EFCOG-SAWG-2000-001
September 15, 2000

Safety Analysis Working Group SAWG
an EFCOG organization

NRC LICENSING STANDARDS FOR NEW DOE CONSTRUCTION PROJECTS

Safety Analysis Working Group
Energy Facility Contractors Group

EFCOG-SAWG-2000-001
September 15, 2000

Safety Analysis Working Group SAWG
an EFCOG organization

NRC LICENSING STANDARDS FOR NEW DOE CONSTRUCTION PROJECTS

Prepared by: Carl B. Smith
BNFL Inc.

Safety Analysis Working Group
Energy Facility Contractors Group

EXECUTIVE SUMMARY

Throughout the mid-nineties, the U.S. Congress and other parties proposed to transfer regulatory responsibility and enforcement of U.S. Department of Energy (DOE) facilities from the DOE to the U.S. Nuclear Regulatory Commission (NRC) or other agencies. This concept had progressed to such an extent that the 1999 fiscal year appropriation bill directed the DOE to "ensure that all nuclear facilities for which construction begins in the year 2000 and beyond…. be constructed in accordance with NRC licensing standards".

The intent of the budget guidance was to facilitate NRC licensing of new DOE facilities in anticipation of external (NRC) regulation. A cost-effective approach is needed to select appropriate NRC regulations for specific projects that will or may be regulated by the NRC, and for projects that are required to consider the use of NRC licensing standards.

Two papers presented at the January 2000 Energy Facility Contractors Group (EFCOG), Safety Analysis Working Group (SAWG), Authorization Basis (AB) Workshop addressed using NRC licensing standards for two new construction projects:

- The first paper addressed the selection and implementation of NRC licensing standards for two buildings for the Spent Nuclear Fuel Project located on the Hanford site.

- The second paper addressed the selection of NRC licensing standards for the River Protection Program – Waste Treatment Plant.

The results of these two papers were summarized at the May 2000 EFCOG SAWG Workshop. The following are summary results:

1. No obvious safety improvement resulted from using NRC requirements. However, benefits were provided in selected areas. If NRC licensing standards are to be used in conjunction with DOE requirements, the remaining conclusions are keys to success.

2. Avoid facility cost increases by proper selection and implementation of selected NRC licensing standards. The key to a cost-effective design is proper selection of national consensus standards. (It is preferable to not use NRC and DOE regulations/Orders. However, NRC Regulatory Guides or NUREGs can be used conveniently with DOE regulations/Orders. For example, see item 5.)

3. Appropriate time, NRC experienced resources and a systematic process, such as Integrated Safety Management (ISM), must be used to properly select DOE and NRC safety requirements. (This process appears to require more effort than selecting only DOE Work Smart Standards.)

4. Select only one requirement from the set of DOE requirements and NRC licensing standards for each aspect of the design or safety analysis.

5. Select the appropriate mix of analytical models/tools to prepare an improved safety analysis.

The results of the January 2000 AB Workshop and the May 2000 SAWG Workshop provide valuable guidance for new DOE construction projects.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ALARA	As low as reasonably achievable
ASME	American Society of Mechanical Engineers
AB	Authorization Basis
CFR	Code of Federal Regulations
CSB	Canister Storage Building
CVD	Cold Vacuum Drying (Facility)
DOE	U.S. Department of Energy
DOE-RL	U.S. Department of Energy, Richland Operations Office
EFCOG	Energy Facility Contractor Operating Group
ES&H	Environment, Safety and Health
FRS	Fuel retrieval system
IEEE	Institute of Electrical and Electronic Engineers
ISFSI	Independent Spent Fuel Storage Installation
MCO	Multi-canister overpack
NRC	U.S. Nuclear Regulatory Commission
PHMC	Project Hanford Management Contractor
SAR	Safety analysis report
SAWG	Safety Analysis Working Group

SNFP	Spent Nuclear Fuel Project
SSC	Structures, systems and components

1.0 INTRODUCTION

Throughout the mid-nineties, the U.S. Congress and other parties proposed to transfer regulatory responsibility and enforcement of DOE facilities from the DOE to the NRC or other agencies. This concept had progressed to such an extent that the 1999 fiscal year appropriation bill for DOE (Title III) states:

> The Department is directed to ensure that all nuclear facilities for which construction begins in the year 2000 and beyond, with the exception of those defense nuclear facilities...deemed...critical to national security needs, are constructed in accordance with NRC licensing standards.

The intent of the budget guidance was to facilitate NRC licensing of new DOE facilities in anticipation of external (NRC) regulation. A cost-effective approach is needed to select appropriate NRC regulations for specific projects that will or may be regulated by the NRC, and for projects that are required to consider the use of NRC licensing standards.

