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An Analysis of United States Nuclear Power Plant Decommissioning Policy and the Public Participation Process

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ABSTRACT

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As the number of nuclear power plants slated for decommissioning increases, reflecting on the U.S. Nuclear Regulatory Commission's (NRC's) decommissioning regulations in relation to public participation becomes increasingly important. When plants close, communities lose security in economics, employment, and environmental and human health. The NRC's regulations on public involvement are very limited and generally stakeholders do not feel supported in the decommissioning process. Local and tribal governments, citizen groups, the general public, and those directly affected have all found the NRC's public involvement inadequate, ineffective, and infrequent. The case studies of two completely decommissioned plants, Maine Yankee and Big Rock Point, and recommendations/actions of other decommissioning groups, governments, and stakeholders were used to inform policy recommendations for the NRC in order to create a decommissioning process that provides equal opportunity to learn, discuss, and plan for all stakeholders.

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ACADEMIC HISTORY

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DEDICATION

Thank you to my parents for their constant encouragement, interest, and support throughout the entire process of this paper. Your unending love, praise, and faith in me helped me remain determined. I would never be here without you.

Thank you to my brother for always making me smile and remind me what to love and cherish when things get too overwhelming. You inspire me to be stronger, thank you for sharing your joy with me.

To my friends who always kept me laughing – thank you for the happiness and sweets you gave me during this process and thank you for letting me rant to you about nuclear energy for hours on end.

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And finally, thank you to my community in Cortlandt Manor, New York. My home on the Hudson River, just ten minutes from Indian Point Energy Center. When I think of how hard the last few years have been since the announcement of Indian Point's closing, I cannot help but admire our community's strength. This paper is for us to learn and grow together. I look forward to when we meet again and work towards creating a future for Indian Point together, as a community.

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Introduction

The discovering, harnessing, and exploiting of energy sources has been central to human and societal development across time - from early man's struggle for survival to today's technological world. We learned how to control fire and how to create it from biofuels; we used power from the elements of wind, sun, and water; we burned coal, oil, and natural gas and harnessed its chemical energy (Bodansky, 2007). Nuclear energy marked a vast departure from previous methods of energy creation in that it was the first time that humans had actively understood how particulate matter of atoms contained energy and that that energy could be used in electrical power generation (U.S. DOE, 1994).

The first nuclear power reactor was built at the University of Chicago in 1942 (U.S. DOE, 1994). Today, there are 98 active nuclear power plants in the United States (NRC, 2019e). Nuclear power has long been a contested issue globally and especially in the U.S. Only one nuclear reactor has been built in the U.S. in the last twenty years, and as a result the nation has many aging nuclear plants (NRC, 2019d). Eventually, plants reach an age where keeping them running may no longer be economically viable or safe, and, as a result, plants shut down and decommission. Decommissioning a nuclear power plant is a process that can take hundreds of millions of dollars and several decades. Decommissioning means a loss of energy, but it also means a loss of employment and revenue for communities as well as many questions about the site and the plant's waste. The decommissioning process involves many stakeholders and is a key step for planning and transitioning to a future without nuclear power.

Chapter 1: A History of Nuclear Energy in the United States

The beginnings of nuclear energy, an energy source so powerful it powers cities, villages, and towns across the world today, can all be traced back to the tiny, microscopic atom. Atoms are the particles in molecules that make up the foundations of our universe. Three smaller particles make up atoms called protons, neutrons, and electrons. Protons carry a positive charge, electrons carry a negative electrical change, and neutrons do not have an electrical charge. The protons and neutrons make up the atom's nucleus which is the positively charged center of the atom. The nucleus is held together by an enormous amount of energy that is found in its bonds. This energy can be released when the bonds are broken; the process by which this breaking of bonds, or splitting of atoms, occurs, is called nuclear fission (U.S. DOE, 1994).

Nuclear fission was discovered by Italian physicist Enrico Fermi in 1934. He found that when you bombarded uranium with neutrons, a much lighter element was created. In 1938, German scientists Otto Hahn, Fritz Strassman, and Lise Meitner, along with the Danish scientist Niels Bohr and other collaborators, discovered why the post-fission substances were lighter. When the atom is split, matter is lost. That matter changes into energy that is released as heat. The two (or more) resulting atoms are lighter because there is less matter. The energy released as heat can be harnessed to create electricity. Bohr came to America in 1939 and shared the findings of the mass-to-energy properties of nuclear fission with Einstein and Fermi, who discussed the possibility of a self-sustaining chain reaction (U.S. DOE, 1994).

