REGULATORY ANALYSIS OF ENERGY COMPENSATION SOURCES FOR WELL LOGGING AND OTHER REGULATORY CLARIFICATIONS - CHANGES TO 10 CFR PART 39

Final Report

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ABSTRACT

This regulatory analysis examines the values and impacts expected to result from a set of changes to the existing well logging regulations in 10 CFR Part 39. The changes will accommodate the use of well logging technology that was not incorporated when the NRC issued the existing well logging regulations (52 *Federal Register* 8225), and proposes other modifications to improve, clarify and update Part 39. These changes are described in a proposed rule dated April 19, 1999 (64 *Federal Register* 19089) and in a May 1998 Rulemaking Plan (SECY-98-105) entitled, "Energy Compensation Sources for Well Logging and Other Regulatory Clarifications - Changes to 10 CFR Part 39.

This regulatory analysis evaluates the values and impacts expected to result from two regulatory options: (1) no-action; and (2) the proposed action alternative. Under the proposed action, the U.S. Nuclear Regulatory Commission (NRC) would allow licensees to obtain regulatory relief from the current licensing and radiation safety requirements for well logging for low activity energy compensation sources (ECSs) and tritium neutron generator target sources. Specifically, NRC plans to reduce the regulatory burden on licensees to account for innovative and new technology while maintaining adequate protection of public health and safety. The most significant change to 10 CFR Part 39 would exclude a licensee using an ECS or a tritium neutron generator target source from the costly procedures for well abandonment.

Under Option 1, the no-action alternative, NRC would maintain the current licensing and radiation safety requirements for well logging as prescribed in 10 CFR Part 39, and additional requirements in other parts (as described in Section 1). In NRC's estimation, many of these requirements are overly burdensome for low activity (less than 3.7 MBq [100 μCi]) ECS sources and 1,110 GBq (30 Ci) tritium neutron generator target sources. Under this option, however, licensees would continue to be required to meet the current requirements contained in Part 39.

This regulatory analysis estimates the following values and impacts associated with the proposed changes to the current well logging requirements contained in 10 CFR Part 39.

- Relative to the no-action option (Option 1), the proposed action (Option 2) would result in industry operation savings for licensees. First, under Option 2, licensees would avoid the costly requirements for well abandonment for low activity ECSs and tritium neutron generator target sources. Second, licensees would realize savings associated with leak testing of these sources by reducing significantly the frequency of leak tests required to comply with NRC requirements (once every three years versus every six months). Third, licensees would be provided the flexibility to determine the best method for protecting against inadvertent intrusion on an abandoned source (for sources with activities greater than 3.7 MBq [100 μCi] or tritium neutron generator target sources above 1,110 GBq [30 Ci]).

- Relative to the no-action option (Option 1), the proposed action (Option 2) would result in operation savings for NRC. Specifically, under Option 2, NRC would realize savings by reducing the number of abandonment reviews for low activity ECSs and tritium neutron generator target sources. Further, NRC could realize additional savings associated with the change proposed for Section 39.77 allowing flexibility during an emergency for abandoning irretrievable sources. Also, minimal savings would result from fewer exemption requests. Since January 1, 1997, there have been six exemption requests (related to the proposed changes) and all were granted. These attributes are either difficult to evaluate at this time, or are of minimal value, and thus have not been quantified in this analysis.

- Relative to the no-action option (Option 1), the proposed action (Option 2) would result in additional costs for NRC implementation. Specifically, the consolidated regulatory guidance project would need to incorporate all necessary guidance for well logging licensees into NUREG-1556, *Consolidated Guidance About Materials Licenses, Program Specific Guidance About Well-Logging Licenses*. This would require both draft and final NUREG versions. NRC anticipates, however, that the affect on this NUREG would not be significant, since this update would be done regardless of whether this rulemaking were completed. Therefore, the values have not been quantified in this analysis.

- Relative to the no-action option (Option 1), Option 2 would reduce the burden on state and local government organizations actively involved in the regulation of well logging operations, thus yielding these organizations an annual cost savings. These values are expected to be minimal, and have not been quantified in this analysis.

- Relative to the no-action option (Option 1), Option 2 would result in enhanced regulatory efficiency, particularly by eliminating the need for preparing reporting and recordkeeping information for abandonment of low activity ECSs and tritium neutron generator target sources. In addition, Option 2 would provide greater regulatory certainty and clarity than the no-action option, and would ensure consistent treatment among all well logging licensees. These values, while believed to be significant, have not been quantified in this analysis.

1. INTRODUCTION

NRC has issued a proposed rule for amending its current licensing and radiation safety requirements for well logging at 10 CFR Part 39. [1] The regulations controlling use of well logging technology were promulgated in 1987. Since that time, new technologies have emerged that were not envisioned when the original regulations were written. NRC's intent is to revise these regulations to accommodate the use of these newer technologies. NRC is currently studying two regulatory options to accomplish this. This document presents NRC's regulatory analysis of these options.

1.1 Statement of Problem and Background

Almost all oil and gas produced today comes from accumulations in the pore spaces of reservoir rocks – usually sandstones, limestones, or dolomites. The amount of oil or gas contained in a unit volume of the reservoir is the product of its porosity by the hydrocarbon saturation. The volume of the formation containing the hydrocarbons is used to estimate total reserves and to determine whether the accumulation is commercially viable. Knowledge of formation thickness of the reservoir is needed to compute volume. In addition, evaluating the productivity of a reservoir requires knowing its permeability (i.e., how easily the fluid can flow through the pore system). The main parameters needed to evaluate a reservoir, then, are its porosity, hydrocarbon saturation, thickness, area, and permeability. In addition, the reservoir geometry, formation temperature and pressure, and lithology can play a major role in the evaluation, completion, and productivity of a reservoir.

