Technical Report 1
INRA Recommendation on Regulatory Approach

RPT 3000509-002

June 30, 2008

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LIST OF ACRONYMS

BDC	Baseline Design Criteria
COEX	Co-extraction Process
EPA	Environmental Protection Agency
EPC	Engineering, Procurement, Construction
FNMC	Fundamental Nuclear Material Control
FP	Fission Products
GNEP	Global Nuclear Energy Partnership
IAEA	International Atomic Energy Agency
INRA	International Nuclear Recycling Alliance
ISA	Integrated Safety Analysis
ISAS	Integrated Safety Analysis Summary
LEU	Low Enriched Uranium
LWR	Light Water Reactor
MBA	Material Balance Area
MFFF	MOX Fuel Fabrication Facility
MOX	Mixed Oxide
OEC	O-arai Engineering Center
OECD	Organization for Economic Co-operation and Development
PEIS	Project Environmental Impact Statement
PIT	Physical Inventory Tracking
PIV	Physical Inventory Verification
SAR	Safety Analysis Report
SEID	Standard Error of Inventory Difference
SISUS	Safeguards in the U.S.
SNM	Special Nuclear Material
SRP	Standard Review Plan

INTRODUCTION

The purpose of this report is to provide an analysis of existing regulatory requirements and processes and recommend specific changes that will enable the development of an efficient and predictable framework for licensing the Consolidated Fuel Treatment Center (referred to as the Fuel Recycling Facility) under Nuclear Regulatory Commission (NRC) regulations. Further, INRA has identified several initiatives that will create a technical foundation for the regulatory changes and provide a more efficient process for regulatory revisions and ultimately for licensing of the Fuel Recycling Facility. The INRA Team has reviewed many alternatives and issues identified by various entities and believes the framework and changes recommended, while certainly not the only option, provide a path forward that provides an adequate and appropriate regulatory basis, uses proven experiences and processes to ensure the plant can be operated safely, provides for stakeholder participation, and is achievable on an accelerated schedule.

CONCLUSIONS AND RECOMMENDATIONS

INRA recommends the following regulatory approach for licensing of the Fuel Recycling Facility:

- Revise 10CFR70 to provide general authorization for licensing non-reactor production facilities in a one-step process and execute conforming revisions to 10CFR50
- Update 10CFR70 Baseline Design Criteria for additional safety hazards of the Fuel Recycling Facility
- Address 40CFR190 with possible revisions or clarifications
- Apply existing environmental review criteria of 10CFR51 for the Fuel Recycling Facility , consider broader issues associated with Light Water Reactor (LWR) mixed oxide (MOX) for inclusion into DOE Programmatic Environmental Impact Study (PEIS), and consider environmental reviews for future LWR MOX licensing
- Apply existing ISA process in 10CFR70 supplemented by selected probabilistic reviews, where appropriate, for the Fuel Recycling Facility safety basis
- Apply existing requirements of 10CFR19, 20, and 70 for radiation safety and emergency preparedness with consideration for criteria from 10CFR50 Appendix E in guidance documents
- Consider revisions to 10CFR74 and 10CFR75 based on conclusions regarding safeguards attractiveness for the Fuel Recycling Facility process materials
- Apply existing requirements of 10CFR25, 26, 72, 73, and 95, supplemented by existing security orders and a specific security order for the Fuel Recycling Facility , to implement an appropriate security plan
- Apply proven regulatory approaches for management control and QA including use of 10CFR50, Appendix B

While this report focuses primarily on the Fuel Recycling Facility, there are other additional regulatory actions necessary to support a closed fuel cycle that need to be considered in the short term. These recommendations are described in other Continuation 1 Reports and include:

- The regulatory framework and path forward for LWR MOX use in the existing fleet of U.S. reactors need to be developed, considering aspects such as lead test assemblies (LTAs), reactor suitability, accident analysis, and the generic environmental considerations for expanded LWR MOX
- Waste management aspects of storage and disposition of the variety of solid wastes produced by the Fuel Recycling Facility need to be addressed from a regulatory standpoint
- The transportation aspects of LWR MOX fresh and used fuel in a commercial mode considering attributes such as burn-up and fuel age need to be addressed from a regulatory standpoint.

1.0 THE FUEL RECYCLING FACILITY REGULATORY FRAMEWORK

INRA has reviewed the technical aspects that provide a regulatory framework and performed a preliminary gap analysis. The following discussions provide a summary of the scope of this review and our conclusions regarding existing regulations and potential changes to the regulations that INRA believes will provide the appropriate framework for a fuel recycling facility.

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1.1 Summary of Existing Regulations

Current NRC regulations would require that the Fuel Recycling Facility be licensed under 10CFR50, Domestic Licensing of Production and Utilization Facilities. The Atomic Energy Commission used 10CFR50 to license the Nuclear Fuel Services West Valley facility in 1966 and also to issue a construction permit for the Barnwell facility in 1970. In 1976, all licensing activities related to reprocessing were ceased in the U.S. Since that time, many changes have been made in the NRC's processes for licensing nuclear facilities; revisions and upgrades to 10CFR50 have taken place almost solely considering LWRs. As a result, 10CFR50 would likely require a significant effort and many exemptions if it were applied to a recycle facility such as the Fuel Recycling Facility.

The regulations in 10CFR70, Domestic Licensing of Special Nuclear Material (SNM), have been used to license the existing fuel fabrication facilities in the U.S. This regulation was, or is currently being, used for a variety of fuel fabrication activities including low-enriched uranium (U), high-enriched U, centrifuge enrichment, and Pu mixed oxide fuel (MOX) fabrication including chemical recovery operations with these materials. 10CFR70 underwent a major revision that was issued in 2000. This revision resulted in a more risk-informed performance-based regulation that required consideration of the variety of hazards (e.g., chemical, fire, etc.) in an integrated manner. Since that time, 10CFR70 in its revised form has been used to successfully renew existing fuel fabrication licenses, approve a construction permit for the Mixed Oxide Fuel Fabrication Facility (MFFF), and approve a combined construction and operating license for a gas centrifuge enrichment plant.

In 2007, NRC staff reviewed several options for licensing the Fuel Recycling Facility and presented their findings and a recommendation to the Commission. The Commission accepted the recommendation and directed the staff to proceed with their review, which focused primarily

on revisions to 10CFR70 to support the Fuel Recycling Facility licensing. In April of 2008, NRC reported to DOE on their progress and further reinforced that 10CFR70 would provide the best-suited regulation to license the Fuel Recycling Facility in a one-step licensing process.

In addition to the basic facility enabling regulation, there are several key supporting regulations that must be considered, including:

- 10CFR20, Standards for Protection Against Radiation
- 10CFR26, Fitness for Duty Programs
- 10CFR51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions (National Environmental Policy Act of 1969 (NEPA) review process)
- 10CFR72, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste, and Reactor Related Greater Than Class C Waste
- 10CFR73, Physical Protection of Plants and Materials
- 10CFR74, Material Control and Accounting of SNM
- 10CFR75, Implementation of International Atomic Energy Association (IAEA) Criteria
- 10CFR95, Facility Security Clearance and Safeguarding of National Security Information and Restricted Data

These regulations are generally invoked by 10CFR70 and require consideration and demonstrated compliance methods as part of the License Application.

1.2 Proposed Regulatory Framework for the Fuel Recycling Facility

1.2.1 Overview

INRA believes that the most effective regulatory framework for the Fuel Recycling Facility will be a one-step licensing process under a revised 10CFR70. This was reinforced by INRA's financial advisory panel who considered the one-step licensing critical to securing private financing. INRA also believes that appropriate revisions can largely be made by incorporating those relevant sections of existing regulations into 10CFR70 since the majority of the technical or process content required to be included in 10CFR70 already exists in these other approved NRC regulations. This appears to provide opportunity to move quickly and efficiently through the revision process since little new technical content of the regulations needs to be developed.

1.2.2 Regulatory Framework Components

The following sections describe the various regulatory framework components that will allow the licensing of the Fuel Recycling Facility under 10CFR70. Each section provides the INRA vision of a regulatory framework, discusses existing regulations and how they can be used to support the envisioned framework, describes recent experience as it relates to the Fuel Recycling Facility licensing, discusses issues and resolution, and provides a specific recommendation for creating the regulatory framework for licensing the Fuel Recycling Facility. The components considered are illustrated in Figure 1.

FIGURE 1. Regulatory Framework Components. *These components allow the licensing of the Fuel Recycling Facility under 10CFR70.*

From a purpose and scope of 10CFR70 standpoint, there are relatively few changes necessary (Figure 1). The purpose section of 10CFR70.1 can be expanded to include non-reactor production facilities that are currently defined in 10CFR50. Appropriate definitions for a recycling production facility can be included in the definitions of 10CFR70.4. Additionally, 10CFR70.22 and 23 may need to be clarified to allow for a one-step licensing process.

In concert with the recommended revisions to 10CFR70, conforming revisions to 10CFR50 will be necessary to remove requirements for recycle facilities that have been incorporated into 10CFR70. The necessary revisions to 10CFR50 are not discussed in detail in this report because, once the content is identified for inclusion into 10CFR70, revising 10CFR50 should be a straight-forward exercise.

1.2.2.1 Design Criteria

Historically, nuclear facility design and design criteria have been prescriptively applied through NRC regulations. More recently, NRC has developed and applied risk-informed criteria for the design of facilities through performance-based criteria and design objectives set forth in the regulation. These regulatory criteria are supported by guidance documents and safety performance evaluations that demonstrate the ability of the facility to meet the objectives.

INRA believes the performance criteria of 10CFR70.61, supported by the Baseline Design Criteria (BDC) of 10CFR70.64, provide the basic regulatory framework for design criteria that will be necessary for the Fuel Recycling Facility. The BDC requirements were incorporated into 10CFR70 during a major rule-making process in the late nineties when the appropriate design

criteria requirements were added to the regulation. These requirements were derived largely from existing requirements contained in Appendix A of 10CFR50. INRA recognizes the criteria currently contained in 10CFR70 were developed primarily for existing fuel fabrication facilities that handled only un-irradiated material. Given the significant quantities of fission products (FP) in recycled used fuel, the BDC will likely require enhancement to adequately address all potential hazards at the Fuel Recycling Facility. While these enhanced criteria and requirements are not contained in10CFR70, the technical content of these requirements and the supporting guidance documents can be incorporated from various existing regulatory documents and processes and can build upon recent operational and regulatory experience.

INRA believes that, since the 10CFR70.64 BDC are in a single location in 10CFR70 and that the criteria need to be enhanced for the Fuel Recycling Facility , an opportunity to improve regulatory predictability can be capitalized upon by consolidation of the criteria. All applicable design criteria that are currently dispersed throughout regulations can be reviewed and considered. These criteria can then be consolidated into a single location in 10CFR70.64 in a risk-informed performance-based manner. The following sections discuss existing design criteria and how they can be incorporated into 10CFR70.64 BDC.

1.2.2.1.1 Existing Regulations

10CFR70

During the major revisions to 10CFR70 and the development of Subpart H in the late nineties, NRC determined that appropriate BDC should be included for new facilities or new processes at existing facilities. Thus, the criteria on 10CFR70.64 were incorporated into the rule as appropriate for the types of facilities currently licensed and envisioned to be licensed under 10CFR70. Ten BDC were incorporated into the rule as discussed below.

10CFR70 BDC	Regulatory Requirement
Quality Standards and Records	The design must be developed and implemented in accordance with management measures to provide adequate assurance that items relied on for safety will be available and reliable to perform their function when needed. Appropriate records of these items must be maintained by or under the control of the licensee throughout the life of the facility.
Natural Phenomena Hazards	The design must provide for adequate protection against natural phenomena with consideration of the most severe documented historical events for the site.
Fire Protection	The design must provide for adequate protection against fires and explosions.
Environmental and Dynamic Effects	The design must provide for adequate protection from environmental conditions and dynamic effects associated with normal operations, maintenance, testing, and postulated accidents that could lead to loss of safety functions.
Chemical Protection	The design must provide for adequate protection against chemical risks produced from licensed material, facility conditions which affect the safety of licensed material and hazardous chemicals produced from licensed material.
Emergency Capability	The design must provide for emergency capability to maintain control of; (1) Licensed material and hazardous chemicals produced from licensed material, (2) Evacuation of on-site personnel, and (3) Onsite emergency facilities and services that facilitate the use of available offsite services.
Utility Services	The design must provide for continued operation of essential utility services.
Inspection, Testing, and Maintenance	The design of items relied on for safety must provide for adequate inspection, testing, and maintenance to ensure their availability and reliability to perform their function when needed.
Criticality Control	The design must provide for criticality control including adherence to the double contingency principle.
Instrumentation and Controls	The design must provide for inclusion of instrumentation and control systems to monitor and control the behavior of items relied on for safety.