When an atom is split, the by-products include: two lighter atoms, the energy that is

released as heat, and two or three neutrons that are released with the heat. These neutrons may hit other atoms and cause a series of fissions – also called a chain reaction. When enough of the element is brought together under the right conditions, a continuous chain reaction occurs, or a self-sustaining chain reaction. This type of reaction creates a great deal of heat because so many reactions are occurring. Like any other steam-electric powerplant, this heat is used to boil water and the steam from the boiling water turns turbines which generates electricity. Using this idea, in 1942, Fermi led a group of scientists at the University of Chicago to develop the world's first nuclear reactor, Chicago Pile-1 (U.S. DOE, 1994).

When research into nuclear energy first began, its development and funding were for the purpose of creating atomic bombs and nuclear weaponry during World War II, not for civilian power use. Fermi's reactor was developed as part of the Manhattan Project, the Allied Forces' nuclear weaponry research. Fermi's work eventually led to the development of both uranium-based and plutonium-based weapons and the subsequent atomic raids on Japan. After the War, the U.S. encouraged further development of nuclear energy, but this time for civilian purposes. In 1946, Congress created the Atomic Energy Commission (AEC). The AEC's responsibility was for both the promotion and regulation of the nuclear industry (Bradshaw & Gruber, 2007). The AEC worked to create a nuclear reactor that could produce electricity for commercial use (U.S. DOE, 1994). In 1957, the Shippingport Atomic Power Station in Western Pennsylvania became the first nuclear central station to produce electricity in the United States (Bradshaw & Gruber, 2007).

The growth of nuclear reactors was slow for the first decade after Shippingport. Between 1963 and 1966, 9 contracts for nuclear power reactors were awarded (Bradshaw

& Gruber, 2007). However, this did not deter the AEC, who anticipated more than 1,000 reactors would be operating in the U.S. by the year 2000 (Parker & Holt, 2007). Rapid growth of nuclear plants ensued, and between 1966 and 1967, 52 orders were placed (Bradshaw & Gruber, 2007).

Criticism of nuclear power has been around since its inception. In the 1950s and 60s, many people were concerned that the devastation in Japan from the atomic bombs would happen in nuclear powerplants stateside. Others were fearful of the potential environmental and health impacts of radiation and subsequent radioactive waste. While the protests of civilians forced the abandonment of some plans for nuclear power plants, the nuclear industry's rapid growth continued until 1974 (Bradshaw & Gruber, 2007).

The growth of nuclear was coming to a head. In 1974, over 200 orders for nuclear systems were placed (Bradshaw & Gruber, 2007). In the same year, due to the AEC's very low nuclear health and safety standards, the Commission's regulatory programs had come under such attack that Congress abolished the agency. The Department of Energy absorbed the research and development responsibilities of the AEC, while the regulatory branch was turned into an independent commission known as the U.S. Nuclear Regulatory Commission, or NRC (NRC, 2019c). At the same time, it became clear due to the amount time and resources necessary to build plants, that nuclear power could not grow as fast as originally projected by the AEC, and ultimately more than 120 reactor orders were ultimately cancelled (Parker & Holt, 2007). This period marked the beginning of a decline in the progress of the nuclear industry because of the changes and challenges caused by higher nuclear and environmental standards, economic trends that increased inflation and interest rates, nuclear plant disasters, and increased opposition and

protests to nuclear power by civilians (Bradshaw & Gruber, 2007).

In the U.S., there are currently 98 commercial nuclear power plants licensed to operate across 31 different states (NRC, 2019e; Figure 1). The U.S. has two types of nuclear reactors in commercial operation: Pressurized Water Reactors (PWRs) and Boiling Water Reactors (BWRs). The main difference between these two types of reactors are how the steam is generated. PWRs keep hot water under pressure in its primary cooling/heat transfer circuit and steam is generated in a secondary circuit, while BWRs make steam in the primary circuit (Agyeman, 2018). There are currently 65 PWRs and 33 BWRs operating in the U.S. (NRC, 2019e). These power reactors generate about 807 billion kWh, which is about 20% of the nation's electricity (Figure 2). Nuclear is currently the second largest electricity production sector in the nation (EIA, 2019).

