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REGULATORY GUIDE

REGULATORY GUIDE 8.10

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OPERATING PHILOSOPHY FOR MAINTAINING OCCUPATIONAL AND PUBLIC RADIATION EXPOSURES AS LOW AS IS REASONABLY ACHIEVABLE

A. INTRODUCTION

Purpose

This regulatory guide (RG) describes methods and procedures that the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable for maintaining radiation exposures to occupational workers and the public as low as is reasonably achievable (ALARA).

Applicability

This RG applies to all NRC applicants and licensees (reactor and non-reactor) subject to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 20, "Standards for Protection Against Radiation" (Ref. 1).

Applicable Regulations

- 10 CFR Part 20, Section 20.1003, "Definitions," includes amongst the list of defined terms, a definition for ALARA.
- 10 CFR 20.1101(b), "Radiation protection programs," requires licensees to establish to the extent practical, procedures and engineering controls to achieve occupational doses and doses to members of the public which are ALARA.
- 10 CFR 20.1101(c), "Radiation protection programs," requires licensees to periodically (at least annually) review the radiation protection program content and implementation.
- 10 CFR 20.1101(d), "Radiation protection programs," requires, for those licensees not subject to 10 CFR 50.34a, the establishment of a constraint on air emissions of radioactive material to the environment, excluding Radon-222 and its daughters, such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 10 mrem (0.1 mSv) per year from such emissions.

Written suggestions regarding this guide or development of new guides may be submitted through the NRC's public Web site under the Regulatory Guides document collection of the NRC Library at http://www.nrc.gov/reading-rm/doc-collections/reg-guides/contactus.html.

Electronic copies of this regulatory guide, previous versions of this guide, and other recently issued guides are available through the NRC's public Web site under the Regulatory Guides document collection of the NRC Library at http://www.nrc.gov/reading-rm/doc-collections/. The regulatory guide is also available through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html, under ADAMS Accession No. ML16105A136. The regulatory analysis may be found in ADAMS under Accession No. ML15203B408 and the staff responses to the public comments on DG-8033 may be found under ADAMS Accession No. ML16105A137.

- 10 CFR 20.1206(c)(3), "Planned special exposures," requires licensees, before a planned special exposure, to ensure that the individuals involved are instructed in the measures to be taken to keep the dose ALARA, while considering other risks that may be present.

- 10 CFR 20.1402, "Radiological criteria for unrestricted use," requires that the residual radioactivity that is distinguishable from background radiation at a licensed site proposed for unrestricted use be reduced to levels that are ALARA.

- 10 CFR 20.1601(f), "Control of access to high radiation areas," requires hospital licensees, in lieu of controlling entrance or access to rooms or other areas occupied by patients containing radioactive material, to station personnel in such rooms or other areas who will take the necessary precautions to prevent the exposure of individuals to radiation or radioactive material in excess of the limits established in Part 20 and to ensure that the hospital licensee operates within the ALARA provisions of its radiation protection program.

- 10 CFR 20.1702(a), "Use of other controls," requires that licensees maintain the total effective dose equivalent ALARA when considering the use of other controls (e.g., use of respiratory protection equipment) in those circumstances where it is not practical to apply process or engineering controls to control the concentrations of radioactive material in the air.

- 10 CFR 20.1702(b), "Use of other controls," allows licensees to consider safety factors other than radiological factors if the licensee performs an ALARA analysis to determine whether or not respirators should be used.

- 10 CFR 20.2002(d), "Method for obtaining approval of proposed disposal procedures," requires that applications for proposed disposal procedures include analyses and procedures to ensure that doses are maintained ALARA.

- 10 CFR 20.2105(a)(5), "Records of planned special exposures," requires that licensees maintain records that describe how doses were maintained ALARA.

- 10 CFR 20.2203(a)(2)(vi), "Reports of exposures, radiation levels, and concentrations of radioactive material exceeding the constraints or limits," requires that licensees submit a written report within 30 days after learning of a dose in excess of the ALARA air emission constraint established under 10 CFR 20.1101(d).

- 10 CFR 20.2203(b)(1)(iv), "Reports of exposures, radiation levels, and concentrations of radioactive material exceeding the constraints or limits," requires that licensees take or plan corrective steps to ensure against a recurrence of a listed reportable event in 10 CFR 20.2203(a), including a schedule for achieving the applicable ALARA constraint.

