

Rulemaking1CEm Resource

From: RulemakingComments Resource
Sent: Monday, January 06, 2014 2:03 PM
To: Rulemaking1CEm Resource
Cc: RulemakingComments Resource
Subject: PR-51 Waste Confidence
Attachments: 1243 griffin.pdf

**DOCKETED BY USNRC—OFFICE OF THE SECRETARY
SECY-067**

PR#: PR-51
FRN#: 78FR56775
NRC DOCKET#: NRC-2012-0246
SECY DOCKET DATE: 12/20/13
TITLE: Waste Confidence—Continued Storage of Spent Nuclear Fuel
COMMENT#: 00832

Hearing Identifier: Secy_RuleMaking_comments_Public
Email Number: 868

Mail Envelope Properties (377CB97DD54F0F4FAAC7E9FD88BCA6D0014435D730A4)

Subject: PR-51 Waste Confidence
Sent Date: 1/6/2014 2:02:51 PM
Received Date: 1/6/2014 2:02:55 PM
From: RulemakingComments Resource

Created By: RulemakingComments.Resource@nrc.gov

Recipients:

"RulemakingComments Resource" <RulemakingComments.Resource@nrc.gov>

Tracking Status: None

"Rulemaking1CEM Resource" <Rulemaking1CEM.Resource@nrc.gov>

Tracking Status: None

Post Office: HQCLSTR01.nrc.gov

Files	Size	Date & Time
MESSAGE	249	1/6/2014 2:02:55 PM
1243 griffin.pdf	983123	

Options

Priority: Standard
Return Notification: No
Reply Requested: No
Sensitivity: Normal
Expiration Date:
Recipients Received:

PUBLIC SUBMISSION

As of: January 02, 2014 Received: December 20, 2013 Status: Pending_Post Tracking No. 1jx-89em-tmod Comments Due: December 20, 2013 Submission Type: Web

Docket: NRC-2012-0246

Consideration of Environmental Impacts on Temporary Storage of Spent Fuel After Cessation of Reactor Operation

Comment On: NRC-2012-0246-0456

Waste Confidence - Continued Storage of Spent Nuclear Fuel; Extension of Comment Period

Document: NRC-2012-0246-DRAFT-1243

Comment on FR Doc # 2013-26726

Submitter Information

Name: William Griffin

Submitter's Representative: William Griffin

Government Agency Type: State

Government Agency: States of Vermont and Connecticut

General Comment

See attached file(s)

Attachments

2012-0246 Additional Comments of VT and CT

WILLIAM H. SORRELL
ATTORNEY GENERAL

SUSANNE R. YOUNG
DEPUTY ATTORNEY GENERAL

WILLIAM E. GRIFFIN
CHIEF ASST. ATTORNEY
GENERAL



TEL: (802) 828-3171
FAX: (802) 828-2154
TTY: (802) 828-3665
CIVIL RIGHTS: (802) 828-3657
WEBPAGE: www.atg.state.vt.us

**STATE OF VERMONT
OFFICE OF THE ATTORNEY GENERAL
109 STATE STREET
MONTPELIER
05609-1001**

December 20, 2013

Secretary, U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
ATTN: Rulemakings and Adjudications Staff

Re: Additional Comments of the State of Vermont and the State of Connecticut;
Waste Confidence – Continued Storage of Spent Nuclear Fuel;
Docket ID: NRC-2012-0246

Dear Secretary Vietti-Cook,

Attached are Comments of the States of Vermont and Connecticut in the form of an Expert Report titled "Comments on the Waste Confidence Generic Environmental Impact Statement Draft Report for Comment (NUREG-2157) September 2013" (December 19, 2013). This Expert Report was prepared by Dr. Fred C Dilger GISP Ph.D. and Dr. James David Ballard Ph.D., two experts in the field of making forecasts over extended periods of time about events that involve substantial financial and human resources. These Comments should be considered in addition to the Comments being submitted jointly by the States of Vermont, New York, and Connecticut, the Commonwealth of Massachusetts, and the Prairie Island Indian Community.

The Report explains methodological flaws in the Draft Generic Environmental Impact Statement, including the use of "normative forecasting" rather than an appropriate methodology, and the failure to support the assumptions used in the normative forecast.

Sincerely,

A handwritten signature in black ink, appearing to read "W. E. Griffin", written over a horizontal line.

William E. Griffin
Chief Assistant Attorney General



Comments on the Waste
Confidence Generic
Environmental Impact
Statement Draft Report for
Comment (NUREG-2157)
September 2013

Prepared for the States of Vermont and Connecticut

ABSTRACT

This report examines the Draft Waste Confidence Generic Environmental Impact Statement (DGEIS) and the assumptions, methodology and conclusions used therein. The assumptions underlying the DGEIS prevent analysis of the real issues behind the indefinite storage of Spent Nuclear Fuel (SNF). The overall methodology used in the DGEIS does not provide a scientifically sound analysis of the issues. This report offers alternative methodologies, some of which have been used by the NRC in the past, in an effort to offer a roadmap for a more robust, valid and reliable means to analyze the environmental impacts of the proposed action. The conclusion addresses the need for the NRC to do a more meaningful and useful NEPA analysis.

Fred C Dilger GISP Ph.D.

and

James David Ballard Ph.D.

December 19, 2013

TABLE OF CONTENTS

1	Biographical Statements	3
2	The DGEIS.....	5
3	Predicting Future Conditions	5
3.1	Normative Versus Exploratory Forecasting	6
3.2	Prediction vs. Forecast	6
3.3	Accuracy vs. Precision vs. Utility.....	7
3.4	NEPA as Scenario Forecasting.....	7
3.5	Analogous Case	8
3.6	Morphological Analysis.	9
4	Critique of the DGEIS	5
4.1	The Problem of Spent Nuclear Fuel	10
4.2	Failure to Open a Repository, Interim Storage Facility, or a Technological Solution	12
4.2.1	Private Fuel Storage	13
4.2.2	Failure of Yucca Mt	14
4.2.3	WIPP	14
4.3	The Waste Confidence Problem	15
4.4	NRC's Response in the DGEIS.....	15
4.4.1	DGEIS Assumptions	16
4.5	Institutional Controls	22
4.5.1	Definition.....	22
4.5.2	Critique.....	22
4.6	Funding	23
4.6.1	Definition.....	23
4.6.2	Critique.....	23
4.7	Human Capital.....	24
4.7.1	Definition.....	24
4.7.2	Critique.....	24
4.8	Additional Areas of Concern	25
4.8.1	Low-Level Waste Storage.....	25

4.8.2	Unfunded Mandate for State and Local Governments.....	25
4.8.3	Dry Transfer Storage	26
4.8.4	Damaged Fuel	26
4.8.5	SNF Degradation	26
4.8.6	Safety and Security.....	27
4.8.7	Peculiar Characteristics of Each Spent Fuel Pool	27
5	The Nepa Analysis is Insufficient.....	28
6	Conclusion	29
	Bibliography	31
	Appendix A: Loss of Institutional Control (Examples).....	35

1 BIOGRAPHICAL STATEMENTS

Fred C. Dilger Ph.D., GISP

Fred Dilger is an independent consultant with extensive experience in transportation impact assessments, community impact assessments and community planning. He has experience with transportation planning as an analyst for the Nevada Department of Transportation, where he developed expertise in Geographic Information Systems (GIS). He began working in the nuclear field in 1993, when he joined Clark County Nevada's Nuclear Waste Division, as their transportation planner. During this time, he was responsible for analyzing the effects of transporting SNF through Las Vegas to Yucca Mountain. He was responsible for reviewing Department of Energy (DOE) environmental documents and analyzing them through the requirements of the National Environmental Policy Act (NEPA). During this time, he studied and received a Master's Degree in Policy Analysis from the University of Nevada, Las Vegas. The focus of his studies was the epistemology of probabilistic risk analysis as they relate to the problem of spent nuclear fuel. As part of his duties with Clark County he helped negotiate a routing selection process for Low-level Nuclear Waste (LLW). The agreement was between the DOE and the Nevada counties of Clark, Nye, and Lincoln. This agreement resulted in the preparation of an Environmental Assessment (EA) of the impacts. The agreement has remained intact since 1997, and prompted the DOE to award him a certificate of appreciation for his work on this project.

In 1994-1995, he used GIS skills as a project manager for the implementation of this technology in the National Survey Authority in the Sultanate of Oman. While there, he enrolled in University of London, Birkbeck College where he obtained a Master's Degree in Geography. His field of study was probabilistic risk assessment as it relates to the transportation of SNF. His doctorate is from Arizona State University, where he studied the impacts of transporting SNF, environmental impact assessment and qualitative risk analysis. He is also a certified Geographic Information Systems Professional (GISP) which recognizes his long experience applying digital mapping technology to the problem of transporting spent nuclear fuel.

After leaving Clark County, he began work as a consultant in his firm Black Mountain Research. He was retained by Clark County, Nevada to advise on the Environmental Impact Assessment requirements for the Las Vegas Beltway Project. He also formed, managed and led a team of experts performing a probabilistic risk assessment for the transportation of spent nuclear fuel through Inyo County, California. He was subsequently retained as a transportation advisor for Inyo County. He also led a team analysis project for the Western Interstate Energy Board (WIEB), examining the use of advanced GIS techniques as they apply to the risk assessment and environmental consequences of transporting SNF.

He is the author or coauthor of over 46 peer-reviewed articles, conference presentations and book chapters on the issues of transportation impacts related to spent nuclear fuel transportation. He has a B.A. in Economics from Pennsylvania State University, where he was a member of the economics honor society. While at Penn State, he was a member of the Army Reserve Officer's Training Corps and he was a Distinguished Military Graduate. He was commissioned as an armor officer and served in West

Germany, South Korea, and Las Vegas, NV. He was awarded numerous medals during his service, including the Meritorious Service Medal.

James David Ballard, Ph.D.

James David Ballard is a professor of sociology at California State University, Northridge. His doctorate comes from the University of Nevada, Las Vegas (UNLV) and his study concentrations include political sociology, criminology and deviance. While a graduate student he began studying Yucca Mountain and the transportation related issues surround SNF movement. He is the author of over 100 articles, book chapters and governmental reports primarily focused on transportation related terrorism attacks, radiological terrorism and attacks against nuclear waste shipments/storage facilities. His undergraduate and graduate teaching experience reflects an interest in qualitative and quantitative methodologies. He has published several books and articles that reflect this experience (Ballard and Jensen, 2007; Ballard 2005; Ballard 2001). His frequent co-author on SNF issues is Fred Dilger, Ph.D. and their work have used a variety of futures methodologies to study the energy industry (Ballard and Dilger 2008a; Ballard and Dilger 2008b).

Since 1995 he has worked on assessment of transportation, storage and related issues associated with SNF (Ballard 1995/1997; Halstead and Ballard 1997a; Halstead and Ballard 1997b). His research on the variety of risks associated with transportation and storage of these highly radioactive materials has been presented to a variety of agencies and oversight bodies. These include research reports for NATO (Steinhausler et al. 2004), the state of Nevada (Ballard and Dilger 2012; Ballard 2007; Mullendore and Ballard 2005; Becker and Ballard 2005), and testimony to the U. S. House of Representatives (Ballard 2002a), U. S. Senate (Ballard 2002b; Ballard 2008) and National Academies of Science (Ballard 2003).

His first position out of graduate school was as a criminal justice professor at Grand Valley State University in Grand Rapids, Michigan. Here his work started to become recognized as events around the world brought into focus the need to protect and secure SNF and nuclear power plants (NPP). After the 9/11 attacks, discussions arose about the safety and security of the nuclear industry and the research he had done to that point was brought into the spotlight. His initial work on security concerns over SNF transportation and subsequent research on various issues related to SNF allow him to work with a variety of agencies and scholars. This interdisciplinary approach to research is a hallmark of his scholarship and a point of pride.