The nuclear industry in the United States is entering a new period of change and uncertainty. For the last three decades, there have been few new nuclear power plants (EIA, 2018). The main reasons that nuclear power development has been largely stagnant in the U.S. are: 1) civilian and scientific concerns over the safety of nuclear power and nuclear waste, and 2) the high cost of nuclear power, especially input costs, when compared to the fossil fuel alternatives (Walker & Wellock, 2010; Kessides, 2012). However, there have also been changes in ideologies regarding nuclear power in the United States as a result of the volatility of fossil fuel prices and concerns about climate change (Miller & Sagan, 2009). Another reason why the nuclear industry is changing in America is the age of the nation's nuclear fleet. The average age of U.S. commercial reactors is about 37 years old (EIA, 2018). The NRC only licenses commercial nuclear reactors for 40 years because that was the planned lifespan when these reactors were

built. However, recent statements from the NRC and other experts in the nuclear research industry have said that the nation's nuclear plants will likely run for another 50-70 years, more than double the initial lifetime estimate. This is because almost every component of the plants can be replaced. While the actual plant structure will not be the same over its whole lifespan, these estimates indicate that many nuclear plants in the U.S. could run for 90-110 years (Voosen, 2009). Regardless of these scientific findings, more and more nuclear power plants are nearing the end of their licenses. It is anticipated that at least 10 more plants will announce plans to retire by 2025.

The process of retiring a plant is long and costly. Retirement processes – called decommissioning – can take 60 or more years and can cost over a billion dollars (Gospodarczyk & Kincer, 2017). As the number of nuclear plants slated for retirement continues to increase, it is necessary to reflect on these decommissioning regulations, to ensure they reflect the wants and needs of a nation with a divisive relationship to nuclear power and that these regulations actively include the public in decommissioning.

Chapter 2: Nuclear Decommissioning Policy in the United States

Of the 98 nuclear reactors currently operating in the U.S., 92 of them, or 94%, are over 30 years old, while 48 (or 49%) are over 40 years old. Six of the current power reactor licenses will terminate within the next five years, 17 within the next 10 years, and 53 within the next 20 years (NRC, 2019d). Regardless of whether these plants will renew their licenses, the United States has an aging nuclear fleet that must look towards life after operation.

When a power company decides to permanently close a nuclear power plant, the facility must be decommissioned. According to the NRC, decommissioning is, "the process of safely closing a nuclear power plant (or other facility where nuclear materials are handled) to retire it from service after its useful life has ended" (NRC, 2019d). In summary, decommissioning is the process of closing a facility followed by reducing residual radioactivity to levels that permit the release of the property for unrestricted use, after which the license can be terminated. From the initial shutdown decision to the completion of the planned end-state and termination of the license, decommissioning activities are subject to various laws and regulations. In the U.S., the NRC and Department of Energy (DOE) are the primary agencies that oversee compliance with federal requirements. The DOE is responsible for research and development of nuclear power while the NRC is the regulatory branch (NRC, 2019c). Nuclear facilities are subject to many environmental laws and regulations, however much of this authority is delegated to the states, so regulations differ state-by-state. There are numerous federal requirements to which all U.S. nuclear facilities must adhere. The NRC is the federal

agency responsible for regulating the decommissioning of commercial nuclear facilities (Taboas, Moghissi, & LaGuardia, 2004). Currently, the NRC is in the process of decommissioning 20 commercial nuclear reactors and another 21 commercial reactors are likely to shut down in the next decade (Clemmer, Richardson, Sattler, & Lochbaum, 2018). To date, the NRC has completed decommissioning of 10 commercial reactors (Gospodarczyk & Kincer, 2017).