Some new DOE construction projects have used a combination of DOE and NRC requirements to establish design and operation requirements. Two such projects are the Spent Nuclear Fuel Project and the River Protection Project-Waste Treatment Plant, both of which are located at the DOE Hanford site. However, the design teams, the regulatory oversight organizations and the regulatory approaches were different and led to different NRC requirements selections.

The SNFP information was abstracted from the paper presented by Guy Bishop[1], DOE-RL, of the SNF project. The paper was presented at the EFCOG SAWG Conference held in Portland, Oregon in June 1999 and again at the EFCOG SAWG Authorization Basis Workshop held in Las Vegas, Nevada in January 2000.

The RPP-WTP information was abstracted from the paper presented by Don Edwards[2], BNFL Inc., previously of the RPP-WTP. The paper was presented at the EFCOG SAWG Authorization Basis Workshop held in Las Vegas, Nevada in January 2000.

These two projects had successes and experienced challenges in implementing this regulatory concept. This document summarizes the: (i) projects, (ii) regulatory approaches, (iii) resulting selected standards and (iv) lessons learned, and provides improvement recommendations for future DOE projects. The recommendations were abstracted from the paper presented by Carl Smith[3] at the EFCOG SAWG Annual meeting held in Santa Fe, New Mexico in May 2000.

1 Superscripts refer to References at the end of this report.

2.0 SPENT NUCLEAR FUEL PROJECT

2.1 Project Description

The Department of Energy's Hanford site in south-central Washington produced plutonium for nuclear weapons for 45 years. At the end of Hanford's production mission in 1989, approximately 2,100 metric tons (4,630,000 pounds) of spent irradiated fuel elements were left unprocessed in 1950's era concrete basins near the Columbia River. The proximity of the basins to the Columbia River represented a significant hazard. In 1992, Secretary of Energy James Watkins terminated all further plutonium recovery. As a consequence, means had to be found to safely remove approximately 105,000 fuel elements from the basins to a new storage facility.

Due to the perception of risk posed by the basins' proximity to the Columbia River, the project schedule is "fast-track" i.e., safety analysis, procurement and construction are proceeding in parallel with engineering design.

2.2 Regulatory Approach

In anticipation of eventual NRC regulation, the DOE decided to impose NRC requirements on new SNFP facility design and construction, specifically for the Cold Vacuum Drying (CVD) facility and the Canister Storage Building (CSB). In addition, some selected NRC requirements apply to the K Basin Fuel Retrieval System (FRS) and post-FRS fuel handling activities. However, the SNFP maintained applicable DOE requirements in tandem with the NRC regulations.

In order to achieve the project requirement of "nuclear safety equivalency" with an NRC-regulated fuel processing facility, an evaluation was performed to identify additional NRC licensing standards to be used in combination with the existing and applicable DOE requirements. The results and process used to identify these NRC requirements were documented in WHC-SD-SNF-DB-002, Spent Nuclear Fuel Project Path Forward Nuclear Safety Equivalency to Comparable NRC-Licensed Facilities.

DOE used a three-tier approval process for contractor selected NRC requirements, including an independent technical review panel.

2.3 Selected NRC Licensing Standards

Facility design and operation is based on DOE regulations such as 10 CFR 830.120 and 10CFR 835, DOE Orders such as 4700.1, 5000.3B, 5400.5, 5480.7A, 5480.22, 5480.23, 5480.24, 5480.28, and 6430.1A, and associated standards such as DOE-STD-3009-94 (see Section 5.0 for citations). NRC licensing standards were selected from 10CFR regulations, Standard Review Plans, Regulatory Guides, Generic letters, and NRC inspection and enforcement bulletins and notices.

Table 1 summarizes the additional NRC licensing standards selected by the SNFP. These standards were categorized into 29 items. In some categories, no NRC documents were selected as requirements but NRC documents were used for reference purposes. These reference documents are contained within parentheses. The 29 items are listed in the same order as in the Appendix to Bishop but have different category titles for ease of understanding.

2.4 Lessons Learned

The following are the major lessons learned from selection and application of NRC licensing standards to the SNFP.

DOE and NRC definitions of fundamental terms are not the same. For example, the NRC uses the word "containment" for the principle of surrounding nuclear material with barriers to its release. The DOE uses the word "confinement". While similar in intent, the terms are not identical and can cause confusion when overlaying NRC requirements over existing DOE requirements.

NRC requirements refer to other documents that can invoke additional requirements. These other requirements can produce additional direction, interpretation, or guidance that modify, elaborate, or refine the original requirement. The NRC requirement base consists of a whole series of Regulatory Guides, NUREG's, or Standard Review Plans. Whole sets of additional requirements could be invoked by such documents, which, because the requirements are cited within the regulation itself, the SNFP considered to be fully binding. Bishop calls these "hidden" secondary citations Stealth requirements.

