RUBIDIUM-82 GENERATORS, EMERGING TECHNOLOGIES, AND OTHER MEDICAL USE OF BYPRODUCT MATERIAL

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Regulatory Basis

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Abbreviations and Acronyms

ACMUI	Advisory Committee on the Medical Uses of Isotopes
ADAMS	Agencywide Documents Access and Management System
AMP	authorized medical physicist
ANP	authorized nuclear pharmacist
AU	authorized user
CFR	*Code of Federal Regulations*
EGM	enforcement guidance memorandum
EMT	emerging medical technology
FDA	U.S. Food and Drug Administration
FTE	full-time equivalent
Ga	gallium
Ge	germanium
GSR	gamma stereotactic radiosurgery
HDR	high dose rate
I	iodine
IVB	intravascular brachytherapy
Mo	molybdenum
NPV	net present value
NRC	U.S. Nuclear Regulatory Commission
OAS	Organization of Agreement States
PERT	program evaluation and review technique
Rb	rubidium
RSL	radioactive seed localization
RSO	radiation safety officer

SECY	Office of the Secretary of the Commission
SRM	staff requirements memorandum
Sr	strontium
SS&D	Sealed Source and Device (Registry)
T&E	training and experience
Tc	technetium
TEDE	total effective dose equivalent
Y	yttrium

Executive Summary

The U.S. Nuclear Regulatory Commission (NRC) is considering revising Title 10 of the *Code of Federal Regulations* (10 CFR) Part 35, "Medical Use of Byproduct Material," to add requirements that address calibration and dosage measurement for strontium-82/rubidium-82 generators (hereafter referred to as rubidium (Rb)-82 generators) and to establish risk-informed, performance-based requirements for existing and future emerging medical technologies (EMTs). The NRC is also considering additional changes to 10 CFR Part 35 to accommodate developments in the medical field related to new radiopharmaceuticals and EMTs.

The Commission approved initiation of this rulemaking in Staff Requirements Memorandum (SRM)-SECY-21-0013, "Staff Requirements—SECY-21-0013—Rulemaking Plan to Establish Requirements for Rubidium-82 Generators and Emerging Medical Technologies," dated January 13, 2022 (Agencywide Documents Access and Management System Accession No. ML22013A266). As outlined in the rulemaking plan, the next step in the NRC's rulemaking process is the development of a regulatory basis that serves as a precursor to the proposed rule. This regulatory basis document summarizes the current regulatory framework, describes the regulatory issues and proposed changes to 10 CFR Part 35, and evaluates alternatives for establishing requirements in 10 CFR Part 35 for Rb-82 generators and EMTs. This regulatory basis also includes preliminary cost estimates for the NRC, Agreement States, and licensees for each alternative. Table ES-1 shows the estimated net costs (negative values shown in parentheses) or averted costs (positive values) associated with the alternatives considered.

The NRC is conducting rulemaking as described in Alternative 4 of this regulatory basis. Under Alternative 4, the NRC would update 10 CFR Part 35 to (1) establish calibration and dosage measurement requirements for Rb-82 generators, (2) establish risk-informed, performance-based requirements for existing EMTs based on operating experience, and (3) revise other outdated, prescriptive requirements with risk-informed, performance-based requirements such as revisions to quality assurance program requirements for devices regulated under 10 CFR Part 35, Subpart H, "Photon Emitting Remote Afterloader Units, Teletherapy Units, and Gamma Stereotactic Radiosurgery Units." Alternative 4 would align the NRC's medical regulations with advances in technology and operating experience gained since the 2002 rulemaking that revised the NRC's regulatory framework for medical use and would improve the overall flexibility of 10 CFR Part 35 to better accommodate future EMTs.

The rulemaking would result in net averted costs totaling $1,167,000 over 15 years using a 7 percent discount rate.[1] There are additional unquantified benefits of the rulemaking as described in section 8.7 of the regulatory basis. The NRC will further refine these preliminary cost and benefit estimates in the draft regulatory analysis for the proposed rule, as informed by comments on this regulatory basis.

[1] Benefit-cost values in this regulatory basis document are net present value, calculated using a real discount rate of 7 percent in accordance with Office of Management and Budget Circular A-94, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs," available at http://www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/circulars/A94/a094.pdf.

Table ES-1: Summary Table of Alternatives and Net Benefits (Costs)

DESCRIPTION	Net Benefits in 2022 Dollars		
	Undiscounted	7% NPV	3% NPV
Alternative 1—Status Quo	($117,000)	($324,000)	($236,000)
Alternative 2—Generators Only Rulemaking	($963,000)	($1,042,000)	($1,042,000)
Alternative 3—Limited Scope Rulemaking	$7,627,000	$959,000	$3,774,000
Alternative 4—Expanded Scope Rulemaking	$9,387,000	$1,169,000	$4,573,000

Notes: NPV = net present value
Values in parentheses are negative and denote a cost (e.g., $117,000). Averted costs are positive and are shown without parentheses.
Values rounded to the nearest thousand. The tables may differ because of rounding.

1. Introduction

In SECY-21-0013, "Rulemaking Plan to Establish Requirements for Rubidium-82 Generators and Emerging Medical Technologies," dated February 9, 2021 (Agencywide Documents Access and Management System Accession No. ML20261H562), the staff sought Commission approval to initiate rulemaking for Title 10 of the *Code of Federal Regulations* (10 CFR) Part 35, "Medical Use of Byproduct Material." The proposed revision would add requirements for calibration and dosage measurement for strontium-82/rubidium-82 generators (hereafter referred to as rubidium (Rb)-82 generators) and establish risk-informed, performance-based requirements for existing and future emerging medical technologies (EMTs)[1]. The Commission approved initiation of this rulemaking in the staff requirements memorandum (SRM) to SECY-21-0013, dated January 13, 2022.

Additionally, in SRM-SECY-20-0005, "Staff Requirements Memorandum—Rulemaking Plan for Training and Experience Requirements for Unsealed Byproduct Material," dated January 27, 2022 (ML22027A519), the Commission directed the staff, as part of the rulemaking for SECY-21-0013, to do the following:

> …reconsider the full complement of training and experience requirements within the current paradigm and obtain stakeholder comments on the knowledge topics encompassing the safety related characteristics of emerging medical technologies required for Authorized Users to fulfill their radiation safety-related duties and supervision roles; the methods on how knowledge topics should be acquired; and consideration for continuing education, vendor training for new medical uses, and training on the NRC regulatory requirements.

Accordingly, the U.S. Nuclear Regulatory Commission (NRC) has prepared this regulatory basis, which does the following:

- provides background information on the current policies and regulations relative to the issues
- explains proposed changes to the regulations and how they could resolve the issues
- provides the technical and policy information used to support the regulatory basis
- identifies different approaches that could address the regulatory issues and evaluates the cost and benefits of rulemaking and the alternatives
- explains limitations on the scope and quality of the regulatory basis, such as known uncertainties in the data or methods of analysis and the mitigation measures that address these limitations

2. Background and Existing Regulatory Framework

This section briefly discusses background information, including the existing regulatory framework, for Rb-82 generators, EMTs, and other areas where changes are being considered to make

[1] The NRC uses the term "EMT" to describe any medical technology licensed under 10 CFR 35.1000, "Other medical uses of byproduct material or radiation from byproduct material."

10 CFR Part 35 more flexible, risk-informed, and performance-based to accommodate future EMTs.

2.1 Rubidium-82 Generators

Rb-82 generators produce Rb-82 chloride, a positron-emitting radiopharmaceutical used for cardiac imaging. These generators are licensed under 10 CFR 35.200, "Use of unsealed byproduct material for imaging and localization studies for which a written directive is not required." However, the short half-life of Rb-82 and the generator's automated elution and patient infusion makes Rb-82 generators different from other generators licensed under 10 CFR 35.200. Licensees cannot meet the requirements in (1) 10 CFR 35.60, "Possession, use, and calibration of instruments used to measure the activity of unsealed byproduct material," for the calibration of radiation detectors associated with medical use and (2) 10 CFR 35.63, "Determination of dosages of unsealed byproduct material for medical use," to determine the activity of each dosage administered before medical use.

Because licensees cannot meet the requirements of 10 CFR 35.60 and 10 CFR 35.63, the NRC may exercise enforcement discretion in certain circumstances according to Enforcement Guidance Memorandum (EGM) 13-003, "Enforcement Guidance Memorandum—Interim Guidance for Dispositioning Violations Involving 10 CFR 35.60 and 10 CFR 35.63 for the Calibration of Instrumentation to Measure the Activity of Rubidium-82 and the Determination of Rubidium-82 Patient Dosages," dated April 18, 2013 (ML13101A318). Enforcement discretion may be used if all three of the following criteria are met:

(1) The licensee must have written test procedures to ensure that the infusion pump flow rate is consistent and accurate, and that the radiation detector meets the manufacturer's specifications. The licensee must perform the tests, at least every 12 months (and repeated after repair or replacement), and maintain records documenting the performance of and results of these tests. The radiation detector specifications are compared to the values obtained during tests of the detector's electronics and the response to a radiation source in the static mode. The licensee may use documentation of the infusion cart maintenance performed by the manufacturer to document the completion and results of the infusion rate and radiation detector test.

(2) All authorized users (AUs) for medical applications under 10 CFR 35.200 who are using Rb-82 chloride, as well as the radiation safety officer (RSO) for that facility, must have successfully completed training specific to the manufacturer and model of generator and infusion cart being used.

Such training must include (1) elution and quality control procedures needed to determine Rb-82 activity and the strontium (Sr)-82 and Sr-85 breakthrough levels, (2) dose calibrator calibration procedures, and (3) safety procedures for the clinical use of Rb-82 chloride.

Until the generator manufacturer develops static or dynamic calibration procedures for calibrating the radiation detector in the infusion cart, the quality control procedures must include (1) performance of the Rb-82 activity constancy check comparison with Rb-82 measured in a calibrated dose calibrator, (2) how to adjust the infusion cart readout setting, and (3) when the manufacturer requires these tests.

This training requirement is met by satisfactory completion of a training program, which addresses all of these required topics, provided by the manufacturer. The licensee must

maintain documentation that all AUs using Rb-82 and the RSO have satisfactorily completed such training.

(3) The licensee records the activity of each dosage administered, as provided by the infusion cart.

As discussed in section 3, enforcement discretion is not intended to be a long-term solution to regulatory compliance issues. The alternatives evaluated in this regulatory basis involve exemptions or rulemaking to resolve the calibration and dosage measurement compliance issues for Rb-82 generators.

2.2 Emerging Medical Technologies

In 2002, the NRC amended 10 CFR Part 35, in part, to add generic requirements for new medical uses of byproduct material or radiation from byproduct material.[2] Subpart K, "Other Medical Uses of Byproduct Material or Radiation From Byproduct Material" (also referred to as 10 CFR 35.1000), defines the process to obtain a license or license amendment for EMTs. A given EMT may need unique provisions for training and experience (T&E) of AUs, facilities and equipment, or other safety-related considerations that the NRC does not capture in the existing 10 CFR Part 35 subparts. Therefore, the NRC or Agreement States evaluate each radioactive materials license application for an EMT on a case-by-case basis to determine the specific risks associated with the EMT and any additional regulatory requirements needed for its medical use. The NRC or Agreement States may develop licensing guidance that is specific to the EMT, with input from the Advisory Committee on the Medical Uses of Isotopes (ACMUI) and EMT vendors as appropriate. EMT licensing guidance consists of general licensing considerations, specific radiation safety aspects of the EMT, and T&E expectations for those authorized to use the technology. EMT licensing guidance documents may be revised based on feedback from the EMT vendor, licensees using the EMT, and regulators with experience in licensing and inspecting the EMT. The NRC has revised the original guidance documents for some EMTs several times to adopt changes in the devices, administrations, and T&E requirements.

The regulatory requirements and licensing process for EMTs are in 10 CFR 35.1000, while 10 CFR 35.12, "Application for license, amendment, or renewal," includes the specific information licensees and applicants must provide to the NRC in support of an application for use under 10 CFR 35.1000. Model- and vendor-specific EMT licensing guidance assists licensees and applicants in their submission of licensing information required by 10 CFR 35.12 and guides the NRC and Agreement State staff in their reviews of EMT licensing information. NUREG-1556, Volume 9, Revision 3, "Consolidated Guidance About Materials Licenses: Program-Specific Guidance About Medical Use Licenses, Final Report," issued September 2019 (ML19256C219), also assists licensees and applicants in submitting the information to support an application or amendment for an EMT.

Licensing guidance for EMTs provides applicants with an acceptable means to satisfy the requirements for a license for the EMT, but the NRC does not intend that guidance to be the only means for satisfying the requirements, and the guidance is not binding on licensees. Therefore, during licensing to approve use of an EMT, the NRC issues license conditions for applicants who commit to following the EMT licensing guidance, making the guidance a requirement for licensees. If an applicant submits information describing alternative methods that the NRC deems to be

[2] "10 CFR Parts 20, 32, and 35, Medical Use of Byproduct Material; Final Rule" (67 FR 20249; April 24, 2002).

acceptable, those commitments would be placed in license conditions, making them a requirement for the licensee.

Since its issuance in 2002, the Subpart K regulatory framework has enabled the NRC and Agreement States to license 16 EMTs.[3] Some EMTs, such as yttrium (Y)-90 microspheres and newer generations of gamma stereotactic radiosurgery (GSR) units, are frequently licensed and widely used in the medical community, whereas other EMTs are less commonly used. The NRC is currently developing licensing guidance for three EMTs, and the staff expects to develop licensing guidance for several additional EMTs in the near term.

2.3 Agreement State Regulatory Program

Section 274 of the Atomic Energy Act of 1954, as amended, authorizes the NRC to enter into agreements with individual States, known as Agreement States, providing them the authority and responsibility for administering a regulatory program for the safe use of radioactive materials within their borders. Agreement States have the authority to regulate the materials covered by the agreement for the protection of public health and safety. Agreement States are required to adopt regulations in accordance with the compatibility category designation (A, B, C, D, NRC, and health and safety (H&S)) assigned to each NRC regulation, as described in NRC Management Directive 5.9, "Adequacy and Compatibility of Program Elements for Agreement State Programs," dated April 26, 2018 (ML18081A070).

This rule would revise multiple sections of 10 CFR Part 35 (see appendix A for the proposed changes). The staff expects that compatibility categories for revisions to existing regulations would be maintained, and any new regulations would be assigned the same compatibility category as similar existing regulations.[4] The NRC will coordinate with the Standing Committee on Compatibility to determine compatibility categories for revised and new regulations.

3. Regulatory Issues

This section describes the regulatory issues that will be addressed by this rulemaking. The NRC defined the existing medical uses in 10 CFR Part 35, Subparts D through H, in 2002. Existing regulated medical uses of byproduct material have evolved because of changing medical practices, associated technological advances, and increased operational experience, making aspects of the current 10 CFR Part 35 regulatory framework outdated or even obsolete. In this section, the staff has identified the challenges associated with licensing Rb-82 generators and existing and future EMTs under the existing medical uses in 10 CFR Part 35, Subparts D through H. Appendix A lists the proposed changes to 10 CFR Part 35 to regulate calibration and dose measurement for Rb-82 generators and to license current and future EMTs outside 10 CFR Part 35, Subpart K.

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[3] The NRC has issued EMT licensing guidance more than two dozen times since 2002, including revisions to existing guidance to address small changes in the devices, administrations, and T&E requirements. The Medical Uses Licensee Toolkit on the NRC website (https://www.nrc.gov/materials/miau/med-use-toolkit.html) lists EMTs that the agency has previously evaluated and their associated licensing guidance.

[4] Compatibility categories for 10 CFR Part 35 are available on the NRC's Regulation Toolbox website at https://scp.nrc.gov/regsumsheets_newregs.html.

3.1 Rubidium-82 Generators

CardioGen-82® and RUBY-FILL® are two brands of Rb-82 generator systems that produce Rb-82 chloride injection for intravenous use. Given the short half-life of Rb-82, the Rb-82 generator eluate is injected directly into the patient through an infusion cart, and the patient is imaged immediately following infusion. The infusion cart contains a radiation detector and flow rate meter to measure and calculate the activity of the Rb-82. The radiation detector works in a dynamic mode with fluid continuously flowing past the detector during operation.[5] In 10 CFR 35.60, the NRC requires licensees to calibrate the instrumentation that measures the activity of unsealed byproduct material administered to each patient or human research subject. This calibration may be performed either in accordance with nationally recognized standards or calibration instructions provided by the manufacturer. However, there are currently neither nationally recognized standards nor specific calibration procedures that meet the requirements of 10 CFR 35.60 for calibrating the types of radiation detectors in the Rb-82 generator systems, which function dynamically as fluid moves past the detector in a tube. Until such standards or procedures are developed, Rb-82 generator licensees cannot comply with 10 CFR 35.60. Furthermore, 10 CFR 35.63 requires licensees to determine the activity of each dosage administered before medical use. However, licensees are unable to measure patient dosages of Rb-82 before administration using an instrument that is calibrated in accordance with 10 CFR 35.60 because the Rb-82 dosage is directly infused into the patient incrementally as the Rb-82 is eluted from the generator.

As discussed in section 2.1, EGM 13-003 discusses how the NRC may disposition violations of 10 CFR 35.60 and 10 CFR 35.63 based on the inherent issues associated with Rb-82 generators if licensees meet certain criteria. However, longstanding reliance on temporary enforcement guidance to exercise enforcement discretion is inconsistent with the NRC's Enforcement Policy, dated January 14, 2022 (ML21323A042), and is not a substitute for resolving the underlying technical issues associated with calibration and dosage measurement for Rb-82 generators. The guidance states that the EGM will "remain effective until the underlying technical issue is dispositioned through rulemaking or other regulatory action."

3.2 Continued Licensing of Well-Established Emerging Medical Technologies under 10 CFR Part 35, Subpart K

While 10 CFR Part 35, Subpart K, has proven to be a flexible way to review and license new EMTs, the continued licensing of well-established EMTs under Subpart K provides minimal regulatory benefit and is contrary to the NRC's Principles of Good Regulation.[6] As discussed in section 2.2, the basis for licensing EMTs is established through license conditions rather than regulations. This was identified as a problem and addressed for other well-established EMTs in the final regulatory analysis for the 2002 rulemaking for 10 CFR Part 35, which states the following:

> NRC has identified the following six problems that require revisions to 10 CFR Part 35...[R]evisions are needed to place the basis for regulation of certain well-established technologies into 10 CFR Part 35. Specifically, the regulations in 10 CFR Part 35 currently do not address high dose-rate remote brachytherapy, low dose-rate remote brachytherapy, pulsed dose-rate remote brachytherapy, and

[5] Typically, radiation detectors that determine dose activity operate in a static mode with the stationary fluid and are not dependent on flow rate meter measurements.

[6] The NRC's Principles of Good Regulation are independence, openness, efficiency, clarity, and reliability (accessed at https://www.nrc.gov/about-nrc/values.html on August 6, 2022).

gamma stereotactic radiosurgery. The regulatory basis for these technologies is currently established by license conditions rather than regulations.[7]

With sufficient operating experience, EMTs that are no longer considered "emerging" can be moved out of 10 CFR Part 35, Subpart K, and their regulations can be established in existing or new medical use subparts in 10 CFR Part 35. Continued licensing of commonly used and now well-established EMTs under 10 CFR Part 35, Subpart K, could create the following regulatory issues:

- Implementation of EMT licensing guidance is subject to individual interpretation by regulators, and the EMT licensing guidance is not legally binding until it is incorporated into a license through a license condition. Furthermore, EMT licensing guidance is a Compatibility Category C program element, which could create inconsistency in applying some requirements—such as T&E for AUs and medical event reporting, which are Compatibility Category B requirements for technologies licensed under the other subparts of 10 CFR Part 35.[8] For example, T&E requirements in EMT licensing guidance could be adopted differently among the States, which would pose cross-jurisdictional issues in the licensing of AUs for EMTs (i.e., one State's licensing program would not be able to use another State's license authorization for AUs for EMTs since their regulations would not be identical). Agreement States have raised this compatibility issue, and the NRC responded to a request from the Organization of Agreement States (OAS) for clarification on two regulatory topics addressed in EMT licensing guidance: (1) T&E for Y-90 microspheres, and (2) use of safety evaluation reports as license conditions for the NorthStar RadioGenix® Mo-99/Tc-99m Generator System.[9] Establishing regulations for commonly used EMTs will promote consistency, compatibility, and efficiency across the National Materials Program (i.e., licensing and inspection by the NRC and Agreement States) and will improve clarity.

- Developing and frequently updating EMT licensing guidance can be time- and resource-intensive for the NRC and Agreement States. EMT licensing guidance is model- and vendor-specific, so each new model or vendor of even a similar type of technology requires a new guidance document or a revision to a current guidance document. Furthermore, EMT licensing guidance is updated more frequently than other medical use guidance documents (e.g., the generic regulatory guidance in NUREG-1556, Volume 9). The NRC has revised the original guidance documents for some EMTs several times to adopt small changes in the devices, administrations, and T&E requirements. Risk-informed, performance-based regulations that focus on the essential safety-related elements of EMT licensing guidance will minimize the need to develop or revise EMT licensing guidance for new models or vendors of existing EMTs and the need to update outdated EMT licensing guidance.

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[7] See Attachment 12, "Final Regulatory Analysis, 10 CFR Parts 20, 32, and 35," to SECY-00-0118, "Final Rules—10 CFR Part 35, 'Medical Use of Byproduct Material' and 10 CFR Part 20, 'Standards for Protection Against Radiation,'" dated May 31, 2000. (Accessed at https://www.nrc.gov/reading-rm/doc-collections/commission/secys/2000/secy2000-0118/2000-0118scy.pdf, on August 6, 2022.)

[8] Compatibility Category C means that Agreement States should adopt the essential objectives of the provisions in the EMT licensing guidance, but they do *not* have to adopt them "essentially as written." Compatibility Category B means that Agreement States must adopt these requirements in an essentially identical manner.

[9] State and Tribal Communication (STC) 20-049, "Responses to the Organization of Agreement States (OAS) Requests Regarding Clarification of Compatibility Categories for Medical Licensing Guidance Documents; and Use of Safety Evaluation Reports (SERs) as a Legally Binding Requirement," dated June 30, 2020 (ML20178A610).

3.3 Current Emerging Medical Technologies

Sections 3.3.1 through 3.3.9 address the EMTs that will be considered in this rulemaking.[10,11] These sections provide brief background information on the EMTs and why the NRC determined they should be licensed under 10 CFR 35.1000 when the technology emerged. Appendix A discusses proposed changes to 10 CFR Part 35 that the NRC is considering establishing regulations for these EMTs, thereby allowing them to be licensed without the need to meet the requirements in 10 CFR 35.1000.

3.3.1 Germanium-68/Gallium-68 Pharmaceutical Grade Generators

Gallium (Ga)-68 is a positron emitter that is used to label radiopharmaceuticals for positron emission tomography imaging. Ga-68 can be produced in a cyclotron or by the elution of a germanium-68/gallium-68 (Ge-68/Ga-68) radionuclide generator.

Ge-68/Ga-68 generators are similar to conventional molybdenum-99/technetium-99m (Mo-99/Tc-99m) and Rb-82 generators, both of which are regulated under 10 CFR Part 35, Subpart D, "Unsealed Byproduct Material—Written Directive Not Required," because breakthrough of the parent radionuclide is possible when eluting the generator. In the case of Ge-68/Ga-68 generators, this could lead to Ge-68 contaminating the Ga-68 radiopharmaceutical causing an unnecessarily high radiation exposure to patients. In 10 CFR 35.204, "Permissible molybdenum-99, strontium-82, and strontium-85 concentrations," the NRC provides permissible concentration limits for parent radionuclides for Mo-99/Tc-99m and Rb-82 generators to limit such exposure, but no such limit is specified for Ge-68/Ga-68 generators. Therefore, the use of a Ge-68/Ga-68 generator to prepare Ga-68 radiopharmaceuticals for imaging and localization studies authorized under 10 CFR Part 35, Subpart D, is regulated under 10 CFR Part 35, Subpart K. Since the potential for Ge-68 breakthrough exists, the NRC requires appropriate commitments for breakthrough testing and allowable concentrations of Ge-68 from applicants that use these generators before granting authorization to possess and use Ge-68/Ga-68 generators under 10 CFR Part 35, Subpart K. The most recent licensing guidance for Ge-68/Ga-68 generators was issued July 2019 (ML19106A367).

3.3.2 Intravascular Brachytherapy Systems

Intravascular brachytherapy (IVB) is a type of brachytherapy in which the sources are placed within blood vessels for treatment. The current 10 CFR 35.1000 licensing guidance is for the Best Vascular (formally Novoste™) Beta-Cath™ IVB System, which is manually controlled and uses an Sr-90 source to deliver high dose rates of beta radiation.

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[10] This rulemaking will not establish regulations for manual brachytherapy using diffusing sources such as Alpha DART™. This novel technology presents unique radiation safety risks. The staff determined that this technology is not well established and should remain in 10 CFR Part 35, Subpart K, until additional operating experience is gained.

[11] This rulemaking will not establish regulations for the NorthStar RadioGenix® Mo-99/Tc-99m Generator System. The unique methods to isolate and concentrate Tc-99m in the NorthStar system make it a more complex and higher radiation safety risk generator than traditional Mo-99/Tc-99m, Rb-82, and Ge-68/Ga-68 generators. Risk characteristics of the NorthStar RadioGenix® Mo-99/Tc-99m Generator System include higher activity and radiation exposure rates and automated systems with multiple user interfaces. To accommodate the radiation safety risks associated with the NorthStar system, significant revisions to 10 CFR Part 35, Subpart D, would be required. Furthermore, there are no NRC medical licensees authorized to use the NorthStar RadioGenix® Mo-99/Tc-99m Generator System—currently only nuclear pharmacies (which are licensed under 10 CFR Part 32, "Specific Domestic Licenses to Manufacture or Transfer Certain Items Containing Byproduct Material") are using the NorthStar system. The staff anticipates that nuclear pharmacies will continue to be the primary users of the NorthStar system. Therefore, the staff determined that maintaining licensing of the NorthStar RadioGenix® Mo-99/Tc-99m Generator System under 10 CFR Part 35, Subpart K, would be the most practical and cost-effective regulatory approach.

IVB has use characteristics that allow it to be considered for licensing as manual brachytherapy under 10 CFR Part 35, Subpart F, "Manual Brachytherapy," or as a high dose rate (HDR) afterloader under Subpart H, "Photon Emitting Remote Afterloader Units, Teletherapy Units, and Gamma Stereotactic Radiosurgery Units." These uses are defined in 10 CFR 35.2, "Definitions." In manual brachytherapy, small sources (e.g., seeds or ribbons) are manually placed topically on or inserted either into the body cavities that are near a treatment site or directly into the tissue volume. An HDR afterloader remotely delivers a dose rate exceeding 12 grays (1,200 rads) per hour at the point or surface where the dose is prescribed. Since IVB devices can deliver a dose rate in excess of 12 grays (1,200 rads) per hour, they are similar to HDR afterloader treatments. However, they are not delivered remotely like HDR afterloader treatments, and in that sense, IVB is more like manual brachytherapy. Therefore, IVB devices do not directly fall under either Subpart F or H of 10 CFR Part 35.

IVB also has specific safety concerns that are addressed in licensing guidance. Examples include requiring the use of an introducer sheath and a dual syringe system to reduce the risk of a medical event and requiring written procedures for treatment of an area longer than the effective treatment length of the source (which is known as "source-stepping").

As a result of these differences from the technologies currently regulated in 10 CFR Part 35, Subparts F and H, and the additional safety concerns that are not currently addressed in the regulations, the NRC determined that the use of the Best Vascular (formally Novoste™) Beta-Cath™ device should be regulated under 10 CFR Part 35, Subpart K. The NRC issued licensing guidance for the Best Vascular Beta-Cath™ IVB System in August 2006, and it is available at the agency's website at https://www.nrc.gov/materials/miau/med-use-toolkit/intravascular.html.

3.3.3 Liquid Brachytherapy Sources and Devices

Liquid brachytherapy is a type of manual brachytherapy that treats cancer with devices that are implanted temporarily. The current 10 CFR 35.1000 licensing guidance is for the I-125 Iotrex™ Liquid Brachytherapy Source in Cytyc Surgical Products' GliaSite® Radiation Therapy System (GliaSite®). GliaSite® is a single-use, low dose rate brachytherapy system consisting of a double-wall balloon catheter filled with Iotrex™, a liquid brachytherapy solution consisting of iodine-125 (I-125) and saline. The system is intended to deliver intracavity radiation therapy to patients with malignant brain tumors following tumor resection surgery.

Liquid brachytherapy has use characteristics similar to the existing medical uses in 10 CFR Part 35, Subpart F. However, the current regulations in 10 CFR Part 35, Subpart F, do not cover all the safety concerns associated with use of GliaSite®. Safety concerns for GliaSite® include removal of all liquid from the device, leak testing of the device before use, and the need for an AU with experience in radiopharmaceutical procedures to be on call to provide guidance in case of leakage. Additionally, the current written directive requirements[12] do not include requirements specific to liquid brachytherapy to ensure that the prescribed dose is administered. As a result of these differences from the technologies currently regulated in 10 CFR Part 35, Subpart F, and the additional safety concerns that are not currently addressed in the regulations, the NRC determined that the use of GliaSite® should be regulated under 10 CFR Part 35, Subpart K. The licensing guidance for GliaSite® was issued August 2006 and is available at the NRC's website at https://www.nrc.gov/materials/miau/med-use-toolkit/liquid-brach.html.

[12] 10 CFR 35.40, "Written directives," and 10 CFR 35.41, "Procedures for administrations requiring a written directive."

Although the Sealed Source and Device (SS&D) Registry[13] for the GliaSite® Radiation Therapy System is inactive—which means this device can no longer be made or sold—the NRC supports establishing regulations for liquid brachytherapy to capture operational experience for future liquid brachytherapy technologies.