One method to obtain downhole information about oil and gas reservoirs is by using well logging tools. Downhole well logging provides a method of deriving or inferring accurate values for the hydrocarbon and water saturations, porosity, permeability, and lithology of the reservoir rock. Licensed radioactive materials (sealed radioactive sources with associated radiation detectors) are contained in well logging tools. Americium-241 and cesium-137 are the radioactive materials most frequently used for this purpose. Traditionally, these tools are lowered into a well on a wireline. The depth of the well could range from several hundred feet to greater than 30,000 feet. Information collected by the detectors is sent to the surface through a wireline and plotted on a chart as the logging tool is slowly raised from the bottom of the well. Licensed radioactive materials are also used for similar purposes in coal and mineral exploration.

When NRC first promulgated its 10 CFR Part 39 regulations, well logging technology required drilling to stop. After removing portions of the drilling pieces, field workers then lowered logging tools -- encapsulated radioactive sources with associated detector crystals -- into the well on a wireline. More recent technology, referred to as "logging while drilling" (LWD) allows well logging to be accomplished during drilling. The technology provides "real-time" data during drilling operations and improves evaluation of geologic formations. In addition to the larger sources, logging while drilling technology

[1] 64 *Federal Register* 19089.

uses a low activity radioactive source to calibrate the larger source.

1.1.1 Energy Compensation Sources

An ECS is a low activity source (typically less than 3.7 megabequerels (MBq) [100 microcuries (μCi)]) compared to the normal 110 to 740 gigabequerel (GBq) [3 to 20 Ci] sources used in traditional wireline well logging as well as the newer LWD operations. Typical radionuclides used in these sources are Am-241, an alpha particle emitter, and Cs-137, a beta and gamma emitter. Source sizes vary widely depending upon the manufacturer and the intended use of the ECS. The majority of the tools used in well logging operations are custom designed for specific applications. Even so, the standard design is fairly typical: the encapsulated source is mounted inside a steel (or other similar metal) pressure housing in the interior of the LWD tool. The pressure housing (and other tool components) provides additional encapsulation to protect the source from operational impacts (e.g., pressure, stresses). An example of a licensed ECS source is provided below:

- **Steering and Gamma Ray Sub** - Manufactured by Anadrill, Inc., this device uses two 2.2 μCi americium-241 (Am-241) sources. This model is designed for downhole use during logging (or measurement while drilling) operations. It provides a spectrum of gamma radiation in the wellbore due to the naturally occurring concentrations of thorium, uranium and potassium in the surrounding rock formations. The gamma spectrum is measured using a ruggedized gamma ray spectrometer. The spectrometer uses two detectors; each containing its own Am-241 source acting as a reference for energy and activity, allowing the detector to compensate for efficiency fluctuations due to temperature changes in the borehole. The spectrometer and associated electronics operate at one atmosphere pressure within a sealed pressure housing made of stainless steel. This housing is positioned to allow drilling mud to flow between the outer diameter of the pressure housing and the inner diameter of the drilling collar (which acts as an additional encapsulation for the source). The diameter of the tool ranges from between 6.5 and 9 inches, with an overall length of approximately 133 inches. The Am-241 sources are mounted within the pressure housing on the side of each of the scintillating crystals of the spectrometer. The entire detector is then wrapped with 0.10 inch thick silicone rubber and teflon shrink tubing to assist in shock isolation. The wrapped detector is then press fit within the pressure housing. The pressure housing and drill collar shield all of the Am-241 gamma rays emitted toward the outside of the tool. Therefore, the presence of the Am-241 cannot be detected from outside the tool. The device is designed to operate in a high pressure and temperature environment. Testing of the devices indicates an ability to withstand both normal and extreme conditions of handling and use.

1.1.2 Tritium Neutron Generator Target Sources

Tritium neutron generator target sources are used in neutron logs. Neutron logs are used principally for delineation of porous formations and determination of their porosity. They respond primarily to the amount of hydrogen in the formation. Thus, in clean formations whose pores are filled with water or oil, the neutron log reflects the amount of liquid-filled porosity. These sources are not used in logging while drilling tools. They are used in the more traditional well logging procedure (i.e., wireline logging).

Neutrons are uncharged particles, each having a mass almost identical to the mass of a hydrogen atom. High energy neutrons are continuously emitted from a radioactive source (tritium) in the tool. These neutrons collide with nuclei of the formation materials, and with each collision, the neutrons lose energy. The energy lost per collision depends on the relative mass of the nucleus with which the neutron collides. Thus the slowing of the neutrons is dependent on the amount of hydrogen in the formation. These tools are used similar to wireline drilling, whereby the tool is lowered into the well on a wire and measurements are taken while drilling has ceased. Neutrons are generated when a voltage is applied to the tritium neutron generator target source. An example of a licensed tritium neutron generator target source is provided below:

- **Downhole Accelerator** - This source, manufactured by Haliburton Logging Sources, Inc. uses an H-3 source with a maximum activity of 100 GBq (3 Ci) in oil and gas well logging applications. The system consists of a pulsed deuterium-tritium accelerator, a scintillation detector, a digital telemetry system and associated electronics. This system is approximately 23 feet in length and 1-11/16ths inches in diameter. The accelerator tube is 7 inches long and 1-5/16ths inches in diameter. The device is used for neutron activation of underground formations for quantitative and qualitative analysis. It is designed to operate at pressures up to 20,000 psi and at temperatures of 400°F. A radiation hazard exists only when the accelerator is energized. It will then produce $1E^{+8}$ neutrons per second. The expected useful life of the accelerator is more than 400 hours.

1.1.3 Overview of Proposed Regulatory Changes

In its proposed rule, NRC determined that 10 CFR Part 39 should be changed to reflect the changes in the well logging industry. Specifically, NRC believes that many of the requirements in 10 CFR Part 39, when applied to either an ECS or tritium neutron generator target source, may be overly burdensome. Because the existing regulations do not allow for variations based on the activity of the source, licensees using an ECS must currently meet all the requirements of 10 CFR Part 39. Examples of overly burdensome requirements deal with well abandonment (Sections 39.15 and 39.77), leak testing (Section 39.35), design and performance criteria for sealed sources (Section 39.41), and monitoring of sources lodged in a well (Section 39.69). In the proposed action, NRC intends to apply the sections dealing with leak testing (Section 39.35), physical inventory (Section 39.37) and records of material use (Section 39.39) to the use of an ECS. Requirements established in other parts of NRC regulations (e.g.,

Parts 20 and 30) are still applicable to ECSs and tritium neutron generator target sources.