Not all citations of a particular regulation were properly invoked in a timely manner. When the contractor failed to properly implement a requirement, the DOE found itself in the role of "back-fitting" the existing project design to meet the neglected NRC requirement. For example, the SNFP adopted NRC criteria for natural hazards (e.g., tornadoes) to the design. The NRC criteria are more rigorous and thus require a stronger building than the site natural hazards criteria previously used at Hanford. The contractor did not impose the NRC requirements during design of the building. Applying the NRC natural hazards criteria resulted in a marked increase in the building's cost. This additional cost could have been almost entirely avoided by timely implementation of the natural hazards requirements at the time design was initiated.

The SNFP found that implementing NRC requirements on top of DOE requirements is often contentious and costly, both in terms of money and schedule. Other than public perception, obvious benefit is unclear and no major improvement in over-all project safety is obvious by implementing NRC requirements above and beyond those already required by the DOE. This then suggests that the key to

safe facility construction lies with rigorous and competent implementation of sound safety requirements, no matter their source, rather than the pedigree of the requirements themselves.

Table 1. SNFP Selected Licensing Standards

No.	Category	NRC Licensing Standards
1.	Fire Protection	- 10 CFR 50.48, "Fire Protection" - 10 CFR 50, Appendix R, "Fire Protection for Nuclear Power Facilities Operating Prior to January 1, 1979," - 10 CFR 72.122(c), "Protection against Fires and Explosions"
2.	Design Basis Tornado	- 10 CFR 72.24, "Contents of application: Technical information," - 10 CFR 72.122, "General considerations" - NRC Regulatory Guide 1.76, *Design Basis Tornado for Nuclear Power Plants* - NUREG/CR-4461, *Tornado Climatology of the Contiguous United States* (potential revisions to Standard Review Plan 3.5.1.4, Revision 2, *Missiles Generated by Natural Phenomena*). - SECY-93-087, *Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs* (NRC references: 10 CFR 72.92, "Design basis external natural events," 10 CFR 72.102, "Geological and seismological characteristics," 10 CFR 72.122, "Overall requirements," 10 CFR 72.212, "Conditions of general license issued," NRC Regulatory Guide 1.60, *Design Response Spectra for Seismic Design of Nuclear Power Plants* [Revision 1], NRC Regulatory Guide 1.61, *Damping Values for Seismic Design of Nuclear Power Plants* [Revision 0], NRC Regulatory Guide 3.48, *Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation (Dry Storage)* [Revision 1]; and SECY-93-087, *Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Designs)*
3.	Qualification of Electrical Equipment	- 10 CFR 50.49 "Environmental qualification of electrical equipment," see (e)(5), (f)(1-4) and Attachment A, "Detailed Evaluations, Environmental Qualification of Electrical Equipment" - NRC Regulatory Guide 1.97, *Instrumentation for Light Water Cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident* [Revision 3]) - NRC Regulatory Guide 1.89 *Environmental Qualification of Certain Electrical Equipment Important to Safety for Nuclear Power Plants* [Revision 1]
4.	Loss of AC Electrical Power	- None (NRC reference: 10 CFR 50.63, "Loss of all alternating current power")
5.	Large Lead Storage Batteries	- None (NRC reference: NRC Regulatory Guide 1.128, *Installation Design and Installation of Large Lead Storage Batteries for Nuclear Power Plants)*
6.	Qualification of Class 1-E Lead Storage Batteries	- None (NRC reference: NRC Regulatory Guide 1.158, *Qualification of Safety-Related Lead Storage Batteries for Nuclear Power Plants*)