3.3.4 Radioactive Seed Localization

Radioactive seed localization (RSL) procedures implant low-activity I-125 or palladium-103 seeds to help physicians locate nonpalpable lesions and lymph nodes. These procedures use decayed radioactive seeds previously approved for the treatment of tumors under 10 CFR Part 35, Subpart F, or low-activity radioactive seeds approved by the U.S. Food and Drug Administration (FDA) specifically for RSL.

The procedures using RSL are not therapeutic; therefore, RSL does not meet the definition of brachytherapy in 10 CFR 35.2 and subsequently does not meet the requirements of 10 CFR Part 35, Subpart F. The sealed nature of the RSL sources means that the unsealed byproduct material requirements in 10 CFR Part 35, Subpart D, do not apply. The application of RSL for location only, and the sources' original use in therapeutics, also means that the diagnostic purposes in 10 CFR Part 35, Subpart G, "Sealed Sources for Diagnosis," do not apply. As a result of these differences from the technologies currently regulated in 10 CFR Part 35, Subparts D, F, and G, the NRC determined that RSL should be regulated under 10 CFR Part 35, Subpart K. The agency issued Revision 1 of the licensing guidance for RSL in October 2016 (ML16197A568).

3.3.5 Ophthalmic Applicator Sources and Devices

The use of Sr-90 ophthalmic (eye) applicator sources is regulated under 10 CFR Part 35, Subpart F. One type of eye applicator source and device system, the NeoVista, Inc. Epi-Rad90™ Ophthalmic System, is currently regulated under 10 CFR 35.1000, and the NRC is currently developing licensing guidance for another eye applicator source—the LV Liberty Vision Yttrium-90 Disc Source.

3.3.5.1 NeoVista, Inc. Epi-Rad90™ Epiretinal (Strontium-90) Ophthalmic System

The NeoVista, Inc. Epi-Rad90™ Epiretinal Ophthalmic System is an Sr-90 eye applicator device used for treatment of age-related macular degeneration. The design and operation differ significantly from those of traditional Sr-90 superficial eye applicators because the device is used intraocularly, and the dose is delivered internally. The Epi-Rad90™ system needs a retinal surgeon to remove the vitreous clear gel from the middle portion of the eye and place the Sr-90 source to treat the affected area. T&E for AUs follow 10 CFR 35.490, "Training for use of manual brachytherapy sources," or 10 CFR 35.491, "Training for ophthalmic use of strontium-90"; however, additional training is required. All AUs, non-AU retinal surgeons, authorized medical physicists (AMPs), and RSOs must receive additional training in the operation, safety procedures, and clinical use of the Epi-Rad90™ system. There are also specific requirements related to written directives and radiation safety precautions and instructions. As a result of these differences from the eye applicator sources and devices currently regulated in 10 CFR Part 35, Subpart F, the NRC determined that use of the Epi-Rad90™ system should be regulated under 10 CFR Part 35,

[13] The SS&D Registry is a national registry that contains all the registration certificates, generated by both the NRC and the Agreement States, that summarize the radiation safety information for sealed sources and devices and describe the licensing and use conditions approved for the products.

Subpart K. The agency issued the Epi-Rad$_{90}$™ system licensing guidance in April 2009 (ML091140370).[14] The NRC supports establishing regulations for ophthalmic systems to capture operational experience for future technologies.

3.3.5.2 LV Liberty Vision Yttrium-90 Disc Source

The LV Liberty Vision Yttrium-90 Disc Source (LV Y-90 Disc Source) is a temporary eye applicator source used to treat superficial eye conditions, as well as some ocular tumors and benign growths, as part of a hand-held manual brachytherapy applicator system. The applicator system is like traditional Sr-90 eye applicators licensed under 10 CFR Part 35, Subpart F, because the source is affixed to the applicator and the applicator's handles allow for movement of the source. However, the Y-90 source makes the LV Y-90 Disc Source different from traditional eye applicators. Until the advent of the LV Y-90 Disc Source, Sr-90 had been the standard radionuclide for ophthalmic radiotherapy.

In 10 CFR 35.400, "Use of sources for manual brachytherapy," the NRC allows use of a Y-90 source for ophthalmic radiotherapy. However, the regulations limit the AU to a physician with T&E under 10 CFR 35.490 (i.e., a radiation oncologist). Other types of physicians with additional training under 10 CFR 35.491, such as ophthalmologists, could perform ophthalmic radiotherapy under 10 CFR 35.400, but the regulations restrict these physicians to the ophthalmic use of Sr-90 sources. Additional regulations are also limited to Sr-90 sources, including 10 CFR 35.433, "Strontium-90 sources for ophthalmic treatments," which requires an AMP or ophthalmic physicist to perform specific tasks related to source decay and treatment time and written procedures, and 10 CFR 35.2433, "Records of decay of strontium-90 sources for ophthalmic treatments."

Because the LV Y-90 Disc Source uses a different radionuclide than eye applicator sources currently regulated in 10 CFR Part 35, Subpart F, the NRC determined that its use should be regulated under 10 CFR Part 35, Subpart K. The agency expects to issue licensing guidance for the LV Y-90 Disc Source in summer 2023. The guidance will be available on the NRC's website for emerging medical technologies at https://www.nrc.gov/materials/miau/med-use-toolkit/emerg-licensed-med-tech.html.

3.3.6 Gamma Stereotactic Radiosurgery and Photon Emitting Teletherapy Units

Multiple radiation beams in GSR units precisely target tumors and other treatment sites to deliver radiation, while sparing the surrounding areas. In 2002, the NRC developed requirements in 10 CFR Part 35, Subpart H, that allowed for the use of GSR units. Previous GSR units used stationary sources, helmet collimators, and a head frame for treatments of the brain. Since that time, newer GSR units have design and engineering elements that make their operation significantly different than units currently regulated in 10 CFR Part 35, Subpart H. To account for the radiation safety concerns related to these engineering changes, the NRC developed licensing guidance specific to the model and vendor of three GSR units: Leksell Gamma Knife® Perfexion™, Leksell Gamma Knife® Icon™, and Xcision® GammaPod™. The NRC is also developing guidance for additional GSR models in various developmental stages. The ViewRay™ System for Radiation Therapy,[15] a teletherapy unit, is also regulated under 10 CFR Part 35, Subpart K, because it involves technology advances that are not adequately addressed in 10 CFR Part 35, Subpart H.

[14] Although NeoVista, Inc. is no longer in business, the SS&D registry for the Epi-Rad$_{90}$™ is active.
[15] The ViewRay™ System for Radiation Therapy was distributed under the name MRIdian 10000 beginning in 2016. ViewRay stopped manufacturing the device in 2019.

3.3.6.1 Leksell Gamma Knife® Perfexion™ and Leksell Gamma Knife® Icon™

The Leksell Gamma Knife® Perfexion™ and Leksell Gamma Knife® Icon™ include several engineering changes that make their components and operation significantly different from the GSR units currently regulated in 10 CFR Part 35, Subpart H. These engineering changes include (1) the elimination of helmets, relative helmet factors, helmet microswitches, hydraulic backups, trunnions, and a trunnion centricity point, (2) the location of the sources in movable sectors, (3) the location of the source exposure indicator on the treatment room wall and not on the unit itself, and (4) a movable patient couch. The Perfexion™ unit uses a stereotactic head frame and frame adapter. The Icon™ unit is an upgrade from the Perfexion™ unit and uses cone beam computed tomography imaging to obtain stereotactic reference information and position references. The Icon™ unit uses a stereotactic head frame and frame adapter or a frameless thermoplastic mask and mask adapter system to immobilize the patient's head. The Icon™ also uses a high-definition motion management system to monitor movements of the patient during setup and treatment while the patient is immobilized by the mask. As a result of these differences from the GSR units currently regulated in 10 CFR Part 35, Subpart H, the NRC determined that the Perfexion™ and Icon™ units should be regulated under Subpart K. The agency issued Revision 1 of the licensing guidance for Leksell Perfexion™ and Icon™ in January 2019 (ML18333A365).

3.3.6.2 Xcision® Gammapod™

The Xcision® Gammapod™ is a type of GSR unit that delivers a therapeutic dose to a partial volume of the breast for treatment of tumors. This device includes several design and engineering elements that make its components and operation significantly different from the GSR™ units currently regulated in 10 CFR Part 35, Subpart H. These engineering differences include the lack of helmets, relative helmet factors, helmet microswitches, hydraulic backups, trunnions, and a trunnion centricity point. Additionally, GammaPod™ has several engineering features that are not covered in Subpart H, including its vacuum-assisted breast cup immobilization and stereotactic localization system, rotating source and collimator carriers, and table motion during treatment. As a result, the NRC determined that the GammaPod™ should be regulated under 10 CFR Part 35, Subpart K. The agency issued the licensing guidance for the Xcision® Gammapod™ in January 2020 (ML19304B370).

3.3.6.3 ViewRay™ System

The ViewRay™ System, also distributed under the name MRIdian 10000, is a radiation therapy device containing three cobalt-60 sources on a rotating gantry assembly, integrated with a magnetic resonance imaging system capable of imaging during treatment. This device can be used for both teletherapy and GSR. Significantly different components and operation of the ViewRay™ System include realtime image guidance, multileaf collimation, and beam gating to block radiation should the patient move outside of a pre-set threshold. As a result, the NRC determined that the ViewRay™ System should be regulated under 10 CFR Part 35, Subpart K. The agency issued licensing guidance for the ViewRay™ System in July 2013 (ML13179A287).[16]

The NRC supports establishing regulations for advanced technology found in future teletherapy systems to capture operational experience.

[16] Although ViewRay™ System is no longer manufactured and distributed by ViewRay Technologies, Inc and the SS&D registry for the ViewRay™ System is inactive.

3.3.7 Microsource Manual Brachytherapy

Yttrium-90 microspheres are manual brachytherapy sources used as permanent implants for treatment of liver and hepatic tumors. TheraSphere® glass microspheres and SIR-Sphere® resin microspheres are delivered by flushing of the delivery vial using a manual or automatic delivery system through tubing into a prepositioned catheter placed in the patient's hepatic artery. The microspheres become lodged within the tumor vasculature and deliver radiation dose over several days until the microsources decay.

Yttrium-90 microspheres are described as manual brachytherapy devices that have use characteristics similar to the manual brachytherapy uses licensed under 10 CFR Part 35, Subpart F. However, Y-90 microspheres have many unique properties that merit radiation safety considerations other than those required by 10 CFR Part 35, Subpart F. These properties include their small size; the large number of microspheres used in a treatment; the route of administration (injection through tubing); and their use by radiation oncologists, nuclear medicine physicians, and interventional radiologists. Therefore, Y-90 microsphere manual brachytherapy sources do not fit under 10 CFR Part 35, Subpart F, and the NRC determined that Y-90 microspheres should be regulated under Subpart K. The agency issued the guidance to initially license Y-90 microspheres in October 2002 (ML082340866) and has revised it 12 times to address updates to devices, stakeholder input, and medical event reporting. The most recent licensing guidance was issued in April 2021 (ML21089A364).

The NRC's guidance currently describes two types of Y-90 microspheres, TheraSphere® and SIR-Spheres®. The NRC anticipates that additional technologies using permanent implantation therapy of microspheres or microparticles will require evaluation in the coming years. OncoSil™ uses phosphorus-32 embedded in silicon microparticles for the treatment of pancreatic cancer and has been issued an Investigational Device Exemption by the FDA for use in clinical trials. Additionally, QuiremSpheres® use holmium-166 microspheres for the treatment of liver and hepatic tumors through a similar mechanism to Y-90 microspheres but with improved imaging capabilities. QuiremSpheres® are currently used in Europe.

3.4 Other 10 CFR Part 35 Changes

In addition to conforming changes throughout 10 CFR Part 35 to establish regulations for the EMTs discussed above, the NRC is also considering additional changes to accommodate developments in the medical field related to new radiopharmaceuticals and EMTs. This section describes these additional regulatory issues being considered by the NRC, and section A.8 of appendix A describes the proposed changes.

Physician Definition (10 CFR 35.2)

The definition of "physician" in 10 CFR 35.2 is limited to an individual *with a medical degree (medical doctor or doctor of osteopathy)* who is licensed by a State or Territory in the United States, the District of Columbia, or the Commonwealth of Puerto Rico. This requirement limits a physician to a Doctor of Medicine or Doctor of Osteopathy degree, which means that to become an AU, licensed physicians with a foreign equivalent degree, such as Bachelor of Medicine, Bachelor of Surgery, to practice medicine in the United States must request an exemption from the "medical doctor or doctor of osteopathy" requirement. (This NRC definition of a "physician" is different from those for podiatrist, dentist, and pharmacist, which allow for an individual licensed to practice that specialty by a State or Territory in the United States, the District of Columbia, or the Commonwealth of Puerto Rico.)

Radiation Safety Committee (10 CFR 35.24)

Under 10 CFR 35.24, “Authority and responsibilities for the radiation protection program,” licensees must establish a Radiation Safety Committee if they are authorized for two or more different types of uses of byproduct material under Subparts E (“Unsealed Byproduct Material—Written Directive Required”), F, and H, or two or more types of units under Subpart H. The Radiation Safety Committee oversees all uses of byproduct material permitted by the license. The requirement states that the Radiation Safety Committee must include an AU of each type of use permitted by the license, the RSO, a representative of the nursing service, and a representative of management who is neither an AU nor an RSO. Based on the current language in 10 CFR 35.24, EMTs under 10 CFR Part 35, Subpart K, are not considered in the requirement to establish a Radiation Safety Committee, nor are AUs for EMTs required to be part of the Radiation Safety Committee. Furthermore, the requirement to include a representative of the nursing service as a Radiation Safety Committee member is unclear, because large medical institutions may have various nursing services, many with no responsibilities related to the use of licensed byproduct material.

Supervision (10 CFR 35.27)

The supervision regulation allows supervised individuals to receive, possess, prepare, use, and transfer byproduct material under the supervision of an AU or an authorized nuclear pharmacist. The licensee must instruct supervised individuals in, and require supervised individuals to follow, the licensee’s written radiation protection procedures, written directive procedures, applicable medical regulations, license conditions, and procedures for preparing byproduct material for medical use. This requirement clearly defines the instruction requirements for the supervised individual, but it does not clearly state that the supervising AU or authorized nuclear pharmacist has also been instructed in these same procedures, regulations, and license conditions (the T&E regulations in 10 CFR Part 35 do not require instructions in these specific topics). Furthermore, the regulation requires that the licensee be responsible only for the acts and omissions of the supervised individual, but not the acts and omissions of the supervising individual. The regulation should clearly state that the supervising individual must receive the same instruction as the supervised individual.

Procedures for Administrations Requiring a Written Directive (10 CFR 35.41)

Licensees are required to develop, implement, and maintain written procedures for any administration that requires a written directive to ensure that the patient’s or human research subject’s identity is verified before each administration and that each administration is in accordance with the written directive. However, licensees are not required to verify that the written directive is correct, nor are licensees required to take any initial or refresher training on the requirements for written directives. Given an increase in medical events involving incorrect written directives, the increase in number of medical procedures that require written directives, and the increase in the complexity of these procedures, the NRC is considering amending this regulation to require that licensees have procedures in place to verify that the written directive is correct, to require training on written directive procedures for AUs, and to require an annual review of the procedures.

Patient Release (10 CFR 35.75)

In accordance with 10 CFR 35.75, “Release of individuals containing unsealed byproduct material or implants containing byproduct material,” licensees may authorize the release from their control

of any individual who has been administered unsealed byproduct material or implants containing byproduct material if the total effective dose equivalent (TEDE) to any other individual from exposure to the released individual is not likely to exceed 5 millisieverts (0.5 rem). As clarified in the Statements of Consideration for the 1997 final rule for patient release criteria (62 FR 4120; January 29, 1997), this 5-millisievert (0.5-rem) TEDE limit to an individual from the released patient applies to each patient treatment.

As part of the staff's evaluation of the NRC's patient release program, documented in SECY-18-0015, "Staff Evaluation of the U.S. Nuclear Regulatory Commission's Program Regulating Patient Release after Radioisotope Therapy," dated January 29, 2018 (ML17279B139), the staff considered whether the patient release limit should be changed from a per-release limit to a per-year limit. The staff noted that rulemaking to require a per-year limit would be consistent with the occupational and public dose limits in 10 CFR Part 20, "Standards for Protection against Radiation," as well as with national and international standards. However, at the time of the evaluation, the staff concluded that rulemaking was not necessary to change the limit because it was rare for a patient to receive more than one radioactive treatment per year. However, since 2018, the FDA has approved several new therapeutic radiopharmaceuticals, including Lutathera® and Pluvicto®, which involve multiple administrations of lutetium-177 over the course of a single treatment regimen, and additional radiopharmaceuticals that include multiple administrations in a single treatment regimen are in clinical trials or research phases. Therefore, the assumption that it would be rare for a patient to receive more than one radioactive treatment per year no longer applies, and changes would be made to account for multiple releases for a single patient during a treatment regimen. Conforming changes would be made to define the term "regimen" in 10 CFR 35.2, update the written directive requirements in 10 CFR 35.40 to include "regimen," and update medical event reporting in 10 CFR 35.3045, "Report and notification of a medical event," to allow the AU to change a regimen during the treatment protocol if medically necessary.

Training and Experience

Each subpart in 10 CFR Part 35 contains the T&E requirements necessary for a physician to become an AU for the use described in that subpart. As directed by the Commission in SRM-SECY-20-0005, the NRC is seeking stakeholder feedback, through the questions in appendix A, on the knowledge topics encompassing the safety-related characteristics of EMTs required for AUs to fulfill their radiation safety-related duties and supervision roles; the methods on how knowledge topics should be acquired; and consideration for continuing education, vendor training for new medical uses, and training on NRC regulatory requirements. Stakeholder input will inform the establishment of T&E regulations for the EMTs addressed in this regulatory basis document.

Recentness of Training (10 CFR 35.59)

The requirements for continuing education and work experience do not currently include T&E for EMTs regulated under 10 CFR Part 35, Subpart K. Conforming changes would be made to this regulation to account for EMT T&E that would be established in 10 CFR Part 35.

4. Evaluation of Alternatives

This section summarizes the four alternatives that the NRC considered. Alternative 1 is the status quo, which involves the use of exemptions. Alternatives 2, 3, and 4 are rulemaking alternatives. These alternatives build on each other, with Alternative 2 being the most limited-scope rulemaking and Alternative 4 being the expanded-scope rulemaking. Under every alternative, EGM 13-003 would be retired, because it was intended for use only temporarily while the NRC determined an appropriate regulatory path. The regulatory framework of 10 CFR Part 35, Subpart K, would remain unchanged and available for future EMTs that may not fit into the revised medical use subparts of 10 CFR Part 35.

Costs are negative values and are denoted in parentheses; averted costs are positive values and are denoted without parentheses. All costs and averted costs are presented assuming a 7 percent discount rate to calculate the net present value (NPV) and are rounded to the nearest thousand. Costs and averted costs of each alternative are discussed in more detail in section 8 (cost considerations) and section 10 (rulemaking cost justification). Tables 5 and 6 and the tables in appendix B and appendix C give more details on costs.

The net cost information presented in tables 2, 3, and 4 below is derived from the NRC rulemaking costs in table 5 and from values in the detailed tables of appendix C. All values are 7% NPV.

4.1 Alternative 1—Status Quo

The staff evaluated maintaining the status quo. In this alternative, the NRC would use a non-rulemaking option to address the licensing of Rb-82 generators. Without rulemaking, approximately 220 NRC and Agreement State licensees would need to apply for exemptions from 10 CFR 35.60 and 10 CFR 35.63 to continue use of these generators. Submitting and processing exemptions would cost the NRC, Agreement States, and licensees approximately ($682,000) over 4 years using a 7 percent discount rate. Future Rb-82 generator licensees would also need to submit exemption requests. After exemptions are in place, the NRC, Agreement States, and licensees may realize some averted costs for Rb-82 generator inspection totaling $359,000 using a 7 percent discount rate over 15 years[17] associated with no longer having to document the conditions required for enforcement discretion. The estimated total net cost of Alternative 1 is ($324,000) over 15 years using a 7 percent discount rate.[18]

The staff does not recommend Alternative 1 because continuous and widespread use of exemptions would not be an effective means of regulating Rb-82 generators. Rather, establishing appropriate regulatory requirements for Rb-82 generators would eliminate the compliance issues that exist today and would provide a more efficient, clear, and reliable regulatory framework for these generators.

[17] The staff chose 15 years after the rule goes into effect for the NRC and the Agreement States as the period to evaluate operational savings resulting from implementation of the rule because this is the duration of a materials license.

[18] Alternatives 2, 3, and 4 would also retire EGM 13-003—through rulemaking instead of exemptions. Therefore, the net costs of these alternatives include the averted costs associated with avoiding the need for exemptions plus inspection efficiencies.

4.2 Alternative 2—Rulemaking Only for Rubidium-82 Generators

This rulemaking would solely address calibration and dosage measurement requirements for Rb-82 generators. It would not result in any changes related to EMTs. The estimated total net cost of Alternative 2 is ($1,042,000) over 15 years using a 7 percent discount rate. The advantages and disadvantages of the Alternative 2 rule are summarized in table 2.

Table 2: Advantages and Disadvantages of Alternative 2

Advantages
• This alternative would remove the need for licensees to submit exemption requests for 10 CFR 35.60 and 10 CFR 35.63 (exemptions would be required absent EGM 13-003 or a rulemaking). • The public would have an opportunity to comment on calibration and dosage measurement requirements for Rb-82 generators. • Regulatory openness, efficiency, clarity, and reliability for Rb-82 generators would improve and result in averted costs of $940,000 for the NRC, Agreement States, and licensees. The averted costs are associated with inspection efficiencies and avoiding the need for exemptions. • Rulemaking and implementation costs would be comparatively less than those for Alternatives 3 and 4: ($680,000) for the NRC and ($1,298,000) for the Agreement States.
Disadvantages
• The NRC would continue to license EMTs with extensive operating experience using guidance and without the benefit of public feedback on these established technologies. • Compatibility issues and inconsistency in guidance implementation for EMTs would continue across the National Materials Program. • Regulators and licensees would need continued resources to develop, maintain, and use 10 CFR 35.1000 licensing guidance, which is updated more frequently than other medical use guidance. • Because this rulemaking would address only Rb-82 generators, there would be no averted costs related to increased EMT licensing efficiencies, and the total net cost of Alternative 2 would be ($1,042,000) over 15 years.

4.3 Alternative 3—Limited-Scope Rulemaking to Establish Requirements for Rubidium-82 Generators and Certain Emerging Medical Technologies

In addition to Rb-82 generators, this limited-scope rulemaking would address GSR units and microspheres. These EMTs are well established and commonly used. Alternative 3 would amend 10 CFR Part 35 such that current and future GSR units could be licensed under 10 CFR Part 35, Subpart H, and the NRC would develop a new subpart for current and future microsphere and microparticle technologies. Rule language would be performance based, focusing on intended functions and outcomes rather than prescriptive requirements. For example, outdated requirements to test helmet microswitches and trunnions that no longer exist in newer generation GSR units would be replaced with testing requirements for functional items (e.g., dose delivery accuracy and positional accuracy). Risk-informed and performance-based requirements would be informed by operating experience, recommendations from the ACMUI, nationally recognized standards, recommendations from appropriate medical professional societies, and the medical community. The Alternative 3 rule would accommodate device updates and T&E changes for GSR units and would create a new subpart for microspheres and microparticles, with the goal of creating flexibilities to accommodate the safe use of potential new models and vendors of these technologies. The estimated total net averted cost of Alternative 3 is $959,000 over 15 years using a 7 percent discount rate. The advantages and disadvantages of the Alternative 3 rule are summarized in table 3.

Table 3: Advantages and Disadvantages of Alternative 3

Advantages
• The alternative would maintain safety while increasing regulatory openness, consistency, clarity, and reliability for commonly used EMTs and Rb-82 generators. • It would improve regulatory consistency and resolve compatibility issues across the National Materials Program for commonly used EMTs and resolve Rb-82 generator issues as discussed under Alternative 2. • The public would have an opportunity to comment on proposed regulations and associated licensing guidance for these commonly used EMTs. • The NRC would no longer develop or update EMT licensing guidance for these technologies. • It would require less resources than Alternative 4 by focusing NRC and Agreement State rulemaking resources on widely used, well-established EMTs with expected continued use. • The NRC, Agreement States, and licensees would realize increased licensing efficiencies for GSR units and microspheres, resulting in an estimated $1,031,000 in averted costs over 15 years for the NRC, an estimated $3,981,000 in averted costs over 15 years for Agreement States, and an estimated $672,000 in averted costs over 15 years for licensees.
Disadvantages
• The NRC would still require licensing under 10 CFR 35.1000 for other EMTs, precluding the regulatory benefits and efficiencies associated with establishing regulations for these technologies. • Rulemaking, rulemaking participation, and implementation for Alternative 3 would require more time and resources than under Alternative 2, resulting in costs of ($895,000) for the NRC, ($3,113,000) for Agreement States, and ($1,657,000) for affected licensees.

4.4 Alternative 4—Performance-Based Rulemaking to Increase Regulatory Flexibility (NRC Recommendation)

Alternative 4 is an expanded version of the Alternative 3 rulemaking. In addition to developing performance-based requirements for Rb-82 generators, GSR units, and microspheres/microparticles, the NRC would evaluate how to make additional sections of 10 CFR Part 35 more flexible. Alternative 4 would revise specifics in the 10 CFR Part 35 subparts for General Information, Technical Requirements, Administrative Requirements, Records, and Reports. Like Alternative 3 but on a larger scale, Alternative 4 would replace outdated, prescriptive quality assurance regulations with performance-based requirements informed by operating experience, recommendations from the ACMUI, nationally recognized standards, recommendations by appropriate medical professional societies, and the medical community. The Alternative 4 rule would enable licensing of all approved EMTs, future updates to currently licensed EMTs, and potentially new EMTs, with reduced reliance on 10 CFR 35.1000. The estimated total net averted cost of Alternative 4 is $1,169,000 over 15 years using a 7 percent discount rate. The advantages and disadvantages of the Alternative 4 rule are summarized in table 4.

Table 4: Advantages and Disadvantages of Alternative 4

Advantages
• Alternative 4 has advantages similar to those of Alternative 3 but on a larger scale. It would maintain safety while increasing regulatory openness, consistency, clarity, reliability, public participation, and efficiency. • It would reduce reliance on 10 CFR 35.1000 by developing performance-based requirements for all well-established EMTs that would accommodate updated or new EMT models, new vendors, and similar new technologies. • The NRC and Agreement States would realize increased licensing efficiencies for EMTs included in the Alternative 4 rulemaking, resulting in estimated averted costs of $1,153,000 over 15 years for the NRC and $4,298,000 in averted costs over 15 years for Agreement States.
Disadvantages
• The medical community has a good understanding of the current licensing framework for EMTs; therefore, not all stakeholders may fully support changing this framework significantly under the Alternative 4 rulemaking. • Alternative 4 would be the most resource-intensive rulemaking and would require the most time to complete of the three alternatives. Rulemaking, rulemaking participation, and implementation costs would be ($1,658,000) for the NRC and ($2,939,000) for the Agreement States. Rulemaking participation and implementation costs for affected licensees would be similar to those under Alternative 3 at ($1,546,000).

4.5 Recommendation

The NRC recommends Alternative 4, “Performance-Based Rulemaking to Increase Regulatory Flexibility.” The Alternative 4 rulemaking would provide an opportunity for more risk-informed, performance-based regulation of existing and potentially new EMTs. Rather than regulating each EMT and use on a case-by-case basis through license conditions that make prescriptive EMT licensing guidance legally binding, the revised regulations and accompanying licensing guidance would focus on the essential performance-based requirements that focus on outcomes necessary to promote radiation safety and to protect workers, the general public, and patients. Alternative 4 would also allow the NRC to address the flexibility of other regulations in 10 CFR Part 35, which would improve the NRC’s regulation of future medical uses. The NRC staff previously provided a similar evaluation of the four alternatives and rulemaking recommendation in SECY-21-0013, and the Commission approved the Alternative 4 rulemaking in the SRM to SECY-21-0013.

5. Basis for Proposed Changes

Appendix A explains the proposed changes to 10 CFR Part 35 that the NRC is considering, discusses the technical bases and assumptions used to support those changes, and describes how the considered changes could resolve the issues identified in section 3 of this document.

Most of the changes described in appendix A would establish regulations to codify the essential safety-related elements of existing EMT licensing guidance. Licensees authorized to use these EMTs are likely already in compliance with the changes described in appendix A. However, stakeholder feedback on this regulatory basis will inform the proposed rule, so the NRC is requesting stakeholder input throughout appendix A on certain regulatory issues or proposed regulatory approaches to an issue. The NRC is particularly interested in feedback (with bases and rationale) on the following topics: (1) whether there is enough operating experience to inform regulations for diffusion brachytherapy, (2) whether the effort to establish regulations for less widely used EMTs is warranted, (3) the proposed regulatory framework for the new “microsource

manual brachytherapy" subpart, and (4) whether changes to T&E requirements for EMTs are warranted.

6. Backfitting and Issue Finality Analysis

There are no backfitting or issue finality provisions in 10 CFR Part 35. The Commission's backfitting provisions and issue finality provisions do not apply to the applicants or licensees that would be affected by this rulemaking.

7. Stakeholder Involvement

Members of the public will have an opportunity to comment on this regulatory basis document, and those comments will inform the draft proposed rule.

7.1 Agreement States

In accordance with Management Directive 5.3, "Agreement State Participation in Working Groups," dated June 22, 2016 (ML18073A142), the staff provided early opportunities for Agreement State engagement on this rulemaking. A representative from the OAS served on the working group that developed the rulemaking plan (SECY-21-0013), and Agreement States were given an opportunity to comment on the draft rulemaking plan. A representative from the OAS served on the working group that developed this regulatory basis, and one or more OAS representatives will participate in the rulemaking working group that will develop the proposed and final rules.