Related Guidance

- RG 1.8, "Qualification and Training of Personnel for Nuclear Power Plants," provides qualifications for the radiation protection manager (RPM) for a nuclear power reactor facility (Ref. 2).

- RG 1.21, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste" (Ref. 3), addresses the measuring, evaluating, and reporting of effluent releases, solid radioactive waste, and public dose from nuclear power plants.

- RG 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)" (Ref. 4), provides information (including information on radiation protection) that should be provided in the Safety Analysis Report and it establishes a uniform format for presenting this information.

- RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)" (Ref. 5), provides guidance regarding the information to be submitted in a combined license (COL) application for a nuclear power plant that includes radiation protection.

- RG 8.8, "Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable" (Ref. 6), provides information relevant to attaining ALARA goals and objectives during planning, design, construction, operation, and decommissioning of a nuclear power station.

- RG 8.15, "Acceptable Programs for Respiratory Protection" (Ref. 7), specifies the conditions under which respiratory protection equipment may be used to limit the intake of radioactive material (Regulatory Position 2 of RG 8.15 provides guidance for performing ALARA evaluations to justify the use or nonuse of respirators; other provisions of RG 8.15 also address ALARA).

- RG 8.18, "Information Relevant to Ensuring That Occupational Radiation Exposures at Medical Institutions Will Be as Low as Is Reasonably Achievable" (Ref. 8), provides information and recommended methods relevant to attaining ALARA goals and objectives for employees, visitors, and patients at medical institutions (see also NUREG-1556, Vol. 9, Rev. 2 for additional guidance) (Ref. 9).

- RG 8.19, "Occupational Radiation Dose Assessment in Light-Water Reactor Power Plants Design Stage Man-Rem Estimates" (Ref. 10), provides information and acceptable methods for performing an assessment of the estimated collective occupational radiation dose for a light-water reactor application.

- RG 8.31, "Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be as Low as Is Reasonably Achievable" (Ref. 11), provides guidance on design criteria and administrative practices relevant to attaining ALARA goals for uranium recovery and uranium conversion facilities.

- RG 8.37, "ALARA Levels for Effluents from Materials Facilities" (Ref. 12), provides ALARA guidance for designing an acceptable program for gaseous and liquid effluents at materials facilities.

- NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants" (Ref. 13), provides guidance to NRC staff in performing safety reviews of construction permit or operating license applications under 10 CFR Part 50 and early site permit, design certification, combined license, standard design approval, or manufacturing license applications under 10 CFR Part 52.

- NUREG-1556, Vol. 9, "Consolidated Guidance About Materials Licenses, Program-Specific Guidance About Medical Use Licenses," includes ALARA guidance for medical use licensees.

Purpose of Regulatory Guides

The NRC issues regulatory guides to describe to the public methods that the staff considers acceptable for use in implementing specific parts of the agency's regulations, to explain techniques that the staff uses in evaluating specific problems or postulated accidents, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations, and compliance with them is not required. Methods and solutions that differ from those set forth in regulatory guides will be deemed acceptable if they provide a basis for the findings required for the issuance or continuance of a permit or license by the Commission.

Paperwork Reduction Act

This regulatory guide contains and references information collections covered by 10 CFR Part 20, which is subject to the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.). These information collections were approved by the Office of Management and Budget (OMB), control number 3150-0014.

Public Protection Notification

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

B. DISCUSSION

Reason for Revision

The NRC issued RG 8.10 in April 1974. The NRC issued Revision 1 to this RG in September 1975, followed by Revision 1-R in May 1977. In 1991, the NRC promulgated amendments to its 10 CFR Part 20 regulations (56 FR 23360; May 21, 1991). The 1991 rulemaking included substantive amendments to the 10 CFR Part 20 regulations, as well as a renumbering of those regulations. This revision (Revision 2) updates the guide to correspond to the revised numbering system and to any changes in requirements contained in the revised 10 CFR Part 20.

In addition, this revision includes additional guidance from operating experience with ALARA since 1977. In particular, it provides more details describing management responsibilities to ensure commitment to ALARA.

Background

As part of the overall protection of workers, 10 CFR 20.1101(b) requires licensees to use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses that are ALARA. This guide describes an operating philosophy, and certain specific guidance, that the NRC staff believes all licensees should follow to keep both public and occupational exposures to radiation ALARA. For those licensees (or applicants for licenses) planning to construct new, or modify existing, facilities, providing both operational and public doses that are ALARA starts with incorporating appropriate dose reduction features (e.g., remote operation of radioactive systems and components, properly designed shielding, and ventilation as necessary) into the facility design.