No.	Category	NRC Licensing Standards
		(Reference: NRC Regulatory Guide 1.158, *Qualification of Safety-Related Lead Storage Batteries for Nuclear Power Plants*)
7.	Instrumentation and Controls	- None (NRC references: 10 CFR 50.55a, "Codes and standards" and NRC Regulatory Guide 1.153, *Criteria for Power, Instrumentation, and Control Portions of Safety Systems* [Revision 0])
8.	Criticality Accident Alarm System	- NRC Regulatory Guide 8.12, Criticality Accident Alarm Systems [Revision 2] (References: NRC Regulatory Guide 8.5, *Criticality and Other Interior Evacuation Signals*, 10 CFR 70.24, "Criticality accident requirements," and 10 CFR 72.124, "Criteria for nuclear criticality safety")
9.	Control Room Design	- NUREG-0700, *Guidelines for Control Room Design Reviews* - Standard Review Plan 18.1, *Control Room*
10.	ASME Boiler and Pressure Vessel Coded Systems and Components	- NRC Regulatory Guide 1.26, *Quality Group Classifications and Standards for Water, Steam, and Radioactive-Waste-Containing Components of Nuclear Power Plants* [Revision 3]
11.	ASME Boiler and Pressure Vessel Code for Safety-Class Applications	- NRC Regulatory Guide 1.84 [Revision 30], *Design and Fabrication Code Case Acceptability ASME Section III, Division 1* - NRC Regulatory Guide 1.85 [Revision 30], *Materials Code Case Acceptability ASME Section III, Division 1*
12.	HVAC	- None (NRC reference: NRC Regulatory Guide 1.140, *Design, Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants* Revision 1])
13.	SNF Handling and Storage	- None (NRC references: NRC Standard Review Plan 9.1.5, *Overhead Heavy Load Handling Systems* [Revision 0], NUREG-0554, *Single Failure Proof Cranes for Nuclear Power Plants* and NUREG-0612, *Control of Heavy Loads at Nuclear Power Plants, Resolution of Generic Technical Activity A-36*)
14.	Instrument Air, Motor-Operated Valves, and Open-Cycle Cooling Water Systems	- NRC Generic Letter 88-14, *Instrument Air Supply System Problems Affecting Safety-Related Equipment* - NRC Generic Letter 89-10, *Safety-Related Motor-Operated Valve Testing and Surveillance* - NRC Generic Letter 89-13, *Service Water System Problems Affecting Safety-Related Equipment* (NRC reference: 10 CFR 50.54(f), with supplements)

No.	Category	NRC Licensing Standards
15.	Reporting of Defects and Noncompliance	- None (NRC reference: 10 CFR 21, "Reporting of Defects and Noncompliance")
16.	DOE Approval of Changes to QA Programs	- None (NRC reference: 10 CFR 50.54(a), "Conditions of licenses [Quality Assurance Provisions]")
17.	Occurrence Reporting	- None (Reference: 10 CFR 50.55(e), “Conditions of construction permits”)
18.	Quality Assurance	- None (NRC references: 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants" and 10 CFR 72, Subpart G, "Quality Assurance")
19.	Potentially Defective Safety Class Equipment	- None (NRC references: A number of NRC Inspection and Enforcement Bulletins and NRC Notices addressing procurement of potentially defective equipment)
20.	Radiological Protection for High-Radiation Areas and of the Public	- 10 CFR 20.1601, “Control of assess to high radiation areas” - 10 CFR 20.1003, “Definitions” - (NRC reference: 10 CFR 72.126, "Criteria for radiological protection")
21.	Radiological Protection of the Public	- 10 CFR 72.100, "Defining potential effects of the ISFSI or MRS on the region" - 10 CFR 72.104, "Criteria for radioactive materials in effluents and direct radiation from an ISFSI or MRS" (NRC reference: 10 CFR 72.126, "Criteria for radiological protection")
22.	Radiological Protection	- Deleted 10 CFR 72, “Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste” – See item 29
23.	ALARA	- NRC Regulatory Guide 8.8, *Information Relative to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will be as Low as Reasonably Achievable* [Revision 3]

No.	Category	NRC Licensing Standards
24.	Safety Analysis Report Documentation	- 10 CFR 72.24, "Contents of an application: Technical information," and 10 CFR 72.98, "Identifying regions around an ISFSI or MRS site" - NRC Regulatory Guide 3.48, *Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation (Dry Storage)* [Revision 1] - NRC Regulatory Guide 3.26, *Standard Format and Content of Safety Analysis Reports for Fuel Reprocessing Plants* [Revision 0] (NRC reference: 10 CFR 50.34, "Contents of an application: Technical information")
25.	Effluent Monitoring Reporting Requirements	- 10 CFR 20, "Standards for Protection Against Radiation" - 10 CFR 70.59, "Effluent monitoring Reporting Requirements" (NRC references: 10 CFR 50.36a, "Technical specifications on effluents from power reactors" and 10 CFR 70, "Domestic Licensing of Special Nuclear Material")
26.	Safety Documentation	- None (NRC reference: 10 CFR 50, Appendix A, "General Design Criteria for Nuclear Power Plants")
27.	Safety Documentation – Criticality Safety	- None (NRC references: NRC Standard Review Plan 9.1.2, *Spent Fuel Storage* [Revision 3] and NUREG-0612, *Control of Heavy Loads at Nuclear Power Plants, Resolution of Generic Technical Activity A-36*)
28.	Spent Fuel Storage	- None (NRC reference: NRC Regulatory Guide 3.60, *Design of an Independent Spent Fuel Storage Installation (Dry Storage)* [Revision 0])
29.	Identification of SSCs that are "important-to-safety"	- 10 CFR 72.3, "Definitions" - 10 CFR 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste" - NUREG/CR-6407, *Classification of Transportation Packaging and Dry Spent Fuel Storage Systems* (NRC references: 10 CFR 72.106, "Controlled area of an ISFSI or MRS" and 10 CFR 72.122, "Overall requirements")