The Agreement States had an opportunity to review a draft of this regulatory basis and provide comments. The OAS Board provided detailed comments and feedback throughout the draft of this regulatory basis (ML23003A023). The State of Arkansas provided detailed comments on appendix A to the draft of this regulatory basis (ML23003A021). Following is a summary of the comments from the OAS and the NRC's responses to the comments:

- In general, the OAS Board indicated support of the proposed training requirements for radionuclide generators and 10 CFR Part 35, Subpart H, devices.

- The OAS Board stated that the NRC should consider scaling back some of the regulatory development for this rulemaking effort. Developing medical uses should be allowed to be authorized under emerging technologies; this will allow for appropriate regulations to be based on guidance that may be revised. Implementing regulations for developing medical uses may have unintended consequences, such as having to issue enforcement discretion guidance or process exemption requests for regulations that no longer apply as the medical use evolves. The NRC considered this feedback and determined that, given a lack of operating experience, this rulemaking effort would not address diffusing brachytherapy sources. However, the NRC intends to create flexibilities within 10 CFR Part 35 to allow future EMTs to be immediately regulated in 10 CFR Part 35, Subparts D through I. The NRC staff does not believe EMTs that fit within the regulatory framework need to be licensed under 10 CFR Part 35, Subpart K, for any prescribed amount of time.

- The OAS Board recommended that the NRC consider developing a T&E pathway for individuals who administer radioactive materials. The NRC recognizes that individuals administering radioactive material, such as technologists, have an important role in the medical use of byproduct material. However, the licensee is responsible for ensuring that

the T&E of individuals working under the supervision of an AU or authorized nuclear pharmacist (ANP) is adequate. Supervision requirements in 10 CFR 35.27 are in place to ensure that individuals working under the supervision of an AU or ANP receive adequate training. Therefore, this rulemaking would not establish T&E requirements for technologists or other individuals using byproduct material under the supervision of an AU or ANP. Additionally, the NRC considered alternate T&E options for AUs in SECY-20-0005, dated January 13, 2020. The Commission directed the staff to maintain the current T&E requirements, as described in SRM-SECY-20-0005. However, the NRC staff is developing guidance to clarify the agency's expectations for current T&E requirements.

- The OAS board recommended that the NRC consider developing a structured pathway with defined metrics for determining that a type of medical use of radioactive materials is no longer an emerging technology. The NRC staff believes this is a policy issue and will consider this suggestion.

7.2 Advisory Committee on the Medical Uses of Isotopes

The NRC's Advisory Committee on the Medical Uses of Isotopes (ACMUI) had an opportunity to review a draft of this regulatory basis. The ACMUI Subcommittee on Emerging Medical Technologies/Rubidium-82 Generator Rulemaking Draft Regulatory Basis provided a draft recommendation report, submitted November 18, 2022 (ML22322A157), which was discussed and voted on by the full Committee during a public meeting on December 5, 2022.[19] The ACMUI approved the Subcommittee's report, which was finalized on December 19, 2022 (ML22353A053), and includes responses to the questions posed in appendix A to this document. The NRC responded to the Subcommittee's report and transmitted correspondence to ACMUI regarding resolution of the comments on May 3, 2023 (ML23122A118). The following is a summary of the comments from the ACMUI and the NRC's responses to the comments:

- Some ACMUI members believe the scope of the proposed rulemaking is ambitious, but reasonable. Other members believe the scope of the proposed rulemaking should be limited to products that are in broader use because time and clinical experience are needed to understand the technology and safety issues before codifying requirements via rulemaking. The NRC staff reviewed the proposed changes in light of the ACMUI comments. The review was based on the operating experience of each technology, which includes the breadth of use and the maturity of the technology. Additionally, the NRC staff assessed the scope of regulatory changes that would be needed to move each EMT from 10 CFR Part 35, Subpart K, into another subpart of 10 CFR Part 35.

- The ACMUI recommended not moving diffusing brachytherapy sources from 10 CFR Part 35, Subpart K, to 10 CFR Part 35, Subpart F. The NRC staff determined not to address diffusing brachytherapy sources at this time based on a lack of operating experience.

- The ACMUI recommended that the NRC create a contamination control requirement for IVB and diffusing sources. The NRC staff considered this suggestion and is proposing a contamination control requirement for all medical licensees. Currently, NRC guidance asks licensees to make general commitments regarding contamination control. This proposed change would reduce the number of commitments that licensees would need to make during licensing.

[19] ACMUI meeting summary (ML23005A166) and transcript (ML23012A007)

- The ACMUI recommended not moving the Gammapod™ and the ViewRay™ System from 10 CFR Part 35, Subpart K, into 10 CFR Part 35, Subpart H. The NRC staff believes the changes to Subpart H for the two 10 CFR Part 35, Subpart K, Gamma Knife® units would also cause the Gammapod™ and the ViewRay™ System to be moved into Subpart H. The general approach to the revision is to reduce the reliance on specific components and refer to objective requirements. Based on this approach, the two Gamma Knife® units (the Gammapod™ and the ViewRay™ System) could be licensed under the revised 10 CFR Part 35, Subpart H.

- The ACMUI recommended that the NRC revise the licensing process for ophthalmic applicator systems. Specifically, the ACMUI suggested that the NRC comprehensively reevaluate the requirements for ophthalmic applicator systems licensed under 10 CFR Part 35, Subpart F and Subpart K. The Subcommittee also recommended that training requirements for physicians and physicists be streamlined and cautioned the NRC against using prescribed dose as a basis for various training pathways. The NRC staff does not believe the impact on licensees currently using ophthalmic applicator systems under 10 CFR Part 35, Subpart F, is justified by a wholesale revision of the requirements. The current regulatory structure has provided reasonable assurance of adequate protection of public health and safety, and the NRC staff views the potential impacts on currently licensed Subpart F ophthalmic sources as an undue burden. The ACMUI also stated that requirements for ophthalmic sources that are no longer distributed should not be moved from Subpart K to Subpart F. However, the NRC staff believes the valuable operating experience already gained allows for incorporating more complex ophthalmic applicators into Subpart F. During this rulemaking effort, the NRC staff will continue to evaluate whether amending Subpart F for the ophthalmic applicator systems is reasonable.

8. Cost/Impact Considerations

This section discusses cost and other impacts related to the Alternative 4 rulemaking for Rb-82 generators and EMTs. This section discusses potential impacts on three groups: (1) the NRC, (2) the Agreement States, and (3) the licensees. The analyses presented in this section are based on the NRC's preliminary assessment and estimates. The staff will carry out a more detailed cost/impact evaluation as part of the draft regulatory analysis that will be done in accordance with NUREG/BR-0058, Revision 5, "Regulatory Analysis Guidelines of the U.S. Nuclear Commission, Draft Final Report," dated January 28, 2020 (ML19261A277), during the proposed rule phase of the rulemaking.

8.1 Affected Entities

The proposed changes to 10 CFR Part 35 would impact NRC and Agreement State materials licensees that currently use, or will apply to use in the future, Rb-82 generators, existing EMTs, and future EMTs that can be licensed under the revised 10 CFR Part 35 subparts. These licensees are mostly 10 CFR Part 35 licensees but, for some generator systems, can also include licensees regulated under 10 CFR Part 32, "Specific Domestic Licenses to Manufacture or Transfer Certain Items Containing Byproduct Material." The affected entities of the Alternative 4 rulemaking are these materials licensees, the NRC, and the Agreement States.

Sections 8.3 through 8.5 present Alternative 4 rulemaking costs, implementation costs, and averted costs associated with licensing and inspection for the NRC, Agreement States, and licensees. Costs are negative values and are denoted in parentheses; averted costs are positive

values and are denoted without parentheses. All costs and averted costs are presented assuming a 7 percent discount rate to calculate the NPV and are rounded to the nearest thousand.

8.2 Analysis Assumptions

Cost estimates for the four alternatives include several actions related to rulemaking, implementation of the new rule, and licensing actions under the new rule, which would be done by the NRC, Agreement States, and affected licensees. The assumptions used in developing the cost estimates are based on (1) a search of the NRC's Web-Based Licensing system for an approximate number of NRC-licensed EMTs and Rb-82 generators, (2) labor and licensing action estimates provided by NRC regional licensing and inspection staff, and (3) information from STC-22-034, "Results of the Annual Count of Radioactive Materials Licenses in the National Materials Program," dated May 19, 2022 (ML22139A026).

For calculating future costs, the cost estimate assumes 40 Agreement States. This estimate assumes that recent Agreement State applicants Connecticut and Indiana would be Agreement States by the effective date of the rulemaking and excludes Wyoming, which does not have regulatory jurisdiction over materials that would be impacted by this rulemaking.[20] According to the licensee count data from STC-22-034, the total number of medical use licenses issued by the NRC and Agreement States is 7,933. Using that data, by the effective date of this rule, the NRC would regulate about 7 percent of the total number of medical use licensees in the National Materials Program (555 NRC medical licensees) and Agreement States would regulate about 93 percent (7,378 Agreement State medical licensees).

NRC regional licensing and inspection staff developed hourly labor estimates for (1) review of EMT license applications, renewals, and various amendments under the existing 10 CFR 35.1000 EMT licensing guidance process and under a revised 10 CFR Part 35, (2) inspection of Rb-82 generators after EGM 13-003 is retired, (3) review of requests for exemption from 10 CFR 35.60 and 10 CFR 35.63 for Rb-82 generators, and (4) implementation of the new rule by licensees, the NRC, and Agreement States. The NRC relied on the experience of NRC regional licensing and inspection staff to develop the hourly labor estimates associated with licensing actions and inspections, and the NRC estimated the number of future licensing actions based on historical workload and the probable future use of the EMT or a similar technology. The staff combined the hourly labor estimates with information from the NRC's Web-Based Licensing system on numbers of affected licensees, along with the estimated numbers of future EMT applications, to develop estimated costs and averted costs for each of the alternatives. These NRC-based estimates were also applied to the Agreement States, although the NRC acknowledges that there is variability among the NRC and Agreement States in the hourly labor resources required for licensing actions and inspections.

The NRC estimated that the agency and Agreement States would realize increased efficiencies in licensing actions for existing and future EMTs after implementation of the Alternative 3 or Alternative 4 rules. This is because EMT licensing actions would no longer require review and documentation of additional specific license conditions based on the EMT licensing guidance or other approved methods for compliance with the safety objectives of the licensing guidance. Table 7 in appendix B details the future EMT licensing resource assumptions that the NRC used to calculate the averted costs for EMT licensing under the Alternative 4 rule. Appendix B, table 8

[20] West Virginia submitted a letter of intent but the letter was received too late to include West Virginia as a potential Agreement State for this regulatory basis. If the NRC publishes a proposed rule, the NRC will consider the impact from West Virginia's potential change in status at that time.

shows the NRC's assumptions and data for each alternative, including the assumptions explained in appendix B, table 7.

8.3 NRC

The NRC estimates that the projected costs of Alternative 4 for the agency consist of (1) rulemaking costs of ($1,381,000), (2) rulemaking implementation costs of processing license amendments for affected NRC licensees plus compatibility reviews of new Agreement State regulations of ($277,000), (3) averted costs of $102,000 associated with avoiding the need to review Rb-82 generator exemptions, and (4) after the Alternative 4 rule goes into effect, averted costs of $1,202,000 over a 15-year period through increased licensing efficiency for EMTs, increased inspection efficiencies for Rb-82 generators, and a minimized need to develop and update EMT licensing guidance documents. The net averted cost for the NRC over 15 years would be $353,000 using a 7 percent discount rate.

8.4 Agreement States

The Agreement States will participate in the NRC's rulemaking process through the rulemaking working group, government-to-government and public meetings, and reviewing and providing written comments on rulemaking documents. The NRC estimates that for the Alternative 4 rulemaking, the Agreement States will incur a total cost of ($170,000) for participation in the NRC rulemaking process. After the Alternative 4 rule is effective, the Agreement States have 3 years to adopt compatible regulations. Following this, the Agreement States will need to implement their new regulations, which the staff assumed would be similar to NRC implementation (i.e., processing license amendments for affected licensees). The NRC estimates that the Agreement States will have total rulemaking and implementation costs of approximately ($2,769,000). Agreement State rulemaking costs may be lower if the Agreement States choose to incorporate the regulatory changes by reference. The Agreement States would realize averted costs associated with avoiding the need to review Rb-82 generator exemptions of $442,000. After the Agreement States adopt compatible regulations for the Alternative 4 rulemaking, the NRC estimates averted costs for the Agreement States of $4,417,000 over a 15-year period. Averted costs would result from increased efficiencies in licensing existing and future EMTs and increased inspection efficiencies for Rb-82 generators. The net averted costs for the Agreement States over 15 years would be $1,920,000 using a 7 percent discount rate.

8.5 Licensees

The NRC estimates that licensees would incur a cost of ($63,000) to voluntarily participate in the rulemaking process (this could include participating in public meetings and reviewing and submitting comments on rulemaking documents). The NRC estimates that affected licensees would incur total implementation costs of ($1,484,000). Implementation costs would impact medical licensees with uses that are currently licensed under 10 CFR Part 35, Subpart H (i.e., licensees using GSR, teletherapy, or HDR afterloader devices). The NRC believes that these licensees may need to revise their procedures related to calibration and spot checks of these devices, train their staff on revised procedures, and potentially submit revised procedures to the NRC or Agreement States as either a notification or license amendment application. The NRC

estimated that affected licensees may need an average of 20 hours each to complete these implementation tasks.

The NRC does not anticipate that other changes to 10 CFR Part 35 would result in additional implementation costs for licensees. This is because the proposed revisions to 10 CFR Part 35 would primarily establish regulations from existing EMT licensing guidance documents that many EMT licensees already comply with through license conditions, and additional changes being considered to 10 CFR Part 35 would clarify existing regulations. However, the NRC will further examine implementation costs for each proposed regulation change as part of the draft regulatory analysis for the proposed rule.

Licensees with Rb-82 generators would save $138,000 associated with avoiding the costs of submitting exemptions from 10 CFR 35.60 and 10 CFR 35.63, and they may see increased Rb-82 generator inspection efficiencies, estimated to result in averted costs of $89,000 over 15 years.

Some medical licensees may realize increased efficiencies similar to those realized by the NRC and Agreement States in licensing existing and future EMTs because licensing EMTs would no longer require license conditions to impose EMT licensing guidance commitments. Furthermore, licensees would benefit from the increased reliability and clarity of regulations versus guidance. The NRC estimated that averted costs for licensees through increased EMT licensing efficiencies could range from 0 to 25 percent of the estimated averted costs for the NRC and Agreement States. For this initial benefit-cost analysis, the NRC assumed EMT licensing averted costs for licensees would be 12.5 percent of the estimated averted costs for the NRC and Agreement States. This assumption results in averted EMT licensing costs of $922,000 over 15 years for licensees. Net costs for licensees over 15 years would be ($398,000) using a 7 percent discount rate.

The NRC is seeking public input on whether licensees would realize averted costs related to more streamlined licensing of existing and future EMTs and why or why not. Based on this feedback, the NRC will further refine EMT licensing averted costs in the draft regulatory analysis for the proposed rule.

8.6 Summary of Alternatives and Cost

Table 5 summarizes alternatives and net benefits (costs), and table 6 gives Alternative 4 net benefits for the NRC, Agreement States, and licensees. Appendix B to this regulatory basis tabulates the assumptions and inputs by alternative for each affected entity. Appendix C summarizes Alternatives 1–4 and shows the costs and averted costs for each alternative for the NRC, Agreement States, and licensees. The summary information in tables 5 and 6 below is derived from 7% NPV totals in the detailed costs and averted costs tables in appendix C.

Table 5: Alternatives and Net Benefits (Costs)

DESCRIPTION	Net Benefits (Costs) in 2022 Dollars		
	Undiscounted	7% NPV	3% NPV
Alternative 1—STATUS QUO			
NRC Rulemaking	$0	$0	$0
Alternative 1 NRC	($3,861)	($44,367)	($26,290)
Alternative 1 Agreement States	($185,966)	($275,576)	($240,396)
Alternative 1 Licensees	$73,230	($3,901)	$31,101
Alternative 1 Total Net Benefits (Costs)	($116,597)	($323,844)	($235,586)

DESCRIPTION	Net Benefits (Costs) in 2022 Dollars		
	Undiscounted	7% NPV	3% NPV
Alternative 2—RULEMAKING ONLY FOR RB-82 GENERATORS			
Alternative 2 NRC Rulemaking	($537,000)	($505,624)	($522,858)
Alternative 2 NRC	($112,020)	($125,658)	($124,261)
Alternative 2 Agreement States	($1,344,015)	($1,178,991)	($1,288,805)
Alternative 2 Licensees	$231,895	$85,417	$148,743
Averted Rb-82 Generator Exemptions	$798,276	$682,461	$744,927
Alternative 2 Total Net Benefits	($962,865)	($1,042,394)	($1,042,254)
Alternative 3—LIMITED SCOPE RULEMAKING FOR RB-82 GENERATORS AND CERTAIN EMERGING MEDICAL TECHNOLOGIES			
Alternative 3 NRC Rulemaking	($760,867)	($716,410)	($740,829)
Alternative 3 NRC	$1,846,893	$852,613	$1,307,612
Alternative 3 Agreement States	$5,796,213	$867,845	$2,953,340
Alternative 3 Licensees	($743,329)	($984,871)	($934,423)
Averted Rb-82 Generator Exemptions	$798,276	$682,461	$744,927
Rb-82 Generator Inspection Efficiencies	$689,327	$257,331	$443,241
Alternative 3 Total Net Benefits	$7,626,514	$958,969	$3,773,869
Alternative 4—PERFORMANCE-BASED RULEMAKING TO INCREASE REGULATORY FLEXIBILITY [STAFF RECOMMENDATION]			
Alternative 4 NRC Rulemaking	($1,545,939)	($1,380,706)	($1,470,782)
Alternative 4 NRC	$2,110,680	$875,696	$1,429,820
Alternative 4 Agreement States	$7,300,572	$1,358,865	$3,829,513
Alternative 4 Licensees	$33,659	($624,569)	($403,405)
Averted Rb-82 Generator Exemptions	$798,276	$682,461	$744,927
Rb-82 Generator Inspection Efficiencies	$689,327	$257,331	$443,241
Alternative 4 Total Net Benefits	$9,386,576	$1,169,078	$4,573,314

Notes: NPV = Net Present Value
Values in parentheses (e.g., ($3,861)) are negative and denote a cost.

Table 6: Alternative 4 Net Benefits for NRC, Agreement States, and Licensees

DESCRIPTION	**Net Benefits (Costs) in 2022 Dollars**		
	Undiscounted	**7% NPV**	**3% NPV**
NRC Rulemaking	($1,545,939)	($1,380,706)	($1,470,782)
NRC Regulatory Review of Agreement State Regulations	($234,520)	($167,465)	($202,358)
NRC Rule Implementation	($144,144)	($109,967)	($128,070)
NRC Averted Rb-82 Generator Exemption Request Review Costs	$113,256	$102,384	$108,356
NRC Averted Rb-82 Generator Inspection Costs	$116,780	$49,159	$79,084
NRC Averted EMT Licensing Costs	$1,552,694	$719,248	$1,097,931
NRC Averted EMT Licensing Guidance Costs	$936,650	$433,880	$662,318
NRC Alternative 4 Net Benefits	**$794,777**	**($353,465)**	**$146,478**

DESCRIPTION	Net Benefits (Costs) in 2022 Dollars		
	Undiscounted	7% NPV	3% NPV
Agreement State Rulemaking Participation	($187,871)	($170,226)	($179,821)
Agreement State Development of Regulations and Rule Implementation	($3,877,172)	($2,768,590)	($3,345,457)
Agreement State Averted Rb-82 Generator Exemption Request Review Costs	$522,287	$442,274	$485,348
Agreement State Averted Rb-82 Generator Inspection Costs	$336,585	$118,947	$211,463
Agreement State Averted EMT Licensing Costs	$11,365,615	$4,297,681	$7,354,791
Agreement State Alternative 4 Net Benefits	**$8,159,443**	**$1,920,085**	**$4,526,323**
Licensee Rulemaking Participation	($73,970)	($62,638)	($68,738)
Licensee Rule Implementation	($2,330,044)	($1,483,689)	($1,912,107)
Licensee Averted Rb-82 Generator Exemption Request Costs	$162,733	$137,803	$151,224
Licensee Averted Rb-82 Generator Inspection Costs	$235,963	$89,225	$152,694
Licensee Averted EMT Licensing Costs	$2,437,673	$921,758	$1,577,440
Licensee Alternative 4 Net Benefits	**$432,356**	**($397,541)**	**($99,487)**
Alternative 4 Total Net Benefits	**$9,386,576**	**$1,169,078**	**$4,573,314**

Notes: NPV = net present value
Values in parentheses (e.g., ($10,000)) are negative and denote a cost.

The NRC is recommending Alternative 4, “Performance-Based Rulemaking to Increase Regulatory Flexibility.” The Alternative 4 rulemaking would have a total net benefit of approximately $1,169,000 in averted costs over a 15-year period using a 7 percent discount rate after NRC and Agreement State implementation of the rule. Most costs for the Alternative 4 rulemaking are borne by affected licensees for updating certain safety procedures for GSR, teletherapy, or HDR afterloader devices (see section 8.5; this cost is the same for licensees under Alternative 3); the NRC for the rulemaking process; and the Agreement States for the development of compatible regulations. However, the Alternative 4 rulemaking would result in averted costs for the NRC, the Agreement States, and potentially also the licensees, through increased licensing efficiency for existing and future EMTs. Additionally, the NRC would save resources by minimizing the need to develop new or update existing 10 CFR 35.1000 licensing guidance documents. While licensee net benefits are negative based on a 7 percent and 3 percent discount rate, undiscounted net licensee benefits are $432,000. This indicates that benefits (primarily averted EMT licensing costs) are realized later than rulemaking costs (primarily rule implementation).

8.7 Additional Unquantified Benefits of Proposed Changes

- Establishing regulations for commonly used EMTs would promote consistency, compatibility, clarity, reliability, and efficiency across the National Materials Program for licensing, inspection, and enforcement to ensure adequate safety for the use of these medical technologies.

- Adding requirements for calibration and dosage measurement for Rb-82 generators would address the regulatory issues associated with the longstanding EGM 13-003 and would increase inspection efficiency for Rb-82 generators.

- Revising the requirements in the existing medical use subparts of 10 CFR Part 35 to be less prescriptive and more performance based could allow the NRC to license new EMTs with less reliance on 10 CFR Part 35, Subpart K, which would improve the overall applicability of 10 CFR Part 35 for expected future medical uses of byproduct material. This could increase the availability of EMTs for patient use, because currently, if licensing guidance has not yet been developed for an EMT, the use of that EMT is typically limited to broad-scope licensee facilities.

- Similarly, establishing regulations that focus on the essential safety-related elements of EMT licensing guidance would minimize the need to develop new EMT licensing guidance for new models or vendors of existing EMTs and the need to update outdated licensing guidance. Licensees could use new and or updated models of EMTs without waiting for revised licensing guidance, and patients could receive treatment with these EMTs without undue delay.

- Revising requirements related to the definition of “physician,” patient release limits per treatment regimen, and radiation safety committees would improve the clarity of these requirements and improve the efficiency of patient release planning.

- Adding provisions to require confirmation of the accuracy of a written directive, require training on written directive procedures, and require that supervising individuals be instructed in basic safety procedures and pertinent regulations would improve radiation safety for patients and workers.

- Rulemaking will include opportunities for public comment on proposed requirements for Rb-82 generators and EMTs, and this feedback could result in improved knowledge of these technologies.

9. Uncertainty Analysis

Appendix D documents the NRC’s uncertainty analysis for this regulatory basis. To inform the uncertainty analysis, the NRC completed a Monte Carlo sensitivity analysis using the specialty software @Risk®. The Alternative 4 mean net benefit is approximately $1,169,000 in 2022 dollars, with a 90 percent confidence interval that net averted costs are between $574,000 and $1,755,000 using a 7 percent discount rate. In addition to estimating the probability distributions for the net benefits (costs) of the rule, the staff used Monte Carlo simulation to conduct a sensitivity analysis to determine the variables that have the greatest impact on the resulting net costs. The NRC is seeking public comment on whether and how licensees would realize increased EMT licensing efficiencies and averted costs after the Alternative 4 rule is implemented.

10. Rulemaking Cost Justification

The NRC estimates that, considering overall costs and averted costs for the NRC, Agreement States, and licensees, the Alternative 4 rulemaking would be cost justified, resulting in a net benefit of $1,169,000 in averted costs at a 7 percent discount rate over the 15-year analysis period. This estimate may increase or decrease based on input from licensees on whether and how they would

realize averted costs associated with licensing EMTs after the Alternative 4 rule is implemented. The draft regulatory analysis of the proposed rule will examine in more detail the NRC's assumption that licensees would save at a rate of 12.5 percent of the NRC and Agreement State averted costs. Furthermore, based on a 3 percent discount rate, the Alternative 4 rulemaking would have a total net benefit of $4,573,000 in averted costs over 15 years. The net benefits are broken down by NRC, Agreement States, and licensees below (and in table 6).

- The NRC estimates a cost of ($1,658,000) for rulemaking, implementation of the rule, and review of Agreement State regulations (see table 6 in section 8 and tables 32 and 33 in appendix C). The NRC estimates it will save 19,017 labor hours for EMT licensing and Rb-82 generator licensing and inspection actions over the 15-year analysis period after implementation of the rule (including avoiding the need to review Rb-82 generator exemptions and reducing the need to develop new or update existing EMT licensing guidance documents). These labor hour savings result in averted costs of approximately $1,305,000 at a 7 percent discount rate over the 15-year analysis period (see tables 9, 19, 38, and 39 in appendix C). Net costs for the NRC over 15 years would be ($353,000) using a 7 percent discount rate.

- The NRC estimates a cost of ($2,939,000) for rulemaking and implementation of compatible regulations for Agreement States (see tables 34 and 35 in appendix C). The NRC estimates that Agreement States will save 166,838 labor hours for EMT licensing and Rb-82 generator licensing and inspection actions over the 15-year analysis period after implementation of the rule by the Agreement States (including avoiding the need to review Rb-82 generator exemptions). These labor hour savings result in averted costs of $4,859,000 at a 7 percent discount rate over the 15-year analysis period (see tables 11, 20, and 40 in appendix C). Net averted costs for Agreement States over 15 years would be $1,920,000 using a 7 percent discount rate.

- The NRC estimates a total cost of ($1,546,000) for licensees to participate in the Alternative 4 rulemaking and implement the rule (see tables 36 and 37 in appendix C). Licensees will save 21,886 labor hours for EMT licensing and Rb-82 generator licensing and inspections (including avoiding the need to submit exemption requests for Rb-82 generators) over the 15-year analysis period after implementation of the rule across the National Materials Program. These labor hour savings result in averted costs of $1,149,000 at a 7 percent discount rate over the 15-year analysis period (tables 13, 21, and 41 in appendix C). The NRC will use public comments on this regulatory basis to refine estimated licensee averted costs during the draft regulatory analysis for the Alternative 4 rule. Net costs for licensees over 15 years would be ($398,000) using a 7 percent discount rate.

11. Cumulative Effects of Regulation

The NRC has implemented a program to address the possible cumulative effects of regulation in the development of regulatory bases for rulemakings. The cumulative effects of regulation are an organizational effectiveness challenge that results from a licensee or other affected entity implementing several complex positions, programs, or requirements within a prescribed implementation period and with limited available resources. The proposed rulemaking activity to establish requirements for Rb-82 generators and EMTs would reduce the future licensing effort for licensees and regulators by providing a streamlined regulatory structure for regulating Rb-82 generators and licensing existing and future EMTs. Licensees authorized for Rb-82 generators will no longer need to rely on enforcement discretion or request exemptions from current regulatory

requirements that cannot be met given the generator design, and licensees and regulators will no longer need to rely on 10 CFR 35.1000 licensing guidance to license existing and some future EMTs. There will be implementation costs for licensees authorized under Subpart H of 10 CFR Part 35. The NRC is requesting feedback from the public at the regulatory basis stage on the cumulative effects that may result from the NRC rulemaking to amend 10 CFR Part 35 as described in the regulatory basis.

12. Regulatory Flexibility Act

The Regulatory Flexibility Act, as amended by the Small Business Regulatory Enforcement Fairness Act, requires the NRC to consider the impact of its rulemakings on small entities and evaluate alternatives that would accomplish regulatory objectives without unduly burdening small entities or erecting barriers to competition. In developing the proposed rule, the staff will evaluate the number of small entities potentially affected by this rulemaking and identify steps the NRC can take to mitigate the economic impacts on small entities. The staff will use public comments received on this document to inform this analysis.

13. Environmental Analysis

This rulemaking would revise 10 CFR Part 35 to add requirements for the calibration and dosage measurement for Rb-82 generators and establish risk-informed, performance-based requirements for existing and future EMTs. Pursuant to 10 CFR 51.21, “Criteria for and identification of licensing and regulatory actions requiring environmental assessments,” the NRC will develop an environmental assessment along with this rulemaking to determine whether issuing this rule would result in potentially significant environmental impacts. The rulemaking would also revise 10 CFR Part 35 to change requirements related to training and experience, recordkeeping, and reporting requirements. Changes to training and experience and reporting requirements are categorically excluded from conducting an environmental review.