10CFR50

10CFR50 contains design criteria within the body of the regulation and through the appendices. Several of these design criteria were adopted into 10CFR70.64 as BDC; others were not considered necessary for fuel facilities that were envisioned to be licensed under 10CFR70 and were not included. There are several criteria, however, that are either directly or indirectly relevant to a fuel recycling facility. These provide a currently approved regulatory position that can bridge the gap between what is currently in 10CFR70 and what is appropriate for the Fuel Recycling Facility. These criteria can be adopted into a revision to 10CFR70 and implemented through guidance documents to be developed. The relevant design criteria and recommended method of inclusion are described below.

Potential Revisions or Additions to 10CFR70 Baseline Design Criteria for the Fuel Recycling Facility	Technical Content from 10CFR50
Natural Phenomena Hazards (potential revision of 70.64)	Appendix S criteria should be considered for inclusion in this BDC to the extent necessary for a recycling facility.
Emergency Capability (potential revision of 70.64)	Consider 10CFR50 Appendix E if potential offsite dose during an accident warrants a General Emergency Classification and offsite actions.
Confinement of Radioactive Materials (potential addition to 70.64)	Appendix A, Criteria 16, 19, and 50 modified to address Confinement and/or Containment in a risk-informed graded approach.
Control and Monitoring of Radioactive Material Releases and Radiation Levels (potential addition to 70.64)	Appendix A, Criteria 60, and 64 modified to address recycle operations in a risk-informed graded approach. 10CFR50 Appendix I criteria modified appropriately to implement 40CFR190 including any potential revisions.
Fuel and Waste Storage, Monitoring, and Handling (potential addition to 70.64)	Appendix A, Criteria 61, and 62 modified to address recycling operations in a risk-informed graded approach. Appendix F Criteria for onsite waste storage should be considered in light of current waste disposal options and should be included in a risk-informed performance-based manner. Timing for shipment of waste to a disposal facility should also be considered in a more risk-informed manner.
Decommissioning & Minimization of Contamination (potential addition to 70.64)	10CFR50 Appendix F, Item 4 should be addressed.

10CFR72

Storage and handling of UNF is licensed either through 10CFR50 in combination with the reactor license or in accordance with 10CFR72 if the fuel storage is classified as an Independent Spent Fuel Storage Installation. The INRA licensing model assumes the storage of UNF will be included under a single facility license. To this end, it would be appropriate to consider design criteria included in 10CFR72 for potential inclusion in the 10CFR70.64 BDC. The relevant design criteria and recommended method of inclusion are described below.

Potential Revisions/Additions to 10CFR70 Baseline Design Criteria for the Fuel Recycling Facility	Technical Content from 10CFR72
Natural Phenomena Hazards (potential revision of 70.64)	72. 92 should be considered for incorporation into the Natural Phenomena Hazards currently in 10CFR70 BDC. 72.122 (b) should be considered as it relates to used fuel storage.
Fire Protection (potential revision of 70.64)	72.122 (c) criteria should be considered for inclusion as it relates to used fuel storage.
Confinement of Radioactive Materials (potential addition to 70.64)	72.122 (h) criteria should be considered for inclusion as it relates to used fuel storage.
Control and Monitoring of Radioactive Material Releases and Radiation Levels (potential addition to 70.64)	72.104 should be considered for inclusion as it relates to used fuel storage.
Fuel and Waste Storage, Monitoring, and Handling (potential addition to 70.64)	72.120 modified to address in a risk-informed graded approach as related to used fuel storage. 72.128 should be considered for possible inclusion.
Decommissioning & Minimization of Contamination (potential addition to 70.64)	72.130 should be considered for possible inclusion.
External Man-Induced Events (potential addition to 70.64)	72.94 should be considered for possible inclusion.
Geological and Seismological (potential addition to 70.64)	72.102 should be considered for possible inclusion.
Control Room or Area (potential addition to 70.64)	72.122 (j) should be considered for possible inclusion.
Physical Protection	72.182 should be considered for possible inclusion.

10CFR20

10CFR20 establishes operating criteria for protection of workers and the public from exposure to radiation. In general, these are operational requirements that must be adhered to during operational and decommissioning phases of the facility. Clearly, the facility must be designed to achieve these standards. There are, however, some specific design criteria contained in 10CFR20 that should be considered for potential inclusion in the 10CFR70.64 BDC. The relevant design criteria and recommended method of inclusion are described below.

Potential Revisions/Additions to 10CFR70 Baseline Design Criteria for the Fuel Recycling Facility	Technical Content from 10CFR20
Control and Monitoring of Radioactive Material Releases and Radiation Levels (potential addition to 70.64)	20.1101 and 20.1301 (referencing 40CFR190) should be considered for possible inclusion.
Decommissioning & Minimization of Contamination (potential addition to 70.64)	20.1406 should be considered for possible inclusion.

1.2.2.1.2 NRC Experience

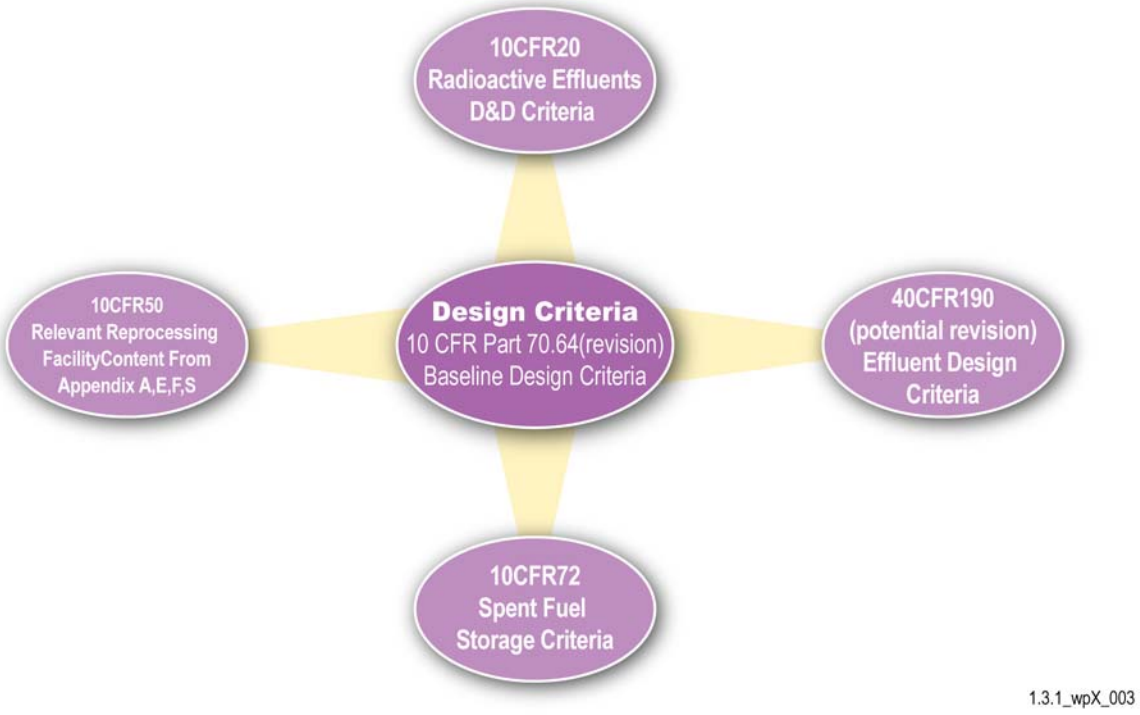
NRC has been successful in applying BDC currently described in 10CFR70.64 in several applications including the MFFF, Gas Centrifuge Enrichment plants, and several new processes at existing facilities currently licensed under 10CFR70.

1.2.2.1.3 Potential Issues and Resolution

INRA has identified a potential issue that will complicate regulatory requirement revision and proposed resolution to those issues: the implementation of design criteria related to environmental discharges of radioactive material must be developed consistent with current regulations contained in 40CFR190. This is discussed in greater detail later in this report.

1.2.2.1.4 Recommendation for the Fuel Recycling Facility Framework

FIGURE 2. the Fuel Recycling Facility Framework Recommendation. *Recommendations as relates to design criteria.*



The following revisions to regulations are recommended to implement the regulatory framework for the Fuel Recycling Facility (Figure 2):

- Consider revising 10CFR70 so that all relevant design criteria are incorporated into 10CFR70.64 in order to create regulatory predictability through a comprehensive set of design criteria for the Fuel Recycling Facility
- Consider revising the following existing 10CFR70.64 BDC to address those aspects of 10CFR50, 70, and 20 that are appropriate to the Fuel Recycling Facility (tabulated above)
  - Natural Phenomena
  - Fire Protection
  - Emergency Capability
- Consider adding the following criteria to 10CFR70.64 BDC to address those aspects of 10CFR50, 70, and 20 that are appropriate to the Fuel Recycling Facility (tabulated above)

- Confinement of Radioactive Materials
- Control and Monitoring of Radioactive Material Releases and Radiation Levels
- Fuel and Waste Storage, Monitoring, and Handling
- Decommissioning & Minimization of Contamination
- External Man-Induced Events
- Geological and Seismological
- Control Room or Area
- Physical Protection

1.2.2.2 Environmental Criteria and Reviews

NEPA (42 USC 4321 et seq.) requires Federal agencies, as part of their decision-making process, to consider the environmental impacts of actions under their jurisdiction. The U.S. NRC has promulgated regulations to implement NEPA requirements in the Code of Federal Regulations. The NRC requirements are provided in 10CFR51.

NEPA mandates that Federal agencies carefully consider the environmental impacts of their actions prior to making decisions that affect the environment. The NEPA review (also referred to as environmental review) process is usually initiated by an application for a new license or certification accompanied by an Environmental Report, change to an existing license, or a decommissioning plan submitted to the NRC.

Federal agencies can also decide to conduct programmatic or generic environmental reviews in order to address multiple facilities or more general environmental impacts. For example, in anticipation of license renewals for several nuclear reactors, NRC published Nuclear Regulation (NUREG) 1437, Generic Environmental Impact Statement (EIS) for License Renewal of Nuclear Power Plants, in order to more efficiently and consistently complete environmental reviews for license renewals. DOE is preparing a GNEP PEIS.

It is clear that a site and facility-specific EIS will be required for the Fuel Recycling Facility. What is less clear is how the generic aspects of recycling and use of MOX fuel in LWRs will be evaluated as discussed below.

1.2.2.2.1 Existing Regulations

10CFR51

10CFR51, Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions, provides the environmental regulations and includes the requirements for the format of an EIS. This part includes the requirements that must be addressed by the EIS, including an evaluation of alternatives to the proposed activity.

The general framework of 10CFR51 provides a process for performing the environmental review for the Fuel Recycling Facility plant and site. Applying the screening criteria of 10CFR51, the INRA model includes submitting an Environmental Report in accordance with 10CFR51.45 and 51.50.

10CFR51 also contains environmental review criteria for nuclear power reactors. 10CFR51.50 requires that the environmental report contain the basis for evaluating the environmental effects of fuel cycle activities for the nuclear power reactor. For LWRs, NRC has included Tables S-3 and S-4 in 10CFR51.51 and 52, respectively. The effects of fuel cycle activities for LWRs have been considered in previous Generic Environmental Impact Statements (e.g., NUREG 1437). From these requirements, it is evident that 10CFR51 requires the impacts of the fuel cycle supporting the operations of the nuclear power reactor be evaluated and considered as part of the reactor environmental reviews. While this does not have a direct impact on the Fuel Recycling Facility environmental reviews, it does have an impact on the generic environmental reviews for reactors that will ultimately burn the fuel produced by the Fuel Recycling Facility. The use of MOX from the Fuel Recycling Facility could impact the data in tables S-3 and S-4 and will require additional generic reviews.

40CFR190.10

This EPA regulation establishes environmental discharge criteria for the U fuel cycle in a collective manner and states:

"Operations covered by this subpart shall be conducted in such a manner as to provide reasonable assurance that:

(a) The annual dose equivalent does not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public as the result of exposures to planned discharges of radioactive materials, radon and its daughters excepted, to the general environment from U fuel cycle operations and to radiation from these operations.

(b) The total quantity of radioactive materials entering the general environment from the entire U fuel cycle, per gigawatt-year of electrical energy produced by the fuel cycle, contains less than 50,000 curies of krypton-85, 5 millicuries of iodine-129, and 0.5 millicuries combined of Pu-239 and other alpha-emitting transuranic radionuclide with half-lives greater than one year.