NRC's proposed rule addresses these issues by modifying the regulations in 10 CFR Part 39 to define an ECS and tritium neutron generator target and provide appropriate regulations for using these technologies in well logging applications. The most significant change excludes the user of an ECS from the costly procedures for well abandonment currently found in 10 CFR Part 39. Well abandonment, in addition to specific reporting and approval requirements, requires that the source be immobilized and sealed in place with a cement plug, that the cement plug be protected from inadvertent intrusion, and that a permanent plaque be mounted at the surface of the well. NRC proposes to implement less stringent abandonment requirements for ECSs, for sources measuring less than 3.7 MBq (100 μCi), and for tritium neutron generator target sources with sources measuring less than 1,110 GBq (30 Ci) in oil and gas wells where surface casing is set.

1.2 Statement of Problem and Background

Based on information about the changing technology in the well logging industry, NRC developed a Rulemaking Plan to consider the need to update Part 39. On May 28, 1997, NRC staff provided a draft Rulemaking Plan entitled, "Energy Compensation Sources for Well Logging and Clarifications -- Changes to 10 CFR Part 39" (SECY-97-111) to the Agreement States for comment. NRC staff received comments on the draft Rulemaking Plan from the States of Utah, Illinois, and Washington. These States generally supported the proposal and provided specific information and comments. Where appropriate, NRC staff incorporated these comments into the final Rulemaking Plan contained in SECY-98-105, dated May 12, 1998. (NRC, 1998) In April, 1999, NRC issued its proposed rule incorporating the changes contained in the rulemaking plan (64 *Federal Register* 19089). The NRC received five comments on the proposed rule. These comments and NRC's responses are discussed in the preamble to the final rule in the "Comments on the Proposed Rule" section.

In the final rule, NRC staff is modifying the existing regulations to account for the use of ECSs and new technologies. NRC staff believes these modifications would reduce regulatory burden to both NRC and Agreement State licensees with minimal impact to public health and safety. In addition, NRC is changing other sections of Part 39 to improve, clarify, and update the regulations.

1.3 Current Licensing and Radiation Safety Regulations

NRC's current requirements pertaining to licensing and radiation safety for well logging operations are contained in 10 CFR Part 39, and cross- reference other provisions in 10 CFR Parts 19, 20, 21, 30, 40, 70, 71, and 150 (e.g., notices, and reporting, radiation protection standards, possession of by-product material, licensing of source material and special nuclear material, packaging and transportation of radioactive material, and exemptions and continued regulatory authority of Agreement States). The rule would not affect the applicability of these other parts as they pertain to ECSs and tritium neutron generator target sources. The rulemaking is intended only to amend certain requirements contained in Part 39 that relate specifically to well logging operations.

As noted above, NRC's formal requirements for licensing and radiation safety for well logging are contained in 10 CFR Part 39. The requirements specified therein include:

- General provisions defining the scope and purpose of the requirements, definitions of key terms associated with the requirements, and requirements specific to information collection (Subpart A);

- Specific licensing requirements for the use of licensed material for well logging (Subpart B); these provisions require compliance with the licensing requirements contained in other NRC regulations, including Section 30.33 for by-product material, Section 40.32 for source material, and Section 70.33 for special nuclear material, as applicable;

- Equipment labeling, use, testing, inventory, and recordkeeping requirements (Subpart C);

- Radiation safety requirements, including training (inclusive of requirements contained in Parts 19, 20, and 39), operating and emergency procedures, personnel monitoring, radiation surveys, and contamination control (Subpart D);

- Security, records and notification requirements, including onsite recordkeeping, incident notification, and abandonment procedures (Subpart E);

- Exemptions (Subpart F); and

- Enforcement provisions (Subpart G).

2. IDENTIFICATION AND PRELIMINARY ANALYSIS OF ALTERNATIVE APPROACHES

The Rulemaking Plan for this rulemaking identified one specific option to address the issues identified in Section 1. This regulatory analysis discusses the option specified in the rulemaking plan, and a no-action alternative.

2.1 Option 1

Under Option 1, the no-action alternative, NRC would maintain the current licensing and radiation safety requirements for well logging as prescribed in 10 CFR Part 39, and additional requirements in other parts (as described in Section 1). In NRC's estimation, many of these requirements are overly burdensome for low activity (less than 3.7 MBq [100 μCi]) ECS sources and less than 1,110 GBq (30 Ci) tritium neutron generator target sources. Under this option, however, licensees would continue to be required to meet the requirements outlined in Section 1.2 above.

Under Option 1, licensees would have the opportunity to request an exemption from the current requirements on a case-by-case basis if they believe that the current level of regulation would be more than necessary based on the level of perceived risk. While exemptions could provide regulatory relief in the future, NRC believes that Option 1 would do so with less regulatory certainty than Option 2 discussed below. In addition, NRC believes that Option 1 may result in inconsistencies among licensees and would result in higher costs to both the licensee populations and NRC because of the cost inefficiencies of dealing with the exemption issue on a case-by-case basis.

2.2 Option 2

Under Option 2, NRC would allow licensees to obtain regulatory relief from the current licensing and radiation safety requirements for well logging for low activity sources. Specifically, NRC is proposing to reduce the regulatory burden on licensees to account for innovative and new technology while maintaining adequate protection of public health and safety. The most significant change to 10 CFR Part 39 would exclude a licensee using an ECS or tritium neutron generator target source from the costly procedures for well abandonment. Well abandonment, in addition to specific reporting and approval requirements, requires that the source be immobilized and sealed in place with a cement plug, that the cement plug be protected from inadvertent intrusion, and that a permanent plaque be mounted at the surface of a well.