The NRC regulatory framework is codified within Title 10 of the Code of Federal Regulations (C.F.R.), especially Parts 0 through 199. These regulations apply to all individuals and organizations with a license to operate nuclear facilities and/or a license to hold or use radioactive materials. In addition to Title 10 of the CFR, the NRC has produced guidance documents and NUREG (nuclear regulatory guides) documents for decommissioning (Taboas, Moghissi, & LaGuardia, 2004).

NRC Decommissioning Strategies

Licensees may choose from three decommissioning strategies – DECON, SAFSTOR, and ENTOMB[1]. In short, DECON is the dismantling and removal of equipment, structures, and portions of the facility containing radioactive contaminants soon after operations cease; when radiation returns to the permissible level for property release, the NRC license can be terminated. SAFSTOR, often considered deferred dismantling, is when the facility is maintained and monitored to allow radioactivity to decay before it undergoes DECON. Under ENTOMB, radioactive contaminants are

[1] See Appendix II for a full description of each decommissioning method (DECON, SAFSTOR, and ENTOMB) along with each's pros and cons.

permanently encased onsite in structurally sound material, such as concrete; the facility is maintained and monitored until the radioactivity decays, permitting restricted release of the property (NRC, 2019a).

The choice of decommissioning method is entirely up to the licensee. However, the NRC would require the licensee to re-evaluate if: their choice could not be completed as described, it could not be completed within the 60-year timeline, the activities would have beyond permissible risk to the public according to the NRC's health and safety regulations, or it would result in a "significant" impact to the environment (NUREG-1628, 2000).

Decommissioning must be completed within 60 years of ceasing plant operations; however, if facilities apply to extend this deadline, it will be reviewed and possibly accepted by the NRC if the extension is necessary to protect public health and safety (Taboas, Moghissi, & LaGuardia, 2004). Some benefits of DECON are that the facility license will be terminated quickly so the site can be released, there is a possibility of a just transition for workers, and it has lower estimated costs than SAFSTOR. Some disadvantages of DECON are that there is higher radiation exposure for workers and the public, it takes more money up-front, and there is a higher chance that spent fuel will remain onsite indefinitely. Benefits of SAFSTOR include a reduction in radiation exposure, less required waste disposal space, and lower upfront costs. Some cons of SAFSTOR are that the site will not be usable for a long time, there is a need for and cost of continued maintenance, security, and surveillance, and there is a small chance for continued staff employment during decommissioning, so SAFSTOR has higher total costs (NUREG-1628, 2000). Licensees may choose to adopt a combination of the

DECON and SAFSTOR strategies with some portions of the facility being immediately dismantled while others are left in SAFSTOR.

No NRC facilities have yet requested the ENTOMB option. The reason why ENTOMB has been used in the U.S. is because there is almost no possibility for the land to be repurposed. Since the facility is completely contained the concentrations of radionuclides would not allow for unrestricted use of the site for at least 100 years. The site also needs to be under constant supervision for security and monitoring purposes, which can accrue high costs over this options indefinite timescale (NUREG-1628, 2000).

Outline of NRC Power Reactor Decommissioning Activities

The decommissioning activities of nuclear power reactors can be divided into three parts: (1) initial activities/transition, (2) major decommissioning & storage, and (3) license termination activities (Figure 3). Decommissioning action begins when the decision to permanently cease operations is made. Within 30 days of the final shutdown, a written certification of permanent operation cessation must be given to the NRC. When radioactive nuclear fuel is permanently removed from the reactor vessel, the owner must submit another written certification to the NRC – this surrenders the licensees' authority to operate the reactor or load fuel into its vessel (NRC, 2018a).

Within the two years after cessation, a post-shutdown decommissioning activities report (PSDAR) must be submitted. This report includes planned decommissioning activities, a schedule, cost estimate, and an evaluation of environmental impacts associated with site-specific activities that states why the decommissioning activities will be appropriately bounded by Environmental Impact Statements (EISs). The NRC will

notice the receipt of the PSDAR in the *Federal Register* and it will be made available to the public (NRC, 2017a). Usually within 90 days of the PSDAR's submission, there is a required public meeting held in the vicinity of the facility. There is also a public comment period for the PSDAR (Taboas, Moghissi, & LaGuardia, 2004). After the PSDAR's submittal, there is a 90-day wait period, after which three major decommissioning activities may begin: (1) the permanent removal of major radioactive components; (2) permanent changes to the containment structure; (3) dismantling components that have Greater-Than-Class C waste[2]. According to 10 C.F.R. § 50.59, after the submittal of the PSDAR, the licensee must notify the NRC before performing any decommissioning activity inconsistent with, or significantly change the schedule of those activities and schedules in the PSDAR (NRC, 2017a).

