 CFR Part 50, Appendix I. As a practical matter, licensees, irrespective of the date of a rulemaking, will not be able to implement a revised rule until the new dose conversion factors are available, and they have been incorporated into procedures and software.

Other Federal agencies are also in the process of considering changes as a result of ICRP Publication 103. During the spring and fall 2008 meetings of the Interagency Steering Committee on Radiation Standards, the members shared preliminary views about the impact of ICRP Publication 103. The U.S. Environmental Protection Agency (EPA) indicated that it was examining the 2005 National Research Council report, Health Risks from Exposure to Low Levels of Ionizing Radiation, and ICRP Publication 103, with a view to updating the dose conversion factors presently contained in Federal Guidance Report No. 11, and then the cancer risk coefficients presented in Federal Guidance Report No. 13. The EPA does not use ICRP-derived dose conversion factors. Instead, EPA creates U.S. specific dose conversion factors based on U.S. census data which includes morbidity and mortality information related to cancer statistics for the U.S. population. EPA has not yet decided whether to update the Presidential Federal Guidance for Occupational Exposure, last issued in 1987. The U.S. Department of Energy indicated that it was continuing with previous plans to update certain portions of its regulations to align with ICRP Publication 60, and that it had not yet considered changes related to ICRP Publication 103.

Regulatory Options:

The staff has examined the current regulatory framework, and recognizes that a number of different areas are candidates for updating the regulations, the implementing guidance, and supporting technical codes and standards. The staff is presenting three principal options for revising the NRC radiation protection framework.

The first option is to make no changes to the existing regulatory framework. The second option is to update certain portions of the regulations, not previously revised, to conform to existing 10 CFR Part 20 concepts and quantities that are based on ICRP Publications 26 and 30. The third option is to begin the process of aligning, to a greater degree, the NRC's regulatory framework with the recommendations contained in ICRP Publication 103. Under this option, several factors come into play in developing approaches for proceeding, including: 1) the schedule upon which additional technical information will be available; 2) the need to revise certain regulations and address their implementation for licensing a new reactor; 3) the variety of other technical and policy issues that may be considered when various portions of the regulations are proposed for amendment; and 4) the availability of resources. These factors are described below in the discussion of regulatory and administrative options.

Option 1: No Action

The no action option will result in no changes being proposed to the existing radiation protection framework of 10 CFR Chapter 1. This option is based upon the fact that the current regulations provide adequate protection of public health and safety and are well understood by licensees, and that the impacts of changing the regulatory framework are not balanced by the benefits of updating scientific information and enhancing international consistency. That is to say that achieving better alignment of the framework with the recommendations contained in ICRP Publication 103 will not significantly improve public health and safety.

Under this option, no resources will be necessary for development of a technical basis for rulemaking, or for rulemaking activities. The staff will continue with previous plans to update Regulatory Guides as needed and appropriate.

The staff recognizes that there have already been challenges raised by industry and intervener organizations to NRC's existing regulatory framework during the initial processing of new reactor applications. This, coupled with the benefits of enhancing international consistency, leads the staff to conclude that making no changes to the existing radiation protection framework is not the preferred option.

The staff notes that the nuclear power industry has stated a strong preference that NRC should update the regulatory structure of 10 CFR Part 50, Appendix I. The staff also notes that questions and concerns have been raised to various NRC senior managers by international organizations and regulators who advocated adoption of the recommendations of either ICRP Publication 60 or ICRP Publication 103. In the increasing globalization of activities, and the desire to harmonize requirements, movement towards alignment with the ICRP recommendations is an important component of aligning the NRC with our international counterparts.

Option 2: Update 10 CFR Part 50 and Appendix I

This option will consider revisions to 10 CFR Part 50 and Appendix I to Part 50 to align with the existing concepts and quantities in the current 10 CFR Part 20. This option, like Option 1, assumes that modifications to 10 CFR Part 20 are not warranted. Furthermore, it assumes that there is a sufficient regulatory rationale and technical justification for updating portions of the NRC regulations that were not updated when 10 CFR Part 20 was revised in 1991, to achieve consistency in approach.

Such an approach will advance the NRC's goal of achieving internal consistency of its regulatory requirements, but will not improve international consistency, in that the NRC's regulatory framework will remain based on concepts and quantities of ICRP Publications 26 and 30. This option would relieve some of the burden currently experienced within the power reactor community, in that those licensees will no longer need to use methods of ICRP Publication 2 (1959) to demonstrate compliance with the NRC regulations.

Under this option, resources will be devoted to developing the technical basis, regulatory analysis, and rulemaking for 10 CFR Part 50 and Appendix I to Part 50. This option will defer consideration of aligning other portions of the regulations at this time, and focus upon the more urgent needs of the power reactor community for updated and consistent regulatory requirements for licensing a new reactor. Other portions of the regulations that were not previously revised can be considered for revision when those regulations are being amended for other purposes, but resources will not be devoted to those actions at this time. Resources will be needed to update Regulatory Guides and supporting scientific and implementation codes.

At this time, approximately 0.5 Full Time Equivalent (FTE) has been budgeted within the Office of Nuclear Reactor Regulation (NRR) in FY 2009 and that about 0.5 and 1.0 FTE will be needed within the Office of New Reactors (NRO) for FY 2009 and FY 2010, respectively. Resources for FY 2011 and beyond would be developed as part of the budget preparation process. Rulemaking will be initiated upon completion of the technical basis, and the timing of this effort will not need to be connected to the current work of the ICRP. The specific resources that will be needed to support this rulemaking and associated guidance cannot be specified until conclusions have been reached upon the extent of the revisions that might be made to 10 CFR Part 50 and Part 50 Appendix I.

The staff notes that this option, while improving the internal consistency of NRC requirements, will not move the NRC towards a greater degree of alignment using current scientific concepts and quantities of ICRP Publication 103. Likewise, it leaves unanswered the requests and concerns from industry and international counterparts. Thus, the staff has concluded that this is not the preferred option.

Option 3: Align the radiation protection regulatory framework with ICRP Publication 103

Option 3 will begin the process of moving towards a greater degree of alignment between the regulatory framework of 10 CFR Parts 20 and 50 and Appendix I to Part 50 with the recommendations contained in ICRP Publication 103. This option is premised on the assumption that there are regulatory and technical justifications sufficient to begin the work necessary to eventually revise NRC regulations and guidance in order to incorporate updated recommendations, concepts, and quantities. While the current regulatory framework continues

to provide adequate protection of public health and safety, the current framework is not fully consistent with the objectives of the NRC Strategic Plan, as described below.

As proposed by the staff, this option will also defer consideration of aligning other portions of the regulations at this time, and focus upon the more urgent needs of the power reactor community for updated and consistent regulatory requirements for licensing a new reactor. Those other portions of the regulations, which continue to rely on ICRP 2 methodology, include portions of 10 CFR Parts 32, 51, 61, and 72. In the staff's analysis, these portions of the regulations will, in addition to requiring additional resources, open other issues for discussion which will detract from the focus needed to complete consideration of 10 CFR Part 20 and 10 CFR Part 50 and Part 50 Appendix I.

A revision of the regulations and associated guidance will provide an opportunity for increasing consistency with the NRC Strategic Plan by introducing a more realistic (risk-informed and performance-based) and scientifically up-to-date approach in licensing and regulating licensed facilities. Based on the consideration of technical issues and options presented below, the staff believes there are likely to be benefits from updating scientific quantities and information, refining the regulatory structure so as to further emphasize the fundamental principle of optimization, adding increasing structure and tools to a licensee's radiation control program, and simplifying the regulatory burden for the NRC and licensees.

Under this option, rulemaking will not be initiated immediately because the information needed for an adequate technical basis for rulemaking, and a regulatory analysis of benefits and impacts, is not yet available. Given the Commission's direction in SRM-SECY-01-0148 to not proceed with development of a technical information base that will eventually be necessary for any contemplated rulemaking, information now needs to be developed for the significant issues and options identified by the staff. The staff believes that this is the appropriate time to undertake these activities, so that when the necessary dose conversion factors are available from ICRP, a rulemaking can be considered. Furthermore, potential impacts of the significant issues and options on various licensees have not been fully assessed. The staff's ability to formulate an appropriate proposed rulemaking will be greatly enhanced by open dialogue with stakeholders and interested parties to identify issues of concern, the options available to address those concerns, and the technical information needed to support preferred approaches. This dialogue is best initiated before specific decisions on the part of the NRC staff have been made.

This option will require only the expenditure of resources that will be necessary to initiate stakeholder and interested party interactions to develop, identify, and elaborate on regulatory issues and options, and to initiate development of the technical basis needed for rulemaking and a regulatory impact assessment. Limited resources are currently included in the budgets for FY 2009 and FY 2010 which can be made available, through the planning, budgeting, and performance management (PBPM) process for stakeholder and interested party interactions and technical basis development.