The underlying basis for ALARA is the linear no-threshold hypothesis, which postulates that any level of radiation exposure carries with it a commensurate risk of adverse effects. In this regard, the decision to implement measures to reduce occupational radiation doses should be weighed against the risk of any other occupational hazards in the workplace, to minimize the total risk to the worker's health and safety.

Harmonization with International Standards

The NRC has a goal of harmonizing its guidance with international standards, to the extent practical. The International Atomic Energy Agency (IAEA) and the International Commission on Radiological Protection (ICRP) have established a series of safety guides and standards constituting a high level of safety for protecting people and the environment and addressing good practices in most aspects of radiation protection including ALARA. Such documents include:

- ICRP Publication 26, "Recommendations of the ICRP" (Ref. 14);
- ICRP Publication 37, "Cost-Benefit Analysis in the Optimization of Radiation Protection" (Ref. 15);
- ICRP Publication 55, "Optimization and Decision Making in Radiological Protection" (Ref. 16);

- ICRP Publication 60, "1990 International Commission on Radiological Protection Recommendations" (Ref. 17);

- ICRP Publication 101(b), "The Optimization of Radiological Protection – Broadening the Process" (Ref. 18);

It should be noted, however, that some of the recommendations issued by these international organizations do not correspond to the requirements specified in the NRC's regulations. In such cases, the NRC's requirements take precedence.

C. STAFF REGULATORY GUIDANCE

Senior management participation is important to ensure that ALARA requirements are established, and that appropriate resources are committed to meeting ALARA. Management and radiation protection staff involvement is necessary to implement the ALARA program. The sections below describe NRC staff positions on policies, procedures, and practices to ensure that both public and occupational radiation doses are maintained ALARA.

1. Management Commitment

ALARA policy should be supported by the highest levels of management in the organization, and as part of this commitment to ALARA, management should:

- Make this ALARA commitment available to personnel in policy statements, instructions to personnel, and similar documents.

- Provide resources and funding to meet implementation of ALARA policies and procedures.

- Promote a work environment where employees are encouraged to raise ALARA concerns and receive timely feedback on submitted issues.

- Ensure that personnel having responsibilities and implementing requirements for the radiation protection program are properly trained in ALARA principles. Regulatory Guide 1.8 describes the qualifications for the radiation protection manager (RPM) position at a nuclear power reactor facility, whereas Regulatory Guide 8.8 describes the ALARA responsibilities of the RPM. Applicants for any specific license other than a nuclear power reactor license should select and state the appropriate qualifications for the lead individual who will be responsible for implementing the radiation protection program for the licensee (i.e., the radiation safety officer (RSO)). The qualifications selected should be commensurate with the potential problems that the applicant expects to encounter while engaging in the licensed activity.

- Provide the RPM or the RSO sufficient authority to enforce safe plant or other licensed operation, to audit and prevent unsafe practices, to approve radiation safety-related issues, and to communicate promptly to an appropriate level of management.

- Ensure that occupational workers receive sufficient training on radiation protection. The worker should understand how radiation protection relates to his or her job and should be tested on this understanding at least annually. A worker should have frequent opportunities to discuss radiation safety with the radiation protection staff whenever the need arises. Management should be committed to a review of radiation protection procedures at least once every 3 years. Training should be sufficient to ensure that workers can correctly answer questions on radiation protection principles as it relates to their jobs.

- Give the RPM or the RSO sufficient authority to enforce safe facility or other licensed operation. The RPM or the RSO should have the authority to prevent unsafe practices and to halt an operation he or she deems unsafe. Radiation protection personnel should review and approve operating procedures related to radiation safety. This authority should be

demonstrable by written policy statements.

- Make modifications to operating and maintenance procedures, and to equipment and facilities where they will substantially reduce exposures. Management should be able to demonstrate, with documented ALARA reviews, that improvements have been sought, that modifications have been considered, and that improvements and modifications have been implemented where practical. The licensee should be prepared to describe its reasons for not implementing a modification that its management had considered.

2. Radiation Protection Manager and Radiation Safety Officer

The RPM or the RSO are responsible for the overall radiation safety at a licensed facility or when the licensee otherwise engages in a licensed activity. The RPM or the RSO responsibilities should include:

- Involvement in the development and planning of radiological work activities and the preparation of Radiation Work Permits (RWPs) (see Glossary for definition of a RWP), which can be an important job-planning tool for achieving ALARA goals.