The costs of implementing safety requirements (either DOE or NRC) should be determined at the time the requirements are chosen for implementation. A careful and methodical cost-benefits analysis of applying NRC regulations to a DOE project should be done before invoking such requirements. Substantial economic impact can occur to a project from applying NRC regulations. Understanding the degree of this impact is crucial in making an informed objective decision.

3.0 RIVER PROTECTION PROJECT - WASTE TREATMENT PLANT

3.1 Project Description

At the Hanford Site, approximately 54 million gallons of highly radioactive wastes are stored in 177 underground tanks including 140 older single-shell tanks. That waste, which was derived from production of plutonium for the nation's nuclear weapons program, has been accumulating since 1944. Current estimates are that nearly a million gallons of tank waste have entered the soil beneath the tanks due to leaks. Some radionuclides have been detected in the groundwater that ultimately flows to the Columbia River.

The River Protection Project - Waste Treatment Plant (RPP-WTP) is an active response to reduce the threat to neighboring communities, the environment, and the Columbia River. Removal of the waste from the tanks, treatment and immobilization, constitutes a lasting solution to this complex and challenging problem. The treatment facilities will process approximately 10 percent of the Hanford tank waste volume to stabilize 20 percent to 25 percent of its radioactivity over the next 20 years.

3.2 Regulatory Approach

In mid-1997, transition to external regulation of DOE facilities was being strongly pursued within the U.S. Congress. The TWRS-P project (earlier name for RPP-WTP) was mentioned as a possible trial case for external regulation. Under a memorandum of understanding, the NRC established a permanent representative on the DOE Regulatory Unit (RU) staff, and established an advisory oversight and technical review role with the RU for the NRC headquarters staff in Bethesda, MD.

The challenge for the RPP-WTP was to select the most appropriate set of requirements from the universe of DOE and NRC requirements (licensing standards). Also, national consensus standards were selected at the same time as the DOE and NRC requirements were selected. The systematic approach to select DOE or NRC licensing standards and national consensus standards for each aspect of the design is based on application of the Integrated Safety Management Process as shown in Figure 1. The process reflects the "Process for Establishing a Set of Radiological, Nuclear, and Process Safety Standards and Requirements for TWRS Privatization" (DOE/RL-96-0004). The details of the selection are contained in the RPP-WTP Safety Requirements Document.

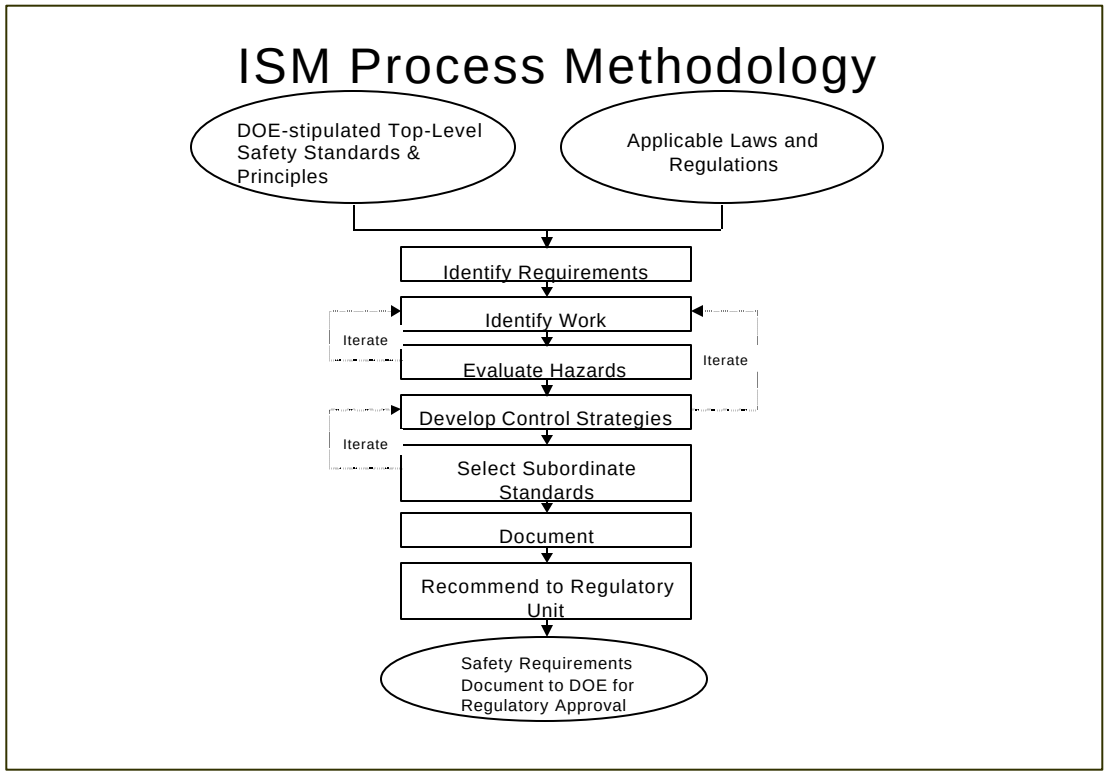
The selection process used a rigorous application of the ISM process, including hazards analysis and substantial documentation to fully justify requirement selections. An independent review team was used for review of the selected requirements.