However, there are certain changes for which the NRC does not require prior notification or approval. The owner can begin major decommissioning activities without specific NRC approval. For example, the NRC does not require approval for the permanent removal of major components – the reactor vessel, steam generators, large piping systems, pumps, and valves. However, if the permanent removal of major components may prevent the release of the site for unrestricted use, cost more than the available funds, or have a "significant" environmental impact, the licensee must submit a license amendment request. The reason why the licensee will have to submit a licensee amendment request is because their actions have deviated from the plan outlined in their license and thus requires further review and subsequent approval by the NRC. As part of

[2] See Appendix II for definition of Greater-Than-Class C waste.

10 C.F.R. § 50.91(a)(2), the NRC must publish any amendment request in the *Federal Register* and there is an opportunity for a public hearing and a public comment period is opened for 30 days (NRC, 2018a).

The owner is required to submit a license termination plan (LTP) within two years of the expected license termination for the reactor. The LTP must include: a site characterization[3]; identification of remaining dismantlement activities; site remediation plans; detailed plans for final radiation surveys for the release of the site; description of the end use of the site (if restricted); updated estimate of remaining decommissioning costs; a supplement to the environmental report describing new information or "significant" environmental change associated with the final cleanup. If the site will be in restricted use, meaning it has radioactivity levels higher than permitted for unrestricted use, then as part of the LTP, the licensee must describe the site's planned end use, public consultation, institutional controls, and financial assurance needed to comply with the license termination for restricted release. If the site plans for public, unrestricted use, meaning residual radiation at the site is below 25 millirem annual exposure, then no further regulatory controls by the NRC are necessary. The LTP requires NRC approval of a license amendment. Before the approval can be granted, there is another opportunity for a hearing, and a public meeting is held near the plant site. The NRC will review the plan and decide to approve it or not (NRC, 2018a). According to 10 C.F.R. § 50.82 (2017), if the remaining dismantlement is in accordance with the LTP and the NRC's final survey demonstrates that the facility and site are suitable for release, the NRC issues a letter

[3] See Appendix II for a full description of what needs to be included in an NRC site characterization.

terminating the operating license once all decommissioning activities are complete.

As noted, the NRC has completed decommissioning of 10 nuclear power reactors. Of those 10 reactors, only three have had their license completely terminated with no spent fuel on site. The remaining seven reactors have completed decommissioning and their licenses terminated but have an Independent Spent Fuel Storage Installation (ISFSI) meaning the spent fuel from nuclear activity is still contained on site. Because this waste is highly radioactive and dangerous, it is monitored and guarded to ensure the safety of the site and community. Of the decommissioned sites with no fuel on-site, decommissioning processes ranged from five to 40 years until license termination (Gospodarczyk & Kincer, 2017). Figures 5 and 6 include information on the decommissioning strategies and reactor locations of NRC licensed reactors, including a map and timeline. Of the seven reactors that completed decommissioning with an ISFSI, the decommissioning processes required between 8 and 20 years to complete. Currently there are 20 nuclear reactors undergoing decommissioning, of which 14 are following the SAFSTOR process and the other 6 are in various stages of DECON (NRC, 2018a). Of the reactors that are in SAFSTOR, most have been going through the decommissioning process for over 40 years. The same is true of those reactors undergoing DECON, with some reactors having been in the process up to 47 years (Gospodarczyk & Kincer, 2017). In short, decommissioning is both a costly and long process that costs between $300-400 million over four decades (NRC, 2017b).