Specifically, approximately 1 FTE in FY 2009 and 1 FTE in FY 2010 can be made available within the Office of Federal and State Materials and Environmental Management Programs (FSME), 0.5 FTE is available for NRO in FY 2009, and 1 FTE will be identified by NRO through the PBPM process for FY 2010. The Office of Nuclear Regulatory Research (RES) has budgeted $100K and 0.2 FTE for FY 2009 and $300K and 1.2 FTE for FY 2010, respectively, to

support rulemaking activities. Approximately 0.5 FTE has been budgeted within NRR in FY 2009.

The staff recommends that the Commission approve Option 3, and direct the staff to begin the process necessary to develop the basis for a rulemaking that will move towards aligning and updating 10 CFR Part 20 using the recommendations and scientific quantities and concepts described in ICRP Publication 103. The staff will provide the Commission with a recommendation to initiate rulemaking once the technical basis has been developed. The staff will, at that time, also provide the Commission with the results of the stakeholder and interested party interactions, the recommended scope of rulemaking, backfit and implementation issues, and the resources necessary. The actual date for a recommendation on rulemaking will be dependent on the availability of the appropriate technical basis for the proposals being made. In interactions with stakeholders and interested parties, the staff will explore the implications and issues associated with initiation of a rulemaking before the complete technical basis for all numeric values in Appendix B to 10 CFR Part 20 become available.

The staff further recommends that the Commission approve a parallel technical basis development that will support a rulemaking for selected changes to 10 CFR Part 50 and Appendix I to Part 50 to bring both into a greater degree of alignment with current international recommendations for radiation protection as contained in ICRP Publication 103. Work can be initiated more quickly on a rulemaking that will revise 10 CFR Part 50 and Appendix I to Part 50 because some issues are not dependent on ICRP dose conversion factors. The development work, described in the technical options below, can proceed in coordination with the work effort in revising 10 CFR Part 20, but the completion of a technical basis supporting a revision of Appendix I to Part 50 and promulgation of a revised Appendix I to Part 50 will be coordinated with that of 10 CFR Part 20 to ensure consistency between the two sets of regulatory requirements.

The staff believes outreach will be an important key to successful development and implementation of the rulemakings and that the approval of Option 3 will give the staff an opportunity to engage in extensive stakeholder and interested party outreach. The staff will solicit stakeholder and interested party identification of potential conflicts and attempt to gain an understanding of any unintended consequences related to the drafting and implementation of the rulemakings. Such discussions will include 10 CFR Part 50 and Appendix I to Part 50 issues when engaging stakeholders and interested parties of the nuclear power reactor industry.

The staff envisions that initial outreach efforts will consist of meetings, workshops, and forums which will take place during FY 2009, and will be followed by additional meetings in FY 2010 to further elaborate and validate issues, options, and impacts. The staff will convene facilitated discussions, and will attempt to leverage existing meeting opportunities to the extent practical, such as meetings of various professional societies and industry organizations. The issues provided in the technical options below, and the enclosures to this paper will be used to facilitate these discussions.

The staff considered the use of an Advance Notice of Proposed Rulemaking (ANPR), but believes that the information in the enclosures is sufficient for initial stakeholder and interested party dialogue, and that the time needed to prepare an ANPR could delay the start of the initial discussions.

The key stakeholders and interested parties have been identified as including the general public, NRC licensees, other Federal agencies, State and local governments, Indian Tribes, industry organizations, industry workers, technical societies, and citizen groups. These interactions will need to include all of the various licensees, including power reactors, test and research reactors, fuel cycle facilities, and the various byproduct materials activities, as well as extensive discussions with Agreement States. The staff is already aware of several opportunities in early calendar year 2009 where initial discussions could be held with stakeholders and interested parties. Interactions with the international community will also be appropriate to understand the direction, scope, and timing of the ongoing revisions of international standards. Further, staff will work with other Federal agencies to encourage consideration of updates to their regulations to facilitate a consistent approach.

Technical Options: 10 CFR Part 20

The staff believes that many of the provisions in 10 CFR Part 20 do not warrant changes and updates, because the majority of ICRP Publication 103 is similar to ICRP Publication 26 on which the greater part of 10 CFR Part 20 is based. However, the staff has identified a number of technical areas in which modifications should be considered to increase alignment of the regulatory structure with international recommendations, increase the focus of radiation protection upon optimizing radiation exposures, add structure to licensee radiation protection programs to assist in identifying and reducing exposures that approach regulatory limits, and allow for a more risk-informed regulatory framework. Enclosure 2 provides a brief summary of several key issues that have been identified, and the principal options that might be considered.

Technical Options: 10 CFR Part 50

In 1975, the NRC adopted the “As Low as Reasonably Achievable” principle in regulating radioactive gaseous and liquid effluents from nuclear power plants. The requirements and numerical guidance are contained in Part 50 and Appendix I, respectively, but the design objectives are not radiation protection standards under 10 CFR Part 50.34a. Over the past decade, there have been discussions with stakeholders and interested parties about updating the basis of Appendix I dose objectives and its supporting guidance documents to be consistent with the dose methodology used in 10 CFR Part 20. For example, issues have been raised in light of new reactor applications. Enclosures 3 and 4 provide details of the staff’s evaluation of these issues.

IMPLEMENTATION:

There are several factors, including the milestones for development of dose conversion factors, updates, revisions of certain key regulatory guides and computer codes, and the schedules for licensing and construction and initial operation of new power reactor facilities, that suggest that a target for completion of activities may be 2015 – 2016 for both 10 CFR Parts 20 and 50. The staff notes that if initiation of rulemaking is delayed until the final publication of all dose conversion factors, the implementation by licensees may not occur until 2020 or later. The staff’s preferred approach described in Option 3 above will support such an ultimate time frame for implementation.

COMMITMENT:

The staff proposes to immediately begin engagement with stakeholders and interested parties, and initiate development of the technical basis and regulatory analysis information during FY 2009, FY 2010 and FY 2011 for possible revision of 10 CFR Part 20, and 10 CFR Part 50 and Part 50 Appendix I. Because certain materials necessary to finalize the technical basis may not be available until 2011 or later, and because of the limited resources budgeted for FY 2009 and FY 2010, the staff will provide specific recommendations for initiation of rulemaking in another Commission paper once the technical basis has been developed after FY 2011.

RECOMMENDATIONS:

The staff recommends that the Commission approve the staff's recommended Option 3. The staff will initiate development of a technical basis and engage in stakeholder and interested party outreach to identify issues, options, and impact information. The staff will provide specific recommendations for initiation of rulemaking once the technical basis has been developed. The staff will also provide the Commission with the results of the stakeholder and interested party interactions, the recommended scope of rulemaking, backfit and implementation issues, and the resources necessary. The actual date for a recommendation on rulemaking will be dependent on the availability of the appropriate technical basis for the proposals being made.

The staff recommends that this paper, and the enclosures, be made publically available to facilitate discussions with stakeholders and interested parties. The staff believes these activities are a high priority, given the significant amount of work necessary to develop a technical basis. This upfront work will position the NRC to initiate rulemaking when the ICRP completes development of the dose conversion factors.

RESOURCES:

Limited resources are currently included in the budgets for FY 2009 and FY 2010 which can be made available, through the PBPM process for stakeholder and interested party interactions and technical basis development. Specifically, approximately 1 FTE in FY 2009 and 1 FTE in FY 2010 can be made available within FSME, 0.5 FTE is available for NRO in FY 2009, and 1 FTE will be identified by NRO through the PBPM process for FY 2010. RES has budgeted $100K and 0.2 FTE for FY 2009 and $300K and 1.2 FTE for FY 2010 to support rulemaking activities. Approximately 0.5 FTE has been budgeted within NRR in FY 2009.

The staff will prepare proposals for budget assumptions, and resources, as part of the FY 2011 budget submittal. The staff recognizes that a large resource effort over a number of years will be necessary to completely align all of the regulations, guidance, and supporting calculation codes and materials, and that such an estimate cannot accurately be provided until a greater understanding of the specific issues and regulatory provisions is understood as part of the proposed stakeholder and interested party interactions. This information will be provided at the time the staff provides its recommendations for rulemaking.

COORDINATION:

The Office of Chief Financial Officer has reviewed this Commission Paper for resource implications and has no objections. The Office of the General Counsel has reviewed this

Commission Paper and its enclosures and has no legal objection. Informational briefings were held with the Advisory Committee on the Medical Use of Isotopes and with the Advisory Committee on Reactor Safeguards.

/RA Martin Virgilio for/

R. W. Borchardt
Executive Director
for Operations

Enclosures:
1. Synopsis of ICRP Publication 103
2. Details of Technical Options and Issues for Revision of 10 CFR Part 20
3. Details of Technical Options for Revision of 10 CFR Part 50 and Appendix I Regulations and Regulatory Guidance for Light Water-Cooled Nuclear Power Reactors
4. Listing of NRC Guidance Documents Potentially Subject for Update in Support of the Revision of 10 CFR Part 50 and Appendix I Regulations for Light Water-Cooled Nuclear Power Reactors

Synopsis of ICRP Publication 103

The radiation protection framework recommended by the International Commission on Radiological Protection (ICRP) Publication 103 is, in most respects, similar to previous recommendations of the ICRP. The framework continues to be based on the fundamental principles of justification of exposures, optimization of protection, and limitation of dose. In particular, the numerical values of dose limits for occupational and public exposure are unchanged from the 1990 recommendations contained in ICRP Publication 60.