In its Rulemaking Plan, NRC proposes several specific changes to improve, clarify, and update Part 39 requirements to provide regulatory relief and account for the use of new well logging technology. The possible changes are discussed below:

- **Revise requirements for ECSs containing less than 3.7MBq (100 μCi) for oil and gas wells.** NRC is proposing to eliminate the well abandonment requirements for ECSs containing less than 3.7MBq (100 μCi). Well abandonment, in addition to specific reporting and approval requirements, requires that the source be immobilized and sealed in place with a cement plug, that the cement plug be protected from inadvertent intrusion, and that a permanent plaque be mounted on the surface of the well. Current requirements in Section 39.35 specify that leak testing shall be conducted for beta-gamma emitting sources with activities above 3.7 MBq (100 μCi), and for alpha-emitters (above 0.37 MBq [10 μCi]) no less frequently than every six months. Current industry practices use several radionuclides in ECSs, the most typical being Cs-137 and Am-241. Typical activity levels of these radionuclides used in well logging applications do not exceed 1.8 MBq (50 μCi). Beta-gamma emitters with activity levels below 3.7 MBq (100 μCi) are already exempt from leak testing requirements. NRC proposes modifying Section 39.35 by changing the time interval for leak testing ECSs to not less than 3 years for non-exempt low activity sources. The changes proposed by NRC would, therefore, only affect those licensees using non-exempt sources.

- **Revise requirements for tritium neutron generator target sources containing less than 1,110 GBq (30 Ci) of tritium.** Tritium neutron sources typically contain less than 740 GBq (20 Ci) of tritium. The neutron generator target sources only produce a neutron stream when a voltage is applied. For well logging applications, NRC is proposing that the tritium neutron generator target sources below 1,110 GBq (30 Ci) be subject to all requirements contained in Part 39 except: (1) sealed source design and performance criteria (Section 39.41) and (2) well abandonment procedures (Sections 39.15 and 39.77) when a surface casing is used. Tritium neutron generator target sources are already exempt from leak testing requirements contained in Section 39.35. NRC believes that the potential hazards associated with these sources do not warrant the existing well abandonment requirements in the event of an irretrievable source.

- **Modify Section 39.15 to provide for performance-based criteria for inadvertent intrusion on an abandoned source.** The current requirement at Section 39.15(a)(5)(ii) requires a mechanical device to prevent inadvertent intrusion on the source that must be set at a point above the cement plug, unless the cement plug and source are not accessible to any subsequent drilling operations. NRC believes this requirement to be too restrictive in some cases, dependent upon the individual well abandonment. NRC proposes that licensees using high activity sources (above 3.7 MBq (100 μCi) or tritium neutron generator target sources above 1,110 GBq (30 Ci) "prevent inadvertent intrusion on the source," which would require that the source be protected but allow the licensee the flexibility to determine the best method. This change would not affect the requirement in (a)(5)(i) for a well logging source to be immobilized with a cement plug or the requirement in (a)(5)(iii) for a permanent plaque. This modification would allow licensees greater procedural latitude while continuing to ensure source integrity. For example, if a significant amount of drilling equipment is abandoned in the well, this equipment maybe effective in preventing inadvertent intrusion on the source, but may not meet the requirements of Section 39.15. These requirements would only apply to larger sources (i.e., above 3.7 MBq [100

μCi]) and tritium neutron generator target sources above 1,110 GBq (30 Ci).

- **Modify Section 39.77 requirements for notification and procedures for abandoning irretrievable well logging sources.** This section specifies that NRC approval must be obtained prior to implementing abandonment procedures for an irretrievable source. In some circumstances, such as high well pressures that could lead to fires or explosions, the delay required to notify NRC may cause an immediate threat. NRC proposes to modify Section 39.77 to allow immediate abandonment without prior NRC approval if a delay could cause an immediate threat to public health and safety. Notification would still be required after completing abandonment. These requirements would only apply to sources above 3.7 MBq (100 μCi) or tritium neutron generator target sources above 1,110 GBq (30 Ci).

- **Include the generic exemption for sealed sources in 1989 within the regulations.** NRC issued a generic exemption from the current design and performance criteria for sealed sources (Section 39.41), allowing the use of older sealed sources which meet an older standard for well logging operations. Sealed sources manufactured prior to July 14, 1989, may use design and performance criteria specified under United States of America Standards Institute (USASI) N5.10-1968 or the criteria contained in Section 39.41. The use of the USASI standard is based on the NRC Notice of Generic Exemption (54 *Federal Register* 30883). This exemption is currently in use, but has not been incorporated in Part 39. NRC proposes to revise Part 39 to include this exemption within the regulations.

- **Update Part 39 to remove date that is time sensitive and have since passed.** Section 39.49 contains a requirement dependent on a date that has already passed and is no longer appropriate. NRC proposes to remove references to the date that has already passed, to avoid confusion on the part of licensees.

- **Update Sections 39.15, 39.35, and 39.41 of Part 39 to conform with NRC's metric policy by stating parameter values in dual units with metric units first and with English units in brackets.**

3. ANALYSIS OF VALUES AND IMPACTS

This section examines the values and impacts expected to result from NRC's rulemaking, and is presented in three subsections. Section 3.1 identifies the attributes that are expected to be affected by the rulemaking. Section 3.2 describes the analytical method used to quantify values and impacts. Finally, the proposal's effects on values and impacts are presented in Section 3.3.