14. NRC Strategic Plan

The planned rulemaking supports the NRC’s Strategic Plan (NUREG-1614, Volume 8, “Strategic Plan, Fiscal Years 2022–2026,” issued April 2022 (ML22067A170) to ensure the safe and secure use of radioactive material and inspire stakeholder confidence in NRC actions. The rulemaking will contribute to the safety and security objective, “Ensure that Regulatory Requirements Adequately Support the Safe and Secure Use of Radioactive Materials,” by improving the effectiveness and efficiency of the regulatory framework for EMTs and Rb-82 generators. The requirements for the safe use of these EMTs are better understood than when they were initially licensed, and 10 CFR Part 35 can be amended to make changes needed for more risk-informed and performance-based regulations for these technologies. Furthermore, since the design of Rb-82 generators is such that licensees cannot meet the calibration and dose measurement requirements in 10 CFR 35.60 and 10 CFR 35.63, revising 10 CFR Part 35 to add requirements for alternative methods that account for the calibration and dose measurement issues will improve regulatory effectiveness and efficiency for licensing and inspection. The NRC currently exercises enforcement discretion, but this is not intended to be a long-term solution.

Stakeholders will have opportunities to comment on this rulemaking, as well as participate in public meetings. The NRC will consider all comments on the regulatory basis in preparing the proposed rule. Public comments on the proposed rule will be considered in preparing the final rule.

15. Decision Rationale

The NRC supports revising 10 CFR Part 35 to (1) establish calibration and dosage measurement requirements for Rb-82 generators, (2) establish risk-informed, performance-based requirements for existing EMTs based on operating experience, and (3) replace other outdated, prescriptive requirements with risk-informed, performance-based requirements. The Alternative 4 rule would align the NRC's medical regulations with advances in technology and operating experience gained since the last major medical rulemaking in 2002; would promote consistency, compatibility, clarity, reliability, and efficiency across the National Materials Program for licensing and inspection of these medical uses; improve the overall flexibility of 10 CFR Part 35 to better accommodate future EMTs; and as discussed in section 10, avert some costs to the NRC and Agreement States.

16. References

Atomic Energy Act of 1954, Pub. L. 83-703, 42 U.S.C. 2011 et seq.

Regulatory Flexibility Act of 1980, Pub. L. 96-354, 5 U.S.C. 601 et seq.

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Appendix A—Proposed Changes to 10 CFR Part 35

This appendix is organized by technology in sections A.1 through A.7. For each technology, there is a brief discussion of the overall rationale for the proposed changes, followed by the proposed changes organized by subpart and section of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 35, "Medical Use of Byproduct Material." Section A.8 addresses revisions to 10 CFR Part 35 that are not associated with any one technology. In several sections, specific requests for comment are provided in ***bold italic font***. The U.S. Nuclear Regulatory Commission (NRC) is seeking public feedback in these areas to inform the development of the proposed rule.

A.1 Strontium-82/Rubidium-82 Generators and Germanium-68/Gallium-68 Pharmaceutical Grade Generators

The proposed changes include amendments to 10 CFR Part 35, Subpart B, "General Administrative Requirements," Subpart C, "General Technical Requirements," and Subpart D, "Unsealed Byproduct Material—Written Directive Not Required," to allow for the use of germanium-68/gallium-68 (Ge-68/Ga-68) generators under Subpart D and resolve outstanding technical items for rubidium (Rb)-82 generators that are currently dispositioned through use of enforcement discretion.[1]

To move the regulation of Ge-68/Ga-68 generators from 10 CFR Part 35, Subpart K, "Other Medical Uses of Byproduct Material or Radiation From Byproduct Material," to Subpart D, an allowable concentration of Ga-68 must be established in Subpart D, and associated reporting requirements must be established in Subpart M, "Reports."[2]

To continue regulating Rb-82 generators under 10 CFR Part 35, Subpart D, without the need for enforcement discretion, changes would be necessary in Subpart C to allow for the currently accepted methods for calibration of radiation detectors in a dynamic mode.

<u>Subpart B—General Administrative Requirements</u>

- 10 CFR 35.27, "Supervision"

  This section would be amended to require individuals using radionuclide generators under the supervision of an authorized user (AU) to have training on the specific type and model of radionuclide generator that is in use.

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[1] Enforcement Guidance Memorandum 13-003, "Enforcement Guidance Memorandum—Interim Guidance for Dispositioning Violations Involving 10 CFR 35.60 and 10 CFR 35.63 for the Calibration of Instrumentation to Measure the Activity of Rubidium-82 and the Determination of Rubidium-82 Patient Dosages," dated April 18, 2013 (ML13101A318).

[2] The rulemaking described in this regulatory basis document would not address the current concerns with decommissioning funding plans associated with Ge-68/Ga-68 generators. It is expected that licensees would continue to use the exemption process outlined in the memorandum dated July 13, 2017, "Revision of Technical Basis for Granting Specific Exemption from Decommissioning Funding Plan Requirements for Germanium-68/Gallium-68 Generators" (ML17075A487). The NRC is conducting a rulemaking that would address decommissioning funding requirements in part for Ge-68/Ga-68 generators. Information about that rulemaking can be found at https://www.regulations.gov/ under Docket ID NRC-2017-0031.

- 10 CFR 35.50, “Training for Radiation Safety Officer and Associate Radiation Safety Officer”

  The types of generator systems authorized by 10 CFR Part 35, Subpart D, have become increasingly complex with greater variation among models of devices. Therefore, the requirements for training for radiation safety officers (RSOs)[3] in this section would be amended to require specific training for all 10 CFR Part 35, Subpart D, generator systems.

  Question A.1.1

  Please provide comments on the need for radiation safety officers to have specific training for all 10 CFR part 35, subpart D generator systems. If general awareness on radionuclide generators, including their functions and risks, is sufficient, explain why.

Subpart C—General Technical Requirements

- 10 CFR 35.60, “Possession, use, and calibration of instruments used to measure the activity of unsealed byproduct material”

  This section would be amended to allow for alternate methods of calibrating dynamic detectors used in Rb-82 generators. Specifically, this section would be revised to allow licensees to develop and maintain written test procedures to ensure that the infusion pump flow rate is consistent and accurate and that the radiation detector meets the manufacturer’s specifications. The tests would need to be performed at least every 12 months and repeated after repair or replacement. The licensee would need to maintain records documenting the performance of and results of these tests. The test results would need to be compared to the radiation detector specifications for the detector’s electronics and response to the radiation to ensure that results are aligned with the manufacturer's specifications. The licensee would be able to use documentation of the infusion cart maintenance performed by the manufacturer to document the completion and results of the infusion rate and radiation detector test. If a nationally recognized standard becomes available for the radiation detectors used for direct incremental infusion carts, then licensees would be permitted to use a nationally recognized standard in accordance with 10 CFR 35.60(b).

- 10 CFR 35.63, “Determination of dosages of unsealed byproduct material for medical use”

  This section would be amended to clarify that measurements do not have to be complete before the incremental administration of Rb-82 when the dosage is determined by a calibrated instrument that is part of an infusion system such that the measurement of the portion of the dosage that has been administered has been completed. Conforming changes would be made to this section to ensure that existing dosage determination methods remain the same.

[3] Regulations that apply to RSOs also apply to associate RSOs.

Question A.1.2

Please provide comments on whether and how the NRC should allow the completion of dosage measurements after the beginning of an incremental administration for radionuclides other than Rb-82. How would such an allowance be bounded? What considerations should go into the expansion of this flexibility?

Subpart D—Unsealed Byproduct Material—Written Directive Not Required

- 10 CFR 35.204, "Permissible molybdenum-99, strontium-82, and strontium-85 concentrations"

  Currently, this section provides permissible concentration limits for parent radionuclides for molybdenum-99/technetium-99m (Mo-99/Tc-99m) and Rb-82 generators but does not specify such a limit for Ge-68/Ga-68 generators. This section would be amended to include a limit for the allowable concentration of Ge-68 in each eluate of the generator. Currently, the U.S. Food and Drug Administration (FDA) works with manufacturers to establish safe values for permissible concentration limits for parent radionuclides. Typically, these limits are specific to each radionuclide generator. The NRC would determine appropriate permissible concentration limits for Ge-68 with input from the FDA and available literature, including manufacturer information.

- 10 CFR 35.290, "Training for imaging and localization studies"

  To date, training and experience (T&E) requirements for AUs of Rb-82 chloride have been a condition for enforcement discretion in EGM 13-003. The guidance in EGM 13-003 will be incorporated into 10 CFR 35.290 to require that AUs who are using Rb-82 chloride have successfully completed training specific to the manufacturer and model of generator and infusion cart being used. Training would be required to include (1) elution and quality control procedures needed to determine Rb-82 activity and the strontium (Sr)-82 and Sr-85 breakthrough levels, (2) dose calibrator calibration procedures, and (3) safety procedures for the clinical use of Rb-82 chloride.

Question A.1.3

The NRC has found that AUs authorized under 10 CFR 35.290, "Training for imaging and localization studies," have sufficient understanding of radionuclide generators, and the NRC is proposing to revise 10 CFR 35.27, "Supervision," to require device-specific training requirements for supervised individuals. Please provide comments with a rationale on whether Section 35.290 AUs should also be required to have device-specific training for all radionuclide generators for which they supervise the use.

Subpart L—Records

- 10 CFR 35.2060, “Records of calibrations of instruments used to measure the activity of unsealed byproduct material”
  This section would be amended to require elements of the calibration of detectors used in infusion systems, including Rb-82 generators.

- 10 CFR 35.2063, “Records of dosages of unsealed byproduct material for medical use”

  This section would be amended to clarify that the prescribed dosage and the determined dosage or a notation that the total activity is less than 1.1 megabecquerels (30 microcuries) is required as part of the record.

- 10 CFR 35.2204, “Records of molybdenum-99, strontium-82, and strontium-85 concentrations”

  This section would be amended to require records for Ge-68.

Subpart M—Reports

- 10 CFR 35.3204, “Report and notification for an eluate exceeding permissible molybdenum-99, strontium-82, and strontium-85 concentrations”

  This section would be amended to require report and notification for an eluate exceeding permissible Ge-68 concentrations.

Other 10 CFR Part 35 Subparts

The following subparts require no changes to address radionuclide generators:

- Subpart E—Unsealed Byproduct Material—Written Directive Required
- Subpart F—Manual Brachytherapy
- Subpart G—Sealed Sources for Diagnosis
- Subpart H—Photon Emitting Remote Afterloader Units, Teletherapy Units, and Gamma Stereotactic Radiosurgery Units
- Subpart I [Reserved] (proposed as a new subpart, “Microsource Manual Brachytherapy”)
- Subpart J [Reserved]
- Subpart K—Other Medical Uses of Byproduct Material or Radiation From Byproduct Material
- Subpart N—Enforcement

A.2 Intravascular Brachytherapy Systems

The NRC is considering revisions to 10 CFR Part 35, Subpart F, "Manual Brachytherapy," to incorporate intravascular brachytherapy (IVB) into this subpart. The current guidance for this use[4] references several requirements of 10 CFR Part 35, Subpart F.

Regulatory changes that need to be addressed to include IVB in 10 CFR Part 35, Subpart F, include T&E requirements. In the current licensing guidance, T&E requirements for AUs of IVB are the same as those in 10 CFR 35.690, "Training for use of remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units." Additionally, all members of the care team, including the AU and authorized medical physicist (AMP), must have additional device-specific training related to hands-on device operation, safety procedures, and clinical use commensurate with the individual's duties, which is beyond the T&E required in 10 CFR Part 35, Subpart H.

Other regulatory changes that need to be addressed for IVB's inclusion in 10 CFR Part 35, Subpart F, include requirements for physical presence, operating procedures, and emergency procedures, like the requirements currently in 10 CFR 35.615, "Safety precautions for remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units," and servicing by qualified individuals in 10 CFR 35.605, "Installation, maintenance, adjustment, and repair." Finally, the requirements for written directives specific to IVB would need to be included in 10 CFR 35.40, "Written directives."

Additionally, the following requirements are applicable to IVB and therefore need to be reflected in 10 CFR Part 35, Subpart F: 10 CFR 35.604, "Surveys of patients and human research subjects treated with a remote afterloader unit"; 35.605; 35.610, "Safety procedures and instructions for remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units"; 35.615; and 35.652, "Radiation surveys."

Subpart A—General Information

- 10 CFR 35.8, "Information collection requirements: OMB approval"

  The information collection requirements under this section would be amended to reflect new procedures requiring submission under 10 CFR Part 35, Subpart F.

- 10 CFR 35.12, "Application for license, amendment, or renewal"

  Requirements for application for licenses, amendments, or renewals under this section would be amended to reflect changes to 10 CFR Part 35, Subpart F, regarding the submission of procedures that cover the practice of source-stepping with this device.

- 10 CFR 35.13, "License amendments"

  This section would be amended to reflect the citation of the applicable requirement added to 10 CFR Part 35, Subpart F, which requires a procedure for source-stepping. As

[4] The licensing guidance for the Best Vascular Beta-Cath™ IVB System was issued in August 2006 and is available at the NRC's website at https://www.nrc.gov/materials/miau/med-use-toolkit/intravascular.html.

required by 10 CFR 35.13(h),[5] any revisions to the procedure that could reduce radiation safety would need to be approved via a license amendment before use.

Subpart B—General Administrative Requirements

- 10 CFR 35.27, "Supervision"

  This section would be amended to include supervision requirements pertaining to IVB. Specifically, procedures should be conducted under the supervision of an AU, who should consult with the interventional cardiologist/physician before initiating treatment. Additionally, this section would be amended to include a requirement that individuals under the supervision of an AU receive device-specific training before using the device.

- 10 CFR 35.40, "Written directives"

  This section would be amended to include written directive requirements for IVB. It would require that the written directive include the specific treatment site, the radionuclide, and the dose before the start of treatment with IVB.

- 10 CFR 35.51, "Training for an authorized medical physicist"

  This section would be amended to require completion of device-specific training by the medical physicist applying to be an AMP on a license authorizing use of this device. This training should be given by either the vendor or an AMP who is authorized for use of the same IVB system. The device-specific training requirement would include hands-on device operation, safety procedures, clinical use, and operation of the treatment planning system.

- 10 CFR 35.57, "Training for experienced Radiation Safety Officer, teletherapy or medical physicist, authorized medical physicist, authorized user, nuclear pharmacist, and authorized nuclear pharmacist"

  This section would be amended to add the effective date of the final rule and specify that experienced individuals added to a license on or before the effective date need not comply with revised training requirements. This would allow these experienced individuals to maintain their authorization (i.e., "legacy individuals," formerly referred to as "grandfathered individuals"). This proposed change would not grant new authorizations to individuals who do not already have authorization for IVB as of the effective date of the final rule.

Subpart F—Manual Brachytherapy

- 10 CFR 35.400, "Use of sources for manual brachytherapy"

  This section would be amended to exclude the use of manual brachytherapy technologies that require additional device-specific training for AUs (such as the

[5] In 10 CFR 35.13(h), the NRC requires that a licensee apply for and receive a license amendment before it revises procedures required by 10 CFR 35.610, 35.642, 35.643, and 35.645, as applicable, where such revision reduces radiation safety.

emerging medical technologies (EMTs) being incorporated into 10 CFR Part 35, Subpart F, through this rulemaking).

- 10 CFR 35.401 (proposed new section)

  This new section would be added to 10 CFR Part 35, Subpart F, to include manual brachytherapy technologies that require AUs to complete device-specific training in addition to the T&E required in 10 CFR 35.490, “Training for use of manual brachytherapy sources.” This would include the EMTs addressed in this rulemaking: IVB, liquid brachytherapy, and the two EMT eye applicator sources.

- 10 CFR 35.404, “Surveys after source implant and removal”

  This section would be amended to ensure that immediately following source retraction from a patient or human research subject, a licensee shall survey the patient or the human research subject and the IVB unit with an appropriate and functional portable radiation detection survey instrument to confirm that the source(s) have been removed from the patient or human research subject and returned to the safe shielded position. The licensee would be required to retain a record of these surveys in accordance with 10 CFR 35.2404, “Records of surveys after source implant and removal.”

- 10 CFR 35.405 (proposed new section)

  This new section would be added to 10 CFR Part 35, Subpart F, to include the requirement that IVB devices be inspected and serviced at intervals recommended by the manufacturer and that maintenance and repair of the device be performed only by the manufacturer or persons specifically licensed by the NRC or an Agreement State to perform such services. The licensee would need to retain a record of the maintenance, adjustment, and repair of IVB devices in accordance with 10 CFR 35.2605, “Records of installation, maintenance, adjustment, and repair of remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units.”

- 10 CFR 35.410, “Safety instruction”

  This section would be amended to include a requirement for licensees to develop, implement, and maintain written emergency procedures for both stuck and detached sources, including the provision of appropriate emergency response equipment and any appropriate surgical procedures. These written emergency procedures would be similar to those required for high dose rate (HDR) remote afterloader treatments as detailed in 10 CFR 35.610. The licensee would need to retain a copy of the procedure, as required in 10 CFR 35.2610, “Records of safety procedures.” Additionally, this section of the regulation will be amended to require annual emergency drills and operational training similar to those required by 10 CFR 35.610 for HDR remote afterloader treatments.

- 10 CFR 35.415, “Safety precautions”

  This section would be amended to include a physical presence requirement during IVB treatment because of the high dose rates delivered to the treatment site. Specifically, this requirement for IVB procedures should be similar to that described in 10 CFR 35.615(f)(2), which states that an AU and an AMP should be physically present

during the initiation of all patient treatments involving the unit; and an AMP and either an AU or a physician, under the supervision of an AU who has been trained in the operation and emergency response for the unit, should be physically present during continuation of all patient treatments involving the unit.

- 10 CFR 35.432, "Calibration measurements of brachytherapy sources"

  This section would be amended to include calibration measurement requirements pertaining to IVB. Specifically, for IVB, the licensee should perform independent measurement of source output, before the first patient treatment, using a dosimetry system that meets the requirements of 10 CFR 35.630(a).

- 10 CFR 35.492 (proposed new section)

  This new section would be added to 10 CFR Part 35, Subpart F, to address the specific T&E requirements to be an AU for IVB and other uses under 10 CFR 35.401 (i.e., liquid brachytherapy, diffusion brachytherapy, and eye applicators). The T&E requirements would be similar to those in 10 CFR 35.690 and would include the completion of device-specific training by the physician applying to be an AU, provided by either the vendor or an AU or AMP who is authorized for the use of the same IVB system. The training would include items such as hands-on device operation, safety procedures, and clinical use.

  Question A.2.1

  Please provide comments on the sufficiency of the T&E requirements for AUs outlined in the current EMT licensing guidance documents for IVB, liquid brachytherapy, and eye applicators. Specifically, the NRC is seeking feedback on the knowledge topics encompassing the safety-related characteristics of these EMTs required for AUs to fulfill their radiation safety-related duties and supervision roles; the methods for acquiring knowledge topics; and consideration for continuing education, vendor training for new medical uses, and training on NRC regulatory requirements.

Subpart L—Records

- 10 CFR 35.2605, "Records of installation, maintenance, adjustment, and repair of remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units"

  This section would be amended to add IVB devices to the title and to reflect the recordkeeping requirements for maintenance and repair detailed in 10 CFR 35.405.

Other 10 CFR Part 35 Subparts

The following subparts require no changes to address IVB:

- Subpart C—General Technical Requirements
- Subpart D—Unsealed Byproduct Material—Written Directive Not Required

- Subpart E—Unsealed Byproduct Material—Written Directive Required
- Subpart G—Sealed Sources for Diagnosis
- Subpart H—Photon Emitting Remote Afterloader Units, Teletherapy Units, and Gamma Stereotactic Radiosurgery Units
- Subpart I [Reserved] (proposed as a new subpart, "Microsource Manual Brachytherapy")
- Subpart J [Reserved]
- Subpart K—Other Medical Uses of Byproduct Material or Radiation From Byproduct Material
- Subpart M—Reports
- Subpart N—Enforcement

A.3 Liquid Brachytherapy Sources and Devices

Liquid brachytherapy is a form of manual brachytherapy that uses sources that are temporarily implanted for radiation therapy. Changes to 10 CFR Part 35, Subpart F, are warranted along with revisions to other pertinent sections, including 10 CFR 35.40, 35.41, and 35.67.

Subpart A—General Information

- 10 CFR 35.2, "Definitions"

  This section would be amended to (1) revise the definition of manual brachytherapy to include liquid sources, (2) clarify that for liquid brachytherapy, "prescribed dose" means the total dose documented in the written directive, and (3) define the term "source leakage" as it relates to liquid brachytherapy—in this instance, it could mean leakage that results in a dose that exceeds 0.5 sieverts (50 rem) dose equivalent to any individual organ other than the treatment site, based on the current guidance.

  Question A.3.1

  Please provide comments with a rationale on whether the current definition of manual brachytherapy in 10 CFR 35.2 should be revised to include liquid brachytherapy and exclude microsources or if liquid brachytherapy should be included in the newly proposed subpart I for microsources.

- 10 CFR 35.8, "Information Collection Requirements: OMB approval"

  The information collection requirements under this section would be amended to reflect new procedures requiring submission under 10 CFR Part 35, Subpart F.

- 10 CFR 35.13, “License amendments”

  This section would be amended to reflect the citation of the applicable regulation added to 10 CFR Part 35, Subpart F, which requires a procedure for the verification that the device is not leaking before treatment. Any revisions to that procedure that could reduce radiation safety would need to be approved via a license amendment before use.

Subpart B—General Administrative Requirements

- 10 CFR 35.40, “Written directives”

  This section would be amended to include written directive requirements for liquid brachytherapy. It would require the written directive to include the following information: (1) before implantation—the treatment site, the radionuclide (including the chemical/physical form), and dose, and (2) after implantation but before completion of the procedure—the radionuclide (including the chemical/physical form), the treatment site, and the total dose.

- 10 CFR 35.41, “Procedures for administrations requiring a written directive”

  This section would be amended to require in 10 CFR 35.41(b) that the written procedure mandated by 10 CFR 35.41(a) address situations that can cause an effective dose reduction of greater than 20 percent. To ensure that each administration is in accordance with the written directive, the written procedure should describe how licensees will ensure that the use of fluid that can cause effective dose reduction is not present when the radionuclide mixture is added to the catheter or when the licensee measures the activity of the radionuclide mixture upon removal from the patient.

- 10 CFR 35.57, “Training for experienced Radiation Safety Officer, teletherapy or medical physicist, authorized medical physicist, authorized user, nuclear pharmacist, and authorized nuclear pharmacist”

  This section would be amended to add the effective date of the final rule and specify that experienced individuals added to a license on or before the effective date need not comply with revised training requirements. This would allow these experienced individuals to maintain their authorization (i.e., “legacy individuals,” formerly referred to as “grandfathered individuals”). This proposed change would not grant new authorizations to individuals who do not already have authorization for liquid brachytherapy as of the effective date of the final rule.

Subpart C—General Technical Requirements

- 10 CFR 35.67, “Requirements for possession of sealed sources and brachytherapy sources”

  This section would be amended to require leak testing of the device that will contain the liquid brachytherapy source before each procedure. Devices found to be leaking would be reported in accordance with the requirements in 10 CFR 35.3067, “Report of a leaking source.”

- 10 CFR 35.69, “Labeling of vials and syringes”

  This section would be amended to incorporate requirements for labeling vials and syringes pertaining to liquid brachytherapy. Specifically, the licensee should label syringes and syringe radiation shields not labeled by the manufacturer with the radioisotope, form, and therapeutic procedure, and label vials and vial radiation shields with the radioisotope and form.

- 10 CFR 35.71, “Contamination control”

  This new section would be created to require licensees to develop, implement, and maintain procedures addressing contamination control and spill response associated with the uses authorized on the license.

  Question A.3.2

  The NRC is seeking input on whether this requirement is needed or if the requirements in 10 CFR Part 20, “Standards for Protection against Radiation,” are sufficient for contamination control. Please provide comments on this proposed requirement and indicate if it should apply to all medical licensees or to a certain subset and why.

Subpart F—Manual Brachytherapy

- 10 CFR 35.400, “Use of sources for manual brachytherapy”

  This section would be amended to exclude the use of manual brachytherapy technologies that require additional device-specific training for AUs (such as the EMTs being incorporated into 10 CFR Part 35, Subpart F, through this rulemaking).

- 10 CFR 35.401 (proposed new section)

  This new section would be added to 10 CFR Part 35, Subpart F, to include manual brachytherapy technologies that require AUs to complete device-specific training in addition to the T&E required in 10 CFR 35.490. This would include the EMTs addressed in this rulemaking: IVB, liquid brachytherapy, the two EMT eye applicator sources, and other future EMTs.

- 10 CFR 35.410, “Safety instruction”

  This section would be amended to include instructions on how to safely handle contamination from unsealed material for brachytherapy. This instruction would be in addition to other instructions already included in this section of the regulation. Further, this section of the regulation would need to be amended to require licensees to develop and maintain procedures that specify how a licensee will confirm that the encapsulation device does not leak before injection of the liquid brachytherapy source or while the source and device are implanted in the patient or human research subject.

- 10 CFR 35.415, “Safety precautions”

  This section would be amended to require that an RSO and AU with experience in radiopharmaceutical therapy procedures be on call to provide guidance in the case of leakage of the implanted liquid brachytherapy device.

- 10 CFR 35.492 (proposed new section)

  This new section would be added to 10 CFR Part 35, Subpart F, to address the specific T&E requirements to be an AU for liquid brachytherapy and other uses permitted under 10 CFR 35.401 (i.e., IVB, liquid brachytherapy, and eye applicators). The T&E requirements specific to liquid brachytherapy would include those in 10 CFR 35.490, in addition to training in delivery, safety procedures, and clinical use of the liquid brachytherapy system provided by either a vendor or qualified AU.

Subpart M—Reports

- 10 CFR 35.3067, “Report of a leaking source”

  This section would be amended to add a requirement to report leaking liquid brachytherapy devices within 5 days of the leakage test, similar to the requirements currently in this section for a leaking sealed source.

  Question A.3.3

  The proposed changes discussed in Subpart A (“General Information”) of this section would define the term “source leakage” as it relates to liquid brachytherapy. A possible leakage rate could be any leakage from a liquid brachytherapy source that results in a dose that exceeds 0.5 sievert (50 rem) dose equivalent to any individual organ other than the treatment site. Please comment on whether this limit is appropriate and explain why or why not. What types of limits for liquid brachytherapy device leakage should the NRC consider (e.g., activity-based, dose-based, external to the patient)?

Other 10 CFR Part 35 Subparts

The following subparts require no changes to address liquid brachytherapy sources and devices:

- Subpart D—Unsealed Byproduct Material—Written Directive Not Required
- Subpart E—Unsealed Byproduct Material—Written Directive Required
- Subpart G—Sealed Sources for Diagnosis
- Subpart H—Photon Emitting Remote Afterloader Units, Teletherapy Units, and Gamma Stereotactic Radiosurgery Units

- Subpart I [Reserved] (proposed as a new subpart, “Microsource Manual Brachytherapy”)
- Subpart J [Reserved]
- Subpart K—Other Medical Uses of Byproduct Material or Radiation From Byproduct Material
- Subpart L—Records
- Subpart N—Enforcement

A.4 Radioactive Seed Localization

Radioactive seed localization (RSL) may use decayed radioactive seeds previously approved for the treatment of tumors under 10 CFR Part 35, Subpart F, or low-activity radioactive seeds approved by the FDA specifically for RSL use. While this technology has similar characteristics to the technologies in 10 CFR Part 35, Subparts D and F, RSL is most similar to the types of uses regulated under Subpart G. In addition to revisions to 10 CFR Part 35, Subpart G, revisions would be made to other applicable subparts.

Subpart A—General Information

- 10 CFR 35.2, “Definitions”

  This section would be amended to add a new definition for RSL, specifying that RSL does not require a written directive and is a procedure for localization, which is a nontherapeutic purpose.

- 10 CFR 35.8, “Information collection requirements: OMB approval”

  This section would be amended to include any changes to information collection requirements if there are changes in 10 CFR Part 35, Subpart G, that require information collection.

Subpart B—General Administrative Requirements

- 10 CFR 35.27, “Supervision”

  This section would be amended to add training requirements for individuals under the supervision of an AU. Specifically, training requirements for radiologists, surgeons, and pathology personnel involved in RSL would be added. This training would need to be completed before these individuals work under the supervision of the AU, as currently stated in the guidance.[6]

[6] “Low Activity Radioactive Seeds Used for Localization of Non-Palpable Lesions and Lymph Nodes—Licensing Guidance,” Revision 1, dated October 7, 2016 (ML16197A568).

- 10 CFR 35.49, “Suppliers for sealed sources or devices for medical use”

  This section would be amended to allow use of decayed sealed sources that were originally intended to deliver a therapeutic dose and were not specifically approved in the SS&D Registry for RSL use.

- 10 CFR 35.57, “Training for experienced Radiation Safety Officer, teletherapy or medical physicist, authorized medical physicist, authorized user, nuclear pharmacist, and authorized nuclear pharmacist”

  This section would be amended to add the effective date of the final rule and specify that experienced individuals added to a license on or before the effective date need not comply with revised training requirements. This would allow these experienced individuals to maintain their authorization (i.e., “legacy individuals,” formerly referred to as “grandfathered individuals”). This proposed change would not grant new authorizations to individuals who do not already have authorization for RSL as of the effective date of the final rule.

Subpart G—Sealed Sources for Diagnosis

This subpart would be renamed “Sealed sources for nontherapeutic uses.” This change would allow for localization, which is not considered diagnosis, to clearly fit within 10 CFR Part 35, Subpart G.

- 10 CFR 35.500, “Use of sealed sources and medical devices for diagnosis”

  This section would be amended to exclude RSL. The use of sealed sources under 10 CFR 35.500 is limited to sealed sources that are approved for diagnostic medical use in the SS&D Registry. However, RSL allows for the use of seeds approved in the SS&D Registry for therapeutic use (that have decayed to an acceptable activity) or “other medical uses.”