Note that the stated requirements apply to the U fuel cycle. Since the feed stock for the Fuel Recycling Facility is part of the U fuel cycle, these requirements would appear to apply. However, since the CTCF represents the initiation of an independent MOX fuel cycle in addition to the end of a U fuel cycle, a new or revised set of requirements may be required.

Insights into compliance with this regulation are discussed in the following excerpts from NUREG 1437 for nuclear power reactors.

The individual dose standards in 40CFR190.10 (25 mrem whole body, 75 mrem thyroid, and 25 mrem to other organs) apply to all pathways of exposure from most fuel-cycle facilities, although doses from radon are excluded. NRC generally implements 40CFR190 by means of license conditions and has incorporated it by reference in 10CFR20.

As noted in the preamble to the final rule revising 10CFR20 in its entirety (56 FR 23374; May 21, 1991), 40CFR190 limits "apply to the total dose from all sources within the U fuel cycle. However, in its practical implementation, the sources would have to be located within a few miles of each other for the combined dose contributions to be significantly different from the

dose from either facility alone." Thus, in the unlikely event that facilities should be near each other, each licensee would have to determine that the combined doses do not exceed the limits. There are other significant changes that would apply to reprocessing if fuel recycling were to be undertaken in the U.S. in the future. Estimates for reprocessing impacts were based on the Barnwell and Exxon reprocessing plant designs of the 1970s. The radioisotope release fractions used in the 1976 report (NUREG-0116) are now considered to be conservative by at least two orders of magnitude in comparison to current design values. Also, the original *Table S-3* assumption that 100 percent of the volatile radioisotopes and compounds would be released is no longer valid. EPA regulations in 40CFR190 require that, after 1983, releases of ^{85}Kr and ^{129}I be limited to 50,000 Ci/GW-year and 5 mCi/GW-year, respectively. Because the model reactor that is the basis for Tables *S-3* and *S-4* values produces 0.8 GW-years of electricity, the EPA limits translate to 40,000 Ci/RRY and 4 mCi/RRY, respectively. Because plants will not be permitted to operate in violation of the EPA requirements, the current *Table S-3* values are even more conservative, taking into account compliance with the new EPA requirements. A further EPA requirement is that releases of alpha-emitting transuranic elements with half-lives longer than 1 year must be limited to 0.5 mCi/GW-year, or 0.4 mCi/RRY. This limit for transuranic elements required no change in the *Table S-3* estimate, which was already well below the new standard.**"**

From this discussion, it appears that compliance with 40CFR190.10(a) is clearly understood and requires a recycling facilty site-specific evaluation and monitoring to ensure the dose-based criteria are met. The specifics of the Fuel Recycling Facility site will dictate whether the combined doses from other sites need to be considered.

In contrast, compliance with 40CFR190.10(b) is much more complex. The development of the regulation included thorough research on the state of the U fuel cycle as it existed pre-1977. The results of this research are contained in a two-volume EPA Report, "40CFR190 Environmental Radiation Protection Requirements for Normal Operations of Activites in the Uranium Fuel Cycle, Final Environmental Statement" and supplements published in 1976. There were fairly extensive emissions and control technology data on all parts of the U fuel cycle with the exception of reprocessing facilities. In the seventies there were no operating reprocessing facilities and none were expected to begin operation until at least 1980. As a result, the EPA was forced to make decisions and establish projected emission levels based on laboratory and limited bench scale testing of proposed control technologies. In fact, the ^{85}Kr and ^{129}I standards are based solely on anticipated control levels from systems that were still in laboratory and/or bench scale testing. With few other environmental regulations to consider in selecting control methodologies, the installation costs for these systems were judged to be justified by the reduction of potential health impact achieved at the regulated levels of performance. In the U.S. today, the costs to install and operate many control technologies is greatly affected by disposal costs of the waste streams produced by the control systems. Expecting near-term advances in control technology, the EPA stated in 1977 with issuance of the regulation (42FR2858) that "As experience is gained with the ability of the industry to limit fuel cycle releases of these materials to the environment, it may be appropriate to reconsider the standards limiting the maximum environmental burdens of these particular radionuclides." Even though these advances have not occurred, this statement should still stand as a commitment to re-evaluate this 30-year-old rule.

1.2.2.2.2 NRC Experience

NRC has extensive and recent experience with NEPA reviews according to 10CFR51, including the MFFF and gas centrifuge enrichment facilities for which site-specific Environmental Impact Statements were developed. While the NEPA process should not be a challenge for NRC, navigating the various generic issues discussed below could present new and unique considerations.

1.2.2.2.3 Potential Issues and Resolution

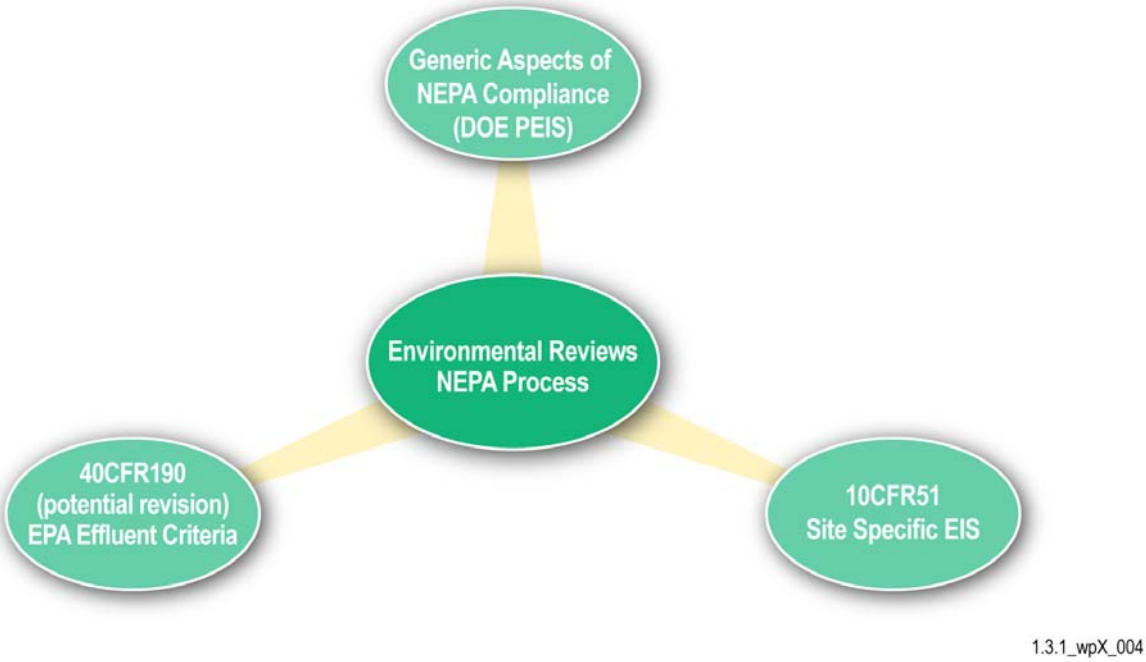
INRA believes there are 3 primary environmental issues associated with the licensing of the Fuel Recycling Facility:

- The cumulative isotope release limits of 40CFR190(b) may not be achievable with existing effluent control technologies. INRA has recommended technology programs in this area; however, DOE should engage both EPA and NRC in parallel to work through possible revisions to 40CFR190.10(b).
- The generic issues associated with a partial closing of the fuel cycle and introduction of MOX from the Fuel Recycling Facility into as many as 15 LWRs will need to be considered in addition to performing a site-specific environmental review for the Fuel Recycling Facility. While this can be done by NRC, INRA believes that DOE could consider many of these aspects in the GNEP Programmatic EIS, thereby achieving early review of these generic areas. This could minimize the need for NRC evaluation.
- 10CFR51 contains information and requirements for reactor environmental reviews that are based on the existing open fuel cycle and LWRs. While these requirements do not create a barrier to licensing the Fuel Recycling Facility , they will need to be considered in the broader context of licensing the reactors to use the MOX fuel produced by the Fuel Recycling Facility. This may require NRC to perform a review similar to NUREG 1437 and either validate or revise Tables S-3 and S-4. While timing of this activity is less critical than creating a framework for the Fuel Recycling Facility licensing, the review would likely need to be completed early enough to ensure there would be no significant barriers to licensing the reactors.

1.2.2.2.4 Recommendation for the Fuel Recycling Facility Framework

INRA believes the existing regulatory framework contained in 10CFR51 is adequate for performing the environmental reviews necessary to specifically license the Fuel Recycling Facility (Figure 3).

FIGURE 3. Fuel Recycling Facility Framework Recommendation. *Recommendation as relates to environmental criteria and reviews.*



There are, however, broader environmental issues that need to be addressed, s recommended below, to adequately consider all environmental impacts associated with the INRA GNEP model.

- Reconsider the requirements of 40CFR190.10(b) as described in RPT-3000510-000, The Fuel Recycling Facility "Liquid and Gaseous Releases".
- Determine what generic environmental reviews can be included in the GNEP Programmatic EIS in order to minimize the amount of generic review required by NRC.
- Identify and begin the necessary generic environmental reviews to enable future reactor licensing environmental review under 10CFR51 in recognition of the Fuel Recycling Facility.

1.2.2.3 Safety Basis

Safety is the central focus of nuclear facility operation and licensing in the U.S., and thus, the demonstration of safety basis in a U.S. nuclear facility is a primary aspect of the license application. The safety basis for a nuclear reactor is typically referred to as a Safety Analysis Report (SAR), while the safety basis for a fuel fabrication facility is referred to as an Integrated Safety Analysis (ISA). Regardless of what the safety basis document is called, it must provide adequate demonstration to NRC that the plant will operate safely. NRC staff review of the

licensee safety basis document results in an NRC documented Safety Evaluation Report (SER). These safety basis documents (SARs or ISAs) vary for facility type. For example, the SAR for a nuclear power plant is typically many more volumes than an ISA Summary for a Low Enriched Uranium (LEU) fuel fabrication facility. In addition to the difference in scope, there has historically been a difference in methodology. This difference has been narrowed as the NRC has taken a position that the safety analyses for all nuclear power plant and nuclear fuel cycle facilities should be risk-informed and performance-based. A brief discussion of risk-informed and performance-based will demonstrate why INRA believes the regulation at 10CFR70 is most relevant to the Fuel Recycling Facility. The concepts of risk-informed and performance-based regulations were identified earlier in the Design Basis discussion above, due to the close link between design and the application of a risk-informed safety analysis.

The expression “risk-informed” in nuclear facility licensing distinguishes between; 1) a set of analyses that pick specific, conservative conditions and assumptions and use those for the safety analyses – thereby artificially introducing a large conservative margin between actual conditions and safety limits without any sense of how likely or unlikely it would be for the margins to be challenged or eroded; from these calculations, the safety controls would be created and systems monitored to ensure that such controls and limits are maintained; and 2) a set of analyses that pick conditions and assumptions that are based on real data and conditions – thereby being risk-informed. The values picked (for a risk-informed analysis) may also be conservative, but the intent is to know the conservatism, and expected real condition, then, by evaluating this condition and a range of values around this condition, the analyst and safety team using the analyses do not have to introduce arbitrary margins. This is not to say that margins are not introduced, in fact, they always are; however, they are not arbitrary, they are “informed.”

Such risk-informed analyses are quite complex, looking at multiple variables in an analysis over ranges of data that can span orders of magnitude and can involve hundreds of thousands of calculations and results. Quantitative treatment of such data sets is performed with statistical tools and thus the technique developed involves the treatment of ranges of data in a probabilistic methodology called probabilistic risk analyses (PRA). Using PRA, individual systems, components, operations, and other nodes can be evaluated quantitatively to document and support the application of appropriate safety measures to that “node.” The techniques of the PRA safety analyses are also used by the regulatory reviewer to confirm the findings of the applicant and to investigate other areas that may be risk important. Using PRA techniques requires that the analyst communicate the scope and boundary conditions for the statistical treatment of data. This judgmental part of PRA is minimized in order to reduce the effect of such judgment introducing artificial or arbitrary conservatism. PRA lends itself well to assessment of mechanical equipment, which performs continuously or is expected to be available continuously in service.

Qualitative, supported by semi-quantitative, risk-informed analysis is also a technique used in evaluating safety in a risk assessment. This technique allows the analyst and safety team to gain risk insights, report, and evaluate safety limits and controls without the requirements of a PRA. The techniques used are well documented and applied in many industries. The application of such techniques also risk informs the safety basis developed; however, margin is often

applied qualitatively and more conservatively, than in safety basis that result from PRA analyses. This set of techniques used by NRC and its applicants and licensees is collectively called an ISA, since the common theme is that multiple safety disciplines must be included in the safety evaluation. ISA lends itself well to chemical processes and human interface processes because broader variability (inherent in chemical processes and human operations) can be bounded more efficiently in the analysis (by the qualitative application of margin in the ISA).