After leaving GVSU for a new position at California State University, Northridge he continued working on safety and security issues. This included administering a large grant program to encourage students to seek opportunities in the American intelligence infrastructure. Additionally local foundation support and national intelligence community organizations supported research on associated issues. These were in addition to dozens of grants and research for hire arrangements (per project) with the state of Nevada's Nuclear Waste Projects Office and flow through administrator the Pacific World History Institute. This research work included extensive analysis of EIS, DEIS and other related agency work for the Yucca project (see Vitea). This work preceded rulemaking hearings initiated by the state of Nevada (Ballard 1999a). In one case Dr. Ballard was asked by federal court to testify about transportation safety and security issues related to mixed oxide (MOX) fuel assemblies through the state of Michigan.

2 THE DGEIS

The purpose of this report is to provide comment on the Nuclear Regulatory Commission's (NRC) Waste Confidence Generic Environmental Impact Statement Draft Report for Comment (NUREG-2157) (DGEIS 2013). This analysis focuses on the alternatives developed by the report and the problematic nature of the assumptions made in the DGEIS.

This report examines how a valid prediction of future SNF related conditions could have occurred, problems with the methods and assumptions used by the NRC as well as a description of the alternate techniques the NRC could have adopted. The analysis will begin by examining the various methods the NRC could have used to actually take a hard look at the issues singularly, in tandem and/or as a bank of analytical tasks (a.k.a. triangulated methodologies). Presentation of these is offered to show that the generic approach was not the appropriate choice here.

3 PREDICTING FUTURE CONDITIONS

Implicit in the Court's charge to the NRC is the need to forecast future conditions. NEPA itself can be seen as a requirement to predict the future. There are a wide variety of accepted, time-honored and reliable methods for anticipating future conditions. The NRC should have used these types of futures methods to better assess the possible environmental impact of its proposed action and/or in conjunction with a more recognized method used in the past like probabilistic risk assessment (PRA) and in conjunction with a more robust generic analysis as purported to be used in the DGEIS. In the DGEIS PRA was noted in relationship to a NRC study on dry casks, in particular the Hi-Storm system (see section 4.18.2.2). That study did not necessarily use generic analysis as this technique may not be compatible with such an abstracted analysis – it relies on real data and real institutions/installations to be effective. This would be true even if the actual NPP site is obscured in the final study write-up so as to not pose a security threat or act as a blueprint for terrorists, saboteurs or otherwise increase site specific threats (NRC 2007).

A perfect prediction of the future is not possible. The methods presented herein are not perfect and they are not a crystal ball. When used as part of an array of analysis techniques, the results of a triangulated analysis are more likely to be valid and reliable over those from when an unrealistic and not representative generic methodology is used. They help in taking a hard look at the issues and allow the agency to truly understand the potential environmental, social, economic and political concerns that may arise in the future. When such a generic methodology is used, its internal and external validity/reliability flaws are revealed. The listing of possible methodologies below could have been used to effectively examine future possible conditions derived from current knowledge and conditions. A discussion of some of the background for these possible techniques is useful and may show how the NRC could have used such techniques to conduct a valid and reliable NEPA analysis.

The DGEIS assumptions and the alternatives derived from them are examples of a normative forecast that describes a desirable future without sufficient reference to current conditions. For example, the DGEIS assumes funding will be sufficient without regard to the existing conditions of an industry in decline. An explorative forecast would have examined the current funding conditions and sought to

create a more realistic description of the future from that basis. It would have possibly identified a forthcoming funding shortage as nuclear power declines and utilities decrease revenues from NPP operations. Such a funding shortfall would have impacts on institutional control, regulatory viability and environmental impacts. To better understand this, the next section will address the differences in such forecasting.

3.1 NORMATIVE VERSUS EXPLORATORY FORECASTING

An initial consideration in preparing a forecast is to decide on a normative or explanatory forecast. This is an important analytical distinction that is fundamental to the forecasting problem. A normative forecast incorporates values and expresses some idea about what kind of future is desirable. Normative forecasts are necessarily colored by the forecaster's own values. The assumptions used therein, both explicit and implicit, create the framework for the forecast.

Examples of normative forecasts include:

- By 2030, guns will be illegal in the United States.
- By 2040, the US will have defaulted on its debt obligations.
- By 2048, there will be sufficient funds available to repackage and manage SNF storage indefinitely

Each of these forecasts is normative in that it contains some future expectation. The DGEIS is a normative forecast of the future. It relies on assumptions about the future that oversimplify important aspects of the problem (e.g. funding, institutional control, staff). These assumptions have the same effect as value judgments on the quality of the assessment.

An explanatory, or positive forecast, is one that provides a prediction about the future that does not incorporate as explicit value judgments about future conditions. Explanatory forecasts strive to be free of the values of the forecasting research team. When judgment is necessary (as it would be in the case of the DGEIS) the explanatory forecast seeks to understand and isolate its effects from the other parts of the forecast.

Examples of an explanatory forecast are:

- By 2030, there will be 42% fewer retail outlets to purchase guns than there are today.
- By 2040, the US national debt will have grown to \$88 billion.
- By 2048 funds to pay for nuclear waste site management will have declined by 56%.

NEPA calls for an examination of the impacts of federal actions on the environment. To accomplish a hard look at the issues, that explanation should be free from the values and preferences of the Federal agency preparing the forecast.

3.2 PREDICTION VS. FORECAST

Predictions are statements that are believed to be true in the future. For example: a prediction could be framed as 'the first complete human organ will be printed by a 3d printer by 2020'. In many ways a prediction mimics a normative forecast.

A forecast is different from a prediction in that it is probabilistic in nature and based on assumptions that are relatively free of value statements. An example of this is a weather forecast: There is a 35% chance of rain is a relatively value free statement. This is then an example of an explanatory forecast.

Depending on the availability of reliable data, it may be possible to establish statistically valid statements about the level of confidence in the forecast and the degree of error in the forecast. For example, there is 95% confidence level that funds available for spent fuel security will decline between 8% and 15% in each of the first eight years after the end of a license.

It is the addition of a probability condition to the forecast that allows for such precision. Such precision is not as readily available when value statements like predictions/normative forecasts are used.

3.3 ACCURACY VS. PRECISION VS. UTILITY

To be of use, any statement about the future must satisfy various analytical conditions. For example, it must be precise. A forecast that predicted that nuclear power will cease to be a viable energy source within a few years would be of no value because it is not precise or accurate. A forecast that predicted the stock market will either go up or down within 500 points would be accurate and timely. But it would not be precise enough to be useful. To be useful forecasts must be precise but this does not mean they are perfect. Forecasts may be precise, but wrong or too late to be useful. Utility refers to the need for a forecast to be timely.

3.4 NEPA AS SCENARIO FORECASTING

As it has been widely applied, NEPA essentially relies on the use of scenarios to forecast the future. This is because the alternatives required by NEPA closely correspond to the scenarios used in that particular analytical technique. Scenario design is a method first used by Herman Kahn in the 1950's. This technique relies on a rich description of alternatives that requires information about specific aspects of the future.

The NRC fails in their choice of alternatives in the DGEIS and as discussed further on, the NRC fails to consider an appropriate range of conditions for those alternatives. This failure to take a hard look at the issues is evidenced by several examples that will act as a running commentary in this review of the DGEIS. These include:

- Scenarios are typically extensive narratives that highlight likely possible alternatives. In this case, the NRC could have examined the problem of lost agency financing from the perspective of several different funding scenarios. Such analysis would have at a minimum addressed the possibility that the funding streams that underlie the very existence of the NRC may change.
- Secondly, the NRC could have written a scenario describing in detail the expected impacts on the environment at each of the time frames used in the DGEIS. The description would have provided insight into how the NRC envisions the environmental conditions at various time periods.
- Thirdly, the NRC could have used scenarios to address the very real possibility of a loss of institutional control at the sites. Such a loss of control does not have to be dramatic as was the

case in Japan at *Fukushima Daiichi*; rather it can represent a gradual loss of institutional command of the site and its operations as was evidenced by various DOE projects related to nuclear weapons production. The history of lost control over the byproducts of nuclear weapons production, failed oversight by DOE/NRC in their stewardship of the environment and failures in regulatory oversight by government agencies provide strong evidence that the loss of institutional control is far more common than the DGEIS would admit (See appendix A). This slide into mediocrity as a scenario could have been augmented with a more dramatic scenario like evidenced by *Fukushima Daiichi*. Such opposing scenarios, or even the use of a continuum of possibilities representing the loss of institutional control, would have better addressed real world conditions. It would have represented more accurately historical experiences with lost institutional controls by agencies like the DOE and NRC in their oversight of the fuel cycle, weapons production and more directly, the issues associated with SNF.

- Closely related and fourthly, the DGEIS should have examined multi-dimensional scenarios in which institutional controls are lost after 30, 60, 100, 160 years and indefinite periods of time. These scenarios would then be looked at as to their potential impacts on the environment and over time. This combination of variables is a more robust approach to analysis that could have been chosen by the NRC staff if they had been given enough time to do their analysis.

To illustrate, as has happened in the past, high-level wastes could be exposed to the environment (e.g., Hanford, Washington). The scenarios the NRC could use should be constructed to examine specific components of institutional control in order to examine the consequences that the loss of control would have on the environment. For example a common sociological phenomenon is the attenuation of vigilance. That is, as a system is shown to be reliable and safe, the safety features are slowly removed to reduce costs. A reasonable and useful kind of scenario construction would have examined the cost of institutional control, over certain time periods and then what withdrawal of part or all of that vigilance would mean to the environment.

3.5 ANALOGOUS CASE

A way in which the DGEIS could have examined future alternatives would be to extrapolate from an analogous case in a manner similar to the case study method. In this method, the NRC would use real data from a real operating reactor site and then apply that data in other localities. In fact, this is what the DGEIS tries to do in its generic application. The DGEIS relied on information about the reactors and ISFISIs at Diablo Canyon, Morris, Humboldt Bay, Robinson, Surry, Calvert Cliffs, and Fort Saint Vrain (DGEIS p. 4-97-4-102). The main difference between the DGEIS and a more vigorous analogous case method is that the DGEIS uses a complete abstraction as the basis for drawing DGEIS conclusions. In an alternative to such abstracted analysis, the DGEIS could have used the analogous case method to extrapolate from operating NPP and licensed ISFSI facilities as a means of examining cask degradation and facilities degradation.

The analogous case study method would have had numerous advantages over a generic analysis based on abstract and unrealistic data. First, it would leverage existing data already being collected by the site licensee and the NRC. Such an analytical framework would relate to actual conditions and would admit other problems that may not have been anticipated in an abstract construct like the DGEIS. A viable case study method also can be useful when there is not sufficient data for statistical sampling or

remodeling. In this case in particular, there is very little relevant available data. By creating a robust case study method and then adapting it to other locations, the NRC could have produced a generic EIS that is less abstract and more grounded in reality. Another advantage is that analogous studies enable the development of a wide range of detailed data and investigations. This additional detail would have made it possible to develop new insights and information about this complex and difficult problem.

In this case, the NRC has developed a case study of a fictional facility, thereby combining the worst aspects of case study methods with the worst aspects of simulation. Another criticism of the analogous case study method is that it relies on data collected by a single organization and therefore may suffer from internal bias. This is the issue in the case of the NRC and its DGEIS. The agency has the political aspect of its operations, the Commission, and the actual day-to-day operational aspect, the agency. This bifurcated structure introduces bias as the Commission tries to meet its political demands/agenda and the agency works to meet a variety of internal and external pressures. A final criticism is that it is often difficult to draw specific cause-and-effect inferences from the analogous case. A hard look at the issues does not justify a casual analysis; rather it requires a meaningful and justifiable analysis to meet NEPA, something the generic analysis fails to accomplish.

3.6 MORPHOLOGICAL ANALYSIS.

Another potential method of predicting the future implications of SNF storage is general morphological analysis (GMA). This method was developed by Fritz Zwicky and the intent of GMA is to investigate relationships in complex problems that will require judgment. The method was applied to a wide variety of fields including astrophysics, jet engine propulsion systems and legal aspects of space development.