- 10 CFR 35.501 (proposed new section)

  This new section would be added to 10 CFR Part 35, Subpart G, to specifically allow for the use of sources for RSL, including sources specifically approved in an SS&D Registry for RSL and those sources that were previously approved for therapeutic use that have decayed to less than or equal to 300 microcuries.

- 10 CFR 35.504 (proposed new section)

  This new section would be added to 10 CFR Part 35, Subpart G, to include a requirement for surveys to be completed after RSL source implant and removal, similar to the requirement in 10 CFR 35.404.

- 10 CFR 35.506 (proposed new section)

  This new section would be added to 10 CFR Part 35, Subpart G, to include a requirement for licensees to develop, implement, and maintain a procedure for source accountability, similar to that in 10 CFR 35.406, “Brachytherapy sources accountability.”

This procedure would not need to be submitted during license application but would be reviewed during inspection.

- 10 CFR 35.510 (proposed new section)

  This new section would be added to 10 CFR Part 35, Subpart G, to include a requirement similar to that in 10 CFR 35.610. The licensee would be required to submit written procedures for (1) the assessment of the radiation dose to tissue for seeds remaining in place for an extended period of time and to provide for a "no later than" date for explantation to ensure that a dose greater than 0.5 sievert (50 rem) is not delivered, (2) the radiation safety program for all departments involved in RSL, including surgical and pathology, (3) routine monitoring before, during, and after all uses of the seeds to ensure rapid identification of seed localization, (4) remediation of contamination resulting from a broken or leaking source, and (5) emergency responses to an abnormal situation. Emergency procedures for responding to an abnormal situation should include instructions for responding to a source rupture and instructions to pathology personnel for responding to a leaking or cut source, the process for restricting access and posting in the event of a leaking or cut source, instructions for patient follow-up should they not return for explantation, and the names and telephone numbers of AUs and RSOs to be contacted.

- 10 CFR 35.515 (proposed new section)

  This new section would be added to 10 CFR Part 35, Subpart G, to include a requirement that the licensee maintain emergency response equipment near each surgery suite and pathology laboratory during specimen handling.

- 10 CFR 35.532 (proposed new section)

  This new section would be added to 10 CFR Part 35, Subpart G, to include a requirement for the activity of sources to be verified before each patient implant using a dosimetry system that meets the requirements of 10 CFR 35.630(a) or by using the sealed source activity measurements, after correcting for decay, provided by the manufacturer for preloaded/prepackaged needles approved by the FDA for RSL use. This would be written in a similar manner to 10 CFR 35.432.

- 10 CFR 35.591 (proposed new section)

  This new section would be added to 10 CFR Part 35, Subpart G, to incorporate the multiple T&E pathways a physician can take to become an AU for RSL. This new section would codify the requirements for becoming an AU for RSL that are already stated in the current guidance document.

<u>Subpart L—Records</u>

- 10 CFR 35.2024, "Records of authority and responsibilities for radiation protection programs"

  This section would be amended based on changes made to 10 CFR 35.24, "Authority and responsibilities for the radiation protection program."

- 10 CFR 35.2026, “Records of radiation protection program changes”

  This section would be amended based on changes made to 10 CFR 35.26, “Radiation protection program changes.”
- 10 CFR 35.2406, “Records of brachytherapy source accountability”

  This section would be amended to require the keeping of source accountability records for sealed sources and brachytherapy sources. Specifically, the title of the regulation would be changed along with the existing regulatory text to include sealed sources used for RSL.

- 10 CFR 35.2432, “Records of calibration measurements of brachytherapy sources”

  This section would be amended to require recordkeeping of calibration measurement of sealed sources used in RSL similar to the requirements for brachytherapy sources.

Subpart M—Reports

- 10 CFR 35.3045, “Report and notification of a medical event”

  This section would be amended to include medical event reporting criteria specific to RSL. These criteria include the administration of byproduct material results in a dose that exceeds 0.05 sievert (5 rem) effective dose equivalent or 0.5 sievert (50 rem) to an organ or tissue from any of the following: (1) an administration of the RSL procedure using the wrong radionuclide, (2) an administration of the RSL procedure to the wrong patient or human research subject, (3) an administration of the RSL procedure using the wrong number of radioactive seeds, or (4) if the licensee fails to perform the explantation surgery.

Other 10 CFR Part 35 Subparts

The following subparts require no changes to address RSL:

- Subpart C—General Technical Requirements

- Subpart D—Unsealed Byproduct Material—Written Directive Not Required

- Subpart E—Unsealed Byproduct Material—Written Directive Required

- Subpart F—Manual Brachytherapy

- Subpart H—Photon Emitting Remote Afterloader Units, Teletherapy Units, and Gamma Stereotactic Radiosurgery Units

- Subpart I [Reserved] (proposed as a new subpart, “Microsource Manual Brachytherapy”)

- Subpart J [Reserved]

- Subpart K—Other Medical Uses of Byproduct Material or Radiation From Byproduct Material

- Subpart N—Enforcement

A.5 Ophthalmic (Eye) Applicator Sources and Devices

The NeoVista, Inc. Epi-Rad90™ Ophthalmic System and the Liberty Vision Yttrium-90 Disc Source differ from other traditional ophthalmic sources and applicator systems in their use, design, and operation. The licensing guidance for the NeoVista, Inc. Epi-Rad90™ Ophthalmic System calls for two pathways for physicians to become AUs. AUs using the FDA-approved Investigational Device Exemption procedure of 24 grays for treatment must meet the T&E requirements in 10 CFR 35.491, "Training for ophthalmic use of strontium-90," while AUs for all other applications of the device must meet the T&E requirements in 10 CFR 35.490, 35.690, or 35.57. Additionally, all members of the care team, including the non-AU retinal surgeon, must have additional device-specific training related to hands-on device operation, safety procedures, and clinical use associated with the individual's duties, which is beyond the T&E required in 10 CFR Part 35, Subpart F or Subpart H. The Liberty Vision Yttrium-90 Disc Source uses yttrium (Y)-90, which differs from what is currently allowed for use by physicians authorized under 10 CFR 35.491. Current regulations for use of ophthalmic eye applicator sources by non-radiation oncology AUs are specific for use of Sr-90. As such, changes to 10 CFR Part 35, Subpart B, are needed to require device-specific training for ophthalmic sources and applicator systems. Changes to 10 CFR Part 35, Subpart F, are needed to allow for use of Y-90 in ophthalmic treatments. Additionally, changes are needed to 10 CFR Part 35, Subparts F and L, to require various safety precautions such as emergency procedures, physical presence, T&E requirements for AUs and AMPs, and recordkeeping requirements for use of Y-90 for ophthalmic treatments.

<u>Subpart A—General Information</u>

- 10 CFR 35.8, "Information collection requirements: OMB approval"

  The information collection requirement would be amended to include new requirements for documentation that the licensee would be required to submit or maintain including new procedures and new records as applicable for use of ophthalmic applicator sources and devices.

<u>Subpart B—General Administrative Requirements</u>

- 10 CFR 35.40, "Written directives"

  The requirement for written directives for all other brachytherapy under 10 CFR 35.40b(7)(i) of this section would be amended to also require the source activity before implantation.

- 10 CFR 35.50, "Training for Radiation Safety Officer and Associate Radiation Safety Officer"

  The requirements for RSO training in this section would be amended to require device-specific training that would account for all ophthalmic sources and applicator systems under 10 CFR Part 35, Subpart F.

- 10 CFR 35.51, “Training for an authorized medical physicist”

  The requirements for training AMPs in this section would be amended to require device-specific training for all ophthalmic sources and applicator systems under 10 CFR Part 35, Subpart F.

- 10 CFR 35.57, “Training for experienced Radiation Safety Officer, teletherapy or medical physicist, authorized medical physicist, authorized user, nuclear pharmacist, and authorized nuclear pharmacist”

  This section would be amended to add the effective date of the final rule and specify that experienced individuals added to a license on or before the effective date need not comply with revised training requirements. This would allow these experienced individuals to maintain their authorization (i.e., “legacy individuals,” formerly referred to as “grandfathered individuals”). This proposed change would not grant new authorizations to individuals who do not already have authorization for those ophthalmic sources and applicator systems as of the effective date of the final rule.

Subpart F—Manual Brachytherapy

- 10 CFR 35.400, “Use of sources for manual brachytherapy”

  This section would be amended to exclude the use of manual brachytherapy technologies that require additional device-specific training for AUs (such as the EMTs being incorporated into 10 CFR Part 35, Subpart F, through this rulemaking).

- 10 CFR 35.401 (proposed new section)

  This new section would be added to 10 CFR Part 35, Subpart F, to include manual brachytherapy technologies that require AUs to complete device-specific training in addition to the T&E required in 10 CFR 35.490. This would include the EMTs addressed in this rulemaking: IVB, liquid brachytherapy, and the two EMT eye applicator sources.

- 10 CFR 35.415, “Safety precautions”

  This section would be amended to require the following three practices:

  (1) Written emergency procedures must address source recovery for cases in which the source does not get to the treatment site or the source does not return to the shielded storage position. The procedures would be required to include a description of the required emergency response equipment and any appropriate surgical interventions.

  (2) Service and maintenance of ophthalmic sources and applicator systems must be conducted at intervals specified in the SS&D Registry by persons specifically licensed by the NRC or an Agreement State to perform such services.

  (3) Licensees must develop, implement, and maintain procedures for performing quality control testing on ophthalmic sources and applicator systems in accordance with the manufacturer’s instructions, performing pretreatment and posttreatment visual inspections and surveys of ophthalmic sources and

applicator systems, and safe handling of ophthalmic sources and applicator systems.

This section would also be amended to include physical presence requirements for use of ophthalmic sources and applicator systems that are regulated under 10 CFR Part 35, Subpart K. Specifically, for certain types of noninvasive standard protocol[7] ophthalmic procedures, the physical presence of an AMP or AU or RSO with device-specific or device- and nonstandard protocol-specific authorizations would be sufficient to meet the physical presence requirements. For nonstandard protocol ophthalmic procedures, the AU would be required to consult with the eye physician specialist (retinal surgeon or ophthalmologist) and an AMP authorized for use of the same device before the treatment. Additionally, the procedure would need to be performed in the physical presence of either an AU authorized for nonstandard protocols or an AMP authorized for use of the same ophthalmic source and applicator system.

- 10 CFR 35.433, "Strontium-90 sources for ophthalmic treatments"

  This section would be amended to allow Y-90 sources for ophthalmic treatments. The title of this section would be amended to include Y-90 sources, and this section would be amended to allow AMPs and certain ophthalmic physicists to perform decay calculations for treatment times. Additionally, these individuals would be allowed to assist the licensee in developing, implementing, and maintaining written procedures to provide high confidence that the administration is in accordance with the written directive.

- 10 CFR 35.492 (proposed new section)

  This new section would be added to 10 CFR Part 35, Subpart F, to address the T&E requirements specific to AUs for ophthalmic applicator systems used intraocularly and ophthalmic applicator systems that use radionuclides other than Sr-90, in addition to other uses under 10 CFR 35.401 (i.e., IVB and liquid brachytherapy). The T&E requirements for these ophthalmic applicators would outline the various pathways for qualification of AUs, including the T&E in 10 CFR 35.490, 35.491, and 35.690, as applicable to the protocol requested. Additionally, the section would require device-specific training on the operation, safety procedures, and clinical use of the ophthalmic sources and applicator systems to be provided by a vendor or a qualified AU.

Subpart L—Records

- 10 CFR 35.2433, "Records of decay of strontium-90 sources for ophthalmic treatments"

  Based on changes to 10 CFR Part 35, Subpart F, the title of this section would be amended to include Y-90 sources for ophthalmic treatments, and the regulation would be expanded to apply to Y-90 sources for ophthalmic treatments.

Other 10 CFR Part 35 Subparts

The following subparts require no changes to address ophthalmic applicator sources and devices:

[7] "Standard protocol" means the FDA-approved Investigational Device Exemption procedure of 24 grays for the treatment of age-related macular degeneration.

- Subpart C—General Technical Requirements
- Subpart D—Unsealed Byproduct Material—Written Directive Not Required
- Subpart E—Unsealed Byproduct Material—Written Directive Required
- Subpart G—Sealed Sources for Diagnosis
- Subpart H—Photon Emitting Remote Afterloader Units, Teletherapy Units, and Gamma Stereotactic Radiosurgery Units
- Subpart I [Reserved] (proposed as a new subpart, “Microsource Manual Brachytherapy”)
- Subpart J [Reserved]
- Subpart K—Other Medical Uses of Byproduct Material or Radiation From Byproduct Material
- Subpart M—Reports
- Subpart N—Enforcement

A.6 Gamma Stereotactic Radiosurgery and Photon Emitting Teletherapy Units

The 2002 revisions to the regulations in 10 CFR Part 35, Subpart H, were based on technology that was current in the early 2000s. Since then, significant technological advances have allowed for major design and engineering changes in GSR and photon emitting teletherapy units. Because of these changes, many new GSR and photon emitting teletherapy units have been regulated under 10 CFR Part 35, Subpart K. Changes are needed throughout 10 CFR Part 35, Subpart H, to allow for the regulation of GSR and photon emitting teletherapy units currently licensed under 10 CFR Part 35, Subpart K. The proposed changes include a shift from a focus on specific device components to a focus on the functional elements such as source output, source collimation, source position, source attenuation, patient safety, and facility safety. This approach would allow for one set of spot check requirements and one set of calibration requirements for all uses under 10 CFR Part 35, Subpart H, including remote afterloader units. The proposed changes include creation of definitions, amendments to general administration requirements, and a restructure of 10 CFR Part 35, Subpart H, to align with a focus on functional elements instead of individual components.

<u>Subpart A—General Information</u>

- 10 CFR 35.2, “Definitions”

  This section would be amended to (1) include new definitions for “gamma stereotactic radiosurgery unit” and “teletherapy unit” to delineate between the two devices and types of use, and (2) revise the existing definition for “stereotactic radiosurgery” to clarify stereotactic guidance and align with the medical community’s definition of stereotactic radiosurgery.

- 10 CFR 35.8, “Information collection requirements: OMB approval”

  The information collection requirements under this section would be amended to reflect the proposed restructure of Subpart H. Specifically, reference to regulations that are taken out of Subpart H would be removed.

- 10 CFR 35.12, “Application for license, amendment, or renewal”

  Requirements for application for licenses, amendments, or renewals under this section would be amended to reflect the proposed restructure of 10 CFR Part 35, Subpart H.

- 10 CFR 35.13, “License amendments”

  Requirements for license amendments under this section would be amended to reflect the proposed restructure of 10 CFR Part 35, Subpart H. Additionally, this regulation would be amended to require the submittal of the procedures for activities required by 10 CFR 35.632, “Full calibration measurements on teletherapy units.” Based on the significant increase in the number of deficiencies during NRC inspections associated with this regulatory requirement and the lack of published protocols by nationally recognized bodies specific to the newer devices, the NRC believes it is pertinent to review licensee procedures associated with 10 CFR 35.632 before authorization. Additionally, the proposed revision of 10 CFR 35.632 will allow additional flexibility for licensees when they are developing and implementing calibration measurement requirements. Because of this flexibility, the procedures must be reviewed before authorization.

Subpart B—General Administrative Requirements

- 10 CFR 35.40, “Written directives”

  The requirement for written directives under 10 CFR 35.40(b)(3) and 10 CFR 35.40(b)(4) would be amended to require the date, total dose for each treatment site, treatment site(s) including volume and anatomically unique treatment site identifiers, dose per fraction and the number of fractions for treatment plans requiring multiple fractions, and geometry settings (or treatment plan including geometry settings). This would accommodate new GSR and photon emitting teletherapy units and reduce emphasis on specific components.

- 10 CFR 35.41, “Procedures for administrations requiring a written directive”

  The ability to safely stop and start therapeutic deliveries of radiation from GSR and teletherapy units has improved; however, this still presents a risk for a medical event. This section would be amended to require determination of whether there was a pause of treatment for significant patient movement or other factors that could affect localization and if so, require verification of patient positioning systems, including immobilization devices, as appropriate, before reinitiation or new shot, as applicable. In addition, this section would be amended to require verification of patient positioning systems, including immobilization devices, before initiation.

- 10 CFR 35.50, “Training for Radiation Safety Officer and Associate Radiation Safety Officer”

  The types of devices authorized by 10 CFR Part 35, Subpart H, have become increasingly complex with greater variation among models of devices. Therefore, the requirements for training for RSOs in this section would be amended to require model-specific training for all 10 CFR Part 35, Subpart H, devices.

  Question A.6.1

  Please provide comments on the need for model-specific training for radiation safety officers for certain 10 CFR part 35, subpart H devices. If model-specific training is needed, how should the NRC determine which devices would require such training?

- 10 CFR 35.51, “Training for an authorized medical physicist”

  The types of devices authorized by 10 CFR Part 35, Subpart H, have become increasingly complex with greater variation among models of devices. Therefore, the requirements for training for AMPs in this section would be amended to require model-specific training for all Subpart H devices, except HDR remote afterloader units.

- 10 CFR 35.57, “Training for experienced Radiation Safety Officer, teletherapy or medical physicist, authorized medical physicist, authorized user, nuclear pharmacist, and authorized nuclear pharmacist”

  This section would be amended to add the effective date of the final rule and specify that experienced individuals added to a license on or before the effective date need not comply with revised training requirements. This would allow these experienced individuals to maintain their authorization (i.e., “legacy individuals,” formerly referred to as “grandfathered individuals”). This proposed change would not grant new authorizations to individuals who do not already have authorization for that model of device as of the effective date of the final rule.

Subpart H—Photon Emitting Remote Afterloader Units, Teletherapy Units, and Gamma Stereotactic Radiosurgery Units

Subpart H of 10 CFR Part 35 will be amended to allow for a fundamental shift in the regulatory requirements for these technologies, from a focus on specific components to a focus on the element, such as source output, source collimation, source position, source attenuation, patient safety, and facility safety. Various conforming text changes may be made throughout 10 CFR Part 35, Subpart H, to align with the restructure of and shift in approach.

Question A.6.2

Current NRC requirements in 10 CFR Part 35, Subpart H, focus on components critical to patient and facility safety for the use of these devices. The proposed changes to Subpart H focus on elements rather than specific components. Please

provide comments on other elements that should be considered.

- 10 CFR 35.610, “Safety procedures and instructions for remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units”

  This section will be revised to clarify that the AU and AMP, as well as any individual who will operate the unit, are required to have operational and safety training. This section will be revised to require licensees to list in emergency procedures the types of immobilization devices they will be using, as well as methods for removing immobilization devices in the event of an emergency.

- 10 CFR 35.615, “Safety precautions for remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units”

  Based on operating experience with 10 CFR Part 35, Subpart H, technologies, it is evident that equipment performance is reliable if patient set up is done correctly and calibrations are properly performed. The physical presence requirements in this section would be amended to require that an AMP and AU be present at initiation of the treatment and require that an AMP and a physician under the supervision of an AU be present throughout the treatment. Additionally, the AU would need to be physically present at the facility and able to return to the treatment if necessary.

- 10 CFR 35.632, “Full calibration measurements on teletherapy units”

  The requirements for full calibration measurements on photon emitting teletherapy units, remote afterloader units, and GSR units would be combined into one regulation. The title of this section would be amended to “Full calibration measurements on remote afterloader units, photon emitting teletherapy units, and gamma stereotactic radiosurgery units.” The other calibration sections—10 CFR 35.633, “Full calibration measurements on remote afterloader units,” and 10 CFR 35.635, “Full calibration measurements on gamma stereotactic radiosurgery units”—would be eliminated.

  The full calibration measurements requirements would be revised to remove the reference to specific components and require certain objective tests to be completed. For example, the regulation could require the following:

  - measurements for output and geometric accuracy for a range of field sizes and distances
  - condition, function, and accuracy of all distance measuring, localizing, attenuation, and collimation devices to include source transfer tubes and applicators
  - timer accuracy
  - timer linearity
  - on-off error
  - emergency retraction devices

- backup power devices

Question A.6.3

Please provide comments on what types of objective tests the NRC should require for full calibration measures for 10 CFR Part 35, Subpart H, devices? Additionally, what functional elements should be considered critical to safety?

- 10 CFR 35.633, “Full calibration measurements on remote afterloader units”

  This section would be incorporated into 10 CFR 35.632 and eliminated.

- 10 CFR 35.635, “Full calibration measurements on gamma stereotactic radiosurgery units”

  This section would be incorporated into 10 CFR 35.632 and eliminated.

- 10 CFR 35.642, “Periodic spot-checks for teletherapy units”

  The requirements for periodic spot-checks for photon emitting teletherapy units, remote afterloader units, and GSR units would be combined into one regulation. The title of this section would be amended to “Periodic spot-checks on photon emitting remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units.” The other spot-check sections—10 CFR 35.643, “Periodic spot-checks for remote afterloader units,” and 10 CFR 35.645, “Periodic spot-checks for gamma stereotactic radiosurgery units”—would be eliminated.

  The requirements would be revised to remove references to specific components and require certain objective tests to be completed. For example, the regulation could require the following:

  - assurance of source output
  - difference between the measured output and the anticipated output
  - difference between the output or dose rate and the computer-generated output or dose rate
  - operation of all distance measuring, localizing, attenuation, and collimation devices to include source transfer tubes and applicators
  - operation of electrical or mechanical stops installed for the purpose of limiting use of the primary beam of radiation
  - operation of treatment room doors with electrical power turned off
  - geometric accuracy
  - timer accuracy
  - on-off error

- emergency retraction devices
- operation of electrical interlocks on the treatment room entrance
- operation of source exposure lights on the console and in the facility inside and outside treatment room
- operation of viewing and intercom systems
- operation of radiation monitors used to indicate source position
- availability of emergency response equipment
- confirmation of treatment console and unit computer date and time
- confirmation of the decayed source activity in the treatment console and unit computer
- operation backup power devices.

Question A.6.4

Please provide comments on what types of objective tests the NRC should require for periodic spot-checks for 10 CFR Part 35, Subpart H, devices. Additionally, what functional elements should be considered critical to safety?

- 10 CFR 35.643, “Periodic spot-checks for remote afterloader units”

  This section would be incorporated into 10 CFR 35.642 and eliminated.

- 10 CFR 35.645, “Periodic spot-checks for gamma stereotactic radiosurgery units”

  This section would be incorporated into 10 CFR 35.642 and eliminated.

- 10 CFR 35.690, “Training for use of remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units”

  This section would be amended to require that AU training be specific for the type of use and for the specific model of the unit being used to accommodate the radiation safety differences between types of units of each use under 10 CFR Part 35, Subpart H.

Subpart L—Records

Conforming changes to 10 CFR Part 35, Subpart L, would be made based on revisions to Subpart H. The requirements would be revised based on the proposed rule.

- 10 CFR 35.2642, “Records of periodic spot-checks for teletherapy units”

  This section would be amended to include records for period spot-checks of photon emitting teletherapy units, remote afterloader units, and GSR units. The other sections

for records of spot-checks—10 CFR 35.2643, “Records of periodic spot-checks for remote afterloader units,” and 10 CFR 35.2645, “Records of periodic spot-checks for gamma stereotactic radiosurgery units”—would be eliminated.

- 10 CFR 35.2643, “Records of periodic spot-checks for remote afterloader units”

  This section would be incorporated into 10 CFR 35.2642 and eliminated.

- 10 CFR 35.2645, “Records of periodic spot-checks for gamma stereotactic radiosurgery units”

  This section would be incorporated into 10 CFR 35.2642 and eliminated.

Other 10 CFR Part 35 Subparts

No changes are needed to the following subparts to address gamma stereotactic radiosurgery and photon emitting teletherapy units:

- Subpart C—General Technical Requirements
- Subpart D—Unsealed Byproduct Material—Written Directive Not Required
- Subpart E—Unsealed Byproduct Material—Written Directive Required
- Subpart G—Sealed Sources for Diagnosis
- Subpart I [Reserved] (proposed as a new subpart, “Microsource Manual Brachytherapy”)
- Subpart J [Reserved]
- Subpart K—Other Medical Uses of Byproduct Material or Radiation From Byproduct Material
- Subpart M—Reports
- Subpart N—Enforcement

A.7 Microsource Manual Brachytherapy

The use of microspheres for permanent implant manual brachytherapy has grown significantly over the past 20 years, and valuable operating experience has accrued. Microsphere use is expected to continue to increase, and the NRC anticipates that additional new technologies, including microparticles and new microsphere systems, may be authorized in the years to come. To incorporate the use of new and existing microspheres and microparticles for manual brachytherapy, the NRC proposes creating a new subpart within 10 CFR Part 35 to address their unique characteristics. This subpart would be created in the currently “reserved” Subpart I of 10 CFR Part 35. The proposed changes include creating a new definition for these types of sources to be defined as “microsources” under a new type of use to be called “microsource manual brachytherapy.” To create a new subpart, changes are needed throughout 10 CFR Part 35 to distinguish between current manual brachytherapy technologies and microsource manual brachytherapy. The new Subpart I would mirror the structure of Subparts F and H, but the requirements would be specific to the use of microsource manual brachytherapy.

Subpart A—General Information

- 10 CFR 35.2, “Definitions”

  This section would be amended to include new definitions for (1) “microsource” to be defined as a microparticle or microsphere, (2) “physiological equilibrium” to include

stasis or other states of equilibrium based on medical determination, and (3) “microsource manual brachytherapy” to include use of microsources to allow for a new type of use of byproduct material.

This section would be amended to clarify the definition for “type of use” to include 10 CFR 35.700 (proposed new section) for medical use of microsources. Additionally, conforming changes to the definition of “prescribed dose” or “prescribed dosage” will be made based on revisions to 10 CFR 35.40 described below.

Question A.7.1

The NRC is considering defining a “microsource” in 10 CFR 35.2 as microparticles and microspheres. What types of radiation (such as alpha, beta, gamma) should be covered by the definition of “microsource”? Please include comments and a rationale for whether 1) microspheres should be limited to specific types of radiation or certain energies, 2) microsources should be limited to sealed sources with a SS&D registry, 3) unsealed microsources should be required to have a SS&D registry, and 4) any additional changes are needed to the current regulations for microsource brachytherapy that would increase flexibility for future microsource brachytherapy.

Question A.7.2

The NRC is considering defining “physiological equilibrium” in 10 CFR 35.2 to include stasis or other states of equilibrium. Please comment on what should be included in physiological equilibrium or identify other considerations for physiological stop points.

- 10 CFR 35.8, “Information collection requirements: OMB approval”

  This section would be amended to add information collection requirements in the new 10 CFR Part 35, Subpart I.

- 10 CFR 35.12, “Application for license, amendment, or renewal”

  This section would be amended to include the use of byproduct material as described in 10 CFR 35.700 for medical use of microsources. This would include changes for the collection of certain procedures during licensing and the inclusion of the new 10 CFR Part 35, Subpart I.

- 10 CFR 35.13, “License amendments”

  This section would be amended to include notifications for AUs receiving device-specific training under new section 10 CFR 35.790 for the AU under 10 CFR 35.700. This regulation will be revised to include requesting amendments for revisions to procedures required by 10 CFR Part 35, Subpart I, for 10 CFR 35.700 uses. Revisions that could reduce radiation safety would need to be approved via a license amendment before use.

- 10 CFR 35.14, “Notifications”

  This section would be amended to include notifications for AUs receiving device-specific training under new section 10 CFR 35.790.

Subpart B—General Administrative Requirements

- 10 CFR 35.24, “Authority and responsibilities for the radiation protection program”

  Because a new Subpart I in 10 CFR Part 35 would be created, paragraph (f) of this section would be amended to require licensees to establish a Radiation Safety Committee to oversee all uses of byproduct material permitted by the license. This regulation would apply to licensees that are authorized for two or more different types of uses of byproduct material under Subparts E, F, H, or the new Subpart I of 10 CFR Part 35; or two or more types of units under Subpart H; or two or more types of uses under the new Subpart I of 10 CFR Part 35.

- 10 CFR 35.27, “Supervision”

  The use of microsource manual brachytherapy is complex, and the safe use of microsources typically involves support from multiple clinicians in a team approach. For these reasons, this section would be amended to include requirements for licensees to ensure appropriate training of individuals involved in the administration, handling, and use of microsource manual brachytherapy. This change would require that licensees develop, implement, and maintain procedures for the team approach to ensure safe use of microsources. These procedures would include a training program for individuals on the team to ensure that training is commensurate with the duties of each team member.

  Question A.7.3

  As the complexity of the medical use of byproduct material increases, use of teams in medical care is becoming more common. Please provide comments on the fundamental elements of a successful team-approach program.

- 10 CFR 35.40, “Written directives”

  This section would be amended to clarify that requirements for manual brachytherapy uses under 10 CFR Part 35, Subpart F, are in 10 CFR 35.40(b)(6). The requirements for written directives for microsource manual brachytherapy uses under 10 CFR Part 35, Subpart I, will be listed under a new item in 10 CFR 35.40(b). The new item will include (1) before implantation: the treatment site, the radionuclide, the radioactive drug or device name and manufacturer, and the prescribed activity or dose, and (2) after implantation but before the patient leaves the licensee’s control: the treatment site, total activity or dose, determination of physiological equilibrium, and the date.

Question A.7.4

For microsource manual brachytherapy, please provide comments and a rationale for whether the before-implant written directive should specify the dose or activity.

Question A.7.5

For microsource manual brachytherapy, please provide comments and a rationale for whether the after-implant written directive should specify the activity administered or the dose delivered to the treatment site.

- 10 CFR 35.41, "Procedures for administrations requiring a written directive"

  This section would be amended to include the uses under 10 CFR Part 35, Subpart I. To provide reasonable assurance of the safe use of microsource manual brachytherapy, this regulation would be amended to require procedures for calculating and documenting the dose or activity to the treatment site, preparing the dose, estimating migration to nontreatment sites before administration, and determining physiological equilibrium.