ICRP Publication 103 consolidated the material from ICRP Publication 60 and the subsequent publications into a more consistent and coherent approach to radiation protection in all controllable exposure situations. Previous recommendations distinguished between "practices" where exposures were being introduced, and "interventions," where actions were being taken to reduce an exposure. The 2007 recommendations eliminated these distinctions, and organized the radiation protection framework based on types of exposure situations. Three types of situations were identified: Planned Exposure Situations, typically licensed activities where planning and controls are in place before the exposure is permitted; Emergency Exposure Situations, such as accidents, where there is a need to take immediate actions to reduce exposures; and Existing Exposure Situations, such as radon in homes or decommissioning sites and other situations where the conditions causing exposure are recognized as already present and remedial actions may be necessary to reduce exposures. In doing so, ICRP has placed an increased emphasis on the optimization of protection for all three types of exposure situations and the use of "constraints" as a planning tool for optimization of planned exposure situations and "reference levels" as a planning tool for optimization in emergency exposure situations and existing exposure situations.

The ICRP continues to recommend the use of the linear no threshold (LNT) hypothesis for the development of prospective radiation control programs. The LNT hypothesis assumes that for each incremental increase in radiation dose there is an incremental increase in the probability of cancer even for low doses and low dose rates which are common for occupational doses and for doses to members of the public.

The radiation risk models and assessments that support the recommendations contained in ICRP Publication 103 generally are consistent with the main conclusions of the 2005 National Research Council report, "Health Risks from Exposure to Low Levels of Ionizing Radiation." The ICRP currently recommends a rounded fatal cancer risk value of 5×10^{-4} per rem (5×10^{-2} per Sv). This value takes into account uncertainties in estimates of probability of fatal cancer used in radiation protection and assumes several factors derived from scientific and epidemiological studies for lifespan of the population, quality of the radiation, total-body exposure, and linear response at low doses. Thus, there has been no significant change in risk estimates for radiation exposure from those contained previously in ICRP Publication 60. However, it should be noted that the current risk estimates are greater than the value of 1.25×10^{-4} per rem (1.25×10^{-2} per Sv) that is currently the basis for 10 CFR Part 20.

Details of Technical Options and Issues
for Revision of 10 CFR Part 20

This enclosure outlines several staff-identified technical issues that are potential areas for revision of 10 CFR Part 20 to facilitate a greater degree of alignment with the recommendations in International Commission on Radiological Protection (ICRP) Publication 103. The staff proposes to use the outlined technical issues as a starting point during stakeholder and interested party dialogue in order to understand the impacts of greater alignment. It is expected that stakeholders and interested parties will identify other issues, in addition to those initially presented by the staff, during the dialogue. Pursuing these discussions before the initiation of rulemaking will facilitate preparation of a more complete catalog of issues, options, and the technical materials needed.

A. "Total Effective Dose Equivalent" (TEDE) versus "Total Effective Dose" (TED)

Recently, the Commission amended the definitions in 10 CFR 20.1003 and 50.2 (72 FR 68058, December 4, 2007) to clarify the definition of TEDE to mean the sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures). The revised definition of TEDE allows a licensee to substitute "effective dose equivalent" for "deep dose equivalent" for external exposures. A conforming change was made to 10 CFR 20.1201(c) to clarify the determination of occupational radiation dose for adults. This action was made effective on February 15, 2008 (72 FR 72233, December 20, 2007). The rule change is consistent with the current recommendations of the ICRP. Implementation of effective dose, for external exposures, may have a significant impact for some licensee communities, such as medical exposures. While licensees are becoming more aware of the change, the U.S. Nuclear Regulatory Commission (NRC) has not yet assessed the implications for licensee compliance with the dose limits.

Another issue that the staff believes that the Commission should consider is whether it is appropriate to adopt current ICRP terminology and methodology throughout 10 CFR Part 20, and other portions of the regulations, by using the term TED instead of the term TEDE. ICRP publications no longer use the term effective dose equivalent, or committed effective dose equivalent. Further, ICRP now refers to the effective dose without designating whether the value is external or internal as the terms in the calculation will indicate if the radiation source is outside the body or inside the body. The 2007 recommendations in ICRP Publication 103 use a complex phrase to indicate the sum of the calculations. However, other ICRP publications use the terminology of total effective dose, TED. 10 CFR Part 20 could simply indicate the sum as the TED.

One argument for changing the term TEDE is that it is no longer consistent with various current industry consensus standards, or international standards. A second reason may be to alert various licensee communities that the Commission has changed its requirements for calculation of external exposure.

The staff recognizes that the change in terminology could be seen as editorial, and is aware that if the Commission chooses to make the change from TEDE to TED that there is a possibility of an impact upon licensees, particularly in the areas of updating procedures and other documentation to replace TEDE with TED. In order to minimize the impact of the change, the regulations could be written to allow for a licensee to gradually change the terminology as the licensee's procedures are updated over a reasonable period of time.

The staff notes that the U.S. Department of Energy has already moved to use of effective dose in its regulations in 10 CFR Part 835, "Occupational Radiation Protection" (72 FR 31904, July 8, 2007). If the Commission decides to update the terminology and methodology to TED, conforming changes would be made to the remaining parts in 10 CFR Chapter I where TEDE is currently used. In addition, the new term TED would be important for revisions of 10 CFR Part 50 and Part 50 Appendix I. With this change, the terminology in the NRC's regulatory framework would be made more consistent.

The staff believes that there is sufficient reason to move to use of the term TED when engaging with stakeholders and interested parties as a way to further evaluate the implications and impacts of replacing TEDE with TED.

B. Dose Limits

1. Public Exposure Dose Limits

The current NRC requirements for dose limits for members of the public align with the recommendations in ICRP Publications 60 (1990) and 103 (2007). This includes a provision for doses greater than 100 mrem (1 mSv) for certain situations. Although ICRP Publication 103 recommended that the dose for exposure to radiation for a child be limited to 100 mrem (1 mSv) in all cases, the staff believes that the regulations should continue to provide flexibility for a licensee in certain cases in which there may be a benefit to a member of the public, for example, when a family member is exposed to a patient who received radionuclide therapy. The staff has not identified changes to the public exposure dose limits as an issue, but recognizes that stakeholders and interested parties may wish to make this a point of discussion.

2. Dose Limit To An Embryo/Fetus Of A Declared Pregnant Woman

The declared pregnant woman's occupational dose and the dose to an embryo/fetus are specified in 10 CFR 20.1208. The current requirements are based on the recommendations available in ICRP Publication 26 for such exposures. The ICRP recommendations now contain a provision that the dose limit should be the same as the public dose limit, which is 100 mrem (1 mSv). Thus, there is an issue of whether NRC's requirements should be revised.

The first option is to maintain the current dose limit. Currently, 10 CFR 20.1208 specifies the dose limit to the embryo/fetus of a declared pregnant worker is 0.5 rem (5 mSv) for the gestation period with 0.05 rem (0.5 mSv) additional dose during gestation period if the dose to the embryo/fetus has already exceeded 0.5 rem (5 mSv) at the time of declaration. Arguments for maintaining the limits "as is" are that the rule as written is well established and understood, the risk difference between 0.5 rem (5 mSv) and an additional 100 mrem (1 mSv) after the declaration of pregnancy might not be considered significant by some stakeholders, and the current rule is consistent with the latest National Council on Radiation Protection recommendation (Report No. 116, 1993). The current rule requires a licensee to make a retrospective assessment of the dose to the embryo/fetus when the pregnancy is declared.

The second option is to change the requirements, and establish the value as 100 mrem (1 mSv) applicable from the declaration of pregnancy for the remainder of the gestation period. There are compelling arguments supporting consideration of the second option.

Limiting the dose to 100 mrem (1 mSv) reduces the numerical value to one consistent with the recommendations contained in ICRP Publication 103. This option also simplifies the requirement, in that a retrospective dose assessment to the embryo/fetus prior to a declaration would not be needed.

A third option is to limit the embryo/fetal dose to 50 mrem (0.5 mSv) applicable from the declaration of pregnancy for the remainder of the gestation period which reduces the numerical value to one most consistent with the requirement for the public exposure (1 mSv (100 mrem) in a year). The staff also notes that the embryo/fetus is several times more sensitive to radiation exposure than members of the general population and should be afforded additional protection.

The staff believes that there is a strong rationale for modification of the requirement, but notes that additional interactions with stakeholders and interested parties are necessary to understand the implications of this proposal on licensee activities. The staff is already aware of certain situations among medical workers, for example nuclear pharmacists, where a change could present an impact.

3. Occupational Dose Limits

The occupational dose limits of 10 rem (100 mSv) over 5 years, with a maximum of 5 rem (50 mSv) in any one year, set by ICRP in 1990, were not incorporated into the last revision of 10 CFR Part 20 because the recommendations were not available during the public comment period for the proposed rule. The staff has identified three options for consideration.