3.1 Identification of Affected Attributes

This section identifies and describes the factors within the public and private sectors that the regulatory alternatives (discussed in Section 2) are expected to affect. These factors were classified as attributes against the list of potential attributes provided by NRC in Chapter 5 of its *Regulatory Analysis Technical Evaluation Handbook*.[2] Each attribute listed in Chapter 5 was evaluated. Following are attributes that would not be affected by the proposed rule:

- **Human Health and Property –** For several reasons, NRC believes that Option 2 would provide sufficient safeguards against radiation exposure to humans and property. NRC believes that excluding low activity (less than 3.7 MBq [100 μCi]) ECSs and 1,110 GBq (30 Ci) tritium neutron generator target sources from the well abandonment requirements is protective of human health and property. NRC also believes that reducing the time period for conducting leak testing of non-exempt sources will reduce the burden on licensees while maintaining protection of human health and property. As part of this rulemaking, NRC has conducted an environmental assessment to evaluate the potential risks associated with these proposed changes. The results of this analysis indicate that risk to human health would not significantly increase as a result of these modifications. Next, NRC believes that allowing flexibility in determining the best method for protecting against inadvertent intrusion on an abandoned source in an oil and gas well (for sources greater than 3.7 MBq [100 μCi] or tritium neutron generator target sources above 1,110 GBq [30 Ci]) is appropriate because it still requires that the source be protected, but provides for the use of performance-based criteria to determine the best method. No change is being made to the requirement that the source be protected from inadvertent intrusion. Further, NRC believes that its proposal to allow for delayed notification in cases of well abandonment will decrease the potential risk to human health and property by allowing for immediate abandonment in cases of immediate threat. In fact, in NRC's estimation, delays caused by requiring notification prior to undertaking abandonment could lead to increased risk to health and property (e.g., fires and explosions) in some instances.

[2] *Regulatory Analysis Technical Evaluation Handbook, Final Report*, NUREG/BR-0184, Office of Nuclear Regulatory Research, January 1997.

- **General Public** – The proposed action is not expected to have any effects on the general public.

- **Improvements in Knowledge** – The proposed action is not expected to result in any improvements in knowledge.

- **Antitrust Considerations** – The proposed action is not expected to have any antitrust effects.

- **Safeguards and Security Considerations** – The proposed action is not expected to have any effects on the existing level of safeguards and security.

- **Environmental Considerations** – The proposed action is not expected to have any significant effect on the existing level of protection of environmental considerations.

The proposed regulatory actions are expected to involve the following attributes:

- **Industry Operation** – Relative to the no-action option (Option 1), the proposed action (Option 2) would result in industry operation savings for licensees. First, under Option 2, licensees would avoid the costly requirements for well abandonment for low activity sources ECSs and tritium neutron generator target sources. Second, licensees would realize savings associated with leak testing of ECSs by reducing significantly the frequency of leak tests required to comply with NRC requirements (once every three years versus every six months). Third, licensees would be provided the flexibility to determine the best method for protecting against inadvertent intrusion on an abandoned source (for sources with activities greater than 3.7 MBq [100 μCi] or tritium neutron generator target sources above 1,110 GBq [30 Ci]).

- **NRC Operation** – Relative to the no-action option (Option 1), the proposed action (Option 2) would result in operation savings for NRC. Specifically, under Option 2, NRC would realize savings by reducing the number of abandonment reviews for low activity ECSs and tritium neutron generator target sources. Further, NRC could realize additional savings associated with the change proposed for Section 39.77 allowing flexibility during an emergency for abandoning irretrievable sources. Also, minimal savings would result from fewer exemption requests. Since January 1, 1997, there have been six exemption requests (related to the proposed changes) and all were granted. These attributes are either difficult to evaluate at this time, or of minimal amount, and thus have not been quantified in this analysis.

- **NRC Implementation** – Relative to the no-action option (Option 1), the proposed action (Option 2) would result in additional costs for NRC implementation. Specifically, the consolidated regulatory guidance project would need to incorporate all necessary guidance for well logging licensees into NUREG-1556, *Consolidated Guidance About Materials Licenses, Program Specific Guidance About Well-Logging Licenses*. This would require both draft and final NUREG versions. NRC anticipates, however, that the affect on this NUREG would not be significant, since this update would be done regardless of whether this rulemaking were

completed. Therefore, the values have not been quantified in this analysis.

- **Other Government** – Relative to the no-action option (Option 1), Option 2 would reduce the burden on state and local government organizations actively involved in the regulation of well logging operations, thus yielding these organizations an annual cost savings. These values are expected to be minimal, and have not been quantified in this analysis.

- **Regulatory Efficiency** – Relative to the no-action option (Option 1), Option 2 would result in enhanced regulatory efficiency, particularly by eliminating the need for preparing reporting and recordkeeping information for abandonment of low activity ECSs and tritium neutron generator target sources. In addition, Option 2 would provide greater regulatory certainty and clarity than the no-action option, and would ensure consistent treatment among all well logging licensees. These values are not believed to be significant and have not been quantified in this analysis.

3.2 Analytical Method

This section describes the general methods used to structure the analysis and calculate results. The quantifiable results of the analysis (see Section 3.3) are based primarily on the costs of satisfying NRC's requirements for licensing and radiation safety for well logging. Although the rulemaking would also result in regulatory efficiency, among other attributes (see Section 3.1), these values have not been quantified.

The discussion in this section is divided as follows: Section 3.2.1 summarizes the types of data collected for this analysis. Section 3.2.2 provides a summary of the licensee responses received. Section 3.2.3 describes the methodology that was used to determine the values associated with the regulatory options under consideration.

3.2.1 Data Collection

To help quantify the effects of the proposed rule, a data collection effort was conducted to obtain information from well logging licensees using ECSs and tritium neutron generator target sources and manufacturers of ECSs and tritium neutron generator target sources. Due to time, resource and OMB clearance constraints, NRC elected to survey only a sample of licensees (less than 10). However, NRC is confident that the information obtained from these licensees represents conditions in the industry. NRC first prepared a list of licensees and manufacturers, and selected a total of nine contacts. An initial list of questions was developed to obtain information on the following topics:

- Number of abandonments due to irretrievable sources (ECS or tritium neutron generator target source) in an average year, including cost of the abandonment and depth of the source.