  Question A.7.6

  As required by Section 35.41 for determining whether a medical event has occurred (as defined in Section 35.3045), please comment on whether and why the NRC should require calculating and documenting the activity administered or the activity or dose specifically delivered to the treatment site. By what deadline (e.g., number of hours or days) should this determination be made?

  Question A.7.7

  For microsource manual brachytherapy, please comment on whether the NRC should require post-treatment imaging to confirm that the treatment was delivered in accordance with the written directive. Why or why not? What other mechanisms are available to confirm that the treatment was delivered in accordance with the written directive?

- 10 CFR 35.50, "Training for Radiation Safety Officer and Associate Radiation Safety Officer"

  The types of devices authorized by 10 CFR Part 35, Subpart I, would be diverse in models, delivery, and involved individuals. Therefore, the requirements for training for RSOs in 10 CFR 35.50 would be amended to require model-specific training for all 10 CFR Part 35, Subpart I, devices, similar to the recommended changes described in section A.7.

- 10 CFR 35.51, "Training for an authorized medical physicist"

Question A.7.8

Please identify any tasks that would require an AMP for the use of microsphere manual brachytherapy and identify whether and how the NRC should revise the T&E requirements for AMPs.

- 10 CFR 35.57, "Training for experienced Radiation Safety Officer, teletherapy or medical physicist, authorized medical physicist, authorized user, nuclear pharmacist, and authorized nuclear pharmacist"

  This section would be amended to add the effective date of the final rule and specify that experienced individuals added to a license on or before the effective date need not comply with revised training requirements. This would allow these experienced individuals to maintain their authorization (i.e., "legacy individuals," formerly referred to as "grandfathered individuals"). This proposed change would not grant new authorizations to individuals who do not already have authorization for that type of microsource as of the effective date of the final rule.

- 10 CFR 35.59, "Recentness of training"

  This section would be amended to include 10 CFR Part 35, Subpart I.

Subpart C—General Technical Requirements

- 10 CFR 35.60, "Possession, use, and calibration of instruments used to measure the activity of unsealed byproduct material"

  Currently, this section applies only to unsealed byproduct material. The title of this section and requirements would be amended to include microsources. Specifically, this section would be amended to include the measurement of microsource activity. Instruments used to measure the activity of microsources for determination of the dose to the patient must be calibrated in accordance with the microsources' manufacturer recommendations and a nationally recognized standard or instrument manufacturer recommendation when a standard is not available.

- 10 CFR 35.63, "Determination of dosages of unsealed byproduct material for medical use"

  Currently, this section applies only to unsealed byproduct material. The title of this section and the requirements for determination of dosages would be amended to include microsources for medical use.

- 10 CFR 35.67, "Requirements for possession of sealed sources and brachytherapy sources"

  Since microsources are not individual discrete sources, this section would be amended to clarify that microsources are not required to be leak tested or inventoried like other brachytherapy sources.

- 10 CFR 35.69, “Labeling of vials and syringes”

  Since some microsources are not considered radioactive drugs, this section would be amended to include labeling of vial radiation shields and syringe radiation shields for microsources.

Subpart I

Subpart I of 10 CFR Part 35 would be used to establish the requirements for microsource manual brachytherapy. At a minimum, this subpart would address requirements for the safe use of microsource manual brachytherapy.

Question A.7.9

Please comment on what types of use should be permitted for microsource manual brachytherapy, including whether the use should be limited to that approved in the sealed source and device registry. Please comment on why unsealed microsources without a unique delivery system[8] should or should not be allowed.

Question A.7.10

Please comment on why any new requirements for microsource manual brachytherapy should or should not be limited to permanent implants.

- 10 CFR 35.700 (proposed new section)

  This new section would establish the use of microsources only for the use(s) approved in the SS&D Registry. This would include approved sealed sources and approved devices with SS&D registries or other materials, such as unsealed microsources, that are prepared for microsource manual brachytherapy and are obtained from approved suppliers. This regulation would, at a minimum, require that the microsources be used in accordance with the radiation safety conditions and limitations described in the SS&D Registry. Additionally, the microsources may be used in research to deliver therapeutic doses for medical use in accordance with an active Investigational Device Exemption application accepted by the FDA, provided that the requirements of 10 CFR 35.49(a) are met.

- 10 CFR 35.704 (proposed new section)

  This new section would establish survey requirements for patients or human research subjects after source implant and removal for temporary implants, if applicable. In addition, this new section would establish survey requirements for all areas where microsources are handled. The frequency for these surveys would be immediately after use for unrestricted areas and at end of day for restricted areas.

[8] Y-90 microspheres licensed through 10 CFR 35.1000, “Other medical uses of byproduct material or radiation from byproduct material,” are designated as devices but not as sealed sources in the SS&D Registry.

- 10 CFR 35.706 (proposed new section)

  This new section would establish microsource accountability for temporary microsource manual brachytherapy sources that are in storage or in use.

- 10 CFR 35.710 (proposed new section)

  This new section would establish minimum requirements for safety procedures and instructions to ensure adequate protection of public health and safety. This section would include (1) radiation safety instruction requirements for personnel caring for patients or human research subjects who are receiving microsource manual brachytherapy and cannot be released under 10 CFR 35.75, "Release of individuals containing unsealed byproduct material or implants containing byproduct material," (2) a requirement to develop, implement, and maintain written procedures for responding to an abnormal situation such as spills, leaks, or emergent patient conditions, and (3) a requirement that before the first use for patient treatment of a new delivery system, a licensee shall ensure that vendor operational and safety training is provided to all individuals involved in microsource manual brachytherapy use. This training must be provided to all individuals preparing, measuring, performing dosimetry calculations, or administering microsources pursuant to 10 CFR 35.27.

  Question A.7.11

  The potential changes to bring microspheres into the regulatory framework include establishing safety procedures and instructions. These changes are based on current licensing guidance for Y-90 microspheres and expected new uses of microsources. Please identify and comment on other items that should be included in a new requirement for safety procedures and instructions for microsource manual brachytherapy.

- 10 CFR 35.715 (proposed new section)

  This new section would establish minimum requirements for safety precautions, the minimum levels and types of controls required to ensure adequate protection of public health and safety. This section would include (1) requirements for patients or human research subjects receiving microsource manual brachytherapy who cannot be released under 10 CFR 35.75, (2) a requirement to have applicable emergency equipment available near each treatment room to respond to spills, leaks, contamination, or losses of pressure in a system, (3) notifications to the RSO, or his or her designee, and an AU as soon as possible if the patient or human research subject has a medical emergency or dies.

  Question A.7.12

  The potential changes to bring microspheres into the regulatory framework include establishing safety precautions. These changes are based on current licensing guidance for Y-90 microspheres and expected new uses of microsources. Please identify and comment on other items

that should be included in a new requirement for safety precautions (controls) for microsource manual brachytherapy.

- 10 CFR 35.790 (proposed new section)

This new section would establish training for AUs for use of microsource manual brachytherapy.

<u>Question A.7.13</u>

The current licensing guidance for Y-90 microspheres states that an AU should successfully complete training in the operation of the delivery system, safety procedures, and clinical use for the specific type of Y-90 microsphere for which authorization is sought. The guidance specifies that clinical use training to support unsupervised use should include at least three hands-on patient cases for each type of Y-90 microsphere requested, conducted in the physical presence of an AU who is authorized for the type of Y-90 microsphere for which the individual is seeking authorization. The guidance allows conditional approval of an AU before completing these three hands-on patient cases if a proposed AU cannot complete patient cases before authorization. This conditional approval was originally added to the guidance because there were limited Y-90 microsphere licensees and AUs to train future AUs. As the use of Y-90 microspheres has increased significantly, please comment on the continued need for conditional approval for Y-90 microsphere AUs. Indicate why the NRC should or should not continue to allow this pathway for all microsphere and microsource AUs.

<u>Question A.7.14</u>

The NRC is seeking input on the 80 hours of classroom and laboratory training for interventional radiologists pursuing AU status for Y-90 microsphere and other microsource uses. The NRC in the current EMT licensing guidance for Y-90 microspheres includes a pathway for interventional radiologists to become AUs for Y-90 microspheres use. This pathway requires the interventional radiologist to demonstrate that they have 80 hours of classroom and laboratory training in specific topics and specific work experience important to radiation safety, in addition to demonstrating that they have sufficient clinical interventional radiology and diagnostic radiology experience. Please comment on why 80 hours is or is not an appropriate amount of time to ensure that these topics are adequately covered. Who should supervise the work experience to ensure that the future AUs have adequate radiation safety knowledge and why?

Question A.7.15

The NRC in the current licensing guidance for Y-90 microspheres provides a pathway for interventional radiologists and physicians who meet the T&E requirements in 10 CFR 35.390 and 10 CFR 35.490 to become AUs for Y-90 microsphere use. This pathway does not require any additional classroom and laboratory training or specific work experience for these physicians besides demonstration of successfully completed training in the operation of the delivery system, safety procedures, and clinical use (including hands-on patient cases) for the type of Y-90 microsphere for which authorization is sought. Please identify and comment on any additional classroom and laboratory training topics or specific work experience that should be required for these physicians to become AUs for all microspheres or other types of microsources in Subpart I. What additional training and work experience should be considered, if any, and why?

Question A.7.16

The NRC in the current licensing guidance for Y-90 microspheres provides pathways for interventional radiologists and physicians that meet the T&E requirements in 10 CFR 35.390 and 10 CFR 35.490 to become AUs for Y-90 microsphere use. Please comment on whether and why the NRC should or should not provide additional pathways for other types of physicians to become AUs for use of microspheres or other types of microsources.

Question A.7.17

In most circumstances, are AUs the individuals administering Y-90 microspheres? Is it appropriate for other individuals to administer microsources under the supervision of an AU? Why or why not?

Subpart L—Records

- 10 CFR 35.2060, “Records of calibrations of instruments used to measure the activity of unsealed byproduct material”

  This section would be amended to make conforming changes based on the creation of 10 CFR Part 35, Subpart I, and revisions to Subpart C. The title of this section would be amended to refer to measurements of microsources.

- 10 CFR 35.2063, “Records of dosages of unsealed byproduct material for medical use”

  This section would be amended to make conforming changes based on the creation of 10 CFR Part 35, Subpart I, and revisions to Subpart C. The title of this section would be amended to refer to measurements of microsources.

- 10 CFR 35.2310, “Records of safety instruction”

  This section would be amended to make conforming changes based on the creation of 10 CFR Part 35, Subpart I, and revisions to Subpart C. This section would be amended to refer to 10 CFR 35.710.

- 10 CFR 35.2404, “Records of surveys after source implant and removal”

  This section would be amended to make conforming changes based on the creation of 10 CFR Part 35, Subpart I, and revisions to Subpart C. This section would be amended to refer to 10 CFR 35.704.

- 10 CFR 35.2406, “Records of brachytherapy source accountability”

  This section would be amended to refer to 10 CFR 35.706 which would require that 10 CFR 35.2406(b) and 10 CFR 35.2406(c) be changed to specifically reference individual discrete source implants. The staff will add 10 CFR 35.2406(d) to provide record requirements for microsources. Alternatively, 10 CFR 35.2406(c) could be amended to reference aggregate microsources. In either case, the title of the section would be amended to reference microsources.

- 10 CFR 35.2710 (proposed new section)

  This section would be created for maintenance of records for safety procedures.

Subpart M—Reports

- 10 CFR 35.3045, “Report and notification of a medical event”

  This section would be amended to adjust reporting requirements for microsource manual brachytherapy. For example, a new set of requirements for microsource manual brachytherapy would be created based on current licensing guidance for microsphere manual brachytherapy and operating experience from these types of uses. Additionally, an exclusion would be included for medical events due to reaching physiological equilibrium during microsource manual brachytherapy. Conforming changes would be needed to differentiate medical event criteria for current brachytherapy use from medical event reporting criteria for microsource manual brachytherapy.

Other 10 CFR Part 35 Subparts

No changes are needed to the following subparts to address microsource manual brachytherapy:

- Subpart D—Unsealed Byproduct Material—Written Directive Not Required

- Subpart E—Unsealed Byproduct Material—Written Directive Required
- Subpart F—Manual Brachytherapy
- Subpart G—Sealed Sources for Diagnosis
- Subpart H—Photon Emitting Remote Afterloader Units, Teletherapy Units, and Gamma Stereotactic Radiosurgery Units
- Subpart J [Reserved]
- Subpart K—Other Medical Uses of Byproduct Material or Radiation From Byproduct Material
- Subpart N—Enforcement

A.8 Other 10 CFR Part 35 Changes

The NRC would consider the following additional issues in this rulemaking to increase flexibilities in 10 CFR Part 35 to accommodate emerging radiopharmaceutical uses and future EMTs.

Question A.8.1

Industry is evaluating various novel radionuclide generators. Some novel radionuclide generators may be used to compound therapeutic dosages of unsealed byproduct material. The NRC is considering a requirement for licensees to perform breakthrough testing on novel radionuclide generators and report instances when breakthrough exceeds a defined limit. Since breakthrough limits for some novel radionuclide generators have not been established by the United States Pharmacopeia, please explain why it would or would not be sufficient for licensees to develop, implement, and maintain procedures for breakthrough testing and reporting for novel radionuclide generators.

Question A.8.2

Please comment on the type of T&E that should be required for AUs utilizing novel radionuclide generators and the type of T&E for authorized nuclear pharmacists utilizing novel radionuclide generators.

Question A.8.3

Please comment on why current structure for AMP involvement in 10 CFR Part 35, Subpart F, "Manual Brachytherapy," is or is not sufficient. If not sufficient, what

specific tasks or skills should be performed by an AMP for manual brachytherapy?

Subpart A—General Information

- 10 CFR 35.2, "Definitions"

  This section would be amended to expand the definition of a physician to include individuals with a foreign-equivalent degree to a medical doctor or doctor of osteopathy, such as Bachelor of Medicine, Bachelor of Surgery. The physician would still need to be licensed by a State or Territory of the United States, the District of Columbia, or the Commonwealth of Puerto Rico to prescribe drugs in the practice of medicine.

  To accommodate changes to 10 CFR 35.75, this section would also be amended to include the definition of "treatment regimen," which could be defined as the number of intended treatments per plan or the total number of intended fractionated radiopharmaceutical treatments.

Subpart B—General Administrative Requirements

- 10 CFR 35.24, "Authority and responsibilities for the radiation protection program"

  This section would be amended to expand the requirement in 10 CFR 35.24(f) for licensees to establish a Radiation Safety Committee if they are authorized for two or more different types of uses of byproduct material under 10 CFR Part 35, Subparts E, F, G, H, I, and K; two or more types of units under Subpart H; two or more types of uses under Subpart I; or two or more types of uses under Subpart K. This requirement would be amended to account for any EMTs under 10 CFR Part 35, Subpart K; current EMTs that would be incorporated into other subparts; Subpart G which now includes RSL procedures; and the new Subpart I for microsource manual brachytherapy. These subparts are not currently accounted for in 10 CFR 35.24.

  Additionally, 10 CFR 35.24(f) would be amended to clarify that the nursing service representative required to serve on a Radiation Safety Committee must be experienced in oversight or performance of licensed activities.

- 10 CFR 35.27, "Supervision"

  This section would be amended to include that the licensee must instruct the supervising individual in addition to the supervised individual in the licensee's written radiation protection procedures, written directive procedures, regulations of 10 CFR Part 35, and license conditions with respect to use of byproduct material. Further, 10 CFR 35.27(c) will be amended to clarify that licensees that permit supervised activities are responsible for both the acts and omissions of both the supervising individual and the supervised individual.

  Additionally, a new requirement would be added to this section requiring the licensee to instruct both the supervising individual and supervised individual on the definition of a medical event and associated reporting requirements for medical events.

- 10 CFR 35.40, “Written directives”

  To support revisions to the patient release regulations to account for radiopharmaceutical therapy regimens with multiple administrations (see discussion of proposed changes to 10 CFR 35.75 below), this section would be amended to require written directives to include dosage per administration and number of administrations (if a regimen is planned) and total dosage.

- 10 CFR 35.41, “Procedures for administrations requiring a written directive”

  This section would be amended to include a requirement that licensees have procedures in place to verify that the written directive is correct, to require training on these procedures for AUs, and to require an annual review of the procedures.

- 10 CFR 35.59, “Recentness of training”

  This section would be amended to include 10 CFR Part 35, Subpart K.

  Question A.8.4

  Due to the increased number and complexity of EMTs, please comment on why the NRC should or should not require continuing education for AUs. If continuing education should be required, what should it entail, at what frequency should it be acquired, and how should knowledge topics be acquired?

Subpart C—General Technical Requirements

- 10 CFR 35.75, “Release of individuals containing unsealed byproduct material or implants containing byproduct material”

  This section would be amended to address the significant increase in fractionated radiopharmaceutical treatments. Specifically, 10 CFR 35.75 would be amended so that the current limits are per treatment regimen and not per release.

Subpart D—Unsealed Byproduct Material—Written Directive Not Required

- 10 CFR 35.190, “Training for uptake, dilution, and excretion studies”

  This section would be amended to address T&E requirements for uses authorized under 10 CFR 35.100, “Use of unsealed byproduct material for uptake, dilution, and excretion studies for which a written directive is not required.” Specifically, 10 CFR 35.190 would be amended to clarify in the preamble that individuals who qualify as AUs under 10 CFR 35.290, “Training for imaging and localization studies,” and 10 CFR 35.390, “Training for use of unsealed byproduct material for which a written directive is required,” may be authorized to use 10 CFR 35.100 materials.

- 10 CFR 35.290, “Training for imaging and localization studies”

  This section would be amended to address T&E requirements for uses authorized under 10 CFR 35.200, “Use of unsealed byproduct material for imaging and localization studies for which a written directive is not required.” Specifically, 10 CFR 35.290 would be amended to clarify in the preamble that individuals who qualify as AUs under 10 CFR 35.390 who have generator elution experience as described in 10 CFR 35.290(c)(1)(ii)(G) may be authorized for use of 10 CFR 35.200 materials.

  The NRC is considering further amendments to this section to address T&E requirements for eluting, measuring, testing, and processing of eluate from radionuclide generator systems. Radionuclide generator systems, facilities, and individual users have changed significantly since the regulations relating to generator systems were last updated in 1994.[9] In evaluating these industry changes, the Advisory Committee for the Medical Use of Isotopes (ACMUI) deliberated the intent of the existing language in 10 CFR 35.290(c)(1)(ii)(G) regarding T&E requirements for AUs. The ACMUI affirmed its belief that AUs must be familiar with how radionuclide generators work, how breakthrough is tested, and how reagent kits are used to label radioactive drugs, but the direct hands-on work experience currently required by 10 CFR 35.290(c)(1)(ii)(G) is not necessary.[10] In accordance with this recommendation, 10 CFR 35.290(c)(1)(ii)(G) would be amended to increase the flexibility of generator-specific training required for AUs.

  Question A.8.5

  Please comment on the need for AUs for 10 CFR 35.200 to have device-specific training on radionuclide generators. If device-specific training is needed, what topics should the training include? Please explain why the training should or should not be specific to the radionuclide generators for which the AUs are supervising the use.

Subpart E—Unsealed Byproduct Material—Written Directive Required

- 10 CFR 35.392, “Training for the oral administration of sodium iodide I-131 requiring a written directive in quantities less than or equal to 1.22 gigabecquerels (33 millicuries)”; 10 CFR 35.394, “Training for the oral administration of sodium iodide I-131 requiring a written directive in quantities greater than 1.22 gigabecquerels (33 millicuries)”; and 10 CFR 35.396, “Training for the parenteral administration of unsealed byproduct material requiring a written directive”

  These sections would be amended to clarify the T&E requirements for uses of unsealed byproduct material requiring a written directive. Specifically, 10 CFR 35.392 would be amended to clarify that physicians trained under 10 CFR 35.390 or 10 CFR 35.394 are eligible to administer sodium iodide I-131 in quantities less than or equal to 33 millicuries. Additionally, 10 CFR 35.394 would be amended to clarify that physicians trained under 10 CFR 35.390 are eligible to administer sodium iodide I-131 in quantities

[9] “Preparation, Transfer for Commercial Distribution, and Use of Byproduct Material for Medical Use” (59 FR 29525; December 2, 1994).

[10] See ACMUI Subcommittee on Radionuclide Generator Knowledge and Practice Requirements, “Final Report,” October 14, 2021 (ML21288A126).

greater than 33 millicuries. Similarly, 10 CFR 35.396 would be amended to clarify that a physician authorized under 10 CFR 35.390 would be eligible to perform parenteral administration of unsealed byproduct material requiring a written directive.

Question A.8.6

Please comment and provide a rationale for whether physicians authorized for full use under 10 CFR 35.300, "Use of unsealed byproduct material for which a written directive is required," need additional T&E to fulfill their radiation safety-related duties and supervision roles because of expected emerging therapeutic radiopharmaceuticals. Please comment on why additional training is or is not needed on regulatory requirements for emerging therapeutic radiopharmaceuticals. If needed, what should the scope of the T&E include? What specific training should these AUs be required to have (e.g., vendor training on clinical use and safety procedures) prior to first-time use, if any? Why should they be required or not required to have continuing education?

Subpart G—Sealed Sources for Diagnosis

- 10 CFR 35.590, "Training for use of sealed sources and medical devices for diagnosis"

Question A.8.7

Please comment on why the current AU T&E requirements for use of sealed sources and medical devices for diagnosis in 10 CFR 35.590 (i.e., 8 hours of classroom and laboratory training in basic radionuclide-handling techniques specifically applicable to the use of the device authorized under 10 CFR 35.500, as well as device-specific training in the use of the device) are or are not appropriate for emerging sealed sources and medical devices containing sealed sources. If AUs for 10 CFR 35.500 need additional training and work experience on emerging sealed sources and medical devices containing sealed sources for diagnosis, what topics should be covered?

Subpart H—Photon Emitting Remote Afterloader Units, Teletherapy Units, and Gamma Stereotactic Radiosurgery Units

- 10 CFR 35.610, "Safety procedures and instructions for remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units"

  To align requirements with the technology of newer model GSR units and other devices regulated under 10 CFR Part 35, Subpart H, the NRC is considering amending this section to include requirements for console passwords.

Question A.8.8

Please comment on any specific changes that are needed to secure consoles, keys, and passwords for remote afterloader units, teletherapy units, and GSR units because of changes in technology.

- 10 CFR 35.615, “Safety precautions for remote afterloader units, teletherapy units, and gamma stereotactic radiosurgery units”

  The NRC is considering amending this section to clarify the types of doors that are acceptable at the treatment room entrance so that the licensee can control access to the treatment room.

  Question A.8.9

  Please comment on the types of doors or entry controls that would be acceptable to maintain security of licensed material while not interfering with patient care. For example, why should a physical door be required, or why are other entry controls such as lasers acceptable?

- 10 CFR 35.2075, “Records of the release of individuals containing unsealed byproduct material or implants containing byproduct material”

  Conforming changes to this section would be made based on changes to 10 CFR 35.75 to incorporate release of patients undergoing a multiple treatment regimen.

- 10 CFR 35.3045, “Report and notification of a medical event”

  To support changes to 10 CFR 35.75, the reporting requirements for medical events will be amended to allow the AU to change a regimen during a treatment protocol if medically necessary.

Appendix B—Data Tables

Table 7 contains the assumptions the U.S. Nuclear Regulatory Commission (NRC) has made about future emerging medical technology (EMT) licensing over a period of 15 years, from 2030 through 2044, after implementation of the Alternative 4 rule by the National Materials Program. The assumptions inform the time (hours) the NRC, Agreement States, and licensees would save on EMT licensing actions after implementation of the Alternative 4 rule. The predicted numbers of future licensing actions for each EMT include licensing actions for updated models of the EMT and new technologies that could be licensed under the revised medical use subpart. For example, the predicted number of future licensing actions for microspheres includes the possibility of new technologies (e.g., microparticles) that could be licensed under the new Title 10 of the *Code of Federal Regulations* (10 CFR) Part 35, "Medical Use of Byproduct Material," Subpart I, "Microsource Manual Brachytherapy."

The NRC first estimated the agency's licensing action labor hour savings and then extrapolated Agreement State licensing action labor hour savings, assuming that the Agreement States will regulate 93 percent of medical licensees by 2030. The agency used data from STC-22-034, "Results of the Annual Count of Active Radioactive Materials Licenses in the National Materials Program," dated May 19, 2022, to calculate the ratio of licensees regulated by the Agreement States and the NRC. The NRC estimated that licensee licensing action labor hour savings could range from 0 to 25 percent of the agency and Agreement State savings. For the purpose of the cost analysis, the NRC calculated licensing action labor hour savings for licensees by assuming that licensee savings would be 12.5 percent of the total NRC and Agreement State estimates. As previously noted, the NRC is interested in obtaining public comment on whether and how licensees would realize averted licensing costs as a result of the Alternative 4 rulemaking.

The licensing action labor hour savings in table 7 (in the column "Licensing Hours Saved over 15 Years") inform the "Submission and Review of EMT License Applications and Amendments" data in table 8 and the operation benefits tables for Alternatives 3 and 4 in appendix C.

Table 7: Emerging Medical Technology Licensing Assumptions

Technology[1]	Licensing Hours Saved over 15 Years			NRC Emerging Medical Technology Licensing Resource Assumptions
	Licensees	NRC	Agreement States	Submission and Review of Initial License Applications and Amendment Requests
Germanium-68/Gallium-68 Pharmaceutical Grade Generators	153	80	1,143	• 25% savings for initial license; no amendments needed. • 40 hours for initial license review. • Less than 10 licensed by NRC to date; NRC will license 8 in the next 15 years.
NeoVista, Inc.'s Epi-Rad90™ (Sr-90) Ophthalmic System[2]	344	180	2,571	• 50% savings for initial license and amendments. • 24 hours for initial license review; 4 hours for amendment review. • Seven licensed by NRC to date; NRC will license five in the next 15 years. • Each licensee (including existing licensees) will submit five amendment requests in the next 15 years.
Best Vascular, Inc. Beta-Cath™ Intravascular Brachytherapy System	401	210	3,000	• 50% savings for initial license and amendments. • 24 hours for initial license review; 4 hours for amendment review. • 10 licensed by NRC to date; NRC will license 5 in the next 15 years. • Each licensee (including existing licensees) will submit five amendment requests in the next 15 years.
I-125 Iotrex Liquid Brachytherapy Source in Cytyc GliaSite® Radiation Therapy System[3]	306	160	2,286	• 50% savings for initial license and amendments. • 24 hours for initial license review; 4 hours for amendment review. • Five licensed by NRC to date; NRC will license five in the next 15 years.

[1] The technologies listed in this table are specific devices. However, the NRC's estimates for each technology also account for similar types of emerging medical technology that would be accommodated in 10 CFR Part 35 as a result of this rulemaking.

[2] While Epi-Rad90™ is no longer distributed, this estimate accounts for other ophthalmic devices using Sr-90 and other ophthalmic devices, such as the Liberty Vision Yttrium-90 Disc Source, licensed in the next 15 years that could be immediately licensed under 10 CFR 35.400 rather than 10 CFR 35.1000.

[3] While GliaSite® is no longer distributed, this estimate accounts for other liquid brachytherapy devices licensed in the next 15 years that could be immediately licensed under 10 CFR 35.400, "Use of sources for brachytherapy," rather than 10 CFR 35.1000, "Other medical uses of byproduct material or radiation from byproduct material."

				• Each licensee (including existing licensees) will submit five amendment requests in the next 15 years.
ViewRay™ System for Radiation Therapy[4]	172	90	1,286	• 25% savings for initial license and amendments. • 40 hours for initial license review; 4 hours for amendment review. • Three licensed by NRC to date; NRC will license three in the next 15 years. • Each licensee (including existing licensees) will submit five amendment requests in the next 15 years.
Low-Activity Radioactive Seeds Use for Localization of Nonpalpable Lesions and Lymph Nodes	1,582	828	11,829	• 50% savings for initial license and amendments. • 24 hours for initial license review; 4 hours for amendment review. • 30 licensed by NRC to date; NRC will license 24 in the next 15 years. • Each licensee (including existing licensees) will submit five amendment requests in the next 15 years.
Gamma Knife®—Perfexion™	268	140	2,000	• 25% savings for initial license; 50% savings for amendments. • 40 hours for initial license review; 4 hours for amendment review. • Four licensed by NRC to date; NRC will license five in the next 15 years. • Each licensee (including existing licensees) will submit five amendment requests in the next 15 years.
Gamma Knife®—Icon™	325	170	2,429	• 25% savings for initial license; 50% savings for amendments. • 40 hours for initial license review; 4 hours for amendment review. • Seven licensed by NRC to date; NRC will license five in the next 15 years. • Each licensee (including existing licensees) will submit five amendment requests in the next 15 years.
GammaPod™	153	80	1,143	• 25% savings for initial license; 50% savings for amendments. • 40 hours for initial license review; 4 hours for amendment review. • None have been licensed by NRC to date; NRC will license 4 in the next 15 years.

[4] While ViewRay™ System for Radiation Therapy is no longer distributed, this estimate accounts for other teletherapy devices licensed in the next 15 years that could be immediately licensed under 10 CFR 35.600, “Use of a sealed source in a remote afterloader unit, teletherapy unit, or gamma stereotactic radiosurgery unit,” rather than 10 CFR 35.1000.

				• Each licensee (including existing licensees) will submit five amendment requests in the next 15 years.
Masep Infini™	344	180	2,571	• 25% savings for initial license; 50% savings for amendments. • 40 hours for initial license review; 4 hours for amendment review. • None have been licensed by NRC to date; NRC will license eight in the next 15 years. • Each licensee (including existing licensees) will submit five amendment requests in the next 15 years.
SIR-Spheres® Microspheres	11,159	5,840	83,429	• 50% savings for initial license and amendments. • 24 hours for initial license review; 4 hours for amendment review. • 100 licensed by NRC to date; NRC will license 120 in the next 15 years. • Each licensee (including existing licensees) will submit 10 amendment requests in the next 15 years.
TheraSphere® Microspheres	5,541	2,900	41,429	• 50% savings for initial license and amendments. • 24 hours for initial license review; 4 hours for amendment review. • 50 licensed by NRC to date; NRC will license 75 in the next 15 years. • Each licensee (including existing licensees) will submit 10 amendment requests in the next 15 years.