The traditional safety basis is a demonstration that design by margin is adequate. Early and first-of-a-kind technologies are often subject to this kind of prescriptive and limited analyses. Both 10CFR50 and 10CFR70 implemented this kind of safety demonstration when they were first promulgated.

License applicants have used ISAs in most non-reactor applications to the NRC where safety analyses have been required to be risk-informed. These ISA have allowed the analyst and the safety teams evaluating the performance of the facilities to complete their analyses and development of safety limits and controls in a manner that combines the rigor of a thorough and holistic safety evaluation with the conservatism of traditional design by margin efficiency. In addition, they provide the regulator with a directed picture of the risk important processes, equipment, procedures, and facilities. Based on this discussion, it is clear that the risk-informed technique that is appropriate for the Fuel Recycling Facility is the ISA expected in license applications tendered under 10CFR70.

Completing the regulatory framework described in 10CFR70 and expected for the Fuel Recycling Facility is the application of performance-based regulatory criteria. Again, the NRC has moved its regulatory strategy from one of prescriptively directing the applicant or licensee to one where the NRC sets performance expectations and the licensee or applicant is required to demonstrate compliance under all activities. This again reflects the shift from a rigid set of rules for a relatively unfamiliar first-of-a-kind type regulatory regime to a flexible yet robust set of rules under which a variety of operations can be demonstrated to comply with protective principles.

10CFR50 and 10CFR70 were originally developed in the era of prescriptive regulations; however, 10CFR70 was specifically revised in 2000 to implement a risk-informed, performance-based approach to licensing. 10CFR50 (while certainly requiring risk-informed analyses) retains many of the prescriptive criteria that were developed in the early days of Nuclear Power Plant licensing and in response to the developing understanding of safety issues. As NRC noted in SECY 07-0081, many of these prescriptive criteria would need exemptions issued in order to license a fuel recycling-type facility under 10CFR50.

1.2.2.3.1 Existing Regulations

10CFR70

INRA believes the requirements for describing and demonstrating adequate safety basis are provided in the existing requirements of 10CFR70. Specifically, the performance objectives and ISA requirements of 70.61 and 70.62, respectively, describe a risk-informed, performance-based set of criteria that will afford the regulatory reviewers the ability to make a determination that there is reasonable assurance the facility can be operated safely and will protect the environment. This set of performance requirement criteria adequately covers the fuel

manufacturing portion of the Fuel Recycling Facility as it currently stands. It also can be applied to the facility for used fuel processing. The requirements are consistent with, and cover the scope of, other used fuel handling requirements as described specifically below (see discussion under 10CFR50, 52, and 72). The performance objectives are broadly applicable to the licensee's entire operations.

10CFR50/52

The requirements of 10CFR52 and 10CFR50 are discussed together here. In many cases, the requirements reference other regulatory requirement sets (e.g., 10CFR20, 10CFR100, etc.) and each other. 10CFR52 requires (52.18, 52.48, 52.81, and 52.97) compliance with NRC limits and requirements specified in multiple parts of the regulations. Further, 10CFR52 requires (52.17, 52.47, and 52.79) content of a SAR that demonstrates a risk-informed and performance-based compliance case. Within the requirements of 10CFR50, specific Technical Specification requirements are identified for fuel reprocessing plants in 10CFR50.36, and a specific requirement to perform risk-informed analysis is included in 10CFR50.69. Both 10CFR50 and 52 specify the quantitative PRA analyses that are required for risk informing the safety evaluations that support the SARs for nuclear power plant facilities. Required subjects for PRA analyses provide the applicant with defined scope for quantitative PRA. These additional analyses then fit within the broader risk-informed, performance-based licensing structure. The 10CFR50/52 requirements substantially overlap the risk-informed, performance-based requirements of 10CFR70 and, therefore, as redundant requirements are unnecessary for the safety analysis of the Fuel Recycling Facility.

1.2.2.3.2 NRC Experience and Recent Successes

Over the past 5 years, NRC staff has successfully reviewed and approved the ISA for several existing and new facilities licensed under 10CFR70. Operations at these facilities are similar in many respects to those of the Fuel Recycling Facility with the primary difference being only the large inventory of FP resulting in additional considerations such as confinement, shielding, and decay heat removal.

1.2.2.3.3 Potential Issues and Resolution

INRA has identified 2 potential issues and recommendations as follows:

- Since risk-informed, performance-based regulation is relatively recently introduced, and risk assessment in particular is a complex set of analyses often including very complex technical analyses, it is often the subject of substantial debate. One such debate is the adequacy of ISA in demonstrating an appropriate safety basis. NRC has adequately demonstrated that, for fuel facilities, the application of ISA does not require PRA analyses to support the risk-informed decision making. Additionally, through guidance documents, NRC recognizes PRA as a potential tool for conducting safety analysis within the context of an ISA. INRA believes that selected activities would benefit from probabilistic analyses to support a fuel recycling licensing safety basis. Areas for potential PRA must be carefully selected to ensure adequate data exists and that the extra level of rigor is warranted from a risk perspective. To this end, INRA recommends an early collaborative activity with NRC to review the safety basis for existing plants in Japan and France to review the MFFF lessons learned from licensing under 10CFR70 to

determine how the existing safety basis for these plants can be translated into an acceptable ISA. This review would entail an initial selection of specific processes that would be of interest to industry and NRC and would benefit from early engagement. Once the processes were selected, a team would review existing safety cases and translate these cases into an ISA format. In addition, the application of probabilistic techniques would be considered for appropriateness. These exercises would provide a significant advantage and opportunity for early NRC interaction and alignment on the safety case.

- NRC experience with reprocessing plants is limited. In contrast, there is significant international experience with operating facilities that could provide expertise to NRC regarding how these plants are operated safely. To this end, INRA recommends that an exchange program between NRC, DOE, and the international regulators be considered to allow NRC the opportunity to be resident at these international plants.

1.2.2.3.4 Recommendation for the Fuel Recycling Facility Framework

FIGURE 4. Fuel Recycling Facility Framework Recommendations. *Recommendations as related to safety basis.*

INRA believes the appropriate framework for licensing the Fuel Recycling Facility is contained in the existing requirements of 10CFR70 and that implementation of a qualitative or semi-quantitative ISA that is supported by probabilistic analysis of selected scenarios is appropriate for the Fuel Recycling Facility (Figure 4). Specific implementing guidance based on review of current experience should indicate where limited quantitative risk assessment analyses are necessary to support the required ISA. This would ensure that the risks are adequately characterized in the ISA.

1.2.2.4 Radiation Safety

The purpose of radiation safety requirements is to provide verification that an applicant for a nuclear facility operating license has established a radiation protection program that is adequate to protect the radiological health and safety of workers and the public and to verify compliance with the applicable regulatory requirements in 10CFR19 and 20.

This section of the report focuses primarily on radiation safety from the perspective of protecting workers, the public, and the environment from the chronic and long-term exposure to radioactive materials versus the radiation safety aspects of preventing accidents that could result in acute exposures which are addressed in the safety basis and emergency planning sections of this report.

Basic radiation protection principles in a variety of facilities are very mature and have benefited from years of operational experience and feedback. The regulations for implementation of radiation protection are also very well understood.

To a large extent, basic radiation protection principles are independent of the type of facility. Depending on the specific facility operations and postulated accident scenarios, the radioactive isotopes of concern may vary, but the basics of radiation safety and protection remain the same.

1.2.2.4.1 Existing Regulations

10CFR19

10CFR19 addresses requirements concerning instructions required for workers related to general radiation safety. These requirements are generic and apply to all nuclear facilities. While the Fuel Recycling Facility will be required to describe how these requirements are met in the license application, there is nothing unique about the Fuel Recycling Facility that would warrant any regulatory changes.

10CFR20

10CFR20 contains the detailed requirements for a radiation safety program. This section addresses the radiation safety definitions, dose limits, survey requirements, posting requirements, and multiple other requirements that are required for a comprehensive radiation safety program. The program aspects are mature, well understood and not necessarily unique for the Fuel Recycling Facility.

From the perspective of the Fuel Recycling Facility license, the dose criteria for workers and the public will need to be planned for during design to ensure they are achievable during operation.

Subpart C of 10CFR20 establishes dose limits for occupationally exposed individuals. The Fuel Recycling Facility will be designed and operated to meet these criteria, and there is little question as to the application of these criteria.

Subpart D of 10CFR20.1301 establishes criteria for exposure to members of the public. These limits are generally established at 100 mrem/yr for individual members of the public. Additionally, the criteria of 20.1301(e) invoke the requirements of 40CFR190. This section of 10CFR20 does not distinguish between the general dose-based criteria in 40CFR190.10(a) and the radioactive material release-based criteria of 40CFR190.10(b) and appears to invoke both. Meeting the effluent release criteria of 40CFR190 is discussed in more detail in the environmental section of this report.

To implement the as low as reasonably achievable (ALARA) requirements of § 20.1101, a constraint on air emissions of radioactive material to the environment has also been established such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 10 mrem per year from these emissions. While not truly a dose limit, from a practical standpoint, the operating facility must meet this objective.

1.2.2.4.2 NRC Experience

As previously noted, the basic elements of radiological safety are essentially the same for all nuclear facilities and the NRC has vast experience in the implementation and review of radiation safety programs.

Every commercial nuclear facility in the U.S. falls under the NRC responsibility for radiological safety, and all nuclear facilities under the purview of the NRC are required to address the radiological safety requirements stated in 10CFR20 and other applicable regulations.

The NRC has reviewed and approved hundreds of nuclear facility submittals that included the review and approval of a radiological safety program.

1.2.2.4.3 Potential Issues and Resolution

Compliance with 10CFR20.1301(e), which invokes 40CFR190, will be a potential issue and is discussed in detail in the environmental section of this report.

1.2.2.4.4 Recommendation for the Fuel Recycling Facility Framework

The current regulatory framework as outlined in 10CFR19 and 20 provides adequate and comprehensive guidance and criteria for the licensing of the Fuel Recycling Facility (Figure 5). These requirements, along with several NUREG and guidance documents, have been successfully utilized for the licensing of hundreds of nuclear facilities. No specific changes are necessary to license the Fuel Recycling Facility.

FIGURE 5. Fuel Recycling Facility Framework Recommendations. *Recommendations as related to radiation safety*.

1.2.2.5 Emergency Preparedness

Emergency preparedness, including a documented emergency management plan, is required to ensure that adequate facility procedures exist to protect workers, the public, and the environment in the unlikely event that a release of radioactive material or hazardous chemicals produced from radioactive materials occurs. Emergency preparedness requirements address the methodology utilized to assess the potential consequences and the required actions and notifications required.

Requirements for submittal of an Emergency Plan as part of the license application are specified in 10CFR70. While these requirements were intended for, and directed toward,

handling of un-irradiated UNF, INRA believes they are generally adequate for licensing the Fuel Recycling Facility. The fundamental difference between existing and newly licensed fuel facilities and nuclear power reactor emergency planning is the potential for offsite dose and the resulting emergency classification criteria. Power reactors define 4 levels of emergency classification within emergency planning including; (1) notification of unusual events, (2) alert, (3) site area emergency, and (4) general emergency. In contrast, fuel facilities define only 2 levels of emergency classification; (1) alert and (2) site area emergency.

1.2.2.5.1 Existing Regulations

10CFR70

10CFR70.22(i) provides the emergency plan requirements for enriched (U,Pu) facilities. While this section does not specifically mention a recycling or production facility, it does require an emergency plan for facilities handling enriched (U,Pu).

This section provides options for emergency planning, depending on the potential release factors and maximum potential offsite dose. The regulation describes general content of the plan, but is not specific regarding emergency classification criteria. Specific content and details of the plan are relegated primarily to Regulatory Guide 3.67, Standard Format and Content for Emergency Plans for Fuel Cycle and Materials Facilities.

Several factors may be credited in the evaluation of offsite dose including storage, separation, solubility, and engineered safety features. This section addresses the possibility that an offsite emergency plan may not be required if the safety analysis indicates that the potential maximum offsite dose is shown to be less than 1 mrem effective dose equivalent or an intake of 2 milligrams of soluble U. For the Fuel Recycling Facility , preliminary INRA reviews indicate that an emergency plan will be required.

10CFR50

10CFR50.34 and 47 include the requirements for emergency planning directed primarily toward power reactors.