- Need for erection of a permanent plaque for an abandoned well to identify the horizontal and vertical location of the source.

- Use of sources manufactured prior to the July 14, 1989 generic exemption from Section 39.41, including description of problems with these sources in logging or logging while drilling tools.
- Description of leak tests conducted on ECSs and the time interval under which they are tested.
- Cost of conducting a leak test on a per source basis.
- Variability in cost of conducting leak tests in conjunction with routine maintenance/repair versus leak testing at six month intervals.
- Estimate of costs to meet the design and performance criteria of Section 39.41, including a breakout of the specific costs associated with vibration testing (Section 39.41(a)(3)(iii)).
- Identification of problems associated with conducting vibration tests.
- Number of preliminary designs (prototypes) since 1989 that were not registered because of failing the vibration test.

3.2.2 Summary of Licensee Responses

This section provides a summary of the responses by licensees to NRC's information request for the key parameters necessary for this analysis.

- Licensees reported an average of only 8 abandoned ECSs per year. Three respondents reported that they have never abandoned an ECS in a well logging operation. The depth at which these sources were abandoned ranged from thousands of feet to in excess of 12,500 feet. Costs for abandonment of an ECS varied widely based on a variety of factors, including depth of the source, location of the well (off-shore or land), and the cost components reported.[3] Abandonment costs reported ranged from a low of approximately $5,000 to a high of over $1 million for a single source.

[3] Costs for abandonment varied widely based on the items the respondent included in their estimates. Some respondents only included the cost of replacing the source in their estimate, while other licensees accounted for additional costs, including lost drill rig time, and costs for complying with abandonment requirements and reporting.

- One respondent indicated abandoning a tritium neutron generator target source. This respondent indicated that the depth of the source when abandoned was in excess of 10,000 feet. Most respondents noted that because retrieval of a lodged source is mainly a function of the depth of the source at the time it becomes lodged and whether the source is located in the well casing, the likelihood of retrieval of tritium neutron generator target sources at shallow depths, within the surface casing, is extremely high.

- Licensees indicated that the costs associated with leak testing well logging tools containing ECSs ranged from $7 to $50 for a wipe test, and up to $100,000 to disassemble the tool and test the source, including the costs of taking the tool out of service. Two respondents indicated that they do not conduct leak testing for two reasons: (1) they use only gamma-beta emitting sources containing less than 3.7 MBq (100 μCi); and (2) they use only tritium neutron generator target sources, both of which are currently exempted from leak testing requirements. Without exception, however, licensees believe that the robust nature of the sources significantly decreases the need to leak test these tools on a frequent basis. No respondent indicated that an ECS that had been wipe tested had been found to have leaked. Respondents noted that a more appropriate interval for leak testing would be during routine maintenance on the tool, or when it is removed from service for repair.

- Licensee responses indicate that the maintenance interval for well logging tools containing an ECS is highly variable. While some licensees reported a routine interval (inspection every month, or once per year), other licensees indicated that the interval can be much longer (up to 18 months), depending on how long the tool is in the field. Respondents indicated that maintenance and repair to these tools is not typically conducted in the field.

- One licensee responded that it had never had a prototype design fail to meet the requirements of Section 39.41 solely because the design failed the vibration test. This respondent further indicated that, typically, no more than one prototype design is developed in a year, and that the cost of conducting the vibration test for each prototype is approximately $2,400.

3.2.3 Calculating Values and Impacts of Alternatives

This section describes how each of the regulatory options under consideration was analyzed to quantify values and impacts associated with the options' licensing and radiation safety requirements for well logging. Option 1 is the no-action alternative and, as such, would have no values or impacts to be estimated. As a result, this discussion focuses on the quantification of values and impacts associated with Option 2.

The requirements proposed in Option 2 are deregulatory in nature and would affect licensees in several ways. First, licensees would avoid the costly requirements for well abandonment for low activity sources. Second, licensees would realize savings associated with leak testing of these sources by reducing significantly the time interval for conducting such tests to comply with NRC requirements (once

every three years versus the current requirement of not more than every 6 months). Third, licensees would be provided the flexibility to determine the best method for protecting against inadvertent intrusion on an abandoned source (for sources with activities greater than 3.7 MBq [100 μCi]) or tritium neutron generator target sources above 1,110 GBq (30 Ci). The cost savings associated with this proposed change have not been calculated for this analysis. Due to limited resources and time, and because the major focus of the proposed rule is to exclude low activity ECSs and tritium neutron generator target sources from well abandonment procedures, NRC elected to focus its data collection efforts on the costs associated with abandonment of low activity ECSs and tritium neutron generator target sources. NRC anticipates, however, that the cost savings associated with changes in abandonment requirements for large sources (i.e., greater than 3.7 MBq [100 μCi]) or tritium neutron generator target sources above 1,110 GBq (30 Ci) would not be significant.

The proposed changes described in Option 2 would benefit NRC in that NRC would realize savings by reducing the number of abandonment reviews for low activity ECSs and tritium neutron generator target sources. Further, NRC could realize additional savings associated with the change proposed for Section 39.77 allowing flexibility during an emergency for abandoning irretrievable sources. Due to the limited number of reviews eliminated, the values have not been quantified in this analysis. The savings are not believed to be significant. State and local government organizations regulating licensing and radiation safety requirements for well logging would benefit under Option 2 in a similar fashion.

The proposed changes under Option 2 would also result in other values that are not quantified in this analysis. In particular, the proposed changes would result in enhanced regulatory efficiency because they would provide greater regulatory certainty and clarity than the no-action option and would ensure consistent treatment among all well logging licensees.