The RU with a team of consultants and support from NRC reviewed the "Safety Requirements Document" prior to approval.

3.3 Selected Standards

The RPP-WTP DOE requirements included regulations such as 10 CFR 830.120 and 10 CFR 835 and DOE standards such as DOE-STD-1020-94 (see Section 5.0 for citations). The project selected a NRC Regulatory Guide for the Safety Analysis Report format (although it was later concluded that DOE-STD-3009-94 would have been a more appropriate standard). The 14 selected NRC licensing standards are summarized in Table 2. The 47 selected national consensus standards are listed in Table 3.

Figure 1 Integrated Safety Management Process Methodology



3.4 Lessons Learned

When RPP-WTP was initiated, the rules by which the NRC might regulate such a high-level waste vitrification facility were not well defined. Thus, automatically adapting to NRC as regulatory authority was not straightforward. 10CFR70, in its then current form, did not appear to be an appropriate basis for regulating RPP-WTP. This was due, in large part, to the fact that 10CFR70 was predicated on a materials license using regulations crafted for a fuel fabrication plant rather than a facilities license needed for RPP-WTP. The hazards and hazardous situations presented by RPP-WTP are different than what would be expected in such a fuel facility. RPP-WTP will have a much larger inventory of radioactive material in a more dispersible form. Alternatively, the fuel fabrication facilities present a significantly greater hazard from a criticality safety point of view. Also, the most significant accidents in the fuel facilities tend to be non-radiological (i.e., release of UF_6 during vaporization leading to a release of hydrogen fluoride). As a result of its limited utility, a number of adjustments to the draft Part 70 were envisioned.

Table 2. RPP-WTP List of Selected NRC Licensing Standards

No.	Category	NRC Licensing Standards
1.	Seismic Analysis and Design	NUREG 0800 Standard Review Plan 3.7.2, *"Seismic Safety Analysis"* NUREG 0800, Standard Review Plan 3.8.4, *"Other Seismic Category I Structures"* Regulatory Guide 1.61, *"Damping Values for Seismic Design of Nuclear Power Plants"*
2.	Short-Term Atmospheric Dispersion	Regulatory Guide 1.3, *Assumptions for Evaluating the Potential Radiological Consequences of a Loss of Cooling Accident for Boiling Water Reactors* Regulatory Guide 1.145, *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants*
3.	Radiological Assessment	Regulatory Guide 1.3, *Assumptions for Evaluating the Potential Radiological Consequences of a Loss of Cooling Accident for Boiling Water Reactors*
4.	Control Room Habitability	NUREG-0800, Standard Review Plan 6.4, *Control Habitability System.* Regulatory Guide 1.78, *Assumptions for Evaluating the Habitability of Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release*
5.	Transportation Accidents	Regulatory Guide 1.91, *Evaluations of Explosions Postulated to Occur on Transportation Routes near Nuclear Power Plants*.
6.	Testing of Shipping Containers	Regulatory Guide 7.4, *Leakage Tests on Packages for Shipment of Radioactive Materia*l.
7.	Radiation Protection and ALARA	Regulatory Guide 8.8, *Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Reasonably Achievable*. Regulatory Guide 8.10, *Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Reasonably Achievable*
8.	Qualification of Electrical Equipment	10CFR 50.49, *Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants*
9.	Emergency Operating Procedures	None (NRC Reference: NUREG-1358, *Lessons Learned from the Special Inspection Program for Emergency Operating Procedures)*
10.	Safety Analysis Report Format	Regulatory Guide 3.52, *Standard Format and Content for the Health and Safety Sections of License Applications for Fuel Cycle Facilities*, draft