10CFR50.47 addresses the requirements for nuclear power reactor emergency planning. Due to the relatively higher potential risk associated with power plants, emergency planning for power plants is much more prescriptive that the requirements of 10CFR70.22. Power plant emergency procedures are required to specifically address the following:

- Onsite and offsite organizations
- Contacts and arrangements made with local, state, and federal agencies
- Protective measures to be taken within the site and each Emergency Planning Zone (EPZ)
- Features of the facility to provide for emergency first aid, decontamination, and emergency transport to offsite treatment centers
- Provisions to be made for emergency treatment at offsite facilities

- Provisions for training both licensee employees and non-licensee personnel who have emergency responsibilities
- A preliminary analysis that projects the time and means to be employed in the notification of outside agencies and the public along with an analysis of the projected time required to evacuate various sectors of the EPZ
- A preliminary analysis that reflects the need to include facilities, systems, and methods for identifying the seriousness and scope of radiological consequences of emergency situations including the capability for dose projection

Appendix E to 10CFR50, Emergency Planning and Preparedness for Production and Utilization Facilities, sets forth standards for both utilization and production facilities. This appendix states in part, that:

"The potential radiological hazards to the public associated with the operation of research and test reactors and fuel facilities licensed under 10CFR50 and 70 involve considerations different than those associated with nuclear power reactors. Consequently, the size of Emergency Planning Zones (EPZs) for facilities other than power reactors and the degree to which compliance with the requirements of this section will be determined on a case-by-case basis."

Appendix E also establishes content of an emergency plan to be submitted with the license application and specifies 4 levels of emergency classification in within emergency planning including; (1) notification of unusual events, (2) alert, (3) site area emergency, and (4) general emergency.

Other Parts of 10CFR

10CFR30.32 addresses emergency plan requirements for by-product facilities.

10CFR40.13 addresses emergency plan requirements for source material facilities.

1.2.2.5.2 NRC Experience

The NRC has licensed several fuel production facilities, including the MFFF, utilizing the emergency planning requirements of 10CFR70, 10CFR40.31, and 10CFR30.32.

In April 2005, NRC approved construction of the MFFF facility and concluded an emergency plan was not required based on projected accident consequences.

In June 2006, the NRC issued a license for the National Enrichment Facility (NEF) in New Mexico. Section 8 of the SER summarizes the submitted emergency plan and the staff's evaluation of that plan.

In April 2007, the NRC issued a license for the American Centrifuge Plant in Ohio. Section 8 of the SER summarizes the submitted emergency plan and the staff's evaluation of that plan.

In addition, NRC has significant experience with nuclear power plant emergency planning.

1.2.2.5.3 Potential Issues and Resolution

The fundamental difference between existing and newly licensed fuel facilities and nuclear power reactor emergency planning is the potential for offsite dose and the resulting emergency classification criteria. Power reactors define 4 levels of emergency classification in emergency planning, including; (1) notification of unusual events, (2) alert, (3) site area emergency, and (4) general emergency. The specification of 4 levels is a regulatory requirement in 10CFR50 Appendix E that currently applies to production facilities.

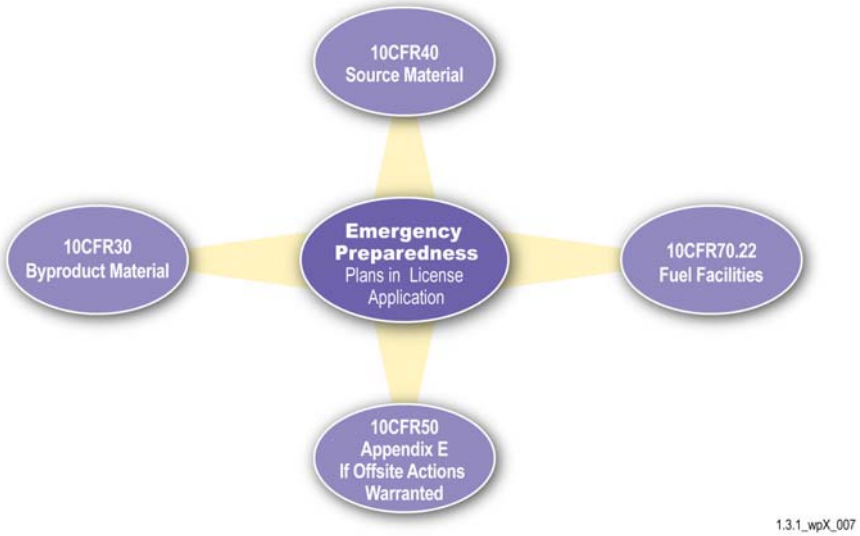
In contrast, fuel facilities define only 2 levels (10CFR70 requirements do not specifically require either 4 or 2 levels of classification) of emergency classification; (1) alert and (2) site area emergency in accordance with guidance in Regulatory Guide 3.67. The absence of potential for significant offsite releases and a General Emergency classification reduces the level of participation by the local and state authorities.

Qualitative accident analysis, along with postulated offsite dose calculations, will be required to determine the appropriate level of emergency planning and outside participation that will be required for the Fuel Recycling Facility. This will depend significantly on the site chosen and the distance to the site boundary. Once this analysis is complete, the existing regulations in 10CFR70 provide sufficient flexibility to implement an appropriate level of emergency planning. To this end, INRA recommends that parametric accident modeling be performed for the Fuel Recycling Facility plant design, considering several model sites to determine which emergency planning framework is likely to be most appropriate for NRC regulatory framework. Understanding this early will facilitate the NRC rulemaking process by narrowing the options necessary to be considered.

1.2.2.5.4 Recommendation for the Fuel Recycling Facility Framework

INRA believes the existing criteria in 10CFR70 can be applied in a risk-informed manner to determine the appropriate level of emergency planning based on the potential severity of an accident (Figure 6). No specific changes to 10CFR70 are recommended, and the general revisions to 10CFR50 to remove its applicability to a recycling facility should eliminate the potentially conflicting requirements for emergency classification of 10CFR50 Appendix E. The concepts of Appendix E can be applied through guidance documents if potential accident consequences warrant.

FIGURE 6. Fuel Recycling Facility Framework Recommendations. *Recommendations related to emergency preparedness.*



1.2.2.6 Safeguards

Effectively safeguarding a commercial reprocessing facility such as the Fuel Recycling Facility is an extremely complex task. It requires that operators meet domestic requirements designed to accurately account for and secure SNM in a harsh environment as well as meet international requirements intended to transparently demonstrate to an international community that the material is not being used for weapons programs. For an NRC licensee, the current domestic requirements are contained in 10CFR74, Material Control and Accounting of Special Nuclear Material. International requirements, if applied, are administered through the International Atomic Energy Agency (IAEA) under the authority granted in "The Agreement Between the United States and the International Atomic Energy Agency (IAEA) for the Application of Safeguards in the United States." The NRC specifically implements these requirements through 10CFR75, Safeguards on Nuclear Material--Implementation of US/IAEA Agreement.

The regulatory framework, as described in these two documents, is considered to be workable, however modifications are warranted especially in 10CFR74 to meet the specific needs of a reprocessing facility. Each of these documents is discussed below.

1.2.2.6.1 Existing Regulations

10CFR74

Domestic safeguard requirements are in 10CFR74 and the companion NUREG documents. The current revision to 10CFR74 provides few regulations specifically tailored to a reprocessing facility. This is expected, as reprocessing has not been a part of the commercial U.S. nuclear

industry landscape in approximately thirty years. However, INRA believes that the current MC&A regulations are generic enough to provide the needed regulatory base.

The basic topics of nuclear material accounting, measurement and measurement control, process monitoring, material control, QA, reporting, and management are adequately documented in these regulations and can be universally applied, regardless of the type of plant. There are, however, some nuances specifically associated with reprocessing facilities that need to be addressed or clarified. The determination of material category and attractiveness, necessary for determining safeguards, detection, and protection levels, is not as straightforward for the mix of UNF and minor actinides (MAs) present in the material streams of a reprocessing plant as it is for a "cold" U or Pu facility. Additionally, the COEX^{TM} process does not result in pure Pu and must be monitored accordingly. The presence of FP will affect the accuracy of some measurements. More nondestructive measurement techniques will have to be utilized. Inventory differences can be expected to be correspondingly larger. Hot cell processing is not conducive to resolving these inventory or process monitoring differences. Shipper/receiver differences on used fuel become more problematic when shipper values on UNF are based on computerized burn-up codes.

Addressing these items generically will necessitate some additional rulemaking. Issues specific to a particular reprocessing plant can probably best be handled through the Fundamental Nuclear Material Control Plan. This plan, as part of the operating license, fully details all of the MC&A methods to be used, and adherence is just as enforceable.

Specific issues in 10CFR74 that INRA believes should be addressed rough rulemaking tare outlined later in this section.

10CFR75

"The Agreement Between the United States and the International Atomic Energy Agency (IAEA) for the Application of Safeguards in the United States" establishes the basis for allowing the IAEA to implement safeguards at U.S. facilities such as the Fuel Recycling Facility. NRC implements these requirements in 10CFR75. The regulations contained therein essentially replicate the requirements of the Agreement, its Subsidiary Arrangement, and establish the protocols to be followed. INRA believes that no additional changes to this regulation are needed specifically to support a reprocessing facility.

INRA expects that, by the time active work begins on a U.S. reprocessing facility, that the "Protocol Additional to the Agreement between the United States of America and the International Atomic Energy Agency (IAEA) for the Application of Safeguards," also known as the Additional Protocol, will be fully implemented in this country. NRC should consider broadening 10CFR75 to include the reporting requirements associated with the additional protocol.

1.2.2.6.2 NRC Experience

With the thirty year hiatus in UNF reprocessing in this country, there is no direct NRC experience in licensing a reprocessing facility as a whole. With that said, NRC nuclear material control & accountability (NMC&A) licensing experience does extend through the majority of individual components that make up a safeguards program. Reactor and UNF storage facilities have been under NRC licenses for years. The country's 2 commercial Category I facilities have

licensed NMC&A programs protecting many metric tons of strategic SNM. Activity associated with licensing and later regulating the MFFF being constructed at the Savannah River Site is providing the NRC with experience in safeguarding Pu. Combined, these facilities represent the same basic chemical processes and safeguards needs that will be utilized in both the hot and cold sections of a reprocessing environment such as the Fuel Recycling Facility. The principal differences between licensing these facilities and the Fuel Recycling Facility then lies with presence of bulk, unencapsulated FP containing measureable quantities of UNF and MAs. These items will make material handling, measurements, accounting, inventory, and control more difficult. Developing appropriate safeguards for material streams with these components will prove to be the most challenging from a regulatory standpoint and is the area where the NRC has the least experience. It will not be possible to maintain the same desired protection and detection levels presently used for radiologically cold plants in a facility processing FP streams.

NRC experience with international safeguards as applied to licensees is also limited. Reactor and fuel fabrication facilities have been available for IAEA inspections for years, though none are under an inspection regime. Though direct IAEA experience has been minimal, the situation is compensated for by the NRC participation in the interagency Subgroup on IAEA Safeguards in the U.S. (SISUS). In this role, the NRC is part of the decision-making process as to the safeguards mechanisms to be allowed to be applied in this country and is fully informed of the efforts the Government is making on the international front. DOE, with its NMC&A experience at Savannah River, Hanford, Los Alamos, and Rocky Flats, along with the efforts of its NLs shaping safeguards activities on the international front, can be of invaluable support to the NRC as it strengthens and molds its existing regulations to meet this new challenge.

1.2.2.6.3 Potential Issues and Resolution

There are several safeguards issues directly related to reprocessing activities that INRA believes need to be addressed as follows:

- Clarification is urgently needed in determining the category and attractiveness levels of the UNF-bearing material streams in a typical reprocessing plant. Many of these streams have mixed material types. For example, in the case of the COEX^{TM} process proposed by INRA, LEU and Pu will coexist completely through the separation process to fuel fabrication. The attractiveness of this combined stream should be substantially lower than that of a pure Pu stream. INRA fully supports efforts to unify the approach for determining categories and attractiveness levels between DOE and NRC. Tables similar to that contained in DOE M 470.4-6, Nuclear Material Control and Accountability, are extremely useful to licensees and should be developed. This guidance directly affects the security features of the plant design and must be resolved prior to beginning the preliminary design. INRA recommends that the DOE accelerate its current effort to research and publish guidance on this issue and for NRC to incorporate this guidance into its regulatory process.