Table 8: Alternatives 1–4 Data Tables

Description	Mean Estimate	Distribution	Low Estimate	Mid Estimate	High Estimate
ALTERNATIVE 1—STATUS QUO					
PROCESSING EXEMPTIONS—COSTS					
Timing: 4 years (2023–2026) inclusive					
Licensees Submitting Exemption Requests					
Number of exemptions per year	55				
Hours for licensees to prepare and submit exemption requests	8	PERT	7	8	9
Agreement States Reviewing Exemption Requests					
Number of exemptions per year	49.5	PERT			
Hours for Agreement States to review exemption requests	(36)	PERT	(39.6)	(36.0)	(32.4)
NRC Reviewing Exemption Requests					
Number of exemptions per year	11	PERT			
Hours for NRC to review exemption requests	(36)	PERT	(40)	(36)	(32)
INSPECTION OF RB-82 GENERATORS AFTER EXEMPTIONS—AVERTED COSTS					
Timing: 15 years (2024–2038) inclusive					
Licensee Inspections					
Number of Rb-82 generator inspections per year	85				
Hours saved per inspection	2	PERT	1.8	2	2.2
Agreement State Inspections					
Number of Agreement State inspections of Rb-82 generators per year	76.5				
Hours saved per Agreement State inspection	4.0	PERT	3.6	4.0	4.4
NRC Inspections					
Number of NRC inspections of Rb-82 generators per year	8.5				
Hours saved per NRC inspection	6	PERT	5	6	7
ALTERNATIVE 2—RULEMAKING ONLY FOR RB-82 GENERATORS					
RULEMAKING AND UPDATING GUIDANCE—COSTS					
Timing: 2.25 years (2022–2024) inclusive					
Licensee Rulemaking Participation					
Number of Rb-82 generator licensees participating in rulemaking	11	PERT	10	11	12
Hours for each Rb-82 licensee to participate in rulemaking	(4)	PERT	(4)	(4)	(4)
Agreement State Rulemaking Participation					
Number of Agreement States	40			40	
Hours for each Agreement State to participate in rulemaking	(28)	PERT	(30)	(28)	(25)
NRC Rulemaking					
Number of NRC full-time equivalents (FTEs)	3	PERT	2.7	3	3.3

Description	Mean Estimate	Distribution	Low Estimate	Mid Estimate	High Estimate
FTE hours	(1,524)	PERT			
Rulemaking comment management	$0			$0	
IMPLEMENTATION OF NEW RULE—COSTS					
Timing: 3 years (2025–2027) inclusive					
Licensee Implementation of New Rule					
(No rulemaking implementation costs for licensees)	0			0	
Hours	0			0	
Agreement State Rulemaking					
Number of Agreement States	40			40	
Cost per Agreement State to develop compatible regulations	(40,000)	PERT	($44,000)	($40,000)	($36,000)
NRC Regulatory Review of New Agreement State Regulations					
Hours for NRC regulatory review for each Agreement State	(40)	PERT	(44)	(40)	(36)
INSPECTION OF RB-82 GENERATORS—AVERTED COSTS					
Timing: 15 years (2028–2042) inclusive					
Licensee Inspections					
Number of Rb-82 generator inspections each year	85				
Hours saved per inspection	2		1.8	2	2.2
Agreement State Inspections					
Number of Agreement State inspections of Rb-82 generators each year	76.6				
Hours saved per Agreement State inspection	4	PERT	3	4	5
NRC Inspections					
Number of NRC inspections of Rb-82 generators each year	8.5				
Hours saved per NRC inspection	6	PERT	4	6	8
ALTERNATIVE 3—LIMITED SCOPE RULEMAKING FOR RB-82 GENERATORS AND CERTAIN EMERGING MEDICAL TECHNOLOGIES					
RULEMAKING AND UPDATING GUIDANCE—COSTS					
Timing: 2.75 years (2022–2024) inclusive					
Licensee Rulemaking Participation					
Number of medical licensees that would participate in rulemaking	100	PERT	90	100	110
Hours for each licensee to participate in rulemaking	(8)	PERT	(9)	(8)	(7)
Agreement State Rulemaking Participation					
Number of Agreement States	40			40	
Hours for each Agreement State to participate in rulemaking	(47)	PERT	(52)	(47)	(43)
NRC Rulemaking					
Number of NRC FTEs	4.3	PERT	4.0	4.25	4.9

Description	Mean Estimate	Distribution	Low Estimate	Mid Estimate	High Estimate
FTE hours	(1,524)			(1,524)	
Rulemaking comment management	($152,500)	PERT	($172,500)	($150,000)	($142,500)
IMPLEMENTATION OF NEW RULE—COSTS					
Timing: 4 years (2025–2028) inclusive					
Licensee Implementation of New Rule					
Number of affected NRC licensees	126				
Number of affected Agreement State licensees	1,134				
Number of affected licensees	1,260	PERT	1,134	1,260	1,386
Hours per licensee implementation	(20)	PERT	(22)	(20)	(18)
Agreement State Rulemaking and Implementation					
Number of Agreement States	40			40	
Cost per Agreement State to develop compatible regulations and implementation	($97,604)	PERT	($107,365)	($97,604)	($87,844)
NRC Rule Implementation					
Hours for NRC regulatory review for each Agreement State	(41)	PERT	(46)	(40)	(38)
Hours for NRC rule implementation	(8)				
SUBMISSION AND REVIEW OF EMT LICENSE APPLICATIONS AND AMENDMENTS—AVERTED COSTS					
Timing: 15 years (2029–2043) inclusive					
By 2026, NRC will regulate 7% of medical licensees			7%		
By 2026, Agreement States will regulate 93% of medical licensees			93%		
Licensees—ViewRay™ System for Radiation Therapy					
Hours	172	Uniform	0		344
Agreement States—ViewRay™ System for Radiation Therapy					
Hours	1,286	PERT	1,157	1,286	1,414
NRC—ViewRay™ System for Radiation Therapy					
Hours	90	PERT	81	90	99
Licensees—Gamma Knife®—Perfexion™					
Hours	268	Uniform	0		535
Agreement States—Gamma Knife®—Perfexion™					
Hours	2,000	PERT	1,800	2,000	2,200
NRC—Gamma Knife®—Perfexion™					
Hours	140	PERT	126	140	154
Licensees—Gamma Knife®—Icon™					
Hours	325	Uniform	0		650
Agreement States—Gamma Knife®—Icon™					
Hours	2,429	PERT	2,186	2,429	2,671

Description	Mean Estimate	Distribution	Low Estimate	Mid Estimate	High Estimate
NRC—Gamma Knife®—Icon™					
Hours	170	PERT	153	170	187
Licensees—GammaPod™					
Hours	153	Uniform	0		306
Agreement States—GammaPod™					
Hours	1,143	PERT	1,029	1,143	1,257
NRC—GammaPod™					
Hours	80	PERT	72	80	88
Licensees—Masep Infini™					
Hours	344	Uniform	0		688
Agreement States—Masep Infini™					
Hours	2,571	PERT	2,314	2,571	2,829
NRC—Masep Infini™					
Hours	180	PERT	162	180	198
Licensees—Sirtex Microspheres					
Hours	11,159	Uniform	0		22,317
Agreement States—Sirtex Microspheres					
Hours	83,429	PERT	75,086	83,429	91,771
NRC—Sirtex Microspheres					
Hours	5,840	PERT	5,256	5,840	6,424
Licensees—Nordion Microspheres					
Hours	5,541	Uniform	0		11,082
Agreement States—Nordion Microspheres					
Hours	41,429	PERT	37,286	41,429	45,571
NRC—Nordion Microspheres					
Hours	2,900	PERT	2,610	2,900	3,190
NRC Averted EMT Licensing Guidance Costs					
Hours per year	343	PERT	309	343	378
	Licensees		**Agreement States**		**NRC**
Sum Hours	**17,961**		**134,286**		**9,400**
ALTERNATIVE 4—PERFORMANCE-BASED RULEMAKING TO INCREASE REGULATORY FLEXIBILITY [STAFF RECOMMENDATION]					
RULEMAKING AND UPDATING GUIDANCE—COSTS					
Timing: One time over 4 years (2022–2025) inclusive					
Licensee Rulemaking Participation					
Number of medical licensees that would participate in rulemaking	100	PERT	90	100	110
Hours for each licensee to participate in rulemaking	(8)	PERT	(9)	(8)	(7)

Description	Mean Estimate	Distribution	Low Estimate	Mid Estimate	High Estimate
Agreement State Rulemaking Participation					
Number of Agreement States	40			40	
Hours for each Agreement State to participate in rulemaking	(64)	PERT	(71)	(64)	(58)
NRC Rulemaking					
Number of NRC FTEs	8	PERT	7.1	7.5	8.6
FTE hours	(1,524)				
Comment management	($203,333)	PERT	($230,000)	($200,000)	($190,000)
IMPLEMENTATION OF NEW RULE—COSTS					
Timing: One time over 4 years (2026–2029) inclusive					
Licensee Implementation of New Rule					
Number of affected NRC licensees	126				
Number of affected Agreement State licensees	1,134				
Number of affected licensees	1,260	PERT	1,134	1,260	1,386
Hours per licensee implementation	(20)	PERT	(22)	(20)	(18)
Agreement State Rulemaking and Implementation					
Number of Agreement States	40			40	
Cost per Agreement State to develop compatible regulations and implementation	(96,929)	PERT	($106,622)	($96,929)	($87,236)
NRC Rule Implementation					
Hours for NRC regulatory review for each Agreement State	(41)	PERT	(48)	(40)	(38)
Hours for NRC rule implementation	(8)				
SUBMISSION AND REVIEW OF EMT LICENSE APPLICATIONS AND AMENDMENTS—AVERTED COSTS					
Timing: 15 years (2030–2044) inclusive					
Licensees—Germanium-68/Gallium-68 Pharmaceutical Grade Generators					
Hours	153	Uniform	0		306
Agreement States—Germanium-68/Gallium-68 Pharmaceutical Grade Generators					
Hours	1,143	PERT	1,029	1,143	1,257
NRC—Germanium-68/Gallium-68 Pharmaceutical Grade Generators					
Hours	80	PERT	72	80	88
Licensees—NeoVista, Inc., Epi-Rad90™ (Sr-90) Ophthalmic System					
Hours	344	Uniform	0		688
Agreement States—NeoVista, Inc., Epi-Rad90™ (Sr-90) Ophthalmic System					
Hours	2,571	PERT	2,314	2,571	2,829
NRC—NeoVista, Inc., Epi-Rad90™ (Sr-90) Ophthalmic System					
Hours	180	PERT	162	180	198
Licensees—Best Vascular, Inc., Beta-Cath™ Intravascular Brachytherapy System					

Description	Mean Estimate	Distribution	Low Estimate	Mid Estimate	High Estimate
Hours	401	Uniform	0		803
Agreement States—Best Vascular, Inc., Beta-Cath™ Intravascular Brachytherapy System					
Hours	3,000	PERT	2,700	3,000	3,300
NRC—Best Vascular, Inc., Beta-Cath™ Intravascular Brachytherapy System					
Hours	210	PERT	189	210	231
Licensees—I-125 Iotrex Liquid Brachytherapy Source in Cytyc GliaSite® Radiation Therapy System					
Hours	306	Uniform	0		611
Agreement States—I-125 Iotrex Liquid Brachytherapy Source in Cytyc GliaSite® Radiation Therapy System					
Hours	2,286	PERT	2,057	2,286	2,514
NRC—I-125 Iotrex Liquid Brachytherapy Source in Cytyc GliaSite® Radiation Therapy System					
Hours	160	PERT	144	160	176
Licensees—ViewRay™ System for Radiation Therapy					
Hours	172	Uniform	0		344
Agreement States—ViewRay™ System for Radiation Therapy					
Hours	1,286	PERT	1,157	1,286	1,414
NRC—ViewRay™ System for Radiation Therapy					
Hours	90	PERT	81	90	99
Licensees—Low-Activity Radioactive Seeds Use for Localization of Nonpalpable Lesions and Lymph Nodes					
Hours	1,582	Uniform	0		3,164
Agreement States—Low-Activity Radioactive Seeds Use for Localization of Nonpalpable Lesions and Lymph Nodes					
Hours	11,829	PERT	10,646	11,829	13,011
NRC—Low-Activity Radioactive Seeds Use for Localization of Nonpalpable Lesions and Lymph Nodes					
Hours	828	PERT	745.2	828	910.8
Licensees—Gamma Knife®—Perfexion™					
Hours	268	Uniform	0		535
Agreement States—Gamma Knife®—Perfexion™					
Hours	2,000	PERT	1,800	2,000	2,200
NRC—Gamma Knife®—Perfexion™					
Hours	140	PERT	126	140	154
Licensees—Gamma Knife®—Icon™					
Hours	325	Uniform	0		650
Agreement States—Gamma Knife®—Icon™					
Hours	2,429	PERT	2,186	2,429	2,671
NRC—Gamma Knife®—Icon™					
Hours	170	PERT	153	170	187

Description	Mean Estimate	Distribution	Low Estimate	Mid Estimate	High Estimate
Licensees—GammaPod™					
Hours	153	Uniform	0		306
Agreement States—GammaPod™					
Hours	1,143	PERT	1,029	1,143	1,257
NRC—GammaPod™					
Hours	80	PERT	72.0	80	88
Licensees—Masep Infini™					
Hours	344	Uniform	0		688
Agreement States—Masep Infini™					
Hours	2,571	PERT	2,314	2,571	2,829
NRC—Masep Infini™					
Hours	180	PERT	162	180	198.0
Licensees—Sirtex Microspheres					
Hours	11,159	Uniform	0		22,317
Agreement States—Sirtex Microspheres					
Hours	83,429	PERT	75,086	83,429	91,771
NRC—Sirtex Microspheres					
Hours	5,840	PERT	5,256	5,840	6,424
Licensees—Nordion Microspheres					
Hours	11,159	Uniform	0		22,317
Agreement States—Nordion Microspheres					
Hours	41,429	PERT	37,286	41,429	45,571
NRC—Nordion Microspheres					
Hours	2,900	PERT	2,610	2,900	3,190
NRC—Averted EMT Licensing Guidance Costs					
Hours per year	437	PERT	393	437	480

Sum Hours	Licensees	Agreement States	NRC
	26,364	**155,114**	**10,858**

Appendix C—Tables of Costs and Averted Costs for Each Alternative by NRC, Agreement States, and Licensees

The appendix C tables show the calculations for the net costs and averted costs associated with each alternative by the U.S. Nuclear Regulatory Commission (NRC), Agreement States, and licensees. (Refer to table 5 for rulemaking costs for the NRC for each rulemaking alternative.)

ALTERNATIVE 1—STATUS QUO

Table 9: Alternative 1—NRC Reviewing Exemptions (Costs)

Year	Activity	Hours	# Exemptions	NRC Hourly Rate	Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2023	NRC Reviewing Exemptions	(36)	11	$143	($56,628)	($52,923)	($54,979)
2024	NRC Reviewing Exemptions	(36)	11	$143	($56,628)	($49,461)	($53,377)
	Total Net Benefits—Costs	(72)			($113,256)	($102,384)	($108,356)
				15-Year Average	($7,550)	($6,826)	($7,224)
				Annualized with 7% Discounting		($11,241)	
				Annualized with 3% Discounting			($9,077)

Table 10: Alternative 1—NRC Rb-82 Generator Inspections (Averted Costs)

Year	Activity	Hours	# Inspections	NRC Hourly Rate	Net Benefits—Averted Costs		
					Undiscounted	7% NPV	3% NPV
2025	NRC Inspections	6	8.5	$143	$7,293	$5,953	$6,674
2026	NRC Inspections	6	8.5	$143	$7,293	$5,564	$6,480
2027	NRC Inspections	6	8.5	$143	$7,293	$5,200	$6,291
2028	NRC Inspections	6	8.5	$143	$7,293	$4,860	$6,108
2029	NRC Inspections	6	8.5	$143	$7,293	$4,542	$5,930
2030	NRC Inspections	6	8.5	$143	$7,293	$4,245	$5,757
2031	NRC Inspections	6	8.5	$143	$7,293	$3,967	$5,589
2032	NRC Inspections	6	8.5	$143	$7,293	$3,707	$5,427

Year	Activity	Hours	# Inspections	NRC Hourly Rate	Net Benefits—Averted Costs		
					Undiscounted	7% NPV	3% NPV
2033	NRC Inspections	6	8.5	$143	$7,293	$3,465	$5,269
2034	NRC Inspections	6	8.5	$143	$7,293	$3,238	$5,115
2035	NRC Inspections	6	8.5	$143	$7,293	$3,026	$4,966
2036	NRC Inspections	6	8.5	$143	$7,293	$2,828	$4,822
2037	NRC Inspections	6	8.5	$143	$7,293	$2,643	$4,681
2038	NRC Inspections	6	8.5	$143	$7,293	$2,470	$4,545
2039	NRC Inspections	6	8.5	$143	$7,293	$2,309	$4,412
Total Net Benefits—Averted Costs		90			$109,395	$58,017	$82,066
				15-Year Average	$7,293	$3,868	$5,471
				Annualized with 7% Discounting		$6,370	
				Annualized with 3% Discounting			$6,874

Table 11: Alternative 1—Agreement States' Reviewing Exemptions (Costs)

Year	Activity	Hours	# Exemptions	Agreement State Hourly Rate	Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2023	Agreement States' Reviewing Exemptions	(36)	49.5	$73	($130,572)	($122,030)	($126,769)
2024	Agreement States' Reviewing Exemptions	(36)	49.5	$73	($130,572)	($114,046)	($123,076)
2025	Agreement States' Reviewing Exemptions	(36)	49.5	$73	($130,572)	($106,585)	($119,492)
2026	Agreement States' Reviewing Exemptions	(36)	49.5	$73	($130,572)	($99,612)	($116,011)
Total Net Benefits—Costs		(144)			($522,287)	($442,274)	($485,348)
				15-Year Average	($34,819)	($29,485)	($32,357)
				Annualized with 7% Discounting		($48,559)	
				Annualized with 3% Discounting			($40,656)

Table 12: Alternative 1—Agreement States' Rb-82 Generator Inspections (Averted Costs)

Year	Activity	Hours	# Inspections	Agreement State Hourly Rate	Net Benefits—Averted Costs		
					Undiscounted	7% NPV	3% NPV
2026	Agreement States' Inspections	4	76.5	$73	$22,421	$17,105	$19,921
2027	Agreement States' Inspections	4	76.5	$73	$22,421	$15,986	$19,341
2028	Agreement States' Inspections	4	76.5	$73	$22,421	$14,940	$18,778
2029	Agreement States' Inspections	4	76.5	$73	$22,421	$13,963	$18,231
2030	Agreement States' Inspections	4	76.5	$73	$22,421	$13,049	$17,700
2031	Agreement States' Inspections	4	76.5	$73	$22,421	$12,196	$17,184
2032	Agreement States' Inspections	4	76.5	$73	$22,421	$11,398	$16,684
2033	Agreement States' Inspections	4	76.5	$73	$22,421	$10,652	$16,198
2034	Agreement States' Inspections	4	76.5	$73	$22,421	$9,955	$15,726
2035	Agreement States' Inspections	4	76.5	$73	$22,421	$9,304	$15,268
2036	Agreement States' Inspections	4	76.5	$73	$22,421	$8,695	$14,823
2037	Agreement States' Inspections	4	76.5	$73	$22,421	$8,127	$14,391
2038	Agreement States' Inspections	4	76.5	$73	$22,421	$7,595	$13,972
2039	Agreement States' Inspections	4	76.5	$73	$22,421	$7,098	$13,565
2040	Agreement States' Inspections	4	76.5	$73	$22,421	$6,634	$13,170
	Total Net Benefits—Averted Costs				$336,321	$166,698	$244,952
				15-Year Average	$22,421	$11,113	$16,330
				Annualized with 7% Discounting		$18,303	
				Annualized with 3% Discounting			$20,519

Table 13: Alternative 1—Licensees' Submitting Exemptions (Costs)

Year	Activity	Hours	# Exemptions	Licensee Hourly Rate	Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2023	Licensees' Submitting Exemptions	(8)	55	$92	($40,683)	($38,022)	($39,498)
2024	Licensees' Submitting Exemptions	(8)	55	$92	($40,683)	($35,534)	($38,348)
2025	Licensees' Submitting Exemptions	(8)	55	$92	($40,683)	($33,210)	($37,231)
2026	Licensees' Submitting Exemptions	(8)	55	$92	($40,683)	($31,037)	($36,147)
Total Net Benefits—Costs		(32)			($162,733)	($137,803)	($151,224)
				15-Year Average	($10,849)	($9,187)	($10,082)
				Annualized with 7% Discounting		($15,130)	
				Annualized with 3% Discounting			($12,668)

Table 14: Alternative 1—Licensees' Rb-82 Generator Inspections (Averted Costs)

Year	Activity	Hours	# Inspections	Licensee Hourly Rate	Net Benefits—Averted Costs		
					Undiscounted	7% NPV	3% NPV
2024	Licensees' Inspections	2	85	$92	$15,731	$13,740	$14,828
2025	Licensees' Inspections	2	85	$92	$15,731	$12,841	$14,396
2026	Licensees' Inspections	2	85	$92	$15,731	$12,001	$13,977
2027	Licensees' Inspections	2	85	$92	$15,731	$11,216	$13,570
2028	Licensees' Inspections	2	85	$92	$15,731	$10,482	$13,174
2029	Licensees' Inspections	2	85	$92	$15,731	$9,796	$12,791
2030	Licensees' Inspections	2	85	$92	$15,731	$9,156	$12,418
2031	Licensees' Inspections	2	85	$92	$15,731	$8,557	$12,056
2032	Licensees' Inspections	2	85	$92	$15,731	$7,997	$11,705
2033	Licensees' Inspections	2	85	$92	$15,731	$7,474	$11,364
2034	Licensees' Inspections	2	85	$92	$15,731	$6,985	$11,033
2035	Licensees' Inspections	2	85	$92	$15,731	$6,528	$10,712
2036	Licensees' Inspections	2	85	$92	$15,731	$6,101	$10,400

Year	Activity	Hours	# Inspections	Licensee Hourly Rate	Net Benefits—Averted Costs		
					Undiscounted	7% NPV	3% NPV
2037	Licensees' Inspections	2	85	$92	$15,731	$5,702	$10,097
2038	Licensees' Inspections	2	85	$92	$15,731	$5,329	$9,803
	Total Net Benefits—Averted Costs	16			$235,963	$133,902	$182,324
			15	15-Year Average	$15,731	$8,927	$12,155
				Annualized with 7% Discounting		$14,702	
				Annualized with 3% Discounting			$15,273

ALTERNATIVE 2—RULEMAKING ONLY FOR RB-82 GENERATORS

Table 15: Alternative 2—NRC Regulatory Review (Costs)

Year	Activity	Hours	# Agreement States	NRC Hourly Rate	Total Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2025	NRC Regulatory Review of New Agreement State Regulations	(13)	40	$143	($76,267)	($62,256)	($69,795)
2026	NRC Regulatory Review of New Agreement State Regulations	(13)	40	$143	($76,267)	($58,183)	($67,762)
2027	NRC Regulatory Review of New Agreement State Regulations	(13)	40	$143	($76,267)	($54,377)	($65,788)
	Total Net Benefits—Costs	(40)			($228,800)	($174,817)	($203,345)
				15-Year Average	($15,253)	($11,654)	($13,556)
				Annualized with 7% Discounting		($19,194)	
				Annualized with 3% Discounting			($22,326)

Table 16: Alternative 2—Agreement States' Rulemaking Participation (Costs)

Year	Activity	Hours	# Agreement States	Agreement State Hourly Rate	Total Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2022	Agreement States' Rulemaking Participation	(9)	40	$73	($26,867)	($26,867)	($26,867)
2023	Agreement States' Rulemaking Participation	(9)	40	$73	($26,867)	($25,109)	($26,084)
2024	Agreement States' Rulemaking Participation	(9)	40	$73	($26,867)	($23,466)	($25,324)
Total Net Benefits—Costs		(28)			($80,600)	($75,442)	($78,275)
15-Year Average					($5,373)	($5,029)	($5,218)
Annualized with 7% Discounting						($8,283)	
Annualized with 3% Discounting							($8,594)

Table 17: Alternative 2—Agreement States' Rulemaking (Costs)

Year	Activity	# Agreement States	Agreement State Cost to Develop Regulations	Total Net Benefits—Costs		
				Undiscounted	7% NPV	3% NPV
2025	Agreement States' Rulemaking	13	($40,000)	($533,333)	($435,359)	($488,076)
2026	Agreement States' Rulemaking	13	($40,000)	($533,333)	($406,877)	($473,860)
2027	Agreement States' Rulemaking	13	($40,000)	($533,333)	($380,259)	($460,058)
Total Net Benefits—Costs		40		($1,600,000)	($1,222,496)	($1,421,993)
15-Year Average				($106,667)	($81,500)	($94,800)
Annualized with 7% Discounting					($134,223)	
Annualized with 3% Discounting						($156,127)

Table 18: Alternative 2—Licensees' Rulemaking Participation (Costs)

Year	Activity	Hours	# Licensees	Licensee Hourly Rate	Total Net Benefits (Costs)		
					Undiscounted	7% NPV	3% NPV
2022	Licensees' Rulemaking Participation	(1.3)	11	$92	($1,356)	($1,356)	($1,356)
2023	Licensees' Rulemaking Participation	(1.3)	11	$92	($1,356)	($1,267)	($1,317)
2024	Licensees' Rulemaking Participation	(1.3)	11	$92	($1,356)	($1,184)	($1,278)
	Total Net Benefits—Costs	(4)			($4,068)	($3,808)	($3,951)
				15-Year Average	($271)	($254)	($263)
				Annualized with 7% Discounting		($418)	
				Annualized with 3% Discounting			($434)

Table 19: Alternative 2—NRC Rb-82 Generator Inspections (Averted Costs)

Year	Activity	# Inspections	Hours	NRC Hourly Rate	Total Net Benefits—Averted Costs		
					Undiscounted	7% NPV	3% NPV
2026	NRC Inspections	8.5	6	$143	$7,299	$4,863	$6,113
2027	NRC Inspections	8.5	6	$143	$7,299	$4,545	$5,935
2028	NRC Inspections	8.5	6	$143	$7,299	$4,248	$5,762
2029	NRC Inspections	8.5	6	$143	$7,299	$3,970	$5,594
2030	NRC Inspections	8.5	6	$143	$7,299	$3,710	$5,431
2031	NRC Inspections	8.5	6	$143	$7,299	$3,468	$5,273
2032	NRC Inspections	8.5	6	$143	$7,299	$3,241	$5,119
2033	NRC Inspections	8.5	6	$143	$7,299	$3,029	$4,970
2034	NRC Inspections	8.5	6	$143	$7,299	$2,831	$4,825
2035	NRC Inspections	8.5	6	$143	$7,299	$2,645	$4,685
2036	NRC Inspections	8.5	6	$143	$7,299	$2,472	$4,548
2037	NRC Inspections	8.5	6	$143	$7,299	$2,311	$4,416
2038	NRC Inspections	8.5	6	$143	$7,299	$2,159	$4,287

Year	Activity	# Inspections	Hours	NRC Hourly Rate	Total Net Benefits—Averted Costs		
					Undiscounted	7% NPV	3% NPV
2039	NRC Inspections	8.5	6	$143	$7,299	$2,018	$4,162
2040	NRC Inspections	8.5	6	$143	$7,299	$1,886	$4,041
2041	NRC Inspections	8.5	6	$143	$7,299	$1,763	$3,923
Total Net Benefits—Averted Costs		136.1	96		$116,780	$49,159	$79,084
15-Year Average					$7,785	$3,277	$5,272
				Annualized with 7% Discounting		$5,397	
				Annualized with 3% Discounting			$6,625

Table 20: Alternative 2—Agreement States' Rb-82 Generator Inspections (Averted Costs)

Year	Activity	# Inspections	Hours	Agreement State Hourly Rate	Total Net Benefits—Averted Costs		
					Undiscounted	7% NPV	3% NPV
2029	Agreement States' Inspections	76.6	4	$73	$22,439	$12,205	$17,198
2030	Agreement States' Inspections	76.6	4	$73	$22,439	$11,407	$16,697
2031	Agreement States' Inspections	76.6	4	$73	$22,439	$10,661	$16,210
2032	Agreement States' Inspections	76.6	4	$73	$22,439	$9,963	$15,738
2033	Agreement States' Inspections	76.6	4	$73	$22,439	$9,311	$15,280
2034	Agreement States' Inspections	76.6	4	$73	$22,439	$8,702	$14,835
2035	Agreement States' Inspections	76.6	4	$73	$22,439	$8,133	$14,403
2036	Agreement States' Inspections	76.6	4	$73	$22,439	$7,601	$13,983
2037	Agreement States' Inspections	76.6	4	$73	$22,439	$7,104	$13,576
2038	Agreement States' Inspections	76.6	4	$73	$22,439	$6,639	$13,181
2039	Agreement States' Inspections	76.6	4	$73	$22,439	$6,205	$12,797
2040	Agreement States' Inspections	76.6	4	$73	$22,439	$5,799	$12,424
2041	Agreement States' Inspections	76.6	4	$73	$22,439	$5,419	$12,062
2042	Agreement States' Inspections	76.6	4	$73	$22,439	$5,065	$11,711
2043	Agreement States' Inspections	76.6	4	$73	$22,439	$4,733	$11,370
Total Net Benefits—Averted Costs			60		$336,585	$118,947	$211,463
15-Year Average					$22,439	$7,930	$14,098