Savings and costs to licensees, state and local governments, and NRC from Option 2 are calculated as follows:

- *Estimate the cost savings for abandoning a source.*

  The costs for abandonment are variable based on several factors, including the depth at which the source is abandoned, or whether the source is in a on-shore (land) or off-shore (water) well. In general, these costs include the costs of replacing the tool, the costs for plugging the hole (cementing), and the costs for marking the location of the source. In addition, there are other costs associated with recordkeeping and notification associated with abandonment of a source downhole. NRC collected data from a representative sample of well logging licensees to determine specifically the costs associated with abandonment of a low activity ECS or tritium neutron generator target source. Due to the variability of the costs, accounting for the factors described above, NRC has included the high and low estimates provided by licensees as a range of possible costs. In estimating the total annual savings to be realized by amending the abandonment requirements, NRC calculated the number of abandonments indicated by each

respondent and multiplied this number by the respondent's estimate of the cost for abandonment per event. These numbers were then totaled to provide an estimate of the minimum cost savings that could be expected to be realized.

- *Estimate the cost savings for conducting a leak test on a low activity ECS only.*

  The cost for conducting a leak test on an ECS type well logging source can vary due to the specific conditions under which the test is conducted. For example, if the test is conducted using a wipe test on the outside of the tool, these costs may be significantly less than the costs for disassembling the tool and sampling the actual source. In addition, low activity gamma and beta emitting sources (i.e., sources containing less than 3.7 MBq [100 μCi]) are currently exempted from leak testing requirements. Because NRC does not have sufficient data to determine the number of non-exempt sources leak tested in a year, NRC estimated the costs associated with conducting individual leak tests for a single source and provided a range for the costs on a per source basis. To calculate a total annual cost savings from leak testing requirements, NRC limited its discussion to the survey respondents and assumed one source for each respondent. This number was multiplied by two to account for the requirement to conduct a leak test every six months. The proposed changes would effectively reduce the annual number of tests from 2 to one-third (i.e., because the proposed option would require one test every three years). To estimate the total annual cost for each source, the cost per test reported was multiplied by 0.33. The total annual cost savings for each source is the difference between the total annual costs under the current rule and the total annual cost under the proposed rule. These values were then added across all sources to estimate the minimum total annual cost savings that could be expected to be realized as shown below:

  Item 1: Annual cost for leak testing per source (current rule) =

  (Cost per leak test) x 2 (Number of annual leak tests)

  Item 2: Annual cost for leak testing per source (proposed rule) =

  (Cost per leak test) x 0.33 (Effective number of annual leak tests)

  Item 3: Annual cost savings per source = Item 1 - Item 2

  Item 4: Total annual cost savings = Sum of amounts calculated under Item 3

  Further, tritium neutron generator target sources are already exempted from leak testing requirements, and thus no costs or cost savings are associated with these sources.

3.3 Results

The results of the analysis for each of the affected attributes identified in Section 3.1 are shown below in Exhibit 3-1, including: (1) the qualitative results for Regulatory Efficiency (i.e,, greater regulatory certainty and clarity, more consistent treatment of licensees), NRC Implementation (i.e., revision of regulatory guidance), NRC Operation (i.e., abandonment review cost savings), Other Government (i.e., cost savings similar to NRC); and (2) the quantitative results for Industry Operation (i.e., annual licensee cost savings for conducting leak tests and source abandonment). As shown in the exhibit, there are no values or impacts associated with Option 1 (the no-action alternative). Rather, licensees would still need to meet all requirements for testing and abandonment as currently specified, unless they submit a request for an exemption.

Option 2 would result in savings to licensees associated with well abandonment and leak testing, in addition to possible savings in ensuring against inadvertent intrusion of abandoned sources greater than 3.7 MBq (100 μCi) or tritium neutron generator target sources above 1,110 GBq (30 Ci). While the cost savings estimated here only reflect a sample of the licensees, it is important to note that there would be no increase in costs to licensees associated with the proposed changes to Part 39. In fact, it can be expected that the values identified in Exhibit 3-1 could be larger when applied to all licensees. In addition, Option 2 would result in increases in regulatory efficiency relative to the no-action alternative. In particular, Option 2 would provide greater regulatory certainty and clarity than the no-action option, would ensure consistent treatment among all licensees, and would eliminate the need for costly delays in effecting regulatory exemptions. These increases in regulatory efficiency have not been quantified, but are believed to be of significance.

On the impact side, NRC would incur very minor costs associated with updating NUREG-1556, *Consolidated Guidance About Materials Licenses, Program Specific Guidance About Well-Logging Licenses*.

Exhibit 3-1
Estimated Values and Impacts Under Options 1 and 2

		Option 1	*Option 2*
Values			
	Avoided costs to licensees of abandonment of source downhole	–	Range: $1K - $1M *Estimated total annual cost savings: $*5M
	Avoided costs to licensees for conducting leak testing on sources	–	Range: $7-$100K *Estimated total annual cost savings: $100K*
	Avoided costs to licensees of preventing inadvertent intrusion on abandoned sources above 100 μCi and tritium neutron generator target sources above 30 Ci	–	Minor
	Increase in regulatory certainty and clarity; increase in consistency of treatment of licensees; and reduction in delays associated with the exemption process	–	Minor
	Avoided costs to NRC of reviewing abandonment reports and exemption requests	–	Minor
	Avoided costs to Other Governments	–	Similar to NRC
Impacts			
	Increased costs to NRC of updating NUREG-1556	–	Minor

4. AGREEMENT STATE IMPLEMENTATION ISSUES

NRC issued a draft rulemaking plan to Agreement States for comment on proposed changes to 10 CFR Part 39 on May 28, 1997. Comments were received from three states: Illinois, Utah, and Washington. In general the states agreed that the current regulations in Part 39 needed modification to reflect the use of new "logging while drilling" technology. a summary of the significant comments and NRC's responses is provided below:

- The State of Illinois argued that ECSs with activities exceeding 3.7 MBq (100 μCi) for beta/gamma emitters or 0.37 MBq (10 μCi) for alpha emitters should be leak tested and therefore, ECSs should not be given a categorical exemption to leak testing requirements. The State of Washington commented that tritium sources have been known to leak and that proper monitoring of these sources should be required. NRC intends to define an ECS as having 3.7 MBq (100 μCi) or less of radioactive material and therefore, by definition an ECS would be excluded from the existing leak testing requirements of Section 39.35(e). Further, based on design requirements, alpha emitters will not be included in the definition of an ECS. NRC does not currently, nor will it in its proposed rulemaking, require leak testing of tritium sealed sources. These sources are specifically exempted from leak testing requirements in Section 39.35(e).