Table 3. Selected National Consensus Codes and Standards

No.	National Consensus Standards and Codes
1.	ACI 318, "Building Code Requirements for Structural Concrete"
2.	ACI 318R, "Commentary on Building Code Requirements for Structural Concrete"
3.	ACI 349, "Code Requirements for Nuclear Safety-Related Concrete Structures"
4.	ACI 349R, "Commentary on Code Requirements for Nuclear Safety-Related Concrete Structures"
5.	AISC, "Manual of Steel Construction –Allowable Stress Design"
6.	AISC N690, "Specification for the Design, Fabrication, and Erection of Steel Safety-Related Structures for Nuclear Facilities"
7.	ANS 6.4, "Guidelines on Nuclear Analysis and Design of Concrete Radiation Shielding for Nuclear Power Plants"
8.	ANS 6.4.2 "Specification for Radiation Shielding Material"
9.	ANS 59.3, "Nuclear Safety Criteria for Control Air Systems"
10.	ANSI N13.1, "Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities"
11.	ANSI N42.18, "Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents"
12.	ARI 670, "Fans and Blowers"
13.	ASCE 4, "Seismic Analysis of Safety-Related Nuclear Structures and Commentary"
14.	ASCE 7, " Minimum Design Loads for Buildings and Other Structures"
15.	ASME B31.3, "Process Piping"
16.	ASME N509, "Nuclear Power Plant Air-Cleaning Units and Components"
17.	ASME N510, "Testing of Nuclear Air Treatment Systems"
18.	ASME PTC 9, "Performance Test Codes, Displacement Compressors, Vacuum Pumps and Blowers"
19.	ASME PTC 11, "Performance Test, Codes, Fans"
20.	ASME Section VIII, "Boiler and Pressure Vessel Codes, Rules for Construction of Pressure Vessels"
21.	Document P001/2 "Rules for the Design of Piping Systems"
22.	Document V001/2 "Rules for the Design of Vessels"
23.	IEEE 308, "Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations"
24.	IEEE 323, "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations"
25.	IEEE 338, "Standard Criteria for the Periodic Surveillance Testing of Nuclear Power Generating Station Safety Systems"
26.	IEEE 344, "Recommended Practice for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations"
27.	IEEE 379, "Standard Application of the Single-Failure Criterion to Nuclear Power Generating Stations Safety Systems"
28.	IEEE 382, "Standard for Qualification of Actuators for Power Operated Valve Assemblies with Safety Related Functions for Nuclear Power Plants"
29.	IEEE 384, "Standard Criteria for Independence of Class 1E Equipment and Circuits"
30.	IEEE 387, "Standard Criteria for Diesel Generator Units Applied as Standby Power Generating Stations." SRP 8.3.1, "AC Power Systems (Onsite)"
31.	IEEE 450, "Practice for Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations"

No.	National Consensus Standards and Codes
32.	IEEE 484, "Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations"
33.	IEEE 485, "Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations"
34.	IEEE 603, "Standard Criteria for Safety Systems for Nuclear Power Generating Stations"
35.	IEEE 628, "Standard Criteria for the Design, Installation, and Qualification of Raceway Systems for Class 1E Circuits for Nuclear Power Generating Stations"
36.	IEEE 741, "Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations"
37.	IEEE 946, "Design of Safety-Related DC Auxiliary Power Systems for Nuclear Power Generating Stations"
38.	IEEE 1023, "Guide for the Application of Human Factors Engineering to Systems, Equipment, and Facilities of Nuclear Power Generating Stations"
39.	ISA S7.0.01, "Quality standard for Instrument Air"
40.	ISA S12.13 " Performance Requirements, Combustible Gas Detectors"
41.	ISA S84.01, "Application of Safety Instrumented Systems for the Process Industries"
42.	NFPA 70, "National Electric Code"
43.	NFPA 214, "Standard on Water Cooling Towers"
44.	NFPA 780, "Standard for the Installation of Lightning Protection Systems"
45.	NFPA 801, "Standard for Facilities Handling Radioactive Materials"
46.	TEMA B, C or R, "Heat Exchangers"
47.	UBC, "Uniform Building Code" UL 586, "UL Standard for Safety High-Efficiency, Particulate, Air Filter Units"

In the fall of 1998, the potential for the NRC to regulate DOE facilities became remote. In an October 5, 1998 meeting with DOE laboratory directors, DOE Secretary Bill Richardson stated he was skeptical that external regulation would work. Also, about the same time, the RU expressed concern with some of the remaining "NRC elements" in the AB documents. Therefore NRC regulatory language (e.g., reference to "licensing basis") was removed from project documentation.