Morphological analysis was developed because many complex policy problems include non-quantifiable components that require judgment to be analyzed. This kind of complex policy problem makes quantitative methods less useful. When these methods are applied to problems requiring judgment, the result fails to show a clear, analytical link between the conclusion and the initial problem. The DGEIS demonstrates this very problem. The report amasses a wealth of facts, but there is no clear connection between the facts in the report and the conclusion drawn by the DGEIS. This gap is due to the absence of clearly articulated and analytically understood judgments. The 'judgment' problem made traditional models methods erratic and unreliable and was the impetus for the development of GMA.

To accomplish the task of analysis, GMA uses morphological boxes that are constructed by setting the parameters against each other in a matrix. Each cell of the box contains one particular value or condition from each of the parameters and thus marks out a particular state or configuration of the problem complex. This technique divides an issue into ever smaller components to try to isolate the individual effects that changes could have in the future.

In this case, the NRC could have assessed the impact and various time periods of various parts of institutional control. For example, one conditional would be the loss of heavily armed guards at the storage site in say a future time frame of 30 years. Likewise this technique would allow the NRC to address the loss of monitoring in 60 years and try to understand what environmental effects would result. The robustness of this technique would have allowed the NRC staff to examine a variety of conditionals and thus provided a vehicle for the mandated hard look at those issues.

4 CRITIQUE OF THE DGEIS

From the beginning of the nuclear age, the waste byproducts of nuclear energy production have been recognized as a problem. In the Atomic Energy Act (AEA), Congress promised utilities that the Federal Government would take control of the waste and dispose of it (AEA 1954). A functioning Federal repository program capable of disposing of the waste was a precondition of the manufacture of the materials and continued production of power.

Despite this mandate, no real progress has been made in development of a Federal repository program. What appeared to be progress with the Yucca Mountain project was illusionary and privatized alternatives like the Private Fuel Storage (PFS) facilities have yet to materialize and may never be built. While the Yucca Mountain Program reached the licensing stage, it is not clear that the license will be granted, nor that a functioning and environmentally acceptable repository and related infrastructure can be constructed. Likewise PFS has been licensed by the NRC but it has yet to overcome judicial, social and political opposition. A third option, use of the pre-existing WIPP facility, has not been addressed by the NRC. That facility is included in the discussion below to show how, if motivated, the NRC could have addressed the purpose and need by analyzing viable alternatives.

Additionally, when the AEA was passed, it was assumed that there was a relatively minor technical problem of SNF which would be easily fixed. This has not occurred. For example, there has been no technical development that will actually reduce the radioactivity of these materials. The United States does not reprocess these materials either. As a result, nuclear materials production has created vast amounts of radioactively contaminated materials that continue to cost billions to remediate (Closing the Circle). The essence of radioactive materials management in the United States is to dispose of the materials by means of a geologic repository, one that is yet to be constructed despite decades of trying.

4.1 THE PROBLEM OF SPENT NUCLEAR FUEL

The problem of SNF is that it remains radioactive for long periods of time. It requires specialized handling and a high degree of technical skill to understand and manage. Almost all commercial reactor fuel in the United States is comprised of solid, cylindrical pellets made of uranium dioxide. These pellets are usually 4/10" to 6/10" in length and about 3/10" to 1/2" an inch in diameter. The pellets are loaded into tubes. The tubes are referred to as fuel cladding. Fuel cladding is made of a zirconium metal alloy called zircalloy. A fully loaded tube is typically 11 to 14 feet in length and referred to as a fuel rod. Fuel rods are bundled together to form a square assembly measuring about 6 to 9 inches on each side. The fuel assembly for a boiling water reactor (BWR) typically holds between 49 and 63 fuel rods. Fuel assemblies for pressurized water reactors (PWR) hold 164 to 264 fuel rods. A typical nuclear reactor will use between 190 and 750 assemblies in the reactor core of the power plant.

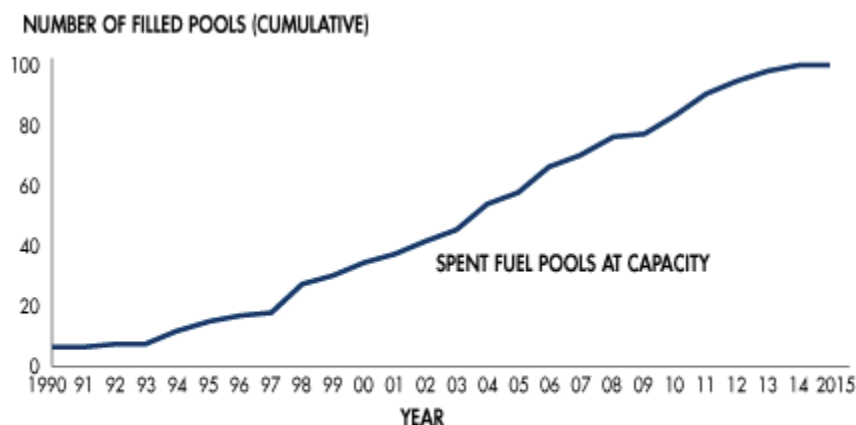
The most hazardous portion of the fuel assemblies are the uranium oxide fuel. This fuel is typically composed of two isotopes of uranium, uranium-235 (U-235) which fuels the fission chain reaction and uranium-238 (U-238) which captures neutrons to produce fissile plutonium and other heavy radioactive isotopes. When the fissile material has been consumed to a level where it is no longer economically viable for energy production, usually from four to six years, the fuel is classified as spent and removed from the reactor core. Those used spent fuel assemblies are then placed in wet storage. A recent trend in the nuclear industry has been to use fuel to generate energy for longer periods of time. Previous

analyses by NRC assumed the same radioactivity as fresh fuel (NUREG 6703 p. iii). The NRC has examined the consequences of this choice, awarding utilities credit for incorporating this additional decrease in radioactivity into their criticality analysis. This is referred to as burnup credit as it refers to the reduction in reactivity that occurs with fuel burn-up due to reduction of fissile nuclides and the production of actinide and fission- product neutron absorbers (NUREG 6703 p. 1). The NRC has concluded that higher burnup fuel will have no environmental impact because it falls within the limits of 10 CFR 50.36a and Appendix I to 10 CFR Part 50 which require that releases of radioactive materials to unrestricted areas are kept "as low as reasonably achievable."

Currently, there are 104 operating light water reactors within the United States operated by 51 utilities (generally referred to as nuclear power plants or NPP). Of the 104 operating reactors, 69 are PWRs, and the remaining 35 are BWRs. The assemblies from these reactors are highly radioactive and generate energy called decay heat. They also produce highly dangerous gamma and neutron radiation. The amount of heat and radiation generated by a spent fuel assembly after removal from a reactor depends on intensity of its use in generating energy. This is generally referred to as burn up and expressed as the time that has elapsed since the fuel was removed from the reactor. The rate of decay heat generation by the spent fuel reactor can be calculated. Even after years of storage and decay, the materials remain hazardous.

NPP were not designed to host and accommodate unlimited amounts of SNF inventory. They were not designed in this way because the original assumption was that the SNF would be removed from the power plant and reprocessed (EPRI p. 1-1). Since the United States has chosen to abandon reprocessing as an option, the only viable alternatives are to stop production of nuclear power or for storage of the by-products like SNF, first at the production site in wet storage and thereafter at a geological or dry storage facility. The problem then becomes the increasing inventories of SNF at the reactor sites. Table One shows the growth in such inventories.

Table One



Note: All operating nuclear power reactors are storing used fuel under NRC license in spent fuel pools. Some operating nuclear reactors are using dry cask storage. Information is based on loss of full-core reserve in the spent fuel pools.

Source: Energy Resources International and DOE/RW-0431 – Revision 1

As noted the U.S. nuclear reactor fleet, as the totality of reactors are called, was initially designed with the assumption that fuel would be reprocessed and therefore, spent fuel pools would not require a large

capacity. When the U.S. reprocessing systems collapsed after 1) a presidential ban and 2) the failure of the West Valley, NY reprocessing plant, reactor operators explored and used three on site storage alternatives: reracking, consolidation and dry storage.

Reracking places the fuel assemblies into different, more compact configurations. Reracking has been the most used method for expanding at-reactor SNF storage capacity over the past 40 years (EPRI). In consolidation, the fuel is placed into different configurations that increase room in the fuel pool. SNF consolidation demonstrations were conducted in the U.S. Although the demonstrations achieved rod consolidation ratios of 2:1, the compaction of the fuel proved to be very complex and required significant cutting in the SNF pool. None of the firms that participated in the program decided to pursue the technique further (EPRI SNF Handbook 2-4).

In July 1986, Virginia Power's Surry station was given the first dry storage or site-specific ISFSI 10 CFR 72 license. Developments followed that offered dry storage systems licensed for use in at-reactor ISFSIs in accordance with NRC's site-specific licensing regulations. Subsequently systems were licensed for dual-purpose configurations that could accommodate transportation as well.

Dry storage at nuclear power plant sites is expected to be implemented at all nuclear power facilities by 2025 as plants reach the limits for expanding in-pool capacity. Additionally, closed nuclear power plants will implement dry storage to empty their fuel pools and enable them to decommission the entire NPP. The Electric Power Research Institute studied the cost and consequences of expedited transfer of SNF from pools to dry cask storage. They found that transferring fuel had physical consequences for the condition of the fuel:

"Transferring from pool-to-pad or wet-to-dry storage is an abrupt change of environment for the used fuel assemblies, and the effects are most pronounced during vacuum drying, especially for high-burnup fuel, because of the likelihood of cladding radial hydride formation and embrittlement" (EPRI p. iv).

The EPRI study concluded there were additional occupational health risks of moving SNF. This suggests that the indefinite number of repackaging of SNF will have physical effects on the fuel. The DGEIS did not study this problem.

As the costs of nuclear power escalated and safety concerns accelerated after Three Mile Island, the financial foundations of the industry were undermined and significant numbers of reactors were not constructed. Forbes magazine referred to the nuclear industry as the largest management failure in the United States history (Forbes 1985). This is a relevant observation because it will be necessary to fund activities at waste sites and energy companies are starting to find the economics of NPP not advantageous. The next section will examine two attempts at storage facility construction and one alternative to the creation of a new facility by use of an existing facility in New Mexico.

4.2 FAILURE TO OPEN A REPOSITORY, INTERIM STORAGE FACILITY, OR A TECHNOLOGICAL SOLUTION

The United States began a program to find a SNF repository in the 1970's. As part of this effort, a variety of different land forms suitable for a geologic repository were studied in a number of different geographic locations. The results were that the Federal government settled on Yucca Mountain as the sole site for a repository. Despite major legislation in 1982 and 1987 that led to the study of Yucca

Mountain as the singular repository site, this choice failed by 2010 when the funding for this site was cut. During the decades long time period, there have been no fundamental technological improvements or changes to our ability to manage SNF. That is, there have been no technological breakthroughs that would reduce or modify the human health risks posed by SNF. Additionally, efforts to develop a new reprocessing system have been inconclusive (GNEP).

These various failed 'solutions' and one operating facility offer the NRC a variety of options from which to analyze NEPA implications relative to future decommissioned NPP or currently operating NPP. These alternatives are detailed below.

4.2.1 Private Fuel Storage

In 1994 a group of energy companies formed the limited liability corporation entitled Private Fuel Storage (PFS) (CRS 1997). This utility consortium was concerned with the lack of progress being made by the NRC and DOE on the development of a geologic repository for SNF. In some cases, like Southern California Edison, the concern was based on the lack of alternatives to wet storage at facilities like the reactors located at San Onofre, California (PFS, 1998).

On a parallel timeframe, the Goshute tribe from Skull Valley, Utah started discussions on the possibility of using their Western Utah Reservation as an above ground repository for SNF, aka as an independent spent fuel storage installation (ISFSI). These two events intertwined when the Goshute's entered into a lease agreement with PFS to seek an NRC license. This agreement would allow PFS to license, construct and operate an ISFSI in Western Utah. In June 1997 the license application was submitted to the NRC and approval was granted in 2006 (NRC 2010).