- The State of Illinois believes that some degree of protection is necessary for ECSs lost near the land surface. NRC intends to build into the regulations separate provisions for ECSs based on whether a surface casing is used or not. Surface casings are used to protect fresh water aquifers from contamination and are extensively used in oil and gas exploration. NRC believes that a surface casing will provide adequate near surface protection (refer to the Environmental Assessment for information on the risk of abandonment near the land surface). When surface casings are not used, more rigorous recovery operations will be required.

- The State of Illinois does not believe that ECSs should be categorically excluded from design and performance criteria for sealed sources (Section 39.41). The State of Utah, on the other hand, suggests that ECSs should be excluded from Part 32 (Section 32.210 discusses registration of sealed sources). Although NRC intends to exclude ECSs from the rigorous design and performance criteria of Section 39.41, the ECSs will still need to meet the licensing requirements of Section 32.32(g), which require more general design and performance criteria.

- Both the States of Illinois and Washington believe that the example used in the draft rulemaking plan comparing radioactive sources in ECSs and gas and aerosol detectors as a basis for excluding ECSs is inappropriate. NRC will remove this reference from the rulemaking, and the Environmental Assessment will assess whether ECSs can be safely excluded from the requirements of Part 39.

- The State of Illinois commented that neutron generator devices containing tritium targets also require above-ground testing for operability and calibration and can produce radiation levels constituting high radiation areas. The State argues that the revised regulations should allow testing and operation of such devices provided procedures are in place to monitor radiation levels and ensure that adequate safety procedures are in place and implemented. NRC agrees with this concept. Tritium sources will remain subject to Section 39.63 (operating and emergency procedures).

- The State of Illinois raised concerns about some sources meeting USASI standards. They noted an event where a source experienced damage due to vibration within a source holder. Specifically, vibration of a sealed source within a source holder may have led to a loss of containment. Therefore, the assumption that sources built under the USASI standard would be so rugged as to preclude a public health and safety problem has been called into question. The State also suggested that the way in which sealed sources maybe loaded into source holders has not been thoroughly evaluated and suggested that NRC may wish to consider the source and the source holder combination. NRC understands that the problem identified was not related to the USASI standard, but an improperly assembled source holder. There was no loss of containment. The vibration test is not designed to account for an improperly loaded source. Historically, the NRC has not regulated source holders or the well logging devices in which the source holders or sources are placed. NRC also notes that there has been no history of problems with the source and source holder combinations. NRC has concluded that no rule change is necessary, and in any event, the comment is beyond the scope of this rulemaking.

5. BACKFIT ANALYSIS

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

6. DECISION RATIONALE FOR SELECTION OF THE PROPOSED REGULATORY ACTION

1. Option 1, the no-action alternative, would retain the existing requirements for licensing and radiation safety for well logging. Option 2 would relieve licensees from overly burdensome requirements associated with well abandonment and leak testing for sources containing less than 3.7 MBq (100 μCi) activity, and for well abandonment for tritium neutron generator target sources containing less than 1,110 GBq (30 Ci) tritium. In addition, Option 2 would clarify existing requirements for other larger sources, and provide for the use of performance-based criteria for preventing inadvertent intrusion on an abandoned source. Relative to Option 1, Option 2 would yield net benefits to licensees, state and local governments, and NRC without additional risk to the public.

2. The proposed requirements under Option 2 would result in enhanced regulatory efficiency because they would provide greater regulatory certainty and clarity than Option 1 (the no-action alternative), and would ensure consistent treatment among all licensees.

3. Because licensees would be able to reduce their licensing and radiation safety requirements thus avoiding the costs of abandoning low activity sources, Option 2 could result in an annual cost savings in excess of $5 million. Additional cost savings could be realized under Option 2 from the extension of the time period for conducting leak testing non-exempt low activity sources from every six months to every three years (approximately $100,000).

4. NRC's environmental assessment supporting this rulemaking indicates that the risks associated with the proposed changes are protective of health and safety. Data collected by NRC indicate that these sources are very robust, do not typically leak, and are not abandoned on a frequent basis.

5. For the reasons stated in (1) through (4) above, Option 2 is superior to Option 1 (the no-action alternative).

7. RELATIONSHIP TO OTHER PROCEDURAL REQUIREMENTS

This action would be enacted through a Proposed Rule Notice and public comment and a Final Rule, with promulgation expected in calendar year 2000. Implementation can begin immediately following the enactment of the final rulemaking. No impediments to implementation of the recommended alternative have been identified, with the exception of the minor revisions to NUREG-1556.

8. PAPERWORK REDUCTION ACT ANALYSIS

This section fulfills NRC's obligation under the Paperwork Reduction Act to examine the information collection impacts of its regulatory actions, in this case in regard to a rulemaking addressing NRC's current licensing and radiation safety requirements for well logging. NRC is proposing to modify these requirements, which are contained in 10 CFR Part 39 to account for new technologies developed since the requirements contained in Part 39 were first promulgated.

NRC's analysis indicates that its proposal is deregulatory in nature and would result in a decreased burden on licensees with regard to reporting and recordkeeping operating wells (with a surface casing), that abandon an ECS or tritium neutron generator target source within that well. Licensees would not be required to report such abandonment to NRC, which is estimated to be a reduction in burden of approximately 4.5 hours per request (§39.77). NRC has determined, that, because the burden reduction for this information collection is insignificant, Office of Management and Budget (OMB) clearance is not required. Current requirements associated with information collection under 10 CFR Part 39 were previously approved by OMB in approval number 3150-0130.