The Integrated Safety Management (ISM) process that has been developed for the design confirmation stage of RPP-WTP has yielded an adequate and appropriate set of standards. Its development has been both interesting and challenging. Documentation of the selection process is considerable, including hazard analyses, safety analyses and justification of the selected requirements. Although the classical Work-Hazards-Controls-Standards sequence seems simplistic, its application to the design of a multi-billion dollar plant consisting of four major process buildings and numerous support structures is complex in its application, sophisticated in its methodology, and both robust and beneficial in its results.

A fundamental lesson learned from the RPP-WTP experience is that a careful, comprehensive, expert-based assessment of the functional requirements that an individual standard must satisfy should be the basis of standards selection in each case. Therefore, the question is not limited to which NRC standard to use but which standard from the available universe DOE, NRC, (etc.) of standards is most suitable?

Also, a key element of cost-effective design of new facilities is proper selection of national consensus standards.

The selection process has progressed through preliminary design and confirmation of preliminary design (Title 1 equivalent). The process will continue through detail design, procurement, construction and mechanical checkout.

There were no obvious facility cost increases due to using NRC requirements.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The following are the major conclusions and recommendations from selecting NRC licensing standards for the two DOE construction projects that are summarized in this report.

1. No obvious safety improvement resulted from using NRC requirements. However, benefits were provided in selected areas. If NRC licensing standards are to be used in conjunction with DOE requirements, the remaining conclusions and recommendations are keys to success.

2. Avoid facility cost increases by proper selection and implementation of selected NRC licensing standards. The key to a cost-effective design is proper selection of national consensus standards. (It is preferable to not use NRC and DOE regulations/Orders. However, NRC Regulatory Guides or NUREGs can be used conveniently with DOE regulations/Orders. For example, see item 5.)

3. Appropriate time, NRC experienced resources and a systematic process, such as Integrated Safety Management (ISM), must be used to properly select DOE and NRC safety requirements. (This process appears to require more effort than selecting only DOE Work Smart Standards.)

4. Select only one requirement from the set of DOE requirements and NRC licensing standards for each aspect of the design or safety analysis.

5. Select the appropriate mix of analytical models/tools to prepare an improved safety analysis.

6. NRC requirements are not always consistent with DOE requirements, leading to potential design criteria incompatibilities, e.g., the NRC term “containment” and the DOE term “confinement”, while similar in intent are not identical.

7. Selected NRC requirements can contain references to other NRC requirements that lead to additional direction, interpretation or guidance. Implementation of such “stealth” requirements can lead to significant issues.

8. A project schedule that is “fast track” requires timely decision making but properly selecting and implementing two sets of regulatory requirements requires time. These incompatible constraints can lead to significant issues.

9. Selecting an appropriate mix of DOE requirements and NRC licensing standards does not necessarily increase project cost.

10. Conduct cost-benefit analyses of safety improvements and cost changes that could result from selecting NRC requirements.

11. The key to a safe facility lies with rigorous and competent implementation of a set of sound safety requirements.

12. The regulatory approaches and tables of NRC licensing standards and national consensus standards in this report serve as valuable guidance for new DOE construction projects where NRC licensing standards are to be used in conjunction with DOE requirements.

5.0 REFERENCES

1. Bishop, G., *Application of "Nuclear Regulatory Commission Regulation Equivalency" to Construction of New Nuclear Facilities*, Safety Analysis Working Group, Portland, OR, June 13-18, 1999

2. Edwards, D., *Use of NRC Requirements for New Construction*, Authorization Basis Workshop, Las Vegas, NV, January 24-25, 2000

3. Smith, C., *Using NRC Design Criteria for New DOE Construction Projects, A Summary from the January 2000 AB Workshop*, Safety Analysis Working Group, Santa Fe, NM, May 2-4, 2000

4. DOE 4700.1, *Project Management System*

5. DOE 5000.3B, *Occurrence Reporting and Processing of Operations Information*

6. DOE 5400.5, *Radiation Protection of the Public and the Environment*

7. DOE 5480.7A, *Fire Protection*

8. DOE 5480.22, *Technical Safety Requirements*

9. DOE 5480.23, *Nuclear Safety Analysis Reports*

10. DOE 5480.24, *Nuclear Criticality Safety*

11. DOE 5480.28, *Natural Phenomena Hazards Mitigation*

12. DOE 6430.1A, *General Design Criteria*

13. DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*

14. DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Facility Safety Analysis Reports*

15. DOE/RL-96-0004, *Process for Establishing a Set of Radiological, Nuclear, and Process Safety Standards and Requirements for TWRS Privatization*

16. 10 CFR 70, *Domestic Licensing of Special Nuclear Material*

17. 10 CFR 830.120, *Quality Assurance Requirements*

18. 10 CFR 835, *Occupational Radiation Protection*