The first option would be to retain the present 5 rem (50 mSv) occupational dose limit. It could be argued that such a value is consistent with the maximum value recommended by ICRP in any 1 year, and provides the greatest operational flexibility to licensees. This approach, perhaps coupled with a strong implementation of occupational dose constraints as described below, could be seen as providing the same level of protection as a reduction in the dose limits.

The second option would be to change the dose limit to 10 rem (100 mSv) over any 5 year period, with a further limitation of 5 rem (50 mSv) in any 1 year. The option would explicitly implement the ICRP recommendations in NRC's regulatory structure and facilitate consistency with other international standards. However, such a requirement would be more complex to implement, because dose histories for each individual would be necessary in order to determine compliance with the 5 year average.

The third option would be to lower the occupational dose limit to 2 rem (20 mSv) per year. This option would align the NRC requirements with the intent of the ICRP recommendations, would be consistent with the regulations of some countries, and would be somewhat less flexible than the provisions of other countries. Such an approach would be the most straightforward change, because no dose histories would be needed to determine compliance with the 5 year average described in Option 2.

The staff has obtained information that 2 rem (20 mSv) per year is achievable for nuclear reactor licensees. The staff needs to obtain additional information about the actual dose distributions for industrial and medical licensees, in order to understand possible impacts of establishing an average occupational dose limit of 2 rem (20 mSv) per year, a

maximum of 5 rem (50 mSv) in any 1 year, and 10 rem (100 mSv) in 5 years. Initial interactions with the medical community suggest that interventional radiologists and cardiologists may be receiving doses well in excess of 2 rem (20 mSv), per year, as measured by the deep dose equivalent. These medical groups have also indicated that they believe any consideration of a change would result in a direct impact on the delivery of patient care. Initial interactions have also disclosed that compliance with the 5 rem (50 mSv) value may still be based on the deep dose equivalent, and that use of the provisions now in 10 CFR Part 20 for effective dose may make compliance somewhat less difficult. However, many of the medical licensees are in Agreement States; the regulations of the Agreement States must also be amended to clarify the definition of TEDE as explained above in Section A.

The staff believes that additional interactions with stakeholders and interested parties are necessary to understand the implications of the proposal on licensee activities, and does not have a recommended position at this time. Further, these discussions should consider the implications of the dose limits together with any proposals related to establishing constraints for occupational exposure (see discussion below on constraints).

C. Incorporation of Constraints

1. Occupational Exposure

One of the most significant modifications made by the ICRP was the use of constraints and reference levels as part of the process of optimization of protection. Licensees are currently required by 10 CFR 20.1101 to use sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA). The term, “constraint,” is already included in the definitions of 10 CFR Part 20. A constraint, as currently defined, is a value at which licensee actions are required. Many licensees are generally familiar with the concept of constraints, although the concept may be implemented through various terms, because they routinely use various planning values in their programs to ensure that the dose limits are not exceeded. Thus many established radiation protection programs already incorporate this concept. The ICRP recommendations indicate that the constraint is the starting point for optimization, serving as an upper bound on the annual dose that members of the public should receive from the planned operation of any controlled source of radiation. ICRP has stated that constraints are not considered as limits.

A radiation protection program should include dose constraints such that if an individual exceeds the designated dose the licensee should take action to control future doses and ensure that the radiation safety practices have been adjusted to minimize the possibility of future situations exceeding the constraint value. For example, the licensee should investigate the situation, and take corrective actions so that exposures for the remainder of the year will not exceed a new planning value or the dose limit. Thus, a situation in which an individual exceeds the dose constraint would not necessarily be a regulatory violation. It would, however, be a violation if the licensee were to fail to take the appropriate corrective actions.

The staff, in considering the possible impact to licensees, has also considered whether exceeding a constraint should be reportable. The staff believes that the implementation of constraints would be best served by not requiring that a situation exceeding the

constraint be reported to the NRC or the Agreement State, as appropriate. The NRC could still become aware of, and examine, the situation through the routine inspection program. For occupational exposure, the staff believes that the addition of a requirement for licensees to establish and use a dose constraint could be an appropriate change to the NRC's radiation protection framework that would assist licensees in achieving occupational doses that are ALARA. While many licensees use planning values, the use of such values is currently not required. The staff has observed applications, such as industrial radiography, where exposures are seen in excess of 2 rem (20 mSv) per year and these licensees generally do not have such optimization.

The staff believes that additional interactions with stakeholders and interested parties are necessary to understand the impact of this proposal on licensee activities. The considerations should include both whether to include the concept, and whether to impose a numerical value as the maximum that a licensee could use. An option could be to set the constraint at 2 rem (20 mSv) per year. Other values could also be considered. This option would provide alignment to ICRP recommendations, while maintaining some flexibility for licensees in the conduct of their activities. The staff believes that additional information about the actual dose distributions from stakeholders and interested parties will be of benefit to the staff in making a determination as to whether to impose a maximum numerical value, and if so, what value would be the most appropriate.

2. Public Exposure

The issue of establishing other constraints, such as for members of the public, could also be the subject of discussion. The staff does not believe that it would be necessary to specify other constraints for public exposure, because other regulations already function to keep exposures below the dose limit for members of the public. For example, doses are further restricted from residual radioactivity at a decommissioned site, including that from groundwater sources of drinking water. In addition, certain licensees are constrained by the U.S. Environmental Protection Agency's generally applicable environmental radiation standards in 40 CFR Part 190 that limit doses to members of the public. 10 CFR Part 50, Appendix I, imposes design criteria to further restrict doses from effluents. Multiple licensees at a site or facility must cooperate with one another to limit their contribution to the dose limit for a common receptor, i.e., a member of the public. The staff notes that 10 CFR 20.1101 already contains a provision for a constraint for airborne effluents from non-reactor facilities. This provision would be retained.

Nevertheless, the staff recognizes that stakeholders and interested parties may wish to engage in discussions on the use of constraints for public exposure. For example, the staff is aware that the medical community has expressed a concern with regard to the current values used in the planning for shielding of facilities.

D. Changes to Weighting Factors and Numeric Values

1. Numeric Values of Weighting Factors

The weighting factors for tissues (W_T) and types of radiation (W_R) are currently specified in 10 CFR Part 20 in the definitions section, and are based on the recommendations in ICRP Publication 26. The 2007 ICRP recommendations provide new values for both quantities. These values are therefore logical candidates for updating. One option could

be to retain the definition of the weighting factors in the definitions sections of Part 20 while the numeric values supporting the defined terms (including monoenergetic neutrons) could be updated and moved from the definitions section to an appendix to 10 CFR Part 20. Such an approach is used in other NRC regulations, for example, the terms for A_1 and A_2 are defined in 10 CFR Part 71 and cited elsewhere in 10 CFR Part 71 while the actual values for A_1 and A_2 reside in tables that are appended to 10 CFR Part 71. Such a format would clarify requirements by assuring that key numeric criteria are not "hidden" in a definition.

The staff believes that it is appropriate to amend the regulations to use the updated values, and would engage stakeholders and interested parties on possible issues and implications.

2. Numeric Values of Annual Limits on Intake (ALI) and Derived Air Concentrations (DAC) in 10 CFR Part 20, Appendix B

The staff believes that revised values for Annual Limits on Intake (ALI) and Derived Air Concentrations (DAC) should be incorporated into Appendix B when the technical basis for the numeric changes become available. At this time, the ICRP has not published new dose conversion factors incorporating the revised radiation and tissue weighting factors, and accounting for the latest biophysical models. The ICRP has indicated that these materials are being developed, although publication is generally not expected much before 2014.

The staff believes that it would be appropriate to amend the regulations to reflect revised values for ALI and DAC when these values are available, and would engage stakeholders and interested parties on possible issues and implications. In particular, the staff will explore the extent to which rulemaking could proceed before a complete set of dose conversion factors has been published by the ICRP. The staff notes that if the initiation of rulemaking is delayed until the final publication of all dose conversion factors, the implementation by licensees might not occur until 2020 or later.

Details of Technical Options for Revision
of
10 CFR Part 50 and Appendix I
Regulations and Regulatory Guidance
for
Light Water-Cooled Nuclear Power Reactors

A. Introduction

For power reactors, radioactive liquid and gaseous effluents are controlled under Part 20, Part 50.34a and 50.36a, and Appendix I to Part 50. Appendix I contains provisions to ensure that gaseous and liquid radioactive effluents released in unrestricted areas and doses to members of the public are As Low As Is Reasonably Achievable (ALARA). These requirements were first published in 1975. The concern with existing regulations and guidance is that they are based on dosimetry concepts issued in 1959 under the recommendations of the International Commission on Radiological Protection (ICRP) in ICRP 2. This approach was consistent with the prior version of Part 20, but is no longer consistent with current Part 20. As revised in 1991, Part 20 changed the methodology by implementing dosimetry concepts of ICRP 26 and ICRP 30. However, Appendix I and guidance documents (e.g., Regulatory Guide 1.109 and others) were not changed, and therefore are still based on ICRP 2 dosimetry concepts.