The Fuel Recycling Facility chemical processes are being designed to extract a mixed (U,Pu) product stream. From a safeguards standpoint, protections against process alteration that could extract pure Pu must be in place. From the point of the initial separation of (U,Pu) from the FP

and other undesirable materials, the plant chemical processes will require a balanced concentration of (U,Pu) in order to produce a mixed stream from which a certifiable dry product suitable for fuel fabrication can be produced. Any alteration in these balances to extract a pure Pu stream will result in a mixed product that is out of specification and readily detectable. Other measures include but are not limited to the following:

- Extensive process modifications are not easily implemented within an existing structure.
- Process controls necessary to maintain the balance of chemicals and elements within the process will be capable of monitoring and comparing solution flows into and from tanks along the entire process. The capability to have flow monitors at strategic points along piping can be added.
- Normal process sampling and destructive and non destructive measurements will ensure that feed and product materials from each measurable processing step remain in defined limits including (U,Pu) ratios.
- The Fuel Recycling Facility will have an extensive nuclear material control and accountability system integrated with the process control systems to enable near real time accountability to be applied through the entire process.

Finally, the plant is expected to be voluntarily offered by the U.S. for the application of IAEA safeguards. Safeguards application will include design verification beginning with the initial the facility construction phase and continuing with regular verification activities throughout the life of the safeguards inspections to ensure that no physical process modification are made. Added to this will be independent process monitoring and surveillance equipment designed to ensure that all Pu is processed as declared and that no diversion, in any form, has occurred.

In summary, process controls along with domestic and international oversight will ensure that the plant functions as intended, and that process modifications cannot be made to produce a separated Pu stream without detection. This will be an area for early engagement with NRC to achieve alignment.

Current regulations require that a shipper/receiver difference analysis be made. However, it should be noted that shipper UNF values for used fuel are based on a burn-up calculation. These codes typically do not predict nuclear material content in used fuel that approaches the accuracy required for UNF accountability measurements. INRA experience has been that the differences will be large and not very meaningful. It is also not very accurate to try to calculate a combined limit of error between a measurement and a calculation. It is recommended that the shipper/receiver analysis for used fuel in a reprocessing facility be eliminated or only provided for information.

To improve plant efficiencies, INRA recommends that the domestic inventory period required for the dissolution and separations material balance areas (MBAs) be set to 1 year following the demonstration of adequate performance. This would take into account the environment (e.g., the difficulty in cleaning and preparing hot cell areas for cleanout inventory), the various material types and attractiveness levels, and the typical IAEA requirement for performing an annual operator Physical Inventory Taking (PIT) and the IAEA's Physical Inventory Verification (PIV). A continuous random selection item monitoring program should be able to provide the necessary

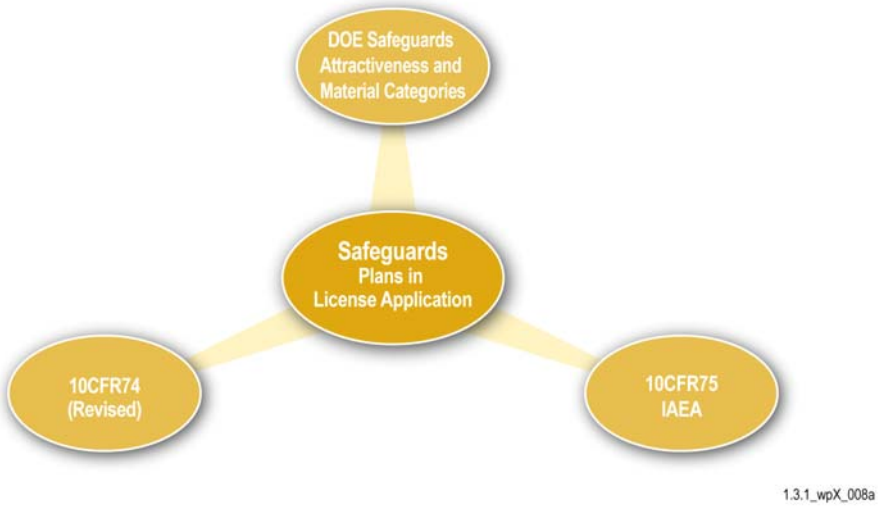
detection levels in the interim. Cold Category I areas could still be inventoried on a semi-annual basis similar to current Category I licensed facilities.

10CFR74.41 needs clarification. It currently denotes reprocessing plants as handling material of moderate strategic significance. This needs to be clarified as separations buildings have cold areas on the tail-end of the process that can have multiple Category I quantities.

1.2.2.6.4 Recommendation for the Fuel Recycling Facility Framework

In order to provide a workable regulatory environment for the Fuel Recycling Facility , the following specific actions should be considered for inclusion in 10CFR74 either directly or by reference (Figure 7).

FIGURE 7. Fuel Recycling Facility Framework Recommendations. *Recommendations related to safeguards.*



Other items more specific to the Fuel Recycling Facility would probably be best handled through the Fundamental Nuclear Material Control (FNMC) Plan submitted with the license application:

- Consolidate and unify DOE and NRC NMC&A and protection approaches and incorporate into 10CFR74.
- Consolidate and clarify DOE and NRC approaches on determining the category and attractiveness levels of the UNF-bearing material streams in a typical reprocessing plant. Issue tables that can be readily understood and incorporated into the FNMC Plans.
- Clarify whether reprocessing plants fall under Subpart D, Special Nuclear Material of Moderate Strategic Significance, (10CFR74.41) or Subpart E, dealing with formula quantities of strategic SNM (10CFR74.51). This must be done in recognition that parts of the entire facility contain strategic SNM that may and may not be mixed with FP.
- Modify 74.43 or 74.59 as appropriate to remove predefined limits on the SEID. Allow the measurement methods approved with the FNMC Plan to drive the SEID and other control indicators.
- Modify 10CFR74.43 to exempt reprocessing plants from analyzing and resolving shipper/receiver differences when those differences are based solely on modeling or

calculation basis. This does not exempt the facility from performing required transfer checks.

- Modify 10CFR74.43 or 10CFR74.51 to either provide for annual inventories across the plant site or allow varying inventory periods defined on an MBA-by-MBA basis, based on the category and attractiveness of material in each MBA, with the restriction that inventory periods must coincide at least once annually.

1.2.2.7 Security

Much of the required regulatory guidance needed for the Fuel Recycling Facility is included within the current NRC regulatory framework. Although no single part of the regulation is inclusive of all requirements that will be needed for the Fuel Recycling Facility , the roll-up of current requirements for the protection of reactors, Category 1 facilities, and used fuel storage contained in the regulations and recently issued security orders is sufficient to serve as the basis for licensing of the Fuel Recycling Facility as a commercial facility under 10CFR70.

Following the terrorist attacks of September 11, 2001, NRC requirements for the protection of most radioactive materials changed substantially. Required upgrades in the levels of physical protection are continuing to evolve. The normal rule-making process is time consuming and not well-suited for the rapid changes required to ensure that protection levels keep pace with evolving threat attributes. To counter this, the NRC has repeatedly employed the Confirmatory Order process to augment rule making to fast track new security requirements to the nuclear industry. The orders issued to date include additional security measures for reactors, fuel facilities, and independent used fuel storage installations (ISFSI). INRA expects that the issuance of an order for the Fuel Recycling Facility security would resemble a hybrid of the Category 1, Reactor, and ISFSI orders. Orders are not made available for public review or comment. INRA would expect to work with NRC to develop order requirements and specific language.

1.2.2.7.1 Existing Regulations

10CFR11

10CFR11 contains the requirements, criteria, and procedures for nuclear material access authorization. A NRC-R or NRC-U clearance is required for certain activities involving access to, and control over, formula quantities of nuclear material. The requirements of 10CFR11 are in addition to and not in lieu of requirements for access to classified nuclear material as described in 10CFR25. The current state of this regulation is sufficient to support the operation of the Fuel Recycling Facility.

10CFR25

10CFR25 details the requirements for granting and maintaining access authorizations for licensee personnel and other persons who require access to classified information or classified nuclear material. The clearance levels authorized under the provisions of this regulation (L and Q) are sufficient for access to all levels of information and materials relating to operation of the Fuel Recycling Facility.

10CFR26

10CFR26 prescribes the requirements and standards for the establishment of fitness-for-duty programs at reactor and Category 1 facilities. The regulation, inclusive of drug and alcohol testing, and employee assistance program requirements are sufficient for direct application to the Fuel Recycling Facility.

10CFR95

10CFR95 establishes the procedures for obtaining a facility clearance and the requirements for the protection of classified information utilized and stored at a cleared facility. The provisions of the current procedure are sufficient to support operation of the Fuel Recycling Facility.

10CFR72

10CFR72 outlines the physical protection licensing requirements for the storage of spent nuclear fuel. Although drafted specifically for the independent storage of SNF, the basic criteria requiring the submittal of the design basis and design criteria as well as security, contingency, and guard training plans would be appropriate for inclusion in revised design criteria as stated in the discussion of Design Criteria in this report.

10CFR73

10CFR73 prescribes the requirements for the establishment and maintenance of a physical protection system that will have capabilities for protection of nuclear material at fixed sites. Included in the regulation is a description of the design basis threats to be used to design security systems to protect against acts of radiological sabotage and theft of nuclear material.

From a security standpoint for the Fuel Recycling Facility , the level of physical protection will depend on the material definition and its attractiveness. DOE has been reassessing material-attractiveness levels of various material types currently processed in the U.S. NRC regulations in 10CFR73 really only have 2 classifications of material attractiveness (1A and 1B). To implement appropriate graded safeguards, additional attractiveness levels specific to the Fuel Recycling Facility materials must be incorporated into NRC regulations. NRC should be encouraged to complete this effort well ahead of the Fuel Recycling Facility licensing and early in the facility design phase to ensure appropriate safeguards are designed into the facility.

Since the feed stock for the Fuel Recycling Facility is used fuel, there will be significant FP inventories in the input stream as well as the waste stream. The presence of FP and concomitant extremely high radiation dose rates *may* provide some relief from physical protection requirements due to self-protecting attributes. Current NRC regulations exempt licensees from the physical security requirements of 10CFR73.67 if the nuclear material possessed is not readily separable from other radioactive materials and has a total external radiation dose rate in excess of 100 mrems/hr at a distance of 3 feet from any accessible surface without intervening shielding. However, recent trends indicate that NRC is changing its view regarding self-protection as described in 10CFR73 and expressing growing concern regarding radiological sabotage scenarios.

1.2.2.7.2 NRC Experience

NRC staff has been actively engaged in modifying a broad range of security requirements since September 11, 2001. The need for establishing clear expectations for the protection of SNF has been a particular focus. Staff personnel have developed and issued security orders for increased protection of spent nuclear fuel at reactor sites, ISFSIs, and in storage at material processing sites. NRC has also addressed the many aspects of protecting sensitive information across a variety of licensees and technologies both for existing plants and new enrichment plant licenses.

1.2.2.7.3 Potential Issues and Resolution

The lack of specificity in the attractiveness levels contained in current NRC regulations represents a challenge to implementing appropriate graded safeguards into the design of the Fuel Recycling Facility. Additionally, the NRC position regarding the self-protecting attributes of used nuclear fuel is in flux. The current regulations would have to be revised to incorporate a more detailed delineation of attractiveness categories as well as recently developed protection requirements contained in the Spent Fuel Upgrade Order. INRA believes the activities previously described in the safeguards section of this report are necessary to resolve this issue and allow for an appropriate understanding of the necessary protective strategies. Additionally, INRA recommends that a conceptual security strategy design effort be initiated with NRC, DOE, and industry so that as the attractiveness levels are defined, security protective strategies can be considered to incorporate very early into the design. This effort could entail review of classified information which INRA partners are capable of performing. This Early Conceptual Design effort would ultimately support the security design criteria and allow for early alignment with NRC.

1.2.2.7.4 Recommendation for the Fuel Recycling Facility Framework

INRA recommends that the Fuel Recycling Facility be licensed as a commercial facility under 10CFR70. The security program for the the Fuel Recycling Facility will have to be designed to ensure compliance with the physical protection requirements contained in existing NRC regulations (Figure 8).

FIGURE 8. Fuel Recycling Facility Framework Recommendations. *Security program designed to ensure compliance with NRC regulations.*

Several Orders requiring additional security measures were issued by the NRC after September 11th. Many of the requirements contained in those Orders have not yet been incorporated in regulation. The security program for the Fuel Recycling Facility must also comply with the requirements contained in those Orders, thus, NRC will have to specifically issue the orders to the Fuel Recycling Facility. Those orders include:

- Interim Compensatory Measures for Category 1 Fuel Cycle Facilities
- Revised Design Basis Threat for Category 1 Fuel Cycle facilities
- Order Imposing Safeguards Information Protection Requirements and Fingerprinting and Criminal History Records Check Requirements for Access to Safeguards Information
- Order Imposing Fingerprinting and Criminal History Records Check Requirements for Unescorted Access to Certain Radioactive Material
- Order Modifying License for Nuclear Material Licensees Who Possess and Ship Spent Nuclear Fuel

Additional orders issued to individual licensees also contain specific security requirements that must be considered in designing the Fuel Recycling Facility security program. B&W is familiar with these additional requirements, having implemented significant upgrades to the security posture at its NRC-licensed facilities in response to these orders.