Opposition was swift and decisive – the State of Utah and various federal agencies offered objections and/or exercised their agency expertise in deliberations. This opposition resulted in several utilities dropping their support for the idea of a PFS and by means of various federal agency decisions; rail access was lost to such a proposed facility. By 2006 the PFS was refused approval to proceed. The issues are currently under litigation and an outcome is uncertain.

The lessons from this failed effort to privatize SNF storage are many. First, the energy industry has become frustrated with NRC and DOE efforts to find a SNF repository solution. This frustration was one of the motivations behind PFS and this whole 'privatization' effort. Additionally, the political opposition to the NRC's licensing decision to allow this project to proceed was intense. This was based in part on the imposition of the project on the state of Utah, a stakeholder that was not necessarily consulted to their satisfaction. Third, the courts have intervened and the status of PFS is unclear given the significant opposition by the state and the failure of the NRC to address the expertise/authorities of various federal level agencies that have some say in the possibility of the creation of a PFS or like project (Interior, Bureau of Indian Affairs, etc.). The NRC's failure to take a hard look at its own efforts and to address real environmental, social, economic and political concerns have so far resulted in failure. This experience should be a lesson to the agency and Commission – meaningful analysis under NEPA can provide some means to accomplish the task of siting a facility but failure to address concerns by stakeholders will likewise block or prevent the accomplishment of the desired goal – and should be integrated into its analysis of when and whether a permanent waste repository is likely to be available. However, no such analysis of the basis for the DGEIS conclusion that a waste repository is likely to be in existence within 60 years of the shutdown of the oldest reactor has been conducted (DGEIS p. xxviii).

4.2.2 Failure of Yucca Mt

The Yucca Mountain nuclear waste repository was designated under the NWPA amendments of 1987. Approval was granted in 2002 by the United States Congress and signed by President Bush that same year. Funding for this project was terminated in 2010 but as of now the status of this facility is still open to debate and the courts are currently addressing how agencies can, or if they should, continue licensing considerations for this facility.

The Yucca Mountain facility was originally conceptualized as a means to serve the nation's SNF storage needs, although Congress limited the total amount SNF that could be stored at the facility to 70,000 metric tons of heavy metal and the total now expected from all operating reactors if they operate for 60 years is 130,000 metric tons of heavy metal. The Report to the President and the Congress by the Secretary of Energy on the Need for a Second Repository, DOE/RW-0595, December, 2008. It was seen as a national level alternative to on-site storage. Yucca Mountain was to have been the solution to the nation's SNF storage problem and despite the NRC professing the lack of engineering barriers to this geological repository; the social, political and economic barriers have proved to be so significant that Yucca Mountain is yet another example of failed NRC and DOE policy.

Various iterations of the Yucca Project have arisen over the decades and in response to NEPA and other challenges to the project. The original idea of a geological repository morphed into ideas such as a dual purpose repository wherein above ground storage was to precede deep geologic storage. Another operational variation was that the Yucca facility could be used to store SNF until the NRC license for permanent storage was granted.

The NRC and DOE fixation on Yucca Mountain is understandable; the nation has invested billions into the facility and the policy choices therein. This is a reality despite the fact that DOE, coupled with oversight by the NRC, has yet to produce a viable plan. Given the variety of alternatives - including such non-Yucca specific ideas as Monitored Retrievable Storage (MRS) and multi-purpose canisters (MPC's) – the Yucca project has been tried and failed multiple times as a solution to the nation's SNF storage problems.

4.2.3 WIPP

The Waste Isolation Pilot Plant (WIPP) east of Carlsbad, New Mexico is currently accepting transuranic wastes, a by-product of the weapons production cycle. This salt basin based geological repository does not accept SNF but it may be an alternative to the failed Yucca Mountain project or PFS facility.

Consideration of such an alternative was not part of the DGEIS and would require analysis of site specific characteristics if such an alternative was to be analyzed by the NRC. The use of such a pre-existing geologic repository site would overcome some of the objections to siting that would arise – it already exists, its environmental impacts are fairly well known and the political/social opposition to its existence has been addressed to date. Methodologically the technical issues of long term storage of the SNF would be easier to analyze since analogous wastes are currently stored at the facility, it is licensed to accept similar wastes and its operational characteristics are known.

WIPP would be an interesting case study for the NRC to analyze since it has many of the characteristics needed for long term geological storage. The assumptions used by the DGEIS precluded analysis of such an alternative and thus that choice limited the viability of alternatives analyzed by the NRC. Those

assumption choices likewise limit the DGEIS ability to address the courts desire for a purpose and need study.

Ultimately, the ongoing failure of these various efforts to construct a permanent SNF site repository has led to the issues that should be addressed in the DGEIS. The study of an alternative like WIPP has not been done and thus another opportunity for alternatives was not explored. The following sections offer some details on the NRC's waste confidence problem and this agency's choices on how to address those given the Court's mandates.

4.3 THE WASTE CONFIDENCE PROBLEM

"Waste Confidence" refers to the requirement the NRC has to not license facilities unless there is a way to dispose of the waste produced therein. The first Waste Confidence rulemaking began in the 1970's when the NRC denied a petition for rulemaking filed by the Natural Resources Defense Council (NRDC). This 1977 petition asked the NRC to refrain from granting licenses for new nuclear facilities unless a disposal pathway for the waste had been developed. The NRC stated in its denial that it "... would not continue to license reactors if it did not have reasonable confidence that the wastes can and will in due course be disposed of safely" (42 FR 34391). Currently, the DOE claims that a repository would be available by 2048 (DOE 2013), approximately 75 years after the NRC made the assurance it had confidence in future disposal.

The moving target of a repository construction date is one issue that the NRC has failed to address in the DGEIS. This may be because the issues the NRC failed to address in the DGEIS are too complex and/or that the methodologies used to analyze the waste confidence concept are too simplistic. Such complexities and analytical failures point out deficiencies in a generic approach to the whole of the waste confidence issue.

In summary, there is currently no viable program to develop a repository. There is no location for a repository and siting efforts using a wide variety of techniques that continued over the last four plus decades have failed. The fundamental problem remains: What are the environmental impacts at the current wet storage waste locations if there is no repository or no reasonably foreseeable repository?

4.4 NRC'S RESPONSE IN THE DGEIS

The NRC response to the need to conduct an environmental analysis of the continued production of spent fuel when no permanent repository is available and to continue to allow storage of spent fuel at reactor sites in pools or dry casks is at best inadequate. After the Court rejected NRC's 2010 attempt to address these issues, the NRC began the current process which has produced the DGEIS for comment. The DGEIS is intended to evaluate the costs of policy options, but without performing any of the detailed analysis necessary to understand the environmental impacts. Further, it abstracts the impacts through the device of a generic analysis, and assesses only the impacts on a generic basis.

It is important to recognize that the DGEIS does not contain any specific information that pertains to any real NPP. It does not describe the conditions at any operating or decommissioned NPP and it does not provide credible forecasts of the impacts that could result from the indefinite storage of SNF at a specific geographic location near or at the NPP.

The DGEIS does not assess any genuine condition of the environment and it does not provide information about the environmental effects in the absence of a physical repository. There is no ground truth. The DGEIS describes the purpose and need for the proposed action as:

1. To improve the efficiency of the NRC's licensing process by generically addressing the environmental impacts of continued storage;
2. To prepare a single document that reflects the NRC's current understanding of these environmental impacts; and
3. To respond to the issues identified in the remand by the Court in the *New York v. NRC* decision.

Part of the efficiency the NRC sought was to decrease the time needed to prepare licensing reviews. The NRC intends to codify the results of its analyses in this draft DGEIS at 10 CFR 51.23. It seeks to do this by attempting in this one document to analyze all the possible adverse environmental consequences for all nuclear reactors at all sites for the next 60 and 160 years and indefinitely.

Of concern in this regard is the statement by Dr. Allison Macfarlane to the Nuclear Energy Institute where she said: "In the area of subsequent license renewal, there are even greater unknowns. Due to the age of the U.S. fleet, the United States is in large measure a pioneer in this area. I must be clear that the NRC is not yet in a position to pass judgment on the viability of operation beyond 60 years" (NRC News S-13-006, February 27, 2013). There is a fundamental disjunction with a DGEIS that purports to analyze 60 and 160 year and indefinite time frames and the NRC Chairperson's admission which suggests that the agency has no expertise in predicting to those timeframes. While the NRC Chairperson's statement was about the viability of NPP, not SNF storage, the same philosophy may hold true for aspects of SNF storage as envisioned in the DGEIS.

4.4.1 DGEIS Assumptions

The key to the DGEIS, and the primary reason it is able to reach the conclusion that the environmental impacts of long term and indefinite storage of spent fuel at reactor sites are small, is that it relies on a number of assumptions which have the effect of eliminating the most troublesome issues from consideration. By this approach, NRC is choosing to address the issues raised by the absence of a permanent waste repository for nuclear wastes by doing normative forecasting – i.e. projecting an ideal, not a reasonably likely, future and then examining the impacts that could occur if that ideal future were reality. As already noted, this approach is inappropriate for conducting an environmental impact analysis which is intended to assist NRC in making choices among alternative ways to deal with the problem created by the absence of a permanent waste repository. The assumptions are not numbered in the DGEIS, but they are numbered here for convenience. The strength of the assumption is addressed by examining what would happen if the assumption were in error or if an alternative, more realistic, assumption were used. The assumptions are taken from the DGEIS and are in italics.

1. *Although the NRC recognizes that the precise time spent fuel is stored in pools and dry cask storage systems will vary from one reactor to another, this draft DGEIS makes a number of reasonable assumptions regarding the length of time the fuel can be stored in a spent fuel pool and in a dry cask before the fuel needs to be moved or the facility needs to be replaced. With respect to spent fuel pool storage, the NRC assumes that all spent fuel is removed from the spent fuel pool and placed in dry cask storage in an ISFSI no later than 60 years after the end of the reactor's licensed life for operation.*

Spent fuel is currently eligible to be removed from a fuel pool and moved into dry storage after five years. The NRC here assumes that there will be money, equipment, available expertise and an ISFSI capable of handling the waste. Additionally, the NRC assumes waste can be safely held in the fuel pool for 55 years. The reality is that fuel pools are filling or full to capacity and everyday operations create more and more inventory that must be addressed in the near future.

2. *With respect to dry cask storage, the NRC assumes that the licensee uses a DTS during long-term and indefinite storage timeframes to move the spent fuel to a new dry cask every 100 years. Similarly, the NRC assumes that the DTS and the ISFSI pad are replaced every 100 years. For an ISFSI that reaches 100 years of age near the end of the short-term storage timeframe, the NRC assumes that the replacement would occur during the long-term storage timeframe.*

There is no DTS facility currently in operation in the U.S. Overseas DTS facilities are small in size and are custom designed for research reactors. The EPRI did a 2010 report (updated in 2012) that estimated the costs for operation of such systems and the early withdrawal of fuel from spent fuel pools. The report concluded there would be significant radiological doses and costs between \$3.5 and \$3.9 billion dollars. The NRC DGEIS assumes that these operations will be indefinitely feasible.

Additionally, the radiological risks of packaging and repackaging the materials will vary by fuel type, age, and volume. Degradation to the fuel assemblies may also adversely impact the transfer. A generic assessment may not be appropriate for these types of variability.

3. *Based on its knowledge of and experience with the structure and operation of the various facilities that will provide continued storage, including the normal life of those facilities, the NRC believes that spent fuel pool storage could last for about 60 years beyond the licensed life for operation of the reactor where it is stored, and that each ISFSI will last about 100 years, for a total of 160 years or less of likely continued storage if a repository becomes available.*

Although it may be valid, there is little empirical data to support it. In fact a recent statement by the director of the NRC may offer insight into the questions NRC has about such timeframes (see MacFarlane statement elsewhere). Other questions arise when the details of such assumptions are questioned. For example, what about the availability of human capital and experience to address the operations of these facilities? What about the financial concerns the long term operations represent?