- Using RWPs to authorize entry into radiologically controlled areas and to provide information on the latest radiological conditions, such as radiation exposure rates and contamination levels, in the work area. RWPs should provide detailed work requirements, such as dosimetry and protective clothing needed, and should describe work precautions and ways to effectively use ALARA engineering controls (e.g., time, distance, shielding, containments, ventilation, and source reductions). To reduce personnel doses for work performed in high dose rate and high contamination areas, RWPs should discuss the options of performing the work remotely or using robotic devices and video monitoring. RWPs should be retained as radiation safety records.

- Assuring that the proper radiation protection instrumentation, equipment and supplies are available at workplaces, in good working order, and are used properly. Written procedures for the use of instrumentation and equipment should be made available and the RPM or the RSO should ensure that such procedures are properly followed.

- Performing an annual audit to review the effectiveness of the ALARA program. This audit should include reviews of exposure records (including the identification of which workers, or groups of workers, or which members of the public, are receiving the highest exposures and which jobs or tasks these exposures are associated with), reviews of the results of the inspections conducted internally by the licensee's staff, and consultations with the radiation protection staff or license consultants regarding the application and implementation of ALARA. This audit may be performed as an integral part of the reviews performed to meet the requirements in 10 CFR 20.1101(c) for a periodic (at least annually) review of the overall radiation protection program.

- Requiring, where practical, modifications to standard operating procedures, equipment, and facilities that will substantially reduce occupational and public exposures.

- Ensuring that proper focus is given to the source of licensee radiation exposures in the facility or other licensed activity by location, operation, and job category and maintaining awareness of trends in occupational and public exposures. The RPM or the RSO should

be able to describe which locations, operations, and jobs are associated with the highest exposures and explain why exposures are increasing or decreasing.

- Investigating unexpected exposures to determine the causes, taking steps to reduce the likelihood of similar occurrences in the future, and documenting conclusions and corrective actions.

- Assessing management of radiological work controls if the planned controls (e.g., RWPs, ALARA plans, work order instructions, radiological hold points, and stop work criteria) are not being properly implemented.

- Routinely reviewing ALARA plans to ensure that they are effective in maintaining both occupational and public doses ALARA.

3. Radiation Protection Staff Responsibility

Examples of good ALARA practices that individual licensee radiation protection staff employees should perform include:

- Incorporating ALARA into routine work practices, including having a familiarity with management's commitment to ALARA and how it should be implemented on everyday assignments.

- Informing management, the RPM or the RSO, and other radiation protection staff of any radiation protection concerns and suggesting ways to reduce doses in the facility or in the conduct of licensed activities.

- Demonstrating, where practical, familiarity with improvements in ALARA principles and practices, why modifications have been considered, and why these modifications have been implemented.

- Obtaining sufficient radiation protection training for applying ALARA engineering controls on the job, (i.e., time, distance shielding, containments, ventilation, decontamination, and source reduction) and employing self-checks to ensure that equipment and supplies are in good working order.

- Performing surveys of licensee operations to identify situations in which both occupational and public exposures can be reduced.

D. IMPLEMENTATION

The purpose of this section is to provide information regarding the NRC's plans for using this regulatory guide and information on how the following entities ("applicants and licensees") may use this guide.

In addition, this section describes how the NRC staff complies with the Backfit Rule found in 10 CFR 50.109(a)(1), 70.76(a)(1), and 72.62(a) or any applicable finality provisions in 10 CFR Part 52, in its use of this regulatory guide.

Applicability

- Applicants for, and holders of, operating licenses for nuclear power reactors under 10 CFR Part 50.
- Applicants for, and holders of, approvals issued under subpart B, C, E, and F of Part 52.
- Applicants for, and holders of, licenses issued under 10 CFR Part 70 to possess or use, at any site or contiguous sites subject to licensee control, a formula quantity of strategic special nuclear material, as defined in 10 CFR 70.4.
- Applicants for, and holders of, operating licenses for nuclear non-power reactors under 10 CFR Part 50.
- Applicants for, and holders of, specific domestic license to manufacture or transfer certain items containing byproduct material under Part 32.
- Applicants for, and holders of, specific domestic licenses of broad scope for byproduct material under Part 33.
- Applicants for, and holders of, licenses for industrial radiography under Part 34.
- Applicants for, and holders of, licenses for medical use of byproduct material under Part 35.
- Applicants for, and holders of, licenses for irradiators under Part 36.
- Applicants for, and holders of, licenses for well logging under Part 39.
- Applicants for, and holders of, licenses for source material under Part 40.
- Applicants for, and holders of, certificates of compliance for packaging of radioactive material under Part 71.
- Applicants for, and holders of, licenses for independent spent fuel storage installations under Part 72.