To ensure that appropriate safeguards attractiveness levels are applied to materials at the Fuel Recycling Facility, DOE and NRC should perform a specific assessment of material types. This

should be done well ahead of licensing and early in the facility design phase to ensure appropriate safeguards are designed into the facility. Appropriate safeguards in this context depend not only on defining the minimum requirements, but also on defining where a lower protective posture is appropriate in order to minimize operational costs. NRC will rely on DOE determinations of material attractiveness in applying appropriate criteria from 10CFR73. It will likely be necessary to revise these regulations, but only to define the attractiveness levels of the various material types.

1.2.2.8 Organization and Management Control

The license to operate a fuel processing facility requires an organization, management system, and administrative controls that enable the effective implementation of health, safety and environment functions necessary for the safety of workers, the public, and the environment. Specifically, 10CFR70.62(d) requires establishment of management systems to ensure compliance with the performance requirements of 10CFR70.61, including significantly mitigating the risk of high and intermediate consequence events and of nuclear criticality accidents. The 10CFR70.22, 70.23, and 70.62 requirements are appropriate for the Fuel Recycling Facility , as the philosophy embodied in these requirements has been effectively implemented for years in the U.S.

10CFR62(d) requires organizational structure and associated administrative programs that include administrative policies and procedures and management policies with qualified personnel assigned to key management positions. A description as to how the organization, management systems, and those assigned to key management positions provide reasonable assurance that the health, safety, and environmental (HS&E) will be protected is required by the applicable Standard Review Plan. Conduct of operations, maintenance and surveillance, operator training and qualification, and configuration management represent attributes of a strong management system and are addressed in the Standard Review Plans for MOX fuel fabrication and fuel cycle facilities as described in NUREG 1520 and NUREG 1718, respectively. The requirements described in 10CFR70, the guidance provided in the cited NUREGs, and the NRC's experience with implementing this guidance lead to the conclusion that the regulation, framework, and precedent for organization and management controls is in place.

1.2.2.8.1 Existing Regulations

10CFR70

Every applicant or licensee must establish management measures to ensure compliance with the performance requirements of 10CFR70.61. A graded approach may be employed to the engineered or administrative control or control system with these systems designed, implemented, and maintained, as necessary, to ensure they are available and reliable to perform their function when needed.

An integrated safety analysis is performed as the basis for assessing and then limiting the risk of credible high-consequence events. Engineered controls, administrative controls, or both, shall be applied to the extent needed to reduce the likelihood of occurrence of the event so that, upon

implementation of such controls, the event is highly unlikely or its consequences are less severe than a number of individual and area criteria.

1.2.2.8.2 NRC Experience

The NRC has reviewed the organization and management controls of many nuclear power plants, not just in the licensing phase, but as operating plants. In addition, the NRC has licensed several fuel facilities utilizing the requirements of 10CFR70 and Standard Review Plans described in NUREG-1520 and NUREG-1718. The NRC has licensed the National Enrichment Facility (NUREG-1827) and the American Centrifuge Plant (1851) with Sections 2 and 11 addressing their reviews of organization and management controls. Therefore, the regulatory framework is in place and precedents exist indicating the NRC's expectations for obtaining an operating license.

1.2.2.8.3 Potential Issues and Resolution

There are no issues identified by INRA related to organization and management control.

1.2.2.8.4 Recommendation for the Fuel Recycling Facility Framework

The organization and management control requirements in 10CFR70 and the associated guidance provided in the NUREGs describing standard review plan guidance are well defined and appropriate for the Fuel Recycling Facility facility (Figure 9). Further, the current regulatory framework drives creation of a strong organization that will implement strong conduct of operations, maintenance and surveillance, operator training and qualification, and configuration management programs which are key attributes of a strong management system.

FIGURE 9. Fuel Recycling Facility Framework Recommendations. *10CFR70 and associated guidance are well defined and appropriate for the Fuel Recycling Facility organization and management control.*

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1.2.2.9 Quality Assurance

The Fuel Recycling Facility Quality Assurance (QA) criteria for all phases – design, construction, and operation – are governed by 10CFR70 which invokes 10CFR50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants (hereafter referred to as Appendix B). Use of Appendix B criteria for the Fuel Recycling Facility is directed by 10CFR70.22 and 10CFR70.23. Specifically, 10CFR70.22(f) specifies the content of the license application and lists, among other requirements, the need to describe the quality assurance program. Footnote 2 to 10CFR70.22f specifically requests a discussion of how the criteria in Appendix B will be met. In addition, Footnote 3 to 10CFR70.23b states that Appendix B of 10CFR50 will be used by the Commission in determining the adequacy of the QA program.

10CFR70.64 specifically calls for quality standards for new facilities or new processes at existing facilities to assure designs are developed and implemented in a manner that assures that items relied on for safety will be available and reliable to perform their function when needed. QA Program elements include:

- Design control
- Procurement document control
- Inspections, procedures, and drawings
- Document control
- Control of purchased items
- Identification and control of items
- Control of special processes
- Inspection
- Test control
- Control of measuring and test equipment
- Handling, storage, and shipping
- Inspection, test, and operating status
- Nonconformance
- Corrective action
- QA records
- Audits and assessments

Appropriate records of these items must be maintained by, or under the control of, the licensee throughout the life of the facility. Regulatory Guide 3.3, Quality Assurance Program Requirements for Fuel Processing Plants and for Pu Processing and Fuel Fabrication Plants, while dated (1974), provides general guidance for the establishment and execution of QA programs. It is reasonable to expect this regulatory guide will considered when updating or creating specific guidance for the Fuel Recycling Facility.

1.2.2.9.1 Existing Regulations

10CFR70

10CFR70.22(f) requires that license applications must contain a description of the QA program to be applied to the design, fabrication, construction, testing, and operation of the structures, systems, and components of the plant.

10CFR70.22(f), Footnote 2 requires that license applications must include a discussion of the QA program and how it meets the Appendix B criteria.

10CFR70.23(b) states that the NRC will approve construction once it has determined among other requirements, that the QA program provides reasonable assurance of protection against natural phenomena and the consequences of potential accidents.

10CFR21 requires that the NRC must be notified of all non-compliances related to substantial safety hazards and any activities or components supplied which could create a substantial safety hazard.

10CFR70.23(b), Footnote 3 requires that Appendix B criteria will be used by the Commission in determining the adequacy of the QA program.

10CFR50, Appendix B requires every applicant for a construction permit is required to include in its preliminary safety analysis report a description of the QA program to be applied to the design, fabrication, construction, and testing of the structures, systems, and components of the facility. Every operating license application is required to include, in its final safety analysis report, information pertaining to the managerial and administrative controls to be used to ensure safe operation.

1.2.2.9.2 NRC Experience

The NRC has reviewed the QA programs of many nuclear power plants, not just in the licensing phase, but as operating plants. In addition, the NRC has licensed several fuel facilities utilizing the requirements of 10CFR70 and Standard Review Plans described in NUREG-1520 and NUREG-1718. Specifically, the NRC has licensed the National Enrichment Facility (NUREG-1827) and the American Centrifuge Plant (1851). The NRC experience with licensing and regulation of both nuclear power plants and fuel facilities leads to a well-understood and tested framework for QA programs.

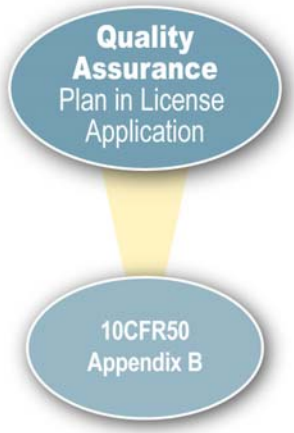
1.2.2.9.3 Potential Issues and Resolution

There are no issues identified by INRA related quality control.

1.2.2.9.4 Recommendation for the Fuel Recycling Facility Framework

The QA program requirements in 10CFR70 and 10CFR50, Appendix B, and the associated regulatory guides are recommended for the Fuel Recycling Facility facility (Figure 10). The current regulatory framework drives creation and implementation of a strong QA program.

FIGURE 10. Fuel Recycling Facility Framework Recommendation. *Current Regulatory Framework Results in Strong QA Program.*



1.2.3 Summary of Proposed Approach and Regulatory Changes

INRA's proposed regulatory framework approach and changes to regulations to enable the recommended framework identified in each section are summarized in the following table.

Regulatory Area	Recommended Approach	Regulatory Changes to Implement Approach
General Authorization	10CFR70 revised to authorize licensing on a non-reactor production facility in a one-step process	Consider revisions to 10CFR70.1, 70.4, 70.22, and 70.23 to specifically authorize all the Fuel Recycling Facility activities.
Design Criteria	Apply a Revised BDC of 10CFR70.64	Consider revising 10CFR70 so that all relevant design criteria are incorporated into 10CFR70.64 in order to create regulatory predictability through a comprehensive set of design criteria for the Fuel Recycling Facility. Consider revising the following existing 10CFR70.64 BDC: ➢ Natural Phenomena ➢ Fire Protection ➢ Emergency Capability Consider adding the following criteria to 10CFR70.64, BDC:

Regulatory Area	Recommended Approach	Regulatory Changes to Implement Approach
		➢ Confinement of Radioactive Materials ➢ Control and Monitoring of Radioactive Material Releases and Radiation Levels ➢ Fuel and Waste Storage, Monitoring, and Handling ➢ Decommissioning & Minimization of Contamination ➢ External Man Induced Events ➢ Geological and Seismological ➢ Control Room or Area ➢ Physical Protection
Environmental Reviews and Criteria	Apply existing criteria of 10CFR51 for the Fuel Recycling Facility specific environmental reviews and consider broader issues of LWR MOX in DOE PEIS as appropriate	Reconsider the requirements of 40CFR190.10(b) and revise as necessary. Determine what generic environmental reviews can be included in the GNEP Programmatic EIS and what needs to be done generically by NRC. Identify and begin the necessary generic environmental reviews to enable future reactor licensing environmental review under 10CFR51 in recognition of the Fuel Recycling Facility.
Safety Basis	Apply existing ISA processes from 10CFR70 with selected use of probabilistic analysis	No changes to regulation required. Consider identification of appropriate areas for probabilistic analysis for inclusion in regulatory guidance.
Radiation Safety	Apply requirements of 10CFR19 and 20	No changes to regulation required
Emergency Preparedness	Apply requirements of 10CFR70 in a graded manner that is flexible enough to accommodate the necessary degree of emergency planning	No specific changes to 10CFR70 are recommended. Adoption of requirements for emergency classification of 10CFR50 Appendix E may be appropriate based on accident consequence analysis.
Safeguards	Apply revised requirements of 10CFR74 and 75	Consolidate and unify DOE and NRC NMC&A and protection approaches and incorporate into 10CFR74. Consolidate and clarify DOE and NRC approaches on determining the category and attractiveness levels of the SNM-bearing material streams in a typical reprocessing plant, issue tables that can be readily understood by facility operators, and incorporate either by reference or revision of 10CFR74. Clarify whether reprocessing plants fall under

Regulatory Area	Recommended Approach	Regulatory Changes to Implement Approach
		Subpart D, Special Nuclear Material of Moderate Strategic Significance (10CFR74.41), or Subpart E, dealing with formula quantities of strategic SNM (10CFR74.51), recognizing that parts of the entire facility contain strategic special nuclear material that may and may not be mixed with FP. Consider revising 10CFR74.43 or 74.59 as appropriate to remove predefined limits on the SEID. Allow the measurement methods approved with the FNMC Plan to drive the SEID and other control indicators. Consider revising 10CFR74.43 to exempt reprocessing plants from analyzing and resolving shipper/receiver differences when those differences are based solely on a modeling or calculation basis. This does not exempt the facility from performing required transfer checks. Consider revising 10CFR74.43 or 10CFR74.51 to either provide for annual inventories across the plant site or allow varying inventory periods defined on an MBA-by-MBA basis, based on the category and attractiveness of material in each MBA, with the restriction that inventory periods must coincide at least once annually.
Security	Apply existing requirements of 10CFR25,26,72,73, and 95 Invoke appropriate security orders previously issued Issue specific security order that applies to the Fuel Recycling Facility	No specific changes to regulation required.
Organization and Management Control	Apply 10CFR70 requirements	No changes to regulation required.
QA	Apply 10CFR70 requirements and invoke 10CFR50 Appendix B	No changes to regulation required.