B. Background

In 1975, the NRC adopted the ALARA principle in regulating radioactive gaseous and liquid effluents from nuclear power plants. The requirements and numerical guidance, respectively, are contained in Part 50 and its Appendix I. The dose criteria are based on ICRP 2 dosimetry (i.e., whole body and critical organ dose concepts and models). This approach was consistent with that used in the prior version of Part 20, Standards for Protection Against Radiation. The current Part 20, promulgated in 1991 and implemented in 1994, applies the dosimetry concepts and dose calculation methodology of ICRP 26 and ICRP 30 in deriving doses to individuals. At that time, Appendix I was not changed and it still incorporates all of the ICRP 2 concepts. In Part 20, dose is expressed as total effective dose equivalent (TEDE), which incorporates a risk-based weighed dose by tissues or organs. Under this risk-based approach, the dose to the body is expressed in a single value instead of the old method of expressing separate doses for the whole body and critical organs. Other differences exist, such as the use of non-stochastic effects in limiting doses to specific organs. The ICRP 2 approach does not make such distinctions among organs.

In practice, the Appendix I design objectives are far more restrictive than Part 20 allowable dose limits or effluent concentration levels. However, Appendix I design objectives are not a radiation protection standard under 10 CFR Part 50.34a. Releases of radioactive effluents from nuclear power plants are controlled by plant specific technical specifications to ensure that releases are maintained (i) ALARA using Appendix I design objectives and guidelines, (ii) to a small fraction of Part 20 dose and concentration limits, and (iii) within the Environmental Protection Agency (40 CFR Part 190) environmental dose standards for facilities that are part of the fuel cycle. As a result**,** Part 20 criteria and limits are rarely controlling in limiting radioactive effluents from nuclear power plants.

The U.S. Environmental Protection Agency (EPA) standards are endorsed in Part 20.1301(e). Inasmuch as the regulatory purpose of Part 20 is not the same as Part 50, Appendix I, the difference in dosimetry concepts between Part 20 and Part 50, Appendix I is not irreconcilable. However, there are regulatory, practical, and public confidence considerations that should be considered by the NRC in determining whether to transition to a common concept in dosimetry for both Part 20 and Part 50, Appendix I. These considerations are discussed below.

In implementing ALARA requirements of Appendix I, the U.S. Nuclear Regulatory Commission (NRC) published a series of regulatory guides to provide guidance on how to demonstrate compliance with design objectives. The regulatory guides address methods for estimating gaseous and liquid effluent releases, dispersion of effluents in the atmosphere and water bodies, and calculating potential radiation doses to offsite members of the public. The main guidance document is Regulatory Guide 1.109. This guide contains the mathematical models and assumptions in estimating radiation doses to members of the public from radioactive effluents during plant operation. Regulatory Guide 1.109 is supported by a series of related documents, including Regulatory Guide 1.111, which describes mathematical models and assumptions for estimating atmospheric transport, dispersion, and deposition of airborne effluents during routine operation. Another document, Regulatory Guide 1.112, describes methods for calculating radioactive source terms for evaluating radioactive waste treatment systems. Regulatory Guide 1.113 provides mathematical models and methods in estimating aquatic dispersion of both routine and accidental releases. Regulatory Guide 1.110 provides methods to conduct cost-benefit analyses in evaluating the performance of radwaste systems used in light water reactors. Regulatory Guide 4.15 addresses quality assurance for maintaining radiological effluent monitoring programs at reactors, including in nearby environments. Regulatory Guide 1.21 provides guidance on how to compile this information and conduct assessments in demonstrating compliance with Appendix I design objectives. It also contains guidance on the submission of periodic reports to the NRC. Finally, the NRC has issued several other documents (as NUREGs) that support the implementation of Appendix I. Enclosure 4 of this Commission paper presents a more detailed listing of NRC guidance.

Over the past decade there have been discussions with stakeholders about updating the basis of Appendix I design objectives and its supporting guidance documents to be consistent with the TEDE dose methodology used in Part 20. Currently, the implementation of Part 50 Appendix I design objectives is not an issue for power reactors because their use is well established and the industry has extensive operational experience in demonstrating compliance. The concern is that the use of an outdated dose calculation methodology, in expressing separate doses for the whole body and critical organs, is inefficient for both licensees and NRC. Specifically, the concerns are:

- the basis of Appendix I design objectives and associated dose calculation methodology are outdated given that its underlying basis has been revised twice since 1959;
- the basis of Appendix I design objectives should be updated to reflect current principle and scientific knowledge underlying radiation protection principles;
- the basis of Appendix I design objectives should be consistent with all other Title 10 regulatory programs;
- radiation protection principles based on ICRP 2 recommendations are no longer taught in current health physics university curriculum. As a result, the staff needs

to instruct new employees about the implementation of ICRP 2 in reviewing reactor license applications using current guidance and dose computer codes;

- the scientific and technical bases of Appendix I design objectives are outdated compared to those used in current international standards and global approach currently being used in siting, designing, and building new reactors under Part 52;
- the results of traditional cost-benefit analyses cannot be justified in maintaining an outdated radiation protection principle on a major segment of NRC licensees; and
- the use of a dual system of radiation protection principles and dose calculation methods may be difficult to defend with stakeholders and may undermine public confidence on how the NRC manages its regulatory programs and during licensing hearings of new reactors.

Together, these concerns present potential impediments in light of new reactor applications. If these requirements and regulatory guides were to remain unchanged, the United States would remain alone in its use of ICRP 2 dose concepts because of a world-wide approach in using current dosimetry methods to design and operate new power reactors. NRC is supporting the review of one early site permit, four design certifications, and seventeen combined licensed applications.

Given this wave of new power reactor licensing, the removal of inconsistencies between Part 20 and the basis of Part 50 Appendix I design objectives would be important to the regulatory process and eliminate confusion in current dual regulatory requirements in calculating doses for demonstrating compliance with Appendix I design objectives using ICRP 2 and ICRP 26 and 30 for Part 20. Applicants would have the option of voluntarily complying with the revised Part 50, Appendix I regulations for efficiency. However, applications for early site permits, reactor certifications, and construction/operating license (COL) applications submitted after the effective date of the rulemaking, would be required to comply with the revised basis of Appendix I dose criteria and supporting guidance. The staff proposes to address the implementation of revised Part 50 and Appendix I requirements in the rule in a manner similar to that incorporated in Sections I and V of Appendix I when these regulations were implemented in 1975. The staff recognizes that the ongoing licensing of new reactors will use the existing 10 CFR Part 50 and Part 50 Appendix I until such time as revisions are made. A key issue in discussions with licensees will be the desirability and impact of implementing a new set of requirements as the new reactors commence operation.

C. Proposed Approach

A review of current rules and requirements indicates that there are a number of regulatory and technical overarching issues that would need to be considered in defining a successful course of action. Some of the overarching issues involve deciding on whether to revise the guidance at all, determining the scope of a rulemaking if a revision were chosen, whether the regulatory guidance could be revised without first considering updating Part 20 to ICRP 103 recommendations, and addressing any constraints associated with the Part 52 design certification rule. In broad terms, the following arguments could be made on whether to revise the basis of the Appendix I design objectives and its related guidance:

a. Do not revise the basis of Appendix I design objectives and related guidance

Leave the basis of Appendix I design objectives and related guidance as they are. This argument makes the case that there is no necessary connection between Appendix I design objectives and Part 20 dose limits to the public, given that Appendix I is not a radiation protection standard. The Appendix I design objectives are an "ALARA design basis" requirement. If the design objectives of Appendix I are met, it constitutes a demonstration that effluents and doses to the public are ALARA and no additional efforts are required to reduce effluent release rates. As a result, there is no need to link the two, as Part 20 and Appendix I address different regulatory objectives. However, the staff has been drawn into discussions and conclusions that compliance with Part 50 Appendix I numerical guides also demonstrates compliance with the dose and effluent concentrate limits of Part 20 given that Appendix criteria are more restrictive. This rational is scientifically and technically incorrect because of the recognized differences in underlying dosimetry concepts and dose calculation methodologies.

b. Integrate the revision of the basis of the Appendix I design objectives and its related guidance with that of Part 20

Integrate the revision with upcoming considerations that will address the update of Part 20 using current ICRP 103 recommendations. This approach would combine both efforts into one coherent rulemaking that would ensure that the revision to Part 20 and basis of Appendix I design objectives and regulatory guidance are implemented using a systematic approach. This course of action would ensure a consistent application of regulatory criteria between Parts 20 and Part 50 and 52. In turn, this option offers several alternatives on how to implement the revision. One approach would be initiate the revisions of Part 20 and Part 50 as two parallel rulemaking efforts with the implementation of the revised rules synchronized to a common implementation date.

In light of the above, the staff proposes the revision to the basis of Appendix I design objectives and regulatory guidance in making them consistent with other NRC regulatory programs using current scientific dosimetry concepts. The revised guidance would retain the current numerical design criteria of Appendix I, but would redefine the dose criteria as Effective Dose (ED) or Total Effective Dose (TED). The approach identifies regulatory programs and requirements for reactor licensing, associated regulatory guidance, and describe the advantages, limitations, and constraints to both NRC and licensees in revising regulations and regulatory guidance. Specifically, the following identifies specific elements of Part 20 and Appendix I to Part 50 regulations requiring update:

1. If Part 20 is revised, align dose definitions and quantities under Part 50.2 and Appendix I criteria with proposed Part 20 revision under the framework of ICPR 103 recommendations.