Use by Applicants and Licensees

Applicants and licensees may voluntarily[1] use the guidance in this document to demonstrate compliance with the underlying NRC regulations. Methods or solutions that differ from those described in this regulatory guide may be deemed acceptable if they provide sufficient basis and information for the NRC staff to verify that the proposed alternative demonstrates compliance with the appropriate NRC regulations. Current licensees may continue to use guidance the NRC found acceptable for complying with the identified regulations as long as their current licensing basis remains unchanged**.** The acceptable guidance may be the previous version of this regulatory guide.

Licensees may use the information in this regulatory guide for actions that do not require NRC review and approval. However, voluntarily using the subject matter in the guidance may change a licensee's radiation protection program such that NRC review may be required under the provisions of 10 CFR 20.1101 and should be evaluated prior to incorporating the methods into the radiation protection program. Licensees may use the information in this regulatory guide or applicable parts to resolve regulatory or inspection issues.

Use by NRC Staff

The NRC staff does not intend or approve any imposition or backfitting of the guidance in this regulatory guide. The NRC staff does not expect any existing licensee to use or commit to using the guidance in this regulatory guide unless the licensee makes a change to its licensing basis. The NRC staff does not expect or plan to request licensees to voluntarily adopt this regulatory guide to resolve a generic regulatory issue. The NRC staff does not expect or plan to initiate NRC regulatory action that would require the use of this regulatory guide. Examples of such unplanned NRC regulatory actions include issuance of an order requiring the use of the regulatory guide, generic communication, or promulgation of a rule requiring the use of this regulatory guide without further backfit consideration for protected licensees.

During regulatory discussions on licensee-specific operational issues, the staff may discuss with licensees various actions consistent with staff positions in this regulatory guide as one acceptable means of meeting the underlying NRC regulatory requirement. Such discussions would not ordinarily be considered backfitting for protected licensees even if prior versions of this regulatory guide are part of the licensing basis. However, unless this regulatory guide is part of the licensing basis, the staff may not represent to the licensee that the licensee's failure to comply with the positions in this regulatory guide constitutes a violation.

The backfitting provisions in 10 CFR 50.109, 70.76, and 72.62 and the issue finality provisions in 10 CFR Part 52 do not apply to holders of licenses under Parts 31, 32, 33, 34, 35, 36, 39, 40 or 71, or to holders of licenses for nonpower reactors under 10 CFR Part 50, unless those licensees also have an NRC regulatory approval under 10 CFR Parts 50 or 52 (for a nuclear power reactor), 70, or 72.

If a licensee protected by a backfitting or issue finality provision (a "protected licensee") voluntarily seeks a license amendment or change, and (1) the NRC staff's consideration of the request involves a regulatory issue directly relevant to this revised regulatory guide and (2) the specific subject matter of this regulatory guide is an essential consideration in the staff's determination of the acceptability of the licensee's request, then the staff may request that the licensee either follow the guidance in this regulatory guide or provide an equivalent alternative process that demonstrates

[1] In this section, "voluntary" and "voluntarily" means that the licensee is seeking the action of its own accord without the force of a legally binding requirement or an NRC representation of further licensing or enforcement action.

compliance with the underlying NRC regulatory requirements. Such a request by staff is not considered backfitting as defined in 10 CFR 50.109(a)(1), 70.76(a)(1), or 72.62(a), or a violation of any applicable finality provisions in 10 CFR Part 52.

If a protected licensee believes that the NRC is either using this regulatory guide or requesting or requiring the protected licensee to implement the methods or processes in this regulatory guide in a manner inconsistent with the discussion in this Implementation section, then the protected licensee may file a backfit appeal with the NRC in accordance with the guidance in NRC Management Directive 8.4, "Management of Facility-Specific Backfitting and Information Collection" (Ref. 19) and NUREG-1409, "Backfitting Guidelines" (Ref. 20).