Year	Activity	# Inspections	Hours	Agreement State Hourly Rate	Total Net Benefits—Averted Costs		
					Undiscounted	7% NPV	3% NPV
				Annualized with 7% Discounting		$13,060	
				Annualized with 3% Discounting			$17,714

Table 21: Alternative 2—Licensees' Rb-82 Generator Inspections (Averted Costs)

Year	Activity	# Inspections	Hours	Licensee Hourly Rate	Total Net Benefits—Averted Costs		
					Undiscounted	7% NPV	3% NPV
2028	Licensees' Inspections	85	2	$92	$15,731	$9,156	$12,418
2029	Licensees' Inspections	85	2	$92	$15,731	$8,557	$12,056
2030	Licensees' Inspections	85	2	$92	$15,731	$7,997	$11,705
2031	Licensees' Inspections	85	2	$92	$15,731	$7,474	$11,364
2032	Licensees' Inspections	85	2	$92	$15,731	$6,985	$11,033
2033	Licensees' Inspections	85	2	$92	$15,731	$6,528	$10,712
2034	Licensees' Inspections	85	2	$92	$15,731	$6,101	$10,400
2035	Licensees' Inspections	85	2	$92	$15,731	$5,702	$10,097
2036	Licensees' Inspections	85	2	$92	$15,731	$5,329	$9,803
2037	Licensees' Inspections	85	2	$92	$15,731	$4,980	$9,517
2038	Licensees' Inspections	85	2	$92	$15,731	$4,654	$9,240
2039	Licensees' Inspections	85	2	$92	$15,731	$4,350	$8,971
2040	Licensees' Inspections	85	2	$92	$15,731	$4,065	$8,710
2041	Licensees' Inspections	85	2	$92	$15,731	$3,799	$8,456
2042	Licensees' Inspections	85	2	$92	$15,731	$3,551	$8,210
	Total Net Benefits—Averted Costs		30		$235,963	$89,225	$152,694
				15-Year Average	$15,731	$5,948	$10,180
				Annualized with 7% Discounting		$9,796	
				Annualized with 3% Discounting			$12,791

ALTERNATIVE 3—LIMITED SCOPE RULEMAKING FOR RB-82 GENERATORS AND CERTAIN EMERGING MEDICAL TECHNOLOGIES

Table 22: Alternative 3—NRC Rulemaking Implementation (Costs)

Year	Activity	Hours	# Licensees	NRC Hourly Rate	Total Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2025	NRC Rule Implementation	(8)	126.00	$143	($1,144)	($934)	($1,047)
	Total Net Benefits—Costs	(8)			($1,144)	($934)	($1,047)
				15-Year Average	($76)	($62)	($70)
				Annualized with 7% Discounting		($103)	
				Annualized with 3% Discounting			($115)

Table 23: Alternative 3—NRC Regulatory Review (Costs)

Year	Activity	Hours	# Agreement States	NRC Hourly Rate	Total Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2025	NRC Regulatory Review	(14)	40.00	$143	($77,538)	($63,294)	($70,958)
2026	NRC Regulatory Review	(14)	40.00	$143	($77,538)	($59,153)	($68,891)
2027	NRC Regulatory Review	(14)	40.00	$143	($77,538)	($55,283)	($66,885)
	Total Net Benefits—Costs	(41)			($232,613)	($177,730)	($206,734)
				15-Year Average	($15,508)	($11,849)	($13,782)
				Annualized with 7% Discounting		($19,514)	
				Annualized with 3% Discounting			($22,698)

Table 24: Alternative 3—Agreement States' Rulemaking Participation (Costs)

Year	Activity	Hours	# Agreement States	Agreement State Hourly Rate	Total Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2022	Agreement States' Rulemaking Participation	(15.8)	40	$73	($46,357)	($46,357)	($46,357)
2023	Agreement States' Rulemaking Participation	(15.8)	40	$73	($46,357)	($43,324)	($45,007)
2024	Agreement States' Rulemaking Participation	(15.8)	40	$73	($46,357)	($40,490)	($43,696)
	Total Net Benefits—Costs	(47)			($139,071)	($130,172)	($135,060)
				15-Year Average	($9,271)	($8,678)	($9,004)
				Annualized with 7% Discounting		($14,292)	
				Annualized with 3% Discounting			($14,829)

Table 25: Alternative 3—Agreement States' Rulemaking and Implementation (Costs)

Year	Activity	# Agreement States	Agreement States' Cost to Develop Regulations and Implement New Rule	Total Net Benefits—Costs		
				Undiscounted	7% NPV	3% NPV
2025	Agreement States' Rulemaking and Implementation	13	($97,604)	($1,301,389)	($1,062,321)	($1,190,956)
2026	Agreement States' Rulemaking and Implementation	13	($97,604)	($1,301,389)	($992,824)	($1,156,268)
2027	Agreement States' Rulemaking and Implementation	13	($97,604)	($1,301,389)	($927,873)	($1,122,590)
	Total Net Benefits—Costs	40		($3,904,168)	($2,983,018)	($3,469,813)
			15-year Average	($260,278)	($198,868)	($231,321)
			Annualized with 7% Discounting		($327,519)	
			Annualized with 3% Discounting			($380,967)

Table 26: Alternative 3—Licensees' Rulemaking Participation (Costs)

Year	Activity	Hours	# Licensees	Licensee Hourly Rate	Total Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2022	Licensees' Rulemaking Participation	(2.7)	100	$92	($24,657)	($24,657)	($24,657)
2023	Licensees' Rulemaking Participation	(2.7)	100	$92	($24,657)	($23,044)	($23,938)
2024	Licensees' Rulemaking Participation	(2.7)	100	$92	($24,657)	($21,536)	($23,241)
Total Net Benefits—Costs		(8)			($73,970)	($69,236)	($71,836)
15-Year Average					($4,931)	($4,616)	($4,789)
Annualized with 7% Discounting						($7,602)	
Annualized with 3% Discounting							($7,887)

Table 27: Alternative 3—Licensees' Rulemaking Implementation (Costs)

Year	Activity	Hours	# Licensees	Licensee Hourly Rate	Total Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2025	Licensees' Implementation of New Rule	(20.0)	126	$92	($233,004)	($190,201)	($213,232)
2028	Licensees' Implementation of New Rule	(20.0)	1,134	$92	($2,097,040)	($1,397,346)	($1,756,238)
Total Net Benefits—Costs		(40)			($2,330,044)	($1,587,547)	($1,969,470)
15-Year Average					($155,336)	($105,836)	($131,298)
Annualized with 7% Discounting						($174,304)	
Annualized with 3% Discounting							($216,237)

Table 28: Alternative 3—NRC Emerging Medical Technology Licensing (Averted Costs)

Year	Activity	Hours	NRC Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2026	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$68,366	$79,620
2027	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$63,893	$77,301
2028	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$59,713	$75,050
2029	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$55,807	$72,864
2030	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$52,156	$70,742
2031	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$48,744	$68,681
2032	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$45,555	$66,681
2033	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$42,575	$64,739
2034	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$39,789	$62,853
2035	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$37,186	$61,022
2036	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$34,754	$59,245

Year	Activity	Hours	NRC Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2037	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$32,480	$57,519
2038	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$30,355	$55,844
2039	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$28,369	$54,218
2040	NRC Review of EMT License Applications and Amendment Requests	627	$143	$89,613	$26,513	$52,638
Total Net Benefits—Costs		9,400		$1,344,200	$666,255	$979,017
			15-Year Average	$89,613	$44,417	$65,268
			Annualized with 7% Discounting		$73,151	
			Annualized with 3% Discounting			$82,009

Table 29: Alternative 3—Development of Emerging Medical Technology Licensing Guidance (Averted Costs)

Year	Activity	Hours	NRC Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2026	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$37,456	$43,622
2027	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$35,005	$42,351
2028	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$32,715	$41,118
2029	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$30,575	$39,920
2030	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$28,575	$38,757
2031	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$26,705	$37,629

Year	Activity	Hours	NRC Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2032	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$24,958	$36,533
2033	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$23,325	$35,468
2034	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$21,800	$34,435
2035	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$20,373	$33,432
2036	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$19,041	$32,459
2037	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$17,795	$31,513
2038	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$16,631	$30,595
2039	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$15,543	$29,704
2040	NRC Development of EMT Licensing Guidance	343	$143	$49,097	$14,526	$28,839
	Total Net Benefits—Costs	5,150		$736,450	$365,022	$536,376
			15-Year Average	$49,097	$24,335	$35,758
			Annualized with 7% Discounting		$40,078	
			Annualized with 3% Discounting			$44,930

Table 30: Alternative 3—Agreement States' Emerging Medical Technology Licensing (Averted Costs)

Year	Activity	Hours	Agreement State Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2029	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$408,501	$533,358
2030	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$381,777	$517,824
2031	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$356,801	$502,741
2032	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$333,459	$488,098

Year	Activity	Hours	Agreement State Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2033	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$311,644	$473,882
2034	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$291,256	$460,080
2035	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$272,202	$446,679
2036	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$254,394	$433,669
2037	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$237,751	$421,038
2038	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$222,198	$408,775
2039	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$207,661	$396,869
2040	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$194,076	$385,309
2041	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$181,379	$374,087
2042	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$169,513	$363,191
2043	Agreement States' Review of EMT License Applications and Amendment Requests	8,952	$73	$655,964	$158,424	$352,613
	Total Net Benefits—Averted Costs	134,286		$9,839,453	$3,981,035	$6,558,214
			15-Year Average	$655,964	$265,402	$437,214
			Annualized with 7% Discounting		$437,096	
			Annualized with 3% Discounting			$549,359

Table 31: Alternative 3—Licensees' Emerging Medical Technology Licensing (Averted Costs)

Year	Activity	Hours	Licensee Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2029	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$68,946	$90,019

Year	Activity	Hours	Licensee Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2030	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$64,436	$87,397
2031	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$60,220	$84,852
2032	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$56,281	$82,380
2033	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$52,599	$79,981
2034	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$49,158	$77,651
2035	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$45,942	$75,390
2036	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$42,936	$73,194
2037	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$40,127	$71,062
2038	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$37,502	$68,992
2039	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$35,049	$66,983
2040	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$32,756	$65,032
2041	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$30,613	$63,138
2042	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$28,610	$61,299
2043	Licensees' Submission of EMT License Applications and Amendment Requests	1,197	$92	$110,712	$26,738	$59,513
	Total Net Benefits—Averted Costs	17,961		$1,660,685	$671,912	$1,106,883
			15-Year Average	$110,712	$44,794	$73,792
			Annualized with 7% Discounting		$73,772	
			Annualized with 3% Discounting			$92,720

ALTERNATIVE 4—PERFORMANCE-BASED RULEMAKING TO INCREASE REGULATORY FLEXIBILITY

Table 32: Alternative 4—NRC Rulemaking Implementation (Costs)

Year	Activity	Hours	# Licensees	NRC Hourly Rate	Total Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2026	NRC Rulemaking Implementation	(8)	126	$143	($144,144)	($109,967)	($128,070)
	Total Net Benefits—Costs	(8)			($144,144)	($109,967)	($128,070)
				15-Year Average	($9,610)	($7,331)	($8,538)
				Annualized with 7% Discounting		($12,074)	
				Annualized with 3% Discounting			($14,061)

Table 33: Alternative 4—NRC Regulatory Review (Costs)

Year	Activity	Hours	# Agreement States	NRC Hourly Rate	Total Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2026	NRC Regulatory Review	(14)	40	$143	($78,173)	($59,638)	($69,456)
2027	NRC Regulatory Review	(14)	40	$143	($78,173)	($55,737)	($67,433)
2028	NRC Regulatory Review	(14)	40	$143	($78,173)	($52,090)	($65,469)
	Total Net Benefits—Costs	(41)			($234,520)	($167,465)	($202,358)
				15-Year Average	($15,635)	($11,164)	($13,491)
				Annualized with 7% Discounting		($18,387)	
				Annualized with 3% Discounting			($22,218)

Table 34: Alternative 4—Agreement States' Rulemaking Participation (Costs)

Year	Activity	Hours	# Agreement States	Agreement State Hourly Rate	Total Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2022	Agreement States' Rulemaking Participation	(16)	40	$73	($46,968)	($46,968)	($46,968)
2023	Agreement States' Rulemaking Participation	(16)	40	$73	($46,968)	($43,895)	($45,600)
2024	Agreement States' Rulemaking Participation	(16)	40	$73	($46,968)	($41,023)	($44,272)
2025	Agreement States' Rulemaking Participation	(16)	40	$73	($46,968)	($38,340)	($42,982)
Total Net Benefits—Costs		(64)			($187,871)	($170,226)	($179,821)
15-Year Average					($12,525)	($11,348)	($11,988)
Annualized with 7% Discounting						($18,690)	
Annualized with 3% Discounting							($19,743)

Table 35: Alternative 4—Agreement States' Rulemaking and Implementation (Costs)

Year	Activity	# Agreement States	Agreement States' Cost to Develop Regulations and Implement New Rule	Total Net Benefits—Costs		
				Undiscounted	7% NPV	3% NPV
2026	Agreement States' Rulemaking and Implementation	13	($96,929)	($1,292,391)	($985,959)	($1,148,273)
2027	Agreement States' Rulemaking and Implementation	13	($96,929)	($1,292,391)	($921,457)	($1,114,828)
2028	Agreement States' Rulemaking and Implementation	13	($96,929)	($1,292,391)	($861,175)	($1,082,357)
Total Net Benefits—Costs		40		($3,877,172)	($2,768,590)	($3,345,457)
15-Year Average				($258,478)	($184,573)	($223,030)
Annualized with 7% Discounting					($303,976)	

Year	Activity	# Agreement States	Agreement States' Cost to Develop Regulations and Implement New Rule	Total Net Benefits—Costs		
				Undiscounted	7% NPV	3% NPV
			Annualized with 3% Discounting			($367,313)

Table 36: Alternative 4—Licensees' Rulemaking Participation (Costs)

Year	Activity	Hours	# Licensees	Licensee Hourly Rate	Total Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2023	Licensees' Rulemaking Participation	(2)	100	$92	($18,492)	($17,283)	($17,954)
2024	Licensees' Rulemaking Participation	(2)	100	$92	($18,492)	($16,152)	($17,431)
2025	Licensees' Rulemaking Participation	(2)	100	$92	($18,492)	($15,095)	($16,923)
2026	Licensees' Rulemaking Participation	(2)	100	$92	($18,492)	($14,108)	($16,430)
	Total Net Benefits—Costs	(8)			($73,970)	($62,638)	($68,738)
				15-Year Average	($4,931)	($4,176)	($4,583)
				Annualized with 7% Discounting		($6,877)	
				Annualized with 3% Discounting			($7,547)

Table 37: Alternative 4—Licensees' Rulemaking Implementation (Costs)

Year	Activity	Hours	# Licensees	Licensee Hourly Rate	Total Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2026	Licensees' Implementation of New Rule	(20)	126	$92	($233,004)	($177,758)	($207,021)

Year	Activity	Hours	# Licensees	Licensee Hourly Rate	Total Net Benefits—Costs		
					Undiscounted	7% NPV	3% NPV
2029	Licensees' Implementation of New Rule	(20)	1,134	$92	($2,097,040)	($1,305,931)	($1,705,085)
	Total Net Benefits—Costs	(40)			($2,330,044)	($1,483,689)	($1,912,107)
				15-Year Average	($155,336)	($98,913)	($127,474)
				Annualized with 7% Discounting		($162,901)	
				Annualized with 3% Discounting			($209,939)

Table 38: Alternative 4—NRC Emerging Medical Technology Licensing (Averted Costs)

Year	Activity	Hours	NRC Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2027	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$73,803	$89,291
2028	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$68,975	$86,690
2029	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$64,463	$84,165
2030	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$60,245	$81,714
2031	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$56,304	$79,334
2032	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$52,621	$77,023

Year	Activity	Hours	NRC Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2033	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$49,178	$74,780
2034	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$45,961	$72,602
2035	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$42,954	$70,487
2036	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$40,144	$68,434
2037	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$37,518	$66,441
2038	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$35,063	$64,506
2039	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$32,770	$62,627
2040	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$30,626	$60,803
2041	NRC Review of EMT License Applications and Amendment Requests	724	$143	$103,513	$28,622	$59,032
	Total Net Benefits—Averted Costs	10,858		$1,552,694	$719,248	$1,097,931
			15-Year Average	$103,513	$47,950	$73,195
			Annualized with 7% Discounting		$78,970	
			Annualized with 3% Discounting			$91,970

Table 39: Alternative 4—NRC Development of Emerging Medical Technology Licensing Guidance (Averted Costs)

Year	Activity	Hours	NRC Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2027	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$44,521	$53,864
2028	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$41,609	$52,295
2029	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$38,887	$50,772
2030	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$36,343	$49,293
2031	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$33,965	$47,858
2032	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$31,743	$46,464
2033	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$29,666	$45,110
2034	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$27,726	$43,796
2035	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$25,912	$42,521
2036	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$24,217	$41,282
2037	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$22,632	$40,080
2038	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$21,152	$38,913
2039	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$19,768	$37,779
2040	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$18,475	$36,679
2041	NRC Development of EMT Licensing Guidance	437	$143	$62,443	$17,266	$35,611
	Total Net Benefits—Averted Costs	6,550		$936,650	$433,880	$662,318
			15-Year Average	$62,443	$28,925	$44,155

Year	Activity	Hours	NRC Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
			Annualized with 7% Discounting		$47,638	
			Annualized with 3% Discounting			$55,480

Table 40: Alternative 4—Agreement States' Emerging Medical Technology Licensing (Averted Costs)

Year	Activity	Hours	Agreement State Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2030	Agreement States' Review of EMT License Applications and Amendments Requests	10,341	$73	$757,708	$440,993	$598,141
2031	Agreement States' Review of EMT License Applications and Amendments Requests	10,341	$73	$757,708	$412,143	$580,720
2032	Agreement States' Review of EMT License Applications and Amendments Requests	10,341	$73	$757,708	$385,180	$563,806
2033	Agreement States' Review of EMT License Applications and Amendments Requests	10,341	$73	$757,708	$359,981	$547,384
2034	Agreement States' Review of EMT License Applications and Amendments Requests	10,341	$73	$757,708	$336,431	$531,441
2035	Agreement States' Review of EMT License Applications and Amendments Requests	10,341	$73	$757,708	$314,422	$515,962
2036	Agreement States' Review of EMT License Applications and Amendments Requests	10,341	$73	$757,708	$293,852	$500,934
2037	Agreement States' Review of EMT License Applications and Amendments Requests	10,341	$73	$757,708	$274,628	$486,344
2038	Agreement States' Review of EMT License Applications and Amendments Requests	10,341	$73	$757,708	$256,662	$472,178
2039	Agreement States' Review of EMT License Applications and Amendments Requests	10,341	$73	$757,708	$239,871	$458,426
2040	Agreement States' Review of EMT License Applications and Amendments Requests	10,341	$73	$757,708	$224,178	$445,073
2041	Agreement States' Submission and Review of EMT License Applications and Amendments	10,341	$73	$757,708	$209,512	$432,110

Year	Activity	Hours	Agreement State Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2042	Agreement States' Submission and Review of EMT License Applications and Amendments	10,341	$73	$757,708	$195,806	$419,524
2043	Agreement States' Submission and Review of EMT License Applications and Amendments	10,341	$73	$757,708	$182,996	$407,305
2044	Agreement States' Submission and Review of EMT License Applications and Amendments	10,341	$73	$757,708	$171,025	$395,442
Total Net Benefits—Averted Costs		155,114		$11,365,615	$4,297,681	$7,354,791
			15-Year Average	$757,708	$286,512	$490,319
			Annualized with 7% Discounting		$471,862	
			Annualized with 3% Discounting			$616,086

Table 41: Alternative 4—Licensees' Emerging Medical Technology Licensing (Averted Costs)

Year	Activity	Hours	Licensee Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2030	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$94,583	$128,288
2031	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$88,396	$124,552
2032	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$82,613	$120,924
2033	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$77,208	$117,402

Year	Activity	Hours	Licensee Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2034	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$72,157	$113,982
2035	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$67,437	$110,662
2036	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$63,025	$107,439
2037	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$58,902	$104,310
2038	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$55,048	$101,272
2039	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$51,447	$98,322
2040	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$48,081	$95,458
2041	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$44,936	$92,678
2042	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$41,996	$89,979
2043	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$39,249	$87,358

Year	Activity	Hours	Licensee Hourly Rate	Total Net Benefits—Averted Costs		
				Undiscounted	7% NPV	3% NPV
2044	Licensees' Submission of EMT License Applications and Amendment Requests	1,758	$92	$162,512	$36,681	$84,814
Total Net Benefits—Averted Costs		17,576		$2,437,673	$921,758	$1,577,440
			15-Year Average	$162,512	$61,451	$105,163
			Annualized with 7% Discounting		$101,204	
			Annualized with 3% Discounting			$132,137

Appendix D—Uncertainty Analysis

The U.S. Nuclear Regulatory Commission (NRC) completed a Monte Carlo sensitivity analysis for this draft regulatory analysis using the specialty software @Risk®. The Monte Carlo approach answers the question, “What distribution of net benefits results from multiple draws of the probability distribution assigned to key variables?”

D.1 Uncertainty Analysis Assumptions

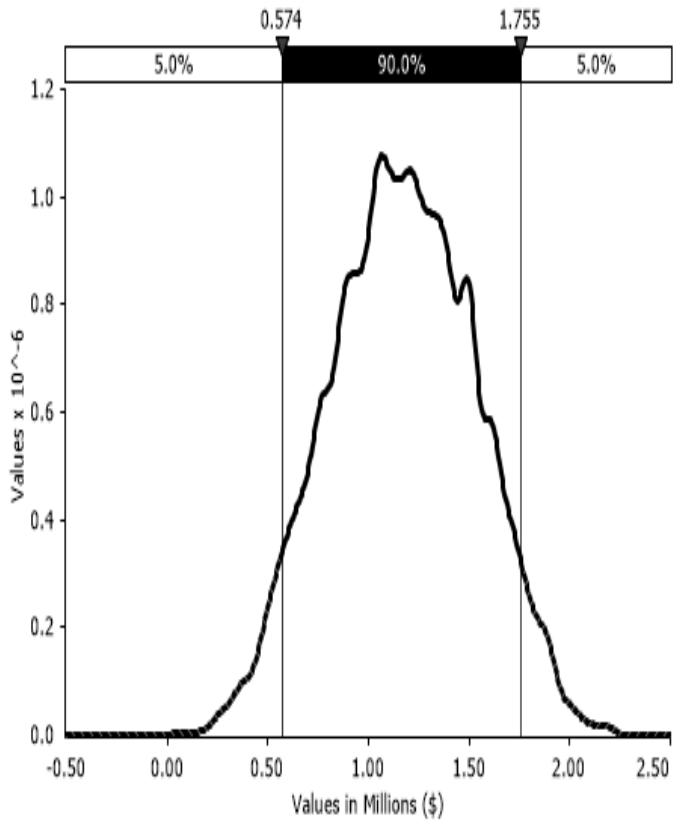
As this draft regulatory analysis uses estimates of labor and predicted future licensing actions, the staff analyzed the variables that have the greatest amount of uncertainty. To perform this analysis, the staff used a Monte Carlo simulation analysis using the @Risk® software program. This was done to determine the robustness of the costs and net benefits of the rulemaking. The NRC examined how anticipated costs and averted costs change because of uncertainties associated with the agency’s analytical assumptions and input data shown in appendix B to this document.

D.2 Uncertainty Analysis Inputs

The probability distributions chosen to represent the different variables in the analysis were bounded by the range-referenced input and the NRC staff’s professional judgment. When defining the probability distributions for use in a Monte Carlo simulation, summary statistics are used to characterize the distributions. These summary statistics include the minimum, most likely, and maximum values of a program evaluation and review technique (PERT) distribution. The staff used the PERT distribution to reflect the relative spread and skewness of the distribution defined by the three estimates—the minimum, most likely, and maximum. Figure 1 provides the probability distribution function and the descriptive statistics of the inputs used in the uncertainty analysis. Appendix B to this document shows the inputs.

D.3 Uncertainty Analysis Results

Figure 1 depicts the results of the uncertainty analysis of Alternative 4 net costs using a 7 percent discount rate. This figure displays the curve of the incremental net averted cost for the rulemaking. The uncertainty analysis graph shows that the Alternative 4 mean net averted cost is approximately $1,169,000 in 2022 dollars with a 90 percent confidence interval that the averted costs are between $574,000 and $1,755,000 using a 7 percent discount rate. Note that there may be differences in totals if the random number generator uses a different seed to initiate the random number sequence.



Statistics	
	Alternative 4 - PERFORMANCE-BASED RULEMAKING TO INCREASE REGULATORY FLEXIBILITY [STAFF RECOMMENDATION]
Cell	ExecSummary!D38
Minimum	$563
Maximum	$2,261,637
Mean	$1,169,081
90% CI	± $5,895
Mode	$1,061,798
Median	$1,168,080
Std Dev	$358,375
Skewness	0
Kurtosis	3
Values	10000
Errors	0
Filtered	0
Left X	$573,649
Left P	5.0%
Right X	$1,754,849
Right P	95.0%

Figure 1: Incremental Net Costs for Alternative 4 (7 Percent Discount Rate)

D.4 Sensitivity Analysis

In addition to estimating the probability distributions for the net benefits of the rule, the staff used Monte Carlo simulation to conduct a sensitivity analysis to determine the variables that have the greatest impact on the resulting net costs. Variables shown to have a large effect on the resulting net benefits may deserve more attention and scrutiny than variables shown to have a small or minimal effect.

Figure 2 shows a tornado diagram that identifies the key variables whose uncertainty drives the largest impact on net benefits for this recommended alternative. Figure 2 ranks the variables based on their contribution to cost uncertainty.

The estimate that has the greatest variation in the Alternative 4 overall results is the licensee time in hours for submission and review of emerging medical technology (EMT) license applications and amendments for Sirtex Microspheres. The uncertainty in this variable would result in a change to the mean of $714,000, a difference in averted costs that ranges between $802,000 to $1,516,000 with a 90 percent confidence interval.

The estimate that has the second greatest variation in the Alternative 4 overall results is the licensee time in hours for submission and review of EMT license applications and amendments for Nordion Microspheres. The uncertainty in this variable would result in a change to the mean of $703,000, a difference in averted costs that ranges between $819,000 to $1,522,000 with a 90 percent confidence interval.

The estimate that has the third greatest variation in the Alternative 4 overall results is the cost per Agreement State to develop compatible regulations and implementation. The uncertainty variable would result in a change to the mean of $334,000, a difference in averted costs that ranges from $1,002,000 to $1,336,000 with a 90 percent confidence interval.

The estimate that has the fourth greatest variation in the Alternative 4 overall results is the cost per Agreement State time in hours for submission and review of EMT license applications and amendments for Sirtex Microspheres. The uncertainty variable would result in a change to the mean of $305,000, a difference in averted costs that ranges from $1,019,000 to $1,324,000 with a 90 percent confidence interval. The remaining variables result in small or minimal effect on the costs.

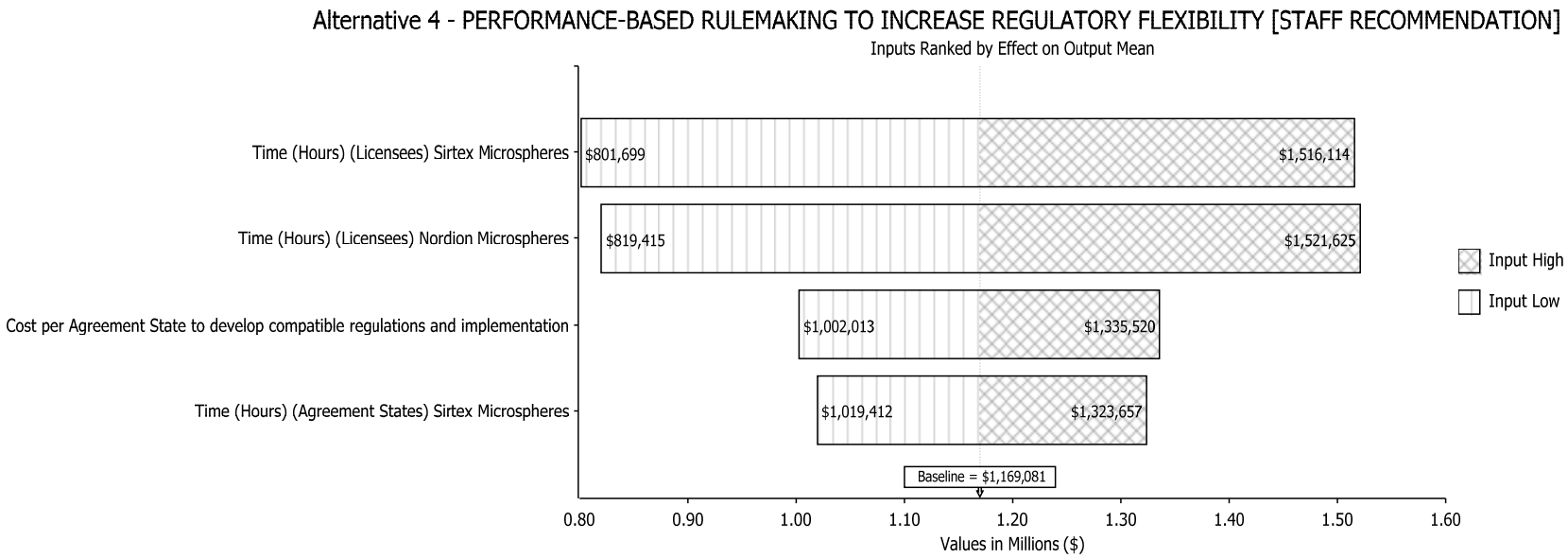


Figure 2: Alternative 4 Cost Drivers (7 Percent Discount Rate)