4. *Institutional controls will continue. This assumption avoids unreasonable speculation regarding what might happen in the future regarding Federal actions to provide for the safe storage of spent fuel. Although government agencies and regulatory safety approaches can be expected to change over long periods of time into the future, the history of radiation protection has generally been towards ensuring increased safety as knowledge of radiation and effectiveness of safety measures has improved. For the purpose of the analyses in this draft DGEIS, the NRC assumes that regulatory control of radiation safety will remain at the same level of regulatory control as currently exists today. The DOE analyzed a no-action alternative in their Final EIS for Yucca Mountain (DOE 2008) that considered the loss of institutional controls. In particular, the DOE considered a specific scenario in which spent fuel and high-level radioactive waste would remain in dry storage at commercial and DOE sites and would be under institutional controls for*

approximately 100 years, and beyond that time, it was assumed there would be no institutional controls. The NRC provided comments to the DOE related to their assumption about the loss of institutional controls (NRC 2000). The NRC stated that it did not consider the loss of institutional controls a reasonable assumption because the Federal government would (P1-14) the public health and safety.

The NRC assumes that any loss of institutional control is unreasonable. This assumption is not valid. The NRC's assumption is also ahistorical. In the recent past, two operating NPP have been without institutional controls. April 26, 1986 the Chernobyl reactor was evacuated except for staff performing emergency cooling operations. Although firefighters responded to the accident, the site was out of control. On March 16, 2011, all of the workers of the Fukushima Daiichi NPP were evacuated.

The NRC should prepare an assessment that assumes there is a partial or complete loss of institutional control, particularly after an extended period. This may also be true for unused facilities in remote areas, a result of decommissioning. The NRC also assumes that there will be an agency to oversee and ensure the quality and safety of the process. Additionally, the environmental consequences of a loss of institutional control cannot be assessed generically because it is inherently dependent on the NPP site, surrounding demographics and geology.

5. *A DTS will be built at each ISFSI location during long-term storage timeframe to facilitate spent fuel transfer and handling. The NRC assumes a 100-year replacement cycle for spent fuel canisters and casks. This assumption is consistent with assumptions made in the Yucca Mountain Final EIS (DOE 2008). The 100-year replacement cycle also assumes replacement of the ISFSI facility and DTS. Based on currently available information, the 100-year replacement cycle provides a reasonably conservative assumption for a storage facility that would require replacement at a future point in time. However, this assumption does not mean that dry cask storage systems and facilities need to be replaced every 100 years to maintain safe storage.*

The NRC here assumes that there will be money, equipment, available expertise and an ISFSI capable of handling the waste. In addition there are no operating DTS facilities in the US and no DTS facilities of the size and complexity needed for the task that would be created by having to move 60 years of spent fuel from one group of dry casks to another group of dry casks. In addition, the DGEIS does not look at the environmental impacts that would be associated with the construction of a DTS at each reactor site or the environmental impacts that will be caused by the process of moving the wastes from the dry casks.

6. *The NRC assumes that the land used for the ISFSI pads and DTS would be reclaimed after the facilities are demolished and, therefore, could be used again in the next 100-year replacement cycle. The NRC believes this assumption is reasonable because the characteristics of the previously disturbed land is already known and is suitable for ISFSI and DTS design and construction.*

The environmental consequences of future land use cannot be assessed generically. Nor does NRC have special expertise.

7. *The NRC assumes that aging management, including routine maintenance activities and programs occurs between replacements. These “routine” or planned maintenance activities are distinct from the “replacement” of facilities and equipment.*

The NRC here assumes that there will be money, equipment, and available expertise even though each of these sites will be the responsibility of a utility which is obtaining no income from the site and may not even be in existence in the distant future. NRC also does not discuss the basis for any unspoken assumption that funding for these efforts will be adequately provided by funds that are being created today for spent fuel management when the assumed time frame is far less than the timeframes that are to be addressed in the DGEIS. None of these assumptions fall within NRC’s expertise.

8. *The spent fuel is moved from the spent fuel pool to dry cask storage within the short-term storage timeframe.*

While there may be money, equipment and expertise available to make the transfer if it were done while the plants are still operating, there is no analysis in the DGEIS to demonstrate a basis for that assumption 50 years after the plant has been shut down. None of these assumptions fall within NRC’s expertise.

9. *The NRC assumes that nuclear power plant decommissioning occurs within 60 years after the licensed life for operations in accordance with 10 CFR 50.82 or 52.110. The NRC also assumes that, by the end of the short-term storage timeframe, a licensee will either terminate its Part 50 or 52 license and receive a specific Part 72 ISFSI license (see 10 CFR Part 72, Subpart C) or receive Commission approval under 10 CFR 50.82(a) (3) or 52.110(c) to continue decommissioning under its Part 50 or 52 license. In either case, the NRC assumes that the NRC will conduct an appropriate site-specific NEPA analysis for either issuance of a Part 72 ISFSI license or approval to continue decommissioning in accordance with 10 CFR 50.82(a)(3) or 52.110(c). The ISFSI and DTS would be decommissioned separately.*

This is an appropriate assumption if the NRC continues to exist with adequate funding. The funding for the NRC is substantially derived from fees paid by operating nuclear power plants and thus the agency itself is subject to the economic whims of energy production. It may or may not be functioning and/or could be replaced as happened to the AEC. Thus, it is possible that oversight operations of this type would be given to another agency or that Congressional budget constraints would limit the funds available to fully operate the NRC or its successor to the same extent as now available.

10. *Replacement of the entire ISFSI would occur over the course of each 100-year interval, starting at the beginning of the long-term storage timeframe. Construction, operation, and replacement of the DTS are assumed to occur within the timeframe, it could be near the end of its useful life by the end of that storage timeframe. To be conservative, the NRC included the impacts of replacing the DTS one time during the long-term storage timeframe.*

The NRC here assumes that there will be money, equipment, and available expertise. None of these assumptions fall within NRC’s expertise.

11. *Because an away-from-reactor ISFSI could store fuel from several different reactors, the earliest an away-from-reactor ISFSI would enter the short-term timeframe is when the first of these reactors reaches the end of its licensed life for operation.*

This needs to be examined for the timing of shipments and the movement of the waste. There will be substantial movement of fuel required for this to be successful. Such analysis is not generically possible, it is site specific.

12. *The amount of spent fuel generated is based on the assumption that the nuclear power plant operates for 80 years (40-year initial term plus two 20-year renewed terms). A typical spent fuel pool of 700 metric tons of uranium (MTU) storage capacity reaches its licensed capacity limit about 30 years into the licensed life for operation of a reactor. At that point, some of the spent fuel would need to be removed from the spent fuel pool and transferred to a dry cask storage system at either an at-reactor or away-from-reactor ISFSI.*

This may or may not be a reasonable assumption. Burn up times for reactor fuel have changed as the technological controls for reactors have been improved. It may be that in the future, to help in recovery of costs, it will be necessary to run reactors to achieve hotter burn up fuel. This could affect the rate at which waste is produced, how fast wet storage fills to capacity and when/how SNF is moved into dry-storage casks. The results of such operational choices may impact storage, transfer and even the physical integrity of the fuel assemblies (Alvarez).

13. *The environmental impacts of constructing a “spent fuel pool island,” which allows the spent fuel pool to be isolated from other reactor plant systems to facilitate decommissioning, are considered within the analysis of cumulative effects in Chapter 6. Because a new spent fuel pool cooling system would be smaller in size and have fewer associated impacts than existing spent fuel pool cooling systems, the environmental impacts of operating the new spent fuel pool cooling system in support of continued storage in the spent fuel pool, would be bound by the impacts of operating the existing cooling system described in Chapter 4. It is assumed that an ISFSI of sufficient size to hold all spent fuel generated during licensed life for operation will be constructed.*

This assumption ignores the considerable environmental impacts that would be involved in the construction of such a spent fuel pool island, the economic costs of operating and maintaining such a facility, and its vulnerability to natural disasters and malevolent acts.

14. *Sufficient low-level waste (LLW) disposal capacity will be made available when needed. Historically, the demand for LLW disposal capacity has been met by private industry. NRC expects that this trend will continue in the future. For example, in response to demand for LLW disposal capacity, Waste Control Specialists, LLC, opened a LLW disposal facility in Andrews County, Texas on April 27, 2012.*

This assumption may be unrealistic and fails to address the increasing costs of LLW storage. For example, as liability and costs concerns rise, it may not be a desirable business model to be in waste disposal in the future.

In order to comment on the assumptions, they are organized into thematic topics in Table Two below. Some assumptions deserve similar criticism.

Table Two

Assumption	Comment 1 Institutional Control	Comment 2 Funding	Comment 3 Human Capital	Comment 4 Additional Areas of Concern
<i>1. Spent fuel removed 60 years after reactor license</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
<i>2. NRC licensee uses a DTS</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<i>3. Spent fuel pool storage could last for about 60 years, each ISFSI will last about 100 years</i>				<input checked="" type="checkbox"/>
<i>4. Institutional controls will continue</i>	<input checked="" type="checkbox"/>			
<i>5. A DTS will be built at each ISFSI location</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<i>6. The land used for the ISFSI pads and DTS would be reclaimed</i>				<input checked="" type="checkbox"/>
<i>7. Aging management plans, including routine maintenance</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<i>8. The spent fuel is moved to dry cask storage within the short-term storage timeframe</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<i>9. Nuclear power plant decommissioning occurs within 60 years after the license</i>				<input checked="" type="checkbox"/>
<i>10. Replacement of the entire ISFSI would occur over the course of each 100-year interval</i>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
<i>11. The earliest an away-from-reactor ISFSI would enter the short-term timeframe is when the first of these reactors reaches the end of its licensed life for operation</i>				<input checked="" type="checkbox"/>

12. The amount of spent fuel generated is based on the assumption that the nuclear power plant operates for 80 years				<input checked="" type="checkbox"/>
13. The environmental impacts of constructing a “spent fuel pool island” are cumulative impacts				<input checked="" type="checkbox"/>
14. Sufficient low-level waste (LLW) disposal capacity will be made available when needed				<input checked="" type="checkbox"/>

Table 2 Assumptions mapped against comments on their sufficiency

The validity of the assumptions is commented on below. This analysis of the considerations ignored by the DGEIS when it uses these assumptions, illustrates the kind of factors that should be analyzed in a properly conducted predictive forecast. In such a properly conducted predictive forecast, different futures are hypothesized based on consideration of reasonably possible different conditions. Instead of using such a well-recognized methodology the DGEIS eliminates all reasonable possible different future conditions merely by the fiat of using an assumption without even attempting to analyze the basis for the belief that such an assumption is reasonable and analyzing different conditions that would produce different assumptions.

4.5 INSTITUTIONAL CONTROLS

4.5.1 Definition

For the purposes of these comments, the EPA defines institutional controls “as non-engineered instruments, such as administrative and legal controls, that help to minimize the potential for exposure to contamination and/or protect the integrity of a response action” (EPA). The NRC does not provide a precise definition of what it considers institutional controls. Excellent insight into the range of policies that combine to form institutional controls can be found at the State of New York(<http://www.dec.ny.gov/chemical/8665.html>).

4.5.2 Critique

The DGEIS assessment of the environmental impacts of radiological storage is insufficient because it assumes that institutional control will be maintained throughout the future. A review of the lifecycle of nuclear materials suggests that the norm may be better expressed as a partial or complete loss of institutional control rather than a consistent level of institutional control. There have been multiple instances where institutional control of nuclear facilities has been lost. These instances have occurred throughout the nuclear fuel cycle. NRC should use analytical methods that will enable them to assess the environmental consequences of the loss of institutional control for various lengths of time.