2. If Part 20 is not revised, align dose definitions and quantities under Part 50.2 and Appendix I criteria with the current framework of Part 20.

3. Align Part 50, Appendix I Sections II.A to II.C design objective dose criteria with proposed Part 20 revision or current Part 20 if it is not revised, specifically:

   (a) retain the 3 and 5 mrem (0.03 and 0.05 mSv, respectively) annual dose criteria of Appendix I for liquid and gaseous effluents, respectively, and report dose results as ED;

   (b) assess whether to omit reporting requirements of Appendix I for organ doses, e.g., skin and thyroid;

   (c) assess whether organ dose results of Appendix I be available for inspection, beyond that submitted yearly;

   (d) assess whether the gamma and beta air dose criteria should remain in Section II.B.1 of Appendix I;

   (e) update definitions of dose receptors in Section III and IV of Appendix I;

   (f) update Appendix I Section II.D cost-benefit analysis criteria from $1000 per man total body/thyroid rem to $2000 per man-rem (NUREG-1530 & NUREG/BR-0058), or current criteria using new information (e.g., 2007 dollars);

   (g) determine whether the provisions of Sections I and V of Appendix I need qualifiers addressing implementation of revised regulations for the existing fleet of operating reactors vs. Part 52 for newly licensed reactors before fuel load; and

   (h) revise the introduction of Appendix I requirements and their applicability to light-water-cooled and water-moderated power reactors in differentiating these requirements against those applicable to the next generation of nuclear plants with designs other than light water-cooled and water-moderated.

4. Redefine compliance requirements for “licensed operation” to consider sites with two or more licensees contributing radiation exposures to a single offsite dose receptor under Part 20.1301.

5. Given item 4 above, assess whether compliance with 40 CFR Part 190 [in Part 20.1301(e)] needs more elaboration in Part 20, Part 50 Appendix I, or in a regulatory guide.

6. Review and update all related conforming references: Regulatory Guides (Divisions 1, 4 and 8), Standard Review Plan (SRP, NUREG-0800, Sections 11 and 12), Branch Technical Positions of SRP Section 11, Generic Letter 89-01, NUREGs, and computer codes. Enclosure 4 of this Commission paper presents a listing of such guidance documents.

D. Implications

The proposed revision would consider updating key regulatory guides and determine whether other supporting documents need to be revised as well. The revised guidance would retain the current numerical dose criteria of Appendix I, but would redefine the dose criteria as ED or TED.

Also, the adjustments made to the dose calculation methodology would be consistent with the dosimetry concepts of ICRP 103 recommendations, as adopted in the revision to Part 20. For the purpose of this discussion, the focus is on Regulatory Guide 1.109, but it should be recognized that the revision would require, by necessity, the review of other regulatory guides, supporting NUREGs, computer codes, etc., given their complex interlocking relationships in supporting the implementation of Appendix I.

The proposed approach offers several advantages as it provides an opportunity to revise and integrate regulatory and technical issues associated with Part 50 Appendix I requirements with that of Part 20. This approach would result in the use of a consistent concept in regulating other NRC programs. It provides the opportunity to address the implications of the revision on Part 50 licensees, Part 52 early site permit, design certification, and COL applications. Together, these considerations are expected to simplify the regulatory burden for the NRC and licensees.

Conceptually, the proposed revision would result in two sets of regulatory guides, supporting NUREGs, and computer codes. The revised guidance would address the licensing and operation of new reactors, while the current guidance would remain unchanged for the existing fleet of operating reactors. Also, utilities would have the option of adopting the revised guidance for procedural efficiency and consistency in reporting doses to members of the public among multiple reactor sites, e.g., one site with an existing reactor and another with a newly licensed reactor. However, it is recognized that some aspects of the current guidance might be equally applicable to both categories of reactors and would not be revised or duplicated. Finally, a revision to the current guidance, based on new data, operational experience, and technological advances in radiological assessment, would provide an opportunity for introducing a more realistically conservative (risk-informed and performance-based) approach in licensing Appendix I requirements for new power reactors.

In considering the scope of the revision, the update would apply a tiered approach, reflecting varying levels of complexity. The approach and the scope of the revision ultimately implemented would depend on the chosen option. It is envisioned that the revision process might consider:

a. Limited Scope Revision - Target only those elements of the guidance dealing with dose conversion factors and, if necessary, directly supporting radiological parameters, such as specific adjustments to the basis of dose conversion factors. The balance of the technical guidance and default values of all other parameters would remain as stated in current regulatory guides. Also, the revision would address whether changes are needed in computer codes used to calculate doses or dose conversion factors.

b. Expanded Scope Revision - In addition to the above, the basis and values of specific parameters that affect dose results would be evaluated, and an assessment would identify the need to update or retain some or all default values. Such parameters, for example, would include human food or animal consumption rates, bio-accumulation factors, shore-line width factors, agricultural productivity, etc.

c. Full Scope Revision - This approach would consider a full revision of the guidance, including a top-down review and update of conceptual models

addressing effluent source term development, atmospheric and aquatic dispersion, and environmental transport based on an evaluation of the current literature and industry standards; dosimetry concepts and dose calculation methods based on ICRP 103 recommendations; and a review of all model assumptions, parameters, and their default values.

As an approach, the staff recommends the "Expanded Scope Revision" option as it focuses on an alignment with ICRP 103 recommendations and leaves intact all other aspects of current NRC guidance. For example, a top-down review and update of conceptual models addressing atmospheric and aquatic dispersion, and environmental transport is expected to be a resource and time intensive effort. The proposed approach would ensure that only essential regulatory guides and guidance documents would be revised and available in time by the implementation date specified in the final rule for Part 50 and Appendix I. In support of the implementation of the revised regulations, the staff proposes to prioritize the revisions of supporting regulatory guides, computer codes, and other guidance documents because of resource considerations. The revision of the balance of the guidance would be effected in defined subsequent stages.

E. Impact on NRC Regulations

The following presents discussions on potential impacts on the Reactor Oversight Program, nuclear utilities, and public confidence; considers ALARA, backfit, and cost-benefit analyses; and covers technical considerations in comparing impacts between ICRP 2 and methods based on ICRP 103.

Impacts on Reactor Oversight Program

The proposed revision of the basis of Appendix I design objectives and guidance supporting the implementation of Appendix I to Part 50 would have no impacts on current licensee programs and NRC activities. Thus, such a revision should not pose any backfitting considerations under the Backfit Rule, 10 CFR 50.109 - see separate discussion. The staff's evaluation would need to address any potential impacts on the Reactor Oversight Process (ROP). The specific elements of the ROP are those that address the public safety corner stone, cross-cutting issues, impacts on the baseline inspection program, preserving the effectiveness of the significance determination process, and upholding the usefulness of current performance indicators. Other aspects that would need to be evaluated are performance issues associated with reactor license renewals and extensions, and extended power up rates in maintaining safety. The revised guidance would address the licensing of new reactors, while the current guidance would remain unchanged for the existing fleet of operating reactors. The proposed revision would result in two sets of regulatory guides and updated documents. However, it is recognized that some aspects of the current guidance might be equally applicable to both categories of reactors and would need not be revised or duplicated. As part of the rulemaking, the NRC would need to assess regulatory and cost-benefit impacts on NRC programs and licensees, including a provision offering voluntary implementation for utilities operating existing and new reactors.

Impacts on Licensees

Regarding the scope of the proposed revision, it is expected that the industry would take a specific position on the issues and provide recommendations to the NRC. At this time, it is expected that, among others, some of the arguments may include:

- Regulations used to protect workers and the public, which are based on different dose concepts and models, are confusing to the industry and public.
- With new reactor applications, an update of the basis of Appendix I design objectives is appropriate and timely.
- There is an advantage in combining an update of Part 20 with a revision to the basis of Appendix I design objectives in the same rulemaking; thereby, ensuring consistency on the scientific and regulatory basis of how doses are defined and calculated in demonstrating compliance.
- NRC regulations and guidance should reflect current science, taking into account relevant recommendations issued by standards setting radiation protection organizations.
- The use of current science in setting the basis of dose limits would help with public confidence, ensure consistency among regulatory programs, and offers a benefit to the regulated community, assuming that the revision is not backfitted on the industry.
- On the other hand, significant changes to Appendix I might damage the reputation of the public radiation safety cornerstone, given the history of routine compliance with Appendix I design objectives.
- Similarly, the proposed revision should assess whether there are possible ramifications on current or pending applications for plant life extensions, extended power uprates, and licensing of new reactors at sites with existing plants.
- The implementation of revised Appendix I guidance should be optional for currently operating nuclear power plants.
- The NRC should assess potential impacts on different types of utilities, e.g., small utilities as single plant operators vs. utilities owning fleets of reactors.
- Nuclear Energy Institute, American Nuclear Industries, and utilities (large and small) will need to assess whether there are any potential liabilities in instances when plants are operated under different regulatory regimes, e.g., a single utility operating one plant under existing Appendix I regulatory guidance and another using revised Appendix I regulatory guidance.
- The revision of the basis to Appendix I design objectives and its guidance should offer flexibility on how the requirements are implemented in the context of performance-based and risk-informed regulations.