GLOSSARY

ALARA — An acronym for "as low as is reasonably achievable." Title 10 of the *Code of Federal Regulations* (10 CFR) 20.1003, "Definitions," states that this term refers to "making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest."

Assessment — A planned and documented activity performed to determine whether various elements within a radiation protection system are effective in achieving stated objectives.

Audit — A planned and documented activity performed to determine by investigation, examination, or evaluation of objective evidence, the adequacy of and compliance with established regulations, procedures, instructions, drawings, and other applicable documents as well as the effectiveness of implementation. An audit should not be confused with surveillance or inspection activities performed for the sole purpose of process control or product acceptance.

Radiation Work Permit (RWP) — An authorization by the licensee's management to perform a specific procedure involving radiation exposure of personnel in a particular area. It contains detailed procedures for every aspect of the work to be done.

REFERENCES[2]

1. *U.S. Code of Federal Regulations* (CFR), "Standards for Protection against Radiation," Part 20, Chapter 1, Title 10, "Energy." U.S. Nuclear Regulatory Commission (NRC), Washington, DC.

2. NRC, Regulatory Guide (RG) 1.8, "Qualification and Training of Personnel for Nuclear Power Plants." NRC, Washington, DC.

3. NRC, RG 1.21, "Measuring, Evaluating, and Reporting Radioactive Material in Liquid and Gaseous Effluents and Solid Waste," Washington, DC.

4. NRC, RG 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)," Washington, DC.

5. NRC, RG 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," Washington, DC.

6. NRC, RG 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable." NRC, Washington, DC.

7. NRC, RG 8.15, "Acceptable Programs for Respiratory Protection." NRC, Washington, DC.

8. NRC, RG 8.18, "Information Relevant to Ensuring That Occupational Radiation Exposures at Medical Institutions Will Be as Low as Is Reasonably Achievable." NRC, Washington, DC.

9. NRC NUREG-1556, Vol. 9, "Consolidated Guidance About Materials Licensees: Program-Specific Guidance About Medical Use Licenses." NRC, Washington, DC.

10. NRC, RG 8.19, "Occupational Radiation Dose Assessment in Light-Water Reactor Power Plants Design Stage Man-Rem Estimates." NRC, Washington, DC.

11. NRC, RG 8.31, "Information Relevant to Ensuring That Occupational Radiation Exposures at Uranium Recovery Facilities Will Be as Low as Is Reasonably Achievable." NRC, Washington, DC.

12. NRC, RG 8.37, "ALARA Levels for Effluents from Materials Facilities." NRC, Washington, DC.

13. NRC, NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants." NRC, Washington, DC.

14. International Commission on Radiological Protection (ICRP) Publication 26, "Recommendations

2 Publicly available NRC-published documents are available online through the NRC Library on the NRC's public Web site at http://www.nrc.gov/reading-rm/doc-collections/. The documents can also be viewed online or printed for a fee in the NRC's Public Document Room (PDR) at 11555 Rockville Pike, Rockville, MD; the mailing address is USNRC PDR, Washington, DC 20555; telephone 301-415-4737 or (800) 397-4209; fax (301) 415-3548; and e-mail pdr.resource@nrc.gov.

of the ICRP." Annals ICRP 1(3): 1976. Pergamon Press, Elmsford, NY[3].

15. ICRP Publication 37, "Cost-Benefit Analysis in the Optimization of Radiation Protection." Annals ICRP 10 (2-3): 1983. Pergamon Press, Elmsford, NY.

16. ICRP Publication 55, "Optimization and Decision Making in Radiological Protection." Annals ICRP 20(1): 1990. Pergamon Press, Elmsford, NY.

17. ICRP Publication 60, "1990 International Commission on Radiological Protection Recommendations." Annals ICRP 21(1-3): 1990. Pergamon Press, Elmsford, NY.

18. ICRP Publication 101(b), "The Optimization of Radiological Protection – Broadening the Process," Annals ICRP 36(3): 2006. Pergamon Press, Elmsford, NY.

19. Management Directive 8.4, "Management of Facility-Specific Backfitting and Information Collection," Washington, DC.

20. NRC NUREG-1409, "Backfitting Guidelines," Washington, DC.

3 Copies of the International Commission on Radiological Protection (ICRP) documents may be obtained through the organization's Web site: http://www.icrp.org/; 280 Slater Street, Ottawa, Ontario K1P 5S9, CANADA; Tel: +1(613) 947-9750 Fax: +1-613-944-1920.