The two most prominent examples of this are the Chernobyl NPP which was evacuated in 1986 and the Fukushima NPP’s which was briefly evacuated in 2011. In both cases for long and short periods of time operating nuclear facilities were completely out of control. But there are other relevant cases throughout the nuclear fuel cycle. These cases emphasize that the management of these materials has

been sporadic, incomplete, and performed without sufficient institutional controls. These breakdowns have occurred worldwide and include the United States. See Appendix A for additional examples.

4.6 FUNDING

The NRC assumes that the funding will be available for the indefinite storage of the materials. This assumption may not be valid. The following discussion addresses the variety of issues associated with funding and how such funding shortfalls could impact local and state political authorities.

4.6.1 Definition

Funding refers to the monetary resources necessary to obtain the equipment, personnel, security, and other requirements for the maintenance and management of the facility.

4.6.2 Critique

The assumption that funds will be available for the management and disposal of spent nuclear fuel is problematic. First, there is no requirement for nuclear power plant operators to maintain funds to manage spent nuclear fuel following decommissioning. Currently, reactor operators are required to maintain decommissioning accounts. NRC has developed a formula it uses to calculate the adequacy of the decommissioning funds. Based on this formula, those accounts are currently estimated to be sufficient (NREG 1577). Funding assurance for decommissioning nuclear power plants is governed by 10 CFR 50.33(k), 50.75, and 50.82. However, these cost estimates do not include the costs for long-term management of the fuel or the site. As the NUREG states:

"In addition, the costs of managing and storing spent fuel on site until transfer to the Department of Energy for permanent disposal are not included in NRC cost formulas."
(NUREG 1577 p. 16)

The reason power plant operators were not responsible for long-term management of spent fuel was because of the assumption that long-term storage would be provided by DOE. In advance of this assumption, the power plant operators were being assessed fees to support the nuclear waste fund. However, the recent decision by the United States Circuit Court of Appeals has invalidated collection of those fees (*NARUC v. DOE*). Currently, there is no requirement for NPP operators to maintain a fund for the long-term management of SNF. Even today, the NRC's assumptions about funding are unfounded. It is easy to envision a future in which funding is not available.

Second, funding the long-term management of spent fuel requires a dramatic change in the way the United States manages the oversight of commercial nuclear waste. Currently, oversight is performed by the NRC. The NRC, however, receives 90% of its funding from fees assessed from operating NPP's (NRC Press Briefing). As reactors close, there will be fewer funds available for oversight of the stewardship and management of the materials. The NRC assumption of eternal funding for these activities will require Congressional action to change current policy, the funding of either the current organization, or the development of a new organization.

Third, the DGEIS makes the unrealistic assumption that funding is an either/or question. That is, either sufficient funding is available forever, or that it is not. A much more likely outcome is that funding from energy companies will dwindle and backfill funding from the Federal government will have to compete with other priorities and rather than be entirely eliminated, it will be gradually reduced. In this event,

affected States may be compelled to supplement the maintenance or oversight of waste facilities with their own funds. If so, the sites will inevitably become unfunded mandates on the states.

Ultimately, funding is difficult to forecast. As the NRC said:

“It is difficult to determine costs that could be incurred 50 to 100 years in the future. Changes in technology, regulation, or public policy could all have a profound effect on the actual cost. The purpose of including costs is to try to discern the benefit for the expedited transfer alternative. Of course, this analysis is based on best estimates of current spent fuel strategies and cost. If the U.S. government were to take possession of the spent fuel in order to provide storage at a non-operating plant site for extended periods, the costs could be heavily discounted, and the differences between storage alternatives in this analysis might be reduced” (COMSECY-13-0030 p. 7).

It is likely that if funding becomes unavailable for a short or an extended timeframe, that states will be forced to provide essential services and protection to the facilities. This then is an example of how SNF could become an unfunded mandate on states.

4.7 HUMAN CAPITAL

4.7.1 Definition

For the purposes of this report, human capital is referred to as the personnel and staff employed by industry, their skills, training, and motivation.

4.7.2 Critique

A vital ingredient for the continued management of the spent fuel is the skilled and trained staff able to perform the work. The potential failure to train and identify high quality staff will have a variety of effects not discussed in the DGEIS. The NRC and the nuclear industry have paid close attention to human factors engineering as it relates to plant operations because of its effect on accident and other risks. There has been relatively less work on human factors risks associated with the dry cask storage of spent nuclear fuel. If the quality of human capital declines, the risks associated with continually transferring and packaging the spent nuclear fuel will increase. The DGEIS does not comment on this problem.

A recent NRC report suggested the increased risks associated with repeated manipulation of spent fuel:

“The NRC recognizes that there are costs and risks associated with the handling and movement of spent fuel casks. These cost and risk impacts, if included in this analysis, would further reduce the overall net benefit in relation to the regulatory baseline. These effects (e.g., the added risks of handling and moving casks) were conservatively ignored in order to calculate the maximum potential benefit by only comparing the safety of high-density fuel pool storage relative to low-density fuel pool storage and its implementation costs without consideration of cask movement risk” (COMSECY-13-0030 p. 7).

The nuclear industry is critically concerned about the availability of trained staff (ANS). There are reasons to believe that the industry will not be able to provide enough trained and technically sound staff if current trends continue. The continuing aging of the workforce is expected to create a severe

shortage of qualified workers. The workers who are available will be needed for other, more lucrative purposes. These purposes include:

- maintain the safe and reliable operation of commercial and defense nuclear plants
- continue necessary research and development in education, medicine, power, and manufacturing
- continue development and construction of new nuclear facilities
- staff nuclear medicine needs
- continue nuclear education

Spent nuclear fuel management will have to compete with other, more urgent and possibly more lucrative, fields for talent. Another alternative to address the impending talent shortage is that the US will be forced to hire foreign workers or outsource the spent fuel management to a foreign company entirely. This will create a different set of problems related to the safety and security of the fuel. The DGEIS is silent on this imminent problem and the implications it has for the risks and the environmental consequences of spent fuel management.

4.8 ADDITIONAL AREAS OF CONCERN

4.8.1 Low-level waste storage

The DGEIS assumes that LLW storage for all of the materials will be available in a timely and cost-effective manner. The NRC produces a periodic report on the problem (NUREG1307 Rev 15). The report indicates that some facilities do not have a LLW disposal facility available. The report must assume costs for these facilities because of the lack of low level waste storage. Additionally, the year-to-year price increase from 2010-2012 was 12%. The increase in fees is due to the changes in the fees charged by the commercial operators. Such inflationary pressures are not addressed in the DGEIS. This problem is assumed away in NUREG-1307]. These two considerations make the DGEIS assumptions that there will always be LLW storage and that its costs will be addressed in current levels of funding unrealistic.

4.8.2 Unfunded Mandate for State and Local Governments

Reactor operators are not obligated to retain funds for post-decommissioning activities, such as indefinite storage and maintenance of SNF. There is currently no program for the disposal of the SNF and such long term funding is essential to address. States and local governments, acting to protect their citizens ultimately may become responsible for some minimum level of activity at the site. This may include security, monitoring or supervision of maintenance. In any event, the time, attention, and funding to carefully observe the site will necessarily remain with the state. It will be necessary to pay for trained, knowledgeable staff, monitoring equipment, and a public safety program in the area. The DGEIS does not acknowledge this problem and does not address this unfunded mandates that could reasonably be expected to infringe on the state. Nor does the DGEIS acknowledge that all these costs will ultimately be borne by the public in the form of increased taxes.

An additional issue is the potential problem of decontamination and cleanup in the event of an incident at any one of these individual spent fuel storage facilities. What are the guarantees from the NRC for the costs and expertise needed to address such remediation events if in fact the NRC does not recognize these in their vision of the future? An example of an unfunded mandate now being imposed on states from mismanaged nuclear wastes is that states all over the United States are forced to devote staff, time,

political and social attention to the problems created by the contamination of DOE site. For example, the need for Nevada to maintain a Bureau of Federal Facilities devoted solely to the problems of overseeing DOE facilities (<http://ndep.nv.gov/boff/index.htm>). The record is clear – agencies like the DOE and NRC have in the past left such issues off of analysis when in fact those have very real environmental consequences.

4.8.3 Dry Transfer Storage

One of the underpinning assumptions of the DGEIS is that it will be possible to readily move the SNF from one storage canister system to another e.g. from a NUHOMS to a NAC type of canister. This assumption is made despite the fact that there is no system of this type currently operating in the US. There are small systems currently used for research reactors (NAC). There is no DTS currently working at any US nuclear power plant. A DTS system of the type and size envisaged by the DGEIS would require additional research and development, which would in turn require additional funding. Construction and operation of these facilities will create substantial environmental impacts, none of which are considered in the DGEIS. These facilities will need to be designed to withstand all the dangers that current reactors are supposed to withstand, including natural events like floods and earthquakes and malevolent acts. The costs for such facilities can be substantial but the DGEIS gives that concern no consideration.

The absence of the DTS raises the larger issue about how the NRC drew its conclusions about impacts. What is the basis for the NRC's conclusions about the risks and environmental impacts of its alternatives, if those conclusions are based on assumptions about the safe operation of equipment that does not exist?

4.8.4 Damaged Fuel

According to some estimates, 10% of the inventory of SNF is damaged to one extent or another. The Blue Ribbon Commission on America's Nuclear Future received testimony about the seriousness of the damaged fuel problem. A study prepared by Bechtel SAIC (2005) concluded that for the purposes of designing a facility to handle the SNF it was necessary to assume that:

- a. Failed fuel quantities and types of damage arriving at the repository include: approximately **4** percent of he1 assemblies received are expected to have an average of 2.2 failed he1 rods per assembly;
- b. **90** percent of the failed fuel is estimated to be known and identified prior to shipment to the repository; **10** percent of the failed fuel is expected to have pinhole leaks and hairline cracks that will not be identified prior to shipment.

The DGEIS mentions damaged fuel as a potential problem only twice (p. 471, p. 478). The DGEIS does not address the safety or risk implications of this damaged fuel. The Generic assessment does not include any severely damaged fuel and the long-term degradation of the damaged fuel containers is not considered.

4.8.5 SNF degradation

The DGEIS assumes that spent fuel remains intact as time passes. This may not be the case. Recent work prepared by the Pacific Northwest Laboratory (PNL) indicates that the properties of spent nuclear fuel are not well understood at the current levels of burnup (exceeding 45 gigawatt-days per metric ton of uranium [GWd/MTU]). The report concluded that:

“Because limited information is available on the properties of high burnup fuel, and because much of the fuel currently discharged from today’s reactors exceeds this burnup threshold, a particular emphasis of this program is on high burnup fuels assumptions that are not appropriate for generic appraisal” (PNL p. viii).

The fuel being discharged from operating nuclear power plants has properties that are not currently well understood. It is not clear that the NRC has a basis for making future projections about the indefinite handling of spent nuclear fuel, given the absence of reliable technical information.

4.8.6 Safety and Security

A wide variety of issues that could affect a storage facility are not appropriate for generic analysis. Transportation infrastructure barriers and terrorism are two examples.

Generic analysis of a NPP would miss the transportation related issues associated with a real world facility. For example, if the NPP site did not have rail access, movement of the SNF to another site or even within the site may be hindered. Additionally access limitations like geographic barriers to and from the plant may limit the use of heavy haul trucks and thus increase the numbers of transportation links necessary to move the SNF from the facility, to storage and/or to an intermodal transfer stations, that could then load the canisters onto a train, barge or other transport means. These types of site specific transportation related barriers would need to be analyzed in reality, not in the abstract. They require specific planning and articulation as to their impacts on the environment, social structures, political impacts and economic costs. Risks for such shipments rise as the number of transfers increase and as the failure to recognize such site specific realities is a critical mistake in the use of a generic analytical approach (Ballard 2002a, Ballard 2002b, Ballard 2003, Ballard 2008).