It is recognized that recommendations from utilities operating nuclear power plants would be expressed during public meetings and joint NRC and industry workshops.

Impacts on Public Confidence

The proposed revision might be perceived by the public as a relaxation of NRC requirements, e.g., allowing the use of dose models that might result in higher releases of radioactivity in the environment for the same dose limits. It is expected that, among others, issues raised by stakeholders may include:

- The underlying basis of NRC regulations should be updated in light of scientific findings presented in the Biological Effects of Ionizing Radiation (BEIR) VII report.
- Any revision to Appendix I and its guidance should weigh ICRP 103 recommendations and BEIR VII Committee findings.
- The revision to the basis of Appendix I design objectives and its guidance may not be favored pending an evaluation of the findings of the BEIR VII report on low-dose hypersensitivity, bystander effects, and genomic instability.
- If revised guidance is deemed to provide better protection to public health and safety, all power plants should be required to comply with them, regardless of any backfitting costs.
- Methodologies that result in the maximum health and safety protection should be the NRC's first approach, and any revision should aim for more restrictive standards since more nuclear power plants are expected to be built in the near future.
- The NRC should move away from performance-based regulations, because it is a relaxation to regulatory requirements. NRC should continue to use the more conservative and safer defense in depth strategy.

As part of NRC strategic goals, the process supporting the revision to the basis of Appendix I design objectives and guidance will be transacted openly and offer opportunities for public and stakeholder participation in the regulatory process.

ALARA Considerations

The requirements of Part 50 Appendix I define ALARA dose levels associated with radioactive materials present in liquid and gaseous effluents from light water reactors. If the design objectives of Appendix I are met, it constitutes a demonstration that effluents are ALARA and no additional efforts are required to reduce effluent release rates. Compliance with Appendix I is typically judged on whether the licensee has incorporated appropriate measures to track and, if necessary, reduce effluent releases as an operational principle, and not whether exposures and doses have been reduced to an absolute minimum. In this context, the proposed revision to the basis of the Appendix I design objectives will not change the premise of the ALARA dose-based standard and, consequently, the implementation and demonstration of compliance with a revised basis of Appendix I design objectives is not expected to require the expenditure of additional efforts on the part of licensees and NRC staff.

The proposed revision to the basis of Appendix I design objectives will not change the requirements of the EPA standards under 40 CFR Part 190 standards, consequently, the implementation and demonstration of compliance is not expected to require additional efforts by licensees and NRC staff. In order for light water reactors to demonstrate that doses from

effluents and direct radiation are ALARA, it is necessary to confirm that effluents meet the design objectives of Appendix I, that direct radiation from onsite radioactive sources (e.g., from radioactive waste storage buildings, turbine shine, storage tanks, etc.) is also ALARA, and that the total dose to any members of the public at the nearest location is within the EPA dose standards. Meeting these conditions is evidence that offsite doses are ALARA and in conformance with both Appendix I and 40 CFR Part 190. The potential impacts of the proposed revision on ALARA objectives and compliance with EPA standards will be evaluated in ensuring that operational flexibility is maintained and that no new constraints are imposed inadvertently.

Part 50, Appendix I Section II.D Cost-Benefit Ratio

The staff also proposes an update of Appendix I, Section II.D cost-benefit analysis criteria of $1000 per man total body/thyroid rem. Under current policy, the cost-benefit ratio for NRC regulatory analysis has been revised to $2000 per man-rem; see NUREG-1530 & NUREG/BR-0058, Rev. 4. The staff recommends that the cost-benefit ratio in Appendix I be updated using most current information (e.g., based on post-2007 dollars). The staff would address the revision of the supporting guidance, Regulatory Guide 1.110 as well. Specifically, the staff would assess whether liquid and gaseous effluent treatment system efficiencies have been maximized in the design of new reactors, and, if so, determine if there is still a need to evaluate system augmentation in order of diminishing cost-benefit returns, as is currently specified by Appendix I. Given these observations, there might be a need to determine if the NRC needs to redefine “items of reasonably demonstrated technology” for effluent treatment systems. Other aspects of the revision of Regulatory Guide 1.110 would include updating the listings of effluent treatment systems; revise associated maintenance, operating, and other costs of treatment systems; and assess whether a 30-year life cycle is still appropriate for new effluent treatment systems proposed in new reactor designs given the increasing application of modular treatment subsystems. The staff’s understanding of current industry practices is that modular or skid-mounted treatment subsystems are replaced more frequently, on about a 10-year operational cycle.

Backfit Considerations

In assessing the merits of updating the basis of Part 50 Appendix I design objectives, the staff will evaluate the impacts on licensee programs under the provisions of 10 CFR 50.109 – the Backfit Rule. The backfitting issues apply to four different classes of affected entities: (i) currently-operating reactors; (ii) existing design certifications, currently-docketed design certification applications and combined license applications; (iii) future design certifications and combined license applications which have not yet been filed, but will be filed prior to the effective date of any final rule amending Part 20 and Part 50, Appendix I; and (iv) future design certifications and combined license applications filed after the effective date of any final rule amending Part 20 and Part 50, Appendix I. Backfitting considerations and policy implications are expected to differ among these four classes of entities, and the staff will develop its position on backfitting for each affected class. The staff proposes to develop its position on backfitting for each affected class as part of the development of the proposed rule, with input from all affected stakeholders.

Cost-Benefit Considerations

The concern is that the use of an outdated dose calculation methodology is inefficient for both

licensees and NRC since dose calculations have to be done using two different methods, ICRP 2 for demonstrating compliance with Appendix I design objectives and ICRP 26 and 30 in demonstrating compliance with Part 20. The use of the current dose calculation methodology is outdated given that its underlying basis has been revised twice since 1959. The implementation of Appendix I design objectives is not a significant issue for existing power reactors because their use is well established and the industry has extensive operational experience in demonstrating compliance. Over the recent past, there have been discussions about updating the basis of Appendix I design objectives to be consistent with the dose methodology applied in Part 20. However, questions have been raised as to whether changes to the basis of Appendix I design objectives would still qualify for revision if appraised against criteria used in a traditional cost-benefit analysis. Given that the numerical dose criteria would not be changed by the revision, the impact on licensees would be associated with updating procedures, developing new calculation tools, and reformatting required reports to the NRC. Such changes would be implemented as a one time initial effort, followed by gains in administrative and procedural efficiencies and reductions in operating costs accruing over the life of the operational program. On the other hand, cost alone may not be a justifiable reason for imposing outdated radiation protection principles on a major segment of NRC licensees.

Arguments could be made that the basis of Appendix I design objectives should be updated to reflect current scientific knowledge about radiation protection principles. For example, the National Technology Transfer and Advancement Act of 1995 (Public Law 104-113) and Office of Management and Budget Circular A-119 (Federal Participation in the Development and Use of Voluntary Standards, February 10, 1998) encourage Federal Agencies to adopt recognized and applicable standards, harmonize the use of standards as opposed to developing unique government standards, and reduce or eliminate the burden in complying with NRC regulations. Moreover, the use of a dual system of radiation protection principles and dual dose calculation methods may be difficult to defend with stakeholders and may undermine public confidence on how the NRC manages its regulatory programs. The proposed revision to the basis of Appendix I objectives will be evaluated in assessing cost and benefits and qualitative factors in ensuring that all important particulars are considered in the decision making process.

Technical Considerations in Comparing Doses Based on ICRP 2 Dosimetry Concepts Against Doses Derived Under the Proposed Revision of Appendix I Using ICRP 103 Concepts

The basis of the dose criteria of Appendix I are founded on ICRP 2 dosimetry (i.e., whole body and critical organ dose concepts and models). The Appendix I dose criteria are defined for the total body, any organ, skin, and also include absorbed dose limits in air. A summary of the Appendix I design objectives are summarized in Table 1. This approach was consistent with that used in the prior version of Part 20, Standards for Protection Against Radiation. The current Part 20 applies the dosimetry concepts and dose calculation methodology of ICRP 26 and ICRP 30 in deriving doses to individuals. In Part 20, dose is expressed as TEDE, which incorporates a risk-based weighed dose by tissues or organs. The dose to the body is expressed in a single value instead of the old method of expressing separate doses for the whole body and critical organs.

In implementation, the current ICRP dose conversion factors are different than that of ICRP 2. If the basis of Appendix I design objectives were changed to current ICRP recommendations, one would expect some differences in doses for the same unit intake of radioactivity. As a result, there would be a need to assess the impacts of using alternate exposure-to-dose conversion factors on allowable amounts of effluents, while still complying with current Appendix **I** design

objectives and dose criteria. Specifically, such assessments would involve modeling exposure pathways and calculating doses using revised dose conversion factors and performing the same analysis using the method of Regulatory Guide 1.109. The analysis would consider using actual effluent releases from operating power plants and model representative boiling water reactor (BWR) and pressurized water reactor (PWR) plants. The plant data would consider amounts of radioactive materials released in air and water, and would consider plants located at salt and fresh water sites. The analysis would consider pathways defined in Regulatory Guide 1.109, including drinking water, inhalation, and consumption of fish, invertebrates, fruits, vegetables, milk, and meat. Other pathways to be considered would include shoreline recreation, and gamma and beta air doses.