In order to facilitate the regulatory changes tabulated above, INRA recommends the following actions be initiated by DOE. These actions are considered immediate priorities by INRA as they are necessary to create a technical foundation and ultimately support regulatory changes by NRC.

- DOE should begin a dialogue with EPA, NRC, industry, and stakeholders on the appropriateness of current environmental effluent limits in 40CFR190.10(b) in order to support potential changes in light of current technology and risk insights. Industry experience can be used to perform release and offsite-dose modeling parametric studies considering attributes such as burn-up, fuel age, site attributes, etc. These parametric studies to would support a risk-informed approach to potential changes to the effluent limits.
- DOE should initiate a review of the broader generic environmental issues associated with operation of the Fuel Recycling Facility and work with NRC to determine which can be addressed in the GNEP Programmatic EIS.
- DOE should initiate a collaborative effort between industry and DOE to review the safety and design basis at existing reprocessing plants to gain an understanding of appropriate design criteria and to understand where qualitative and quantitative probalistic risk assessment (PRA) analysis is appropriate. This activity would support NRC during consideration of regulatory changes related to design and safety basis.
- DOE should initiate a personnel exchange program between NRC and international regulatory agencies to provide an experience base for future NRC license reviewers.
- DOE should consider parametric accident modeling for the Fuel Recycling Facility plant design, considering several model sites to determine which emergency planning framework is likely to be most appropriate for the NRC regulatory framework. Doing this early will facilitate the NRC rulemaking process as it will narrow the options necessary to be considered.
- DOE should lead the effort, in collaboration with NRC and industry, to consolidate and unify DOE and NRC material control, accounting, and protection approaches. This should include completing ongoing evaluations of attractiveness levels of various material types. This will ultimately support NRC in implementing regulatory changes.
- DOE should initiate a conceptual security strategy design effort with NRC and industry so that, as the attractiveness levels are defined, security protective strategies can be considered to incorporate very early into the design. This effort could entail review of classified information which INRA partners are capable of performing. This Early Conceptual Design effort would ultimately support the security design criteria and allow for early alignment with NRC.

1.2.4 Implementing Guidance

The scope of this report deals primarily with regulations necessary to license the Fuel Recycling Facility. The regulatory picture is not complete without at least a brief discussion of the supporting regulatory guidance documents. The 2 primary guidance documents that exist for

licensing under 10CFR70 are NUREG 1520, Standard Review Plan for the Review of a License Application for a Fuel Cycle Facility, and NUREG 1718, Standard Review Plan (SRP) for the Review of an Application for a Mixed Oxide Fuel Fabrication Facility. These guidance documents provide both a standard format and content guide for the applicant and review guidance for the NRC and have been used successfully by the licensees and NRC. In addition, NRC has implemented several Internal Staff Guidance documents to further clarify and direct NRC reviews in specific technical areas (e.g., natural phenomena, initiating events, double contingency, etc.) and supplement the 2 SRPs. NUREG 1718 would likely address the fuel fabrication portion of the Fuel Recycling Facility with some slight modifications to address commercial versus defense-related mixed oxide fuel. Both NUREG 1520 and 1718 have been used to successfully evaluate chemical recovery processes for un-irradiated fuel. Neither guidance document, however, would be adequate for the unique aspects of used fuel reprocessing where there are significant quantities of FP. Clearly, NRC will have to develop a Standard Review Plan that addresses the Fuel Recycling Facility in conjunction with rulemaking activities to support licensing under 10CFR70.

1.2.5 Commissioning and Operational Oversight

As in the previous section, a detailed review of NRC procedures for commissioning and operational oversight was not performed. From a regulatory framework standpoint INRA believes there are no regulatory changes necessary to effectively perform these functions. The current criteria in 10CFR70 allow for transition from construction to operation through a rigorous inspection by NRC to assure the facility is constructed and ready to be operated according to the previously approved construction and operating license. The regulations also allow for a phased operational inspection process, whereby parts of the facility can be inspected and released to operation prior to others, so long as safety is not impacted by ongoing construction. As an example, INRA may consider an early commissioning of the used fuel storage facility while other parts of the facility are being constructed.

From an operational oversight standpoint, INRA believes the enforcement policy will require review and modifications to the policy supplements may be in order. Additionally, NRC will likely have to review the specific inspection procedures to assure all aspects of a fuel recycling facility are adequately addressed. While commissioning and operational oversight are extremely important components to the overall regulatory framework, INRA considers their revision to be less critical from a timing perspective than the revisions to the initial licensing framework that are discussed in this report.

1.3 Regulatory Framework for Non-Fuel Recycling Facility Associated Activities

While the focus of this report is on licensing the Fuel Recycling Facility facility, there are several other aspects of creating an overall regulatory framework for the Fuel Recycling Facility to be considered. These aspects are mentioned briefly below; however, they are discussed in other reports delivered as part of Continuation 1 activities.

1.3.1 LWR MOX

The Fuel Recycling Facility model for GNEP assumes that a number of existing or newly licensed LWRs will be licensed to burn COEX™ MOX fuel recovered and fabricated at the Fuel Recycling Facility. INRA estimates that as many as 15 LWRs from the existing fleet of plants in the U.S. may need to be licensed for MOX to burn the fuel produced in the base the Fuel Recycling Facility model plant. Licensing of these reactors is discussed in RPT-3000513-000, Reactor Fleet Analysis.

1.3.2 LWR MOX Transportation

Current methods of transporting LWR MOX in the U.S. to be implemented for the fuel produced at MFFF are acceptable for a small-scale approach. They are not, however, sufficient for a commercial application envisioned with the Fuel Recycling Facility and the LWRs being provided fuel. The transportation aspects and their impact on regulatory approaches are discussed in RPT-3000516-000, Transportation.

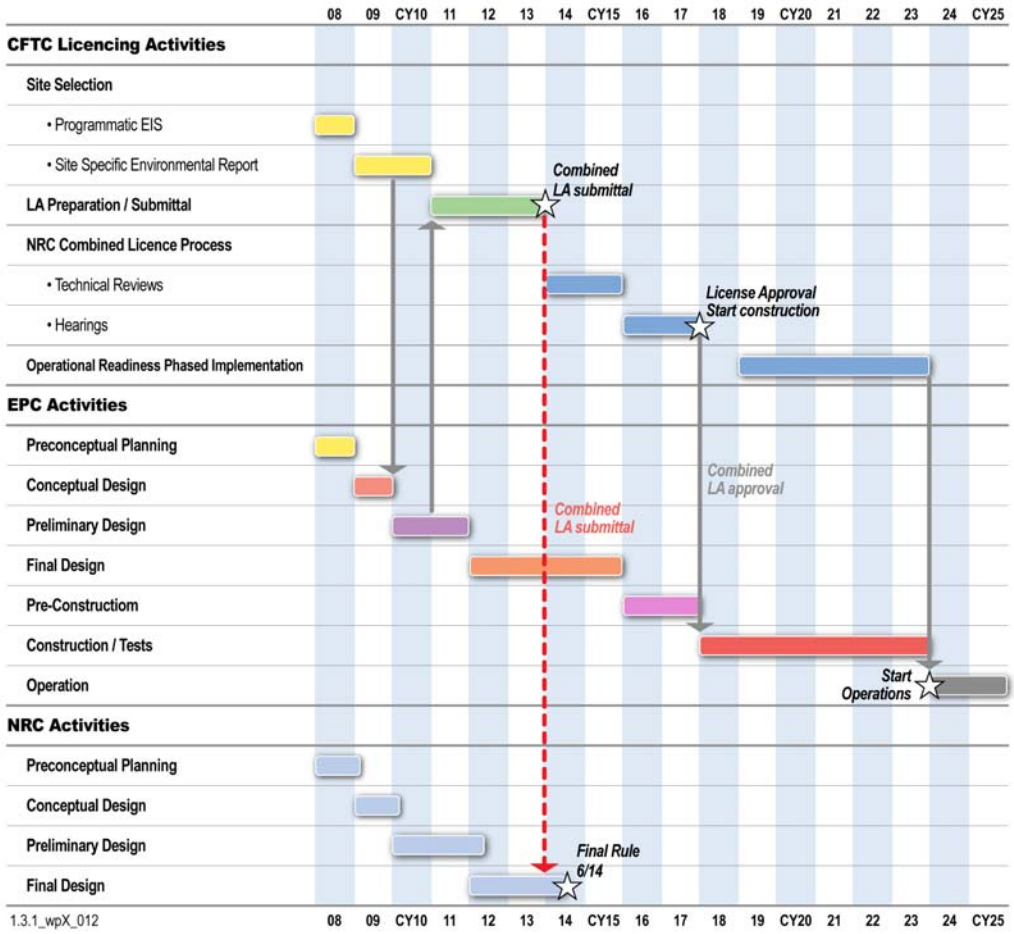
1.3.3 Waste Disposal and Transportation

Disposal of wastes generated by the Fuel Recycling Facility is a complex issue that must be considered during the Fuel Recycling Facility licensing. Primary to the licensing activity will be a need to demonstrate that, through a combination of long-term onsite storage and disposal to various appropriate sites, the Fuel Recycling Facility wastes can be managed safely and securely. This is discussed in detail in RPT-3000512-000, INRA the Fuel Recycling Facility Waste Management Approach.

1.4 Licensing Schedule and Actions

The INRA model for the Fuel Recycling Facility in the initial report to DOE included an integrated schedule that addresses licensing and the engineering/procurement/construction (EPC) activities (Figure 11).

FIGURE 11. Licensing Schedule and Actions. *Integrated schedule addresses licensing and EPC activities.*



Important milestones in this schedule included:

- INRA submittal of Combined License Application by beginning of CY2014
- License Approval and Construction Start by Beginning of CY2018
- Operation of Spent Fuel Storage by beginning of CY2021
- Full Operation of the Fuel Recycling Facility by beginning of 2024
- This schedule was consistent with DOE expectations for the initial phase of work on the contract.

In April of 2008, NRC reported to DOE, describing their activities under the GNEP Technical Information Exchange Project. In that report, NRC indicated that NRC resources were not in place to support GNEP; however, if resources were allocated, the following schedule was envisioned:

- Complete Regulatory Gap Analysis by March 2009
- Complete Technical Basis Document and Rulemaking plan by March 2010
- Issue Proposed Rule and Guidance Document by June of 2012
- Issue Final Rule by June of 2014

There is clearly a gap between the INRA schedule originally proposed and the NRC schedule reported to DOE. INRA believes it is very important to have a regulatory framework in place before beginning final design. On the surface, this gap appears to be about 2-1/2 years; however, this assumes NRC resources are allocated to the effort as their schedule suggests. In reality, there could be additional time necessary for assigning priority and mobilization of resources. While INRA is acutely aware of the level of effort required by NRC to effect the envisioned regulatory changes, we believe there may be opportunity to reduce the spans on the activities identified by NRC. Options for dealing with this schedule gap include the following:

- DOE could initiate the INRA recommendations above to create much of the technical foundation that will support future NRC rulemaking. This could shorten the spans on the Technical Basis document and the development of the proposed rule.
- DOE could support NRC efforts on the Gap analysis in order to help shorten the schedule. INRA believes providing this document with the preliminary gap analysis will be valuable to NRC in their reviews.
- NRC could assign additional resources and focus primarily on the Fuel Recycling Facility licensing, leaving ARR until later in the process. Doing this, they may be able to shorten the spans on the activities identified. The overriding barrier to creating an appropriate and predictable regulatory framework in a timely manner continues to be limited NRC resources dedicated to the project. NRC has demonstrated consistently they can engage and execute when appropriate priorities and resources are committed to a project. If DOE is committed to a schedule consistent with the INRA proposed model, it will be incumbent on them to work directly with the Commission to convince them priority and resources should be dedicated to the GNEP Program, and specifically, the Fuel Recycling Facility licensing. Additionally, industry must work to convince the Commission there is a business that requires them to act.
- The Fuel Recycling Facility licensing could be started before the rulemaking activities are completed, and the License Application could be developed in parallel with the rulemaking. This would require a significant communication commitment from industry and NRC, would introduce risk of rework, and may be difficult for the financial backers of the project to accept.

1.5 Conclusion

On the surface, it appears that creating a regulatory framework and licensing the Fuel Recycling Facility is a daunting task filled with many obstacles. After reviewing the regulations in detail, however, INRA believes the task is not as complex as originally believed and that the recommendations of this report provide a regulatory structure that is achievable. By building on and adopting regulatory language and positions that are already approved, and working in a collaborative manner with stakeholders, INRA believes the regulations can be changed on a schedule that is more optimistic than what is currently envisioned by NRC.