The potential for a terrorist attack against the wet storage pools, dry storage and/or transportation between the reactor and such facilities is another example of a set of issues not appropriate for generic analysis. Terrorism is a potential issue for such shipments, no matter the probability of an attack. Low-probability, high-consequence attacks could happen and the characteristics of an attack will depend on the physical constraints of the facility, the geography of the transportation routes and such variables as the training and expertise of the local first responder community to address any radiological issue that arises. A radiological emergency could range from the inconsequential to a significant radiological release and first responders will need training, expertise and equipment to address such contingencies. The consequences of an attack are not similar to a run-of-the-mill accident and would vary depending on wind patterns, the presence of fire, the size/location of the breach to the cask and many other variables. Pre-existing methodologies and computer programs exist for analysis of these variables but they require site specific knowledge and inputs on the unique characteristics of the local conditions to offer useful data when the analyses are run (Ballard 1997, Halstead and Ballard 1997a).

4.8.7 Peculiar Characteristics of Each Spent Fuel Pool

Each nuclear power plant in the United States has different design characteristics since the United States did not pursue a common design approach to NPP. This variability includes the spent fuel pools (SFP). Of concern is what may occur in the event the SFP loses coolant or the consequences of a fire in the pool in which the zirconium casing of the spent fuel catches fire. Significant releases of radiation can result, only if the heat from spent fuel exceeds the capacity to remove heat from the pool. The NRC has examined the frequency of events leading to water loss from the SPF. Despite real world variability inherent in U.S. NPP, the NRC staff has concluded that a generic analysis of SPF is appropriate. Still the NRC itself has questioned such assumptions. Its own documents suggest this when stating:

“In its thermal-hydraulic analysis, documented in Appendix 1A, the staff concluded that it was not feasible, without numerous constraints, to establish a generic decay heat level (and therefore a decay time) beyond which a zirconium fire is physically impossible. Heat removal is very sensitive to these additional constraints, which involve factors such as fuel assembly geometry and SFP rack configuration. However, fuel assembly geometry and rack configuration are plant specific, and both are subject to unpredictable changes after an earthquake or cask drop that drains the pool. Therefore, since a non-negligible decay heat source lasts many years and since configurations ensuring sufficient air flow for cooling cannot be assured, the possibility of reaching the zirconium ignition temperature cannot be precluded on a generic basis” (NUREG 1738).

This passage suggests that some portions of the NRC staff do not believe that it is possible to generically assess the risks to spent fuel pools.

5 THE NEPA ANALYSIS IS INSUFFICIENT

The NRC’s DGEIS does not provide information about any real reactor site or NPP complex. It does not assess the human health risks of continued storage at a particular site. It does not take a hard look at the issues and does not address the court’s concerns.

The arguments above point out how the choices made by the agency impact the analytical viability of the analysis and thus how the DGEIS does not respond to the task of properly evaluating the environmental consequences of the major federal actions it is evaluating and alternative actions which can mitigate those consequences. These shortcomings are evident in many ways including:

1. The DGEIS overlooks the central problem by using a purpose and need statement that sidesteps the analytical issues raised by the task it is obligated to undertake.
2. The analysis of environmental consequences in the DGEIS does not reflect reasonably foreseeable and different future conditions.
3. The DGEIS does not contain a thorough and in-depth analysis of the consequences of indefinite storage of spent fuel.
4. The DGEIS does not properly assess the impacts of indefinite storage of SNF because its analysis depends upon invalid or questionable assumptions.
5. The NRC is not entitled to agency deference on many of these assumptions because in whole or in part, the assumptions fall outside of the agency’s area of expertise.
6. Because of these assumptions, the NRC did not examine a realistic set of alternatives or a realistic set of potential future conditions and the environmental consequences they would produce.
7. The assessment does not properly address the risks to the environment.
8. The DGEIS fails to justify the use of generic analysis of many of the environmental consequences that are substantially impacted by site-specific variations.

6 CONCLUSION

This report examined the DGEIS and the NRC's assumptions, staff choice of methodology and the validity/reliability of the conclusions that flow from these. The use of these assumptions in the construction of the DGEIS leads the NRC to fail to address the hard look questions NEPA requires be examined. Instead it offers a generic analysis that does not provide an adequate record for NRC to make a decision on this major federal action.

To reiterate specifics, this conclusion will focus on three particular shortcoming themes.

- First, the assumptions underlying the DGEIS conceal the real issues behind the generation, storage and movement of SNF. The NRC's assumptions in the DGEIS were used to limit the alternatives being considered and diminish the scope of the environmental consequences that needed to be evaluated.

These assumptions, in conjunction with the Commission's choice to accelerate the time needed to do the analysis from the staff suggested seven years to the Commission mandated two years, resulted in an insufficient, invalid and unreliable DGEIS.

In addition the NRC fails to consider viable alternatives to on-site storage – for example, the WIPP geologic repository in New Mexico. Inclusion of such an alternative would have been reasonable.

In other words, the assumptive choices made by the Commission and agency staff do not represent a hard look at the issues and thus NRC fails to meet its obligation under NEPA.

- Secondly, the overall methodology used in the DGEIS avoids a valid and scientifically sound analysis of the issues. Using a normative forecasting method and thus assuming a future, rather than analyzing the facts and considering reasonably different futures, avoids the type of analysis required by NEPA.

In addition, the choice of a generic analysis does not meet the needs of NEPA because it glosses over the important site-specific conditions and factors which will markedly alter the environmental consequences and mitigation alternatives for each site. The use of unsupported assumptions led to no consideration of many of these site-specific conditions and factors. NRC has common methodological approaches like probabilistic risk assessment (PRA) that do consider different futures and make predictions about the probability of different conditions arising in the future in making consequences analyses but it fails to use a similar methodology here and thus fails to address a variety of reasonably foreseeable conditions that must be addressed in such an analysis.

- Third, the analysis above offered several realistic and reasonable alternatives to the methodological choice of a generic analysis and the normative forecasting. Good methodological practice recognizes that a singular method for such an important task is often

either invalid or unreliable – or degrees of both. A single method has flaws, as do all methods. What is needed is to address the issues in the best possible manner – one which seeks scientifically sound, valid and reliable results. That can better be achieved with the triangulation of methodologies – two or more wherein each covers the shortcomings of the other. NRC has not used even one of the exploratory methodologies in the DGEIS.

To summarize, the choice of the generic approach, using normative forecasting and unsupported assumptions, does not meet a minimum level of research inquiry. It fails to construct a valid and reliable research endeavor that should be necessary to meet NEPA requirements.

- Fourth, the choices by the NRC to avoid issues like environmental contamination from leaks in the pools/or dry storage, the real possibility of future funding shortfalls for their own operations, the realistic and foreseeable loss of institutional controls and the other issues noted above, should have been part of the analytical process but the DGEIS fails to address these very real concerns.

In short, the NRC has created a fictional world for its DGEIS that does not and cannot exist. It has created a weighty document with no real substance. It has failed in its obligation to take the mandated hard look, and failed to meet the obligations the agency had under NEPA.

This report offered an analysis on the assumptions the NRC used in the DGEIS. These assumptions led the agency to abstract the issues, to address the analysis in a generic, thus unrealistic fashion and in the process avoid its obligations under NEPA. Included in this report are alternative methodologies, some of which have been used by the NRC in the past, offered in an effort to offer a roadmap for a more robust, valid and reliable means to analyze the environmental impacts of the proposed action. The NRC should consider its own staff recommendations of a seven year process and take the time and exert the effort to analyze the issues in a more robust manner.

BIBLIOGRAPHY

- Alvarez, Robert, Jan Beyea, Klaus Janberg, Jungmin Kang, Ed Lyman, Allison Macfarlane, Gordon Thompson, Frank N. von Hippel. Reducing the Hazards from Stored Spent Power-Reactor Fuel in the United States. *Science and Global Security*, 11:1–51, 2003.
- Ballard, James David. 1995/1997. "Preliminary Study of Sabotage and Terrorism as Transportation Risk Factors Associated with the Proposed Yucca Mountain High-level Nuclear Waste Facility." Nuclear Waste Projects Office: Carson City, NV.
- _____. 1999. "Expert Testimony, Injunction Hearing." Qualified and testified as an expert witness, United States District Court, Western District of Michigan, Southern Division. Testimony focused on terrorism and the movement of nuclear materials across Michigan.
- _____. 1999a. "Nuclear Regulatory Commission Documentation for Petition. Agency petition for Rulemaking pursuant to 5 U.S.C. § 553 and 10 C.F.R. § 2.800 - 2.804." Available at: <http://www.state.nv.us/nucwaste/news/ag990622b.htm>
- _____. 2001. *Qualitative Research Methods: Syllabi and Instructional Materials*, 2nd Edition. Compendium editor and contributor. Washington, DC: American Sociological Association.
- _____. 2002a. "Testimony" before the United States Senate, Committee on Energy and Natural Resources, One-Hundredth Seventh Congress regarding S. J. Res.34 Approving the Site at Yucca Mountain, Nevada, for the Development of a Repository for the Disposal of High-level Radioactive Waste and Spent Nuclear Fuel, Pursuant to the Nuclear Waste Policy Act of 1982. Available at <http://www.yuccamountain.org/leg/ballard052202.html>.
- _____. 2002b. "Testimony of James David Ballard." United States House of Representatives, Subcommittee on Highways and the House Subcommittee on Transportation and Infrastructure. Available at <http://gopher.house.gov/transportation/highway/04-25-02/ballard.html>.
- _____. 2003. "Nuclear Waste Transportation: Lessons from 9/11/2001 Applicable to Nuclear Waste Transportation Program Planning, Security, and Emergency Response." Testimony in Las Vegas hearing before the National Academies of Science, Committee on Transportation of Radioactive Waste.
- _____. 2005. *Terrorism, Media and Public Policy*. Cresskill, NJ: Hampton Press.
- _____. 2007. "Where is my Package - Exactly? Nuclear Waste Transportation, Public Safety and ITS." *In Bringing ITS all Together*, pages 45-56. Ed. Sheila H. Conway. Las Vegas, NV: Clark County Comprehensive Planning, Nuclear Waste Program
- _____. 2008. "Terrorism Risk and the Transportation of Spent Nuclear Fuel and High Level Radioactive Waste." Testimony before the United States Senate, Committee on Commerce, Science and Transportation. Hearing on Safety and Security of Spent Nuclear Fuel Transportation, September 24, 2008. Available at <http://commerce.senate.gov/>
- Ballard, James David and Fred Dilger. 2008a. "Scenario Development in Oil and Gas Management: Envisioning the Future by Means of Analytical Techniques." *Strategic Insights*, VII. Available online at <http://www.ccc.nps.navy.mil/si/2008/Feb/ballardFeb08.pdf>.
- _____. 2008b. "Using Social Scientific Methodological Approaches to Reducing Risk: How the Risk Reduction Approach Works with Oil and Gas Facilities." *International Journal of Social Inquiry*, 1(1): 105-119.
- _____. 2012. "Energy-related Counterterrorism." In *Counterterrorism: From the Cold War to the War on Terror*. Eds. Frank Shanty. Santa Barbara: ABC-CILO.
- Bechtel/SAIC. 2005. Commercial Spent Nuclear Fuel Handling in Air Study March Las Vegas, NV.
- Becker, Larry and James David Ballard. 2005. "Federal Programs and their Potential to Incite Political Violence: The Transportation Program for Yucca Mountain and Terrorist Adversaries." In