The results would be compared and differences in doses will be expressed as ratios by pathways, age groups and organs, and types of plants (PWR or BWR). For example, the ratio of doses for exposure to the whole body would be expressed as the dose based on ICRP 103 conversion factors to that of Regulatory Guide 1.109 dose conversion factors. Detailed comparisons would be developed to identify and group radionuclides and pathways by their relative differences. The evaluation of the results would be used to consider impacts, assess if ED could be simply substituted for total doses in Appendix I, address differences in age groups and organs and associated doses between ICRP 103 and ICRP 2 calculation methods, determine whether the gamma and beta air doses should be retained in the revised implementation of Appendix I design objectives, and assess the implication of the revised method in complying with the EPA dose standards of 40 CFR Part 190. Finally, the evaluation will consider changes that will need to be made by licensees in procedures and supporting documents, such as standard radiological effluent controls, offsite dose calculation manual, and annual radiological effluent reports.

Table 1 - Summary of Appendix I Design Objectives and Dose Criteria

Type of Effluent	Pathway	Organ	Dose Limit (per yr per unit)
Liquid	All	total body	3 mrem (0.03 mSv)
	All	any organ	10 mrem (0.1 mSv)
Gaseous	All	total body	5 mrem (0.05 mSv)
	All	skin	15 mrem (0.15 mSv)
Radioiodines & Particulates	All	any organ	15 mrem (0.15 mSv)
Gaseous	gamma air dose	n/a	10 mrad (0.10 mGy)*
	Beta air dose	n/a	20 mrad (0.20 mGy)*

Note: * Air doses are expressed in mrad.

Listing of NRC Guidance Potentially Subject for Update
in support of the revision of
10 CFR Part 50 and Appendix I
Regulations for
Light Water-Cooled Nuclear Power Reactors

A. Introduction

Under current NRC regulations, light water nuclear power reactors are licensed primarily under the requirements of 10 CFR Parts 20, 50, 51, 52, 70, 71, 72, and 100 in the context of radiation protection to workers and members of the public. In addition, guidance on the implementation of these regulations is contained in several guidance documents, both issued by the NRC and as codes and standards issued by non-regulatory agencies. The guidance includes regulatory guides (Divisions 1, 4, and 8), NUREG documents, branch technical positions, generic letters, information notices, regulatory issue summaries, computer codes, etc.

Conceptually, the proposed revision of Part 50 and Appendix I would result in two sets of regulatory guides, supporting NUREGs, and computer codes. The revised guidance would address the licensing and operation of new reactors, while the current guidance would remain unchanged for the existing fleet of operating reactors. Also, utilities would have the option of adopting the revised guidance for procedural efficiency and consistency in reporting doses to members of the public among multiple reactor sites, e.g., one site with an existing reactor and another with a newly licensed reactor. However, it is recognized that some aspects of the current guidance would be equally applicable to new and currently operating reactors and would not need to be revised nor duplicated. Finally, a revision to the current guidance, based on new data, operational experience, and technological advances in radiological assessment, would provide an opportunity for introducing a more realistically conservative (risk-informed and performance-based) approach in licensing Appendix I requirements for new power reactors.

The proposed approach would ensure that only essential regulatory guides and guidance documents would be revised and available in time by the implementation date specified in the final rule for Part 50 and Appendix I. In support of the implementation of the revised regulations, the staff proposes to prioritize the revisions of supporting regulatory guides, computer codes, and other guidance documents because of resource considerations. The revision of the balance of the guidance would be effected in defined subsequent stages.

B. Regulatory Guides

1. Division 1 RG

1. Regulatory Guide 1.21 - Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants.

2. Regulatory Guide 1.23 – Onsite Meteorological Programs.

3. Regulatory Guide 1.68 – Initial Test Programs for Water-Cooled Nuclear Power Plants.

4. Regulatory Guide 1.70 - Standard Format and Content Safety Analysis Reports for Nuclear Power Plants (LWR Edition).

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

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

7. Regulatory Guide 1.111 - Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors, Rev. 1, draft for comment, July 1977.

8. Regulatory Guide 1.112 - Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Nuclear Power Reactors.

9. Regulatory Guide 1.113 - Estimating Aquatic Dispersion of Effluents from Accidental and Routine Reactor Releases for the Purpose of Implementing Appendix I.

10. Regulatory Guide 1.206 – Combined License Applications for Nuclear Power Plants (LWR Edition).

2. Division 4 RG

1. Regulatory Guide 4.1- Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants.

2. Regulatory Guide 4.2 – Preparation of Environmental Reports for Nuclear Power Stations.

3. Supplement 1 to Regulatory Guide 4.2 - Preparation of Supplemental Environmental Reports for Applications To Renew Nuclear Power Plant Operating Licenses.

4. Regulatory Guide 4.8 – Environmental Technical Specifications for Nuclear Power Plants.

5. Regulatory Guide 4.15 - Quality Assurance for Radiological Monitoring Programs (Inception through Normal Operations to License Termination) - Effluent Streams and the Environment, Rev. 2.

6. Regulatory Guide 4.15 - Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment, Rev. 1.

7. Regulatory Guide 4.21 – Minimization of Contamination and Radioactive Waste Generation – Life Cycle Planning, draft 2008.

C. Supporting Guidance Documents

1. Generic Letter 89-01 - Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program (Generic Letter 89-01), January 31, 1989

2. NUREG-0133 - Preparation of Radiological Effluent Technical Specifications for Nuclear Power Plants.

3. NUREG-1301 - Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Pressurized Water Reactors.

4. NUREG-1302 - Offsite Dose Calculation Manual Guidance: Standard Radiological Effluent Controls for Boiling Water Reactors.

5. NUREG-0172 - Age-Specific Radiation Dose Commitment Factors for a One Year Chronic Intake.

6. NUREG-0851 - Nomograms for Evaluation of Doses from Finite Noble Gas Clouds.

7. NUREG-0800 - Standard Review Plan (All applicable sections referring to Part 20 and 50, requirements, doses, and effluent concentration limits.)

8. NUREG-1551 – Environmental Standard Review Plan.

D. Supporting Computer Codes – *Some of this work is in progress*

1. NUREG-0017 - Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactor, PWR-Gale Code, Rev. 1.

2. NUREG-0016 - Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactor, BWR-Gale Code, Rev. 1.

3. NUREG/CR-2919 - User Guide for XOQDOQ: Evaluating Routine Effluent Releases at Commercial Nuclear Power Stations, supersedes NUREG-0324.

4. NUREG/CR-1276 - User's Manual for LADTAP II - A Computer Program for Calculating Radiation Exposure to Man from Routine Releases of Nuclear Reactor Liquid Effluents.

5. NUREG/CR-4013 - LADTAP II - Technical Reference and User Guide.

6. NUREG/CR-4653 - GASPAR II - Technical Reference and User Guide.

7. NUREG-0133 - RATAFR Code for BWRs and PWRs, Assessment of liquid radwaste tank failures; and PARTS and RABFIN Codes, Derivation of ODCM composite dose parameters.

8. NUREG/CR-0781-Supplement 1 - SKYSHINE II Procedure: Calculation of the Effects of Structure Design Assessment on Neutron, Primary Gamma-Ray and Secondary Gamma-Ray Dose Rates in Air.

E. NUREG Documents <u>Possibly Excluded</u> from Updates – Licensing Bases for Existing Fleet of Operating Reactors – *Needs Confirmation*

1. NUREG-0212 - Standard Technical Specifications for Combustion Engineering Pressurized Water Reactors.

2. NUREG-0103 - Standard Technical Specifications for Babcock and Wilcox Pressurized Water Reactors.

3. NUREG-0452 - Standard Technical Specifications for Westinghouse Pressurized Water Reactors.

4. NUREG-0123 - Standard Technical Specifications for General Electric Boiling Water Reactors.

5. NUREG-0472 - Draft Radiological Effluent Technical Specifications for PWRs, Rev. 1.

6. NUREG-0473 - Draft Radiological Effluent Technical Specifications for BWRs, Rev. 1.

F. Standard Technical Specifications - NUREG <u>Potentially Subject</u> to Revision – *Needs Confirmation*

1. Standard Technical Specifications for General Electric Plants, BWR/6, update of NUREG-1434, as referenced in NUREG-1503, FSER for the GE ABWR, and Part 52, Appendix A.

2. Standard Technical Specifications for Combustion Engineering Plants, update of NUREG-1432, as referenced in NUREG-1462, FSER for the ABB-CE System 80+, and Part 52, Appendix B.

3. Standard Technical Specifications for Westinghouse Pressurized Water Reactors, update of NUREG-1431, as referenced in NUREG-1512, FSER for the Westinghouse AP600 PWR, and Part 52, Appendix C.

4. Standard Technical Specifications for Westinghouse Pressurized Water Reactors, update of NUREG-1431, as referenced in NUREG-1793, FSER for the Westinghouse AP1000 PWR, and Part 52, Appendix D.