- Terrorism: Readings, Research, and Realities*. Eds: Lynne Snowden and Brad Whitsel. Upper Saddle River, NJ: Prentice-Hall. Republished as e-book in Jan. 2009 by Pearson Custom Publishing.
- Christensen, M. R., D. C. Koelsch, L. Stewart, and M. A. McKinnon. 2000. *Spent Nuclear Fuel Dry Transfer System Cold Demonstration Project*. INEEL/EXT-99-01335, Idaho National Engineering and Environmental Laboratory, Idaho Falls, Idaho. Available at <http://www.inl.gov/technicalpublications/Documents/3318121.pdf>.
- DOE. Used Fuel Disposition Campaign Gap Analysis to Support Extended Storage of Used Nuclear Fuel Rev. 0 January 31, 2012 Available at <http://energy.gov/ne/downloads/gap-analysis-support-extended-storage-used-nuclear-fuel-0>
- DOE. *Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*. DOE/EIS-0250, Office of Civilian Radioactive Waste Management, North Las Vegas, Nevada.
- DOE (2012). *Managing Aging Effects on Dry Cask Storage Systems for Extended Long-Term Storage and Transportation of Used Fuel*. FCRD-USED-2012-000119, ANL-12/29, Washington, D.C. Available at <http://www.ipd.anl.gov/anlpubs/2012/07/73873.pdf>.
- Environmental Protection Agency Institutional Controls: A Guide to Planning, Implementing, Maintaining, and Enforcing Institutional Controls at Contaminated Sites Washington D.C. Dec 2012.
- EPRI, 1998. Data Needs for Long-Term Dry Storage of LWR Fuel, EPRI, Inc., Palo Alto, CA: 1998. TR-108757.
- EPRI, 2002. Dry Cask storage Characterization Project, EPRI, Palo Alto, CA, U.S. Nuclear Regulatory Commission – Office of Nuclear Regulatory research, Washington, D.C., U.S.
- Electric Power Research Institute (EPRI). 2010. Industry Spent Fuel Storage Handbook. Palo Alto, California. Available at <http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001021048>
- Emshwiller, J. R. and J. Singer-Vine. (October 30, 2013). "A nuclear cleanup effort leaves questions lingering at scores of old sites." Wall Street Journal: South Brunswick, NJ. Downloaded on November 14, 2013.
- Forbes Magazine. (February 11, 1985).
- Halstead, Robert J. and James David Ballard. 1997a. "Nuclear Waste Transportation Security and Safety Issues." Nuclear Waste Projects Office: Carson City, NV. Available at: <http://online.wsj.com/news/articles/SB10001424127887323342404579079483154040874>
- _____. 1997b. "Nuclear Waste Transportation Security and Safety Issues: Potential Transportation Impacts of S.104 and H.R.1270." Nuclear Waste Projects Office: Carson City, NV.
- Johnson, K. (November 12, 2013). "What's holding back nuclear energy: A look at the challenges that keep it from taking off – and how to meet them." *Journal Report*, November 12, 2013, p. R3. Wall Street Journal: South Brunswick, NJ.
- Kirkham, L. and A. J. Kuperman. (August 15, 2013). "Protecting U.S. nuclear facilities from terrorist attack: Re-assessing the current 'Design Basis Threat' approach." Austin, TX: University of Texas, Austin, Nuclear Proliferation Prevention Project.
- Macfarlane, A. M. (February 27, 2013). "Subsequent Licence Renewal: Our Collective Obligations." Prepared remarks of NRC Chairperson Allison M. Macfarlane at the Nuclear Energy Institute Long-term Operations/Subsequent Licence Renewal Forum. Washington, DC: United States Nuclear Regulatory Commission (NRC), Office of Public Affairs, Document Number 13-006.
- _____. (May 14, 2013). "Life after Fukushima: 'The new normal': Prepared remarks of NRC

- Chairperson Allison M. Macfarlane at the Nuclear Energy Institute (NEI) Nuclear Energy Assembly." Washington, DC: United States Nuclear Regulatory Commission (NRC), Office of Public Affairs, Document Number 13-008.
- Magwood, W. D. (2013). "Who are we?: Prepared comments of Commissioner William D. Magwood, IV at the NRC Regulatory Information Conference (RIC)." Washington, DC: United States Nuclear Regulatory Commission (NRC), Office of Public Affairs, Document Number S-13-004.
- Martino, Joseph. *Technological Forecasting for Decision Making*. 3rd Edition McGraw Hill, New York. 1993.
- McCord, Joan ed. *Facts, Frameworks and Forecasts, Advances in Criminological Theory*. Transaction Publishers. New Brunswick New Jersey.
- Mullendore, Kristine and James David Ballard. 2005. "Presumption of Response to Terrorism: Potential Legal Aspects Relative to First Responders." *In NATO and Terrorism: Catastrophic Terrorism and First Responders*, pages 82-99. Eds. Friedrich Steinhausler and Frances Edwards. Dordrecht, Netherlands: Springer
- National Academy of Sciences (NAS). (2006). "Safety and security of commercial spent nuclear fuel storage: Public report." Washington, DC: National Academies Press.
- National Environmental Policy Act of 1969 (NEPA). 42 USC 4321 et seq.
- NEA, 2002. Report of the Task Group Reviewing Activities in the Area of Ageing of Concrete Structures Used to Construct Nuclear Power Plant Fuel-Cycle Activities, NEA/CSNI/R(2002)14, Nuclear Energy Agency Committee on the Safety of Nuclear Installations, Paris.
- NRC, 1997. U.S. Nuclear Regulatory Commission (NRC). 1997. Standard Review Plan for Dry Cask Storage Systems. NUREG-1536, NRC, Washington, D.C.
- NRC (U.S. Nuclear Regulatory Commission). 2007. "A Pilot Probabilistic Risk Assessment of a 21 Dry Cask Storage System at a Nuclear Power Plant." NUREG-1864, Washington, D.C. 22 Accession No. ML071340012.
- NRC. (October 28, 2013). "Frequently asked questions about the waste confidence generic environment impact statement (DGEIS) and rulemaking." Downloaded on November 14, 2013. Document is available at: <http://www.nrc.gov/waste/spent-fuel-storage/wcd/faq.html>
- NUREG-1738. Available at: <http://www.pbadupws.nrc.gov/docs/ML0104/ML010430066.pdf>
- NUREG-2157. (August 2013). "Waste confidence generic environmental impact statement: Draft report for comment." Washington, DC: United States Nuclear Regulatory Commission (NRC), Waste Confidence Directorate.
- Ord, Keith and Robert Fildes. (2013) *Principles of Business Forecasting*. Southwestern. Mason OH.
- Ritchey, T. (1997) "Scenario Development and Risk Management using Morphological Field Analysis." *Proceedings of the 5th European Conference on Information Systems* (Cork: Cork Publishing Company) Vol. 3:1053-1059.
- _____. (1998) "Fritz Zwicky: 'Morphologie' and Policy Analysis." Presented at the 16th Euro Conference on Operational Analysis, Brussels
- _____. (2002) "Modeling Complex Socio-Technical Systems using Morphological Analysis." Adapted from an address to the Swedish Parliamentary IT Commission, Stockholm, December 2002. (Available for download at: www.swemorph.com/downloads.html).
- _____. (2003a) "Nuclear Facilities and Sabotage: Using Morphological Analysis as a Scenario and Strategy Development Laboratory". Presented to the 44th Annual Meeting of the Institute of Nuclear Materials Management - Phoenix, Arizona, July 2003. (Available for download at: www.swemorph.com/downloads.html.)
- _____. (2007) "Threat Analysis for the Transport of Radioactive Material using Morphological Analysis." Adapted from a paper presented at the 15th International Symposium on the

- Packaging and Transportation of Radioactive Materials, PATRAM 2007, Miami, Florida. Available for download at:
www.swemorph.com/downloads.html.)
- _____. (2009). "Developing Scenario Laboratories with Computer-Aided Morphological Analysis. " Presented at the 14th International Command and Control Research and Technology Symposium, Washington DC. (Available for download at:
www.swemorph.com/downloads.html.)
- Steinhausler, Friedrich, Morton Bremer Maerli, Stan Rydell, George Bunn and James David Ballard. 2004. Terrorist Attacks on Nuclear Power Plants and Nuclear Materials Transports. Brussels, Belgium: NATO.
- Transnuclear, 2001. Final Safety Analysis Report for the Standardized NUHOMS Horizontal Modular Storage System for Irradiated Nuclear Fuel, NUH-003, Revision 6, Transnuclear West, Fremont, California, October 2001.
- Zwicky, F. (1969) *Discovery, Invention, Research - Through the Morphological Approach*, Toronto: Macmillan Company.

APPENDIX A LOSS OF INSTITUTIONAL CONTROL (US EXAMPLES)

The DGEIS assumes that institutional control is guaranteed and sufficient for spent fuel storage in perpetuity. The history of the nuclear fuel cycle, both here and in other countries suggests that institutional control is often lost and that extremely severe contamination and concomitant environmental effects are normal rather than exceptional.

The nuclear fuel cycle is a complex, dangerous heavy industrial process. Failure at any part of the process can create severe radiation exposures. The history of the nuclear materials production has been persistently dogged by questions of funding. Inadequate funding (combined with poor management decisions) led to the later, extremely costly, cleanup programs associated with the DOE nuclear weapons production complex. The contamination at these sites is estimated to cost between \$200 and \$250 billion dollars to clean up and will require indefinite stewardship at more than 100 sites (RFF p. vii). The prohibitive costs of funding these programs have led to an impending shortfall (NGA p. 8). This has been particularly true of nuclear waste.

These brief descriptions are included to demonstrate the frequency and severity with which nuclear materials escape institutional control and the expense of cleaning up their contamination.

Uranium mining

The substantial loss of life associated with uranium mining has been extensively documented (BEIR). Mining exposures occurred over a long period, primarily when the hazards of radiation exposure were either poorly understood or ignored. One example should help as an illustration. The Church Rock uranium mining tailing spill occurred on July 16, 1979. The facility was owned by United Nuclear Corporation. Over 1,000 tons of solid waste and 93 million gallons of acidic radioactive tailings were washed into the Puerco River. The contamination traveled 80 miles downriver. The loss of control of these radioactive materials created a severe environmental impact.

Sequoyah

Sequoyah Fuels Corporation operated a licensed fuel cycle facility near Gore, OK. The purpose of the facility was to convert yellowcake (concentrated uranium ore) into gaseous uranium hexafluoride (UF₆). The yellowcake was treated with nitric acid to purify and extract uranium. The uranium was then treated with hydrogen fluoride to produce UF₆ to be stored and transported in compressed gas cylinders. This process is similar to the need to refill dry cask storage containers with inert gases.

On January 4, 1986, an overfilled UF₆ cylinder ruptured. Half of the UF₆ from the cylinder was washed into the emergency pond at the site. The other half formed a plume of white vapor containing uranyl fluoride and hydrofluoric acid. The facility ventilation system carried the plume toward the scrubber building 15 meters away. The plume also left the area of the plant and traveled 17 miles south, over an interstate and through a sparsely populated residential area. The incident led to the immediate death of one worker and the hospitalization of 37 additional workers. On the day of the rupture, Sequoyah Fuels Corporation lacked a systematic procedure to deal with the emergency. While

regulators have oversight of such processes the institutional controls such policies represent were insufficient.

Formerly Utilized Sites Remediation Action Program (FUSRAP)

This program was initiated in 1974 to identify, investigate and clean up or control sites throughout the United States that became contaminated as a result of the Nation's early atomic energy program. During the 1940s, 1950s and 1960s, private companies throughout the United States, under contract with the Government, performed work for the Manhattan Engineer District (MED) and during peacetime for the Atomic Energy Commission (AEC). Both the MED and AEC were predecessors to the present day DOE. FUSRAP was initiated in 1974 to study and take appropriate cleanup action at sites that had become contaminated because of work performed by private companies for the MED and AEC. The Energy and Water Development Appropriations Act for fiscal year 1998, signed into law on October 13, 1997, transferred responsibility for the administration and execution of FUSRAP from the DOE to the U.S. Army Corps of Engineers (USACE).

Department of Energy EM (environmental management) sites

The failure to adequately manage the production of nuclear weapons in the United States led to radiological contamination. This contamination, in turn, led to the largest environmental cleanup in the world. Billions of dollars have been spent on the cleanup effort. The contamination has occurred at 107 sites across the country, with an area equal in size to Rhode Island and Delaware. EM has made substantial progress in nearly every area of nuclear waste cleanup and as of September 2012, completed cleanup at 90 of these sites.