Over the last decade, the culture surrounding nuclear power has changed, with more American supporting this source of energy as a result of climate change. However, some opinions on nuclear power remain constant, for example those related to the issue of

nuclear waste. Regardless, the nation's political climate on the nuclear industry is changing. The nuclear industry's changing and uncertain future are not unnoticed by those in charge; the NRC is currently in the process of developing new decommissioning regulations (NRC, 2018a). These plans have not been made fully public, and there is no mention of what specific types of new regulations are being developed and if those regulations will only deal with the transitional period of decommissioning or have further implications. The NRC is taking action to make changes to decommissioning regulations, which is important. However, given current issues and complaints surrounding nuclear decommissioning policy, there are clear advantages to involving the public in the development of new regulation. Regardless of whether the public is invited to participate in new policy development, for those with nuclear reactor facilities and/or waste in their communities, it is time to fight for a just transition, including increased mandatory, effective, active public involvement.

Chapter 3: Public Involvement in NRC Decommissioning

Nuclear power plants demand a lot of the communities where they are located. Generally, nuclear power plants require large quantities of water to produce energy and so they require access to local natural resources. Reactor facilities are expansive and require a lot of staff to operate, maintain, and secure the reactor. Because a large staff is necessary, many community members will work for the nuclear power plant in their area. The size of facilities requires a large swath of land that is removed from densely populated areas; such property could have otherwise been used by the community or for other economic development. The community has to give a lot to a nuclear facility in order for it to run, and in return the plant provides employment opportunities and economic incentives, such as community tax breaks, revenue in the form of state and local taxes, and/or monetary contributions to community services such as the budgets for local government, school districts, and public libraries (Duke Energy, 2012). However, when a plant ceases operation, those monetary contributions and employment opportunities go away and the community's future becomes less secure (Clemmer et al., 2018). As plants decommission, the future of those communities becomes less certain and is highly dependent on the decisions of the nuclear power plant owner and the NRC. Due to the demands nuclear power plants make of communities and the institutionalized reliance of communities on this industry, public involvement throughout the decommissioning process is essential.

Basics of Mandatory NRC Decommissioning Public Involvement

According to the NRC, they consider "public involvement in decommissioning

activities to be a cornerstone of strong, fair regulation of decommissioning" (NRC, 2018c). As part of its policies regarding public involvement, the NRC allows the opportunity for public meetings, hearings, and comments at various points throughout the entire decommissioning process. However, according to NRC regulations, the Commission only has to hold two public meetings. For the entire decommissioning process, from the announcement of the plant's closure to the license termination (which, remember, typically unfolds over the course of more than 60 years), the NRC is required to meet with the community only two times. In addition, there are opportunities to provide comments whenever a licensee submits a PSDAR, LTP, or other licensee amendment requests (NRC, 2018c). However, there are no requirements that the NRC and/or licensee read and/or consider these comments. Finally, whenever the NRC prepares an environmental impact statement (EIS), the draft has to be announced and published in the *Federal Register* and the NRC's website. In accordance with the National Environmental Policy Act (NEPA), this document also must be made available for public comment (Taboas, Moghissi, & LaGuardia, 2004). Similar to the licensee-submitted documents, although there is a comment period open to the public, there are no regulations to enforce or incentivize the NRC to read or consider these comments. The NRC has agreed to release "non-sensitive" incoming correspondence (except for Congressional correspondence) within 24 hours after distribution to the NRC. However, there are no mechanisms to enforce this policy (NRC, 2003).

Mandatory Public Comment in NRC Decommissioning

The types of documents that have to be made available for public comment during decommissioning are the PSDAR, LTP, licensee amendment, and EIS. These documents

are published in the *Federal Register* and on the NRC's website under "Documents for Comment" as wells as sometimes as press releases. Comments to these types of documents must be submitted online (NRC, 2019b). The documents are usually linked via the NRC's website and comments are written on the Federal rulemaking website, Regulations.gov. These comments are posted on the NRC website and Regulations.gov. These comments are not edited nor do they remove any identifying or contact information so the NRC cautions against using any information that you would not want to be publicly disclosed (NRC, 2018d). There are no specific references or regulations as to how/if public comments will be read, reviewed, answered, and/or integrated into the NRC decommissioning process. However, the one specific reference to public comments by the NRC states, "in finalizing the [regulatory] guides, the staff considers all comments received during the public comment period, as appropriate" (NRC, 2018d).

According to 10 C.F.R. § 50.91(a)(2) (2017), the comment period for a licensee amendment will begin the day after its publication and this period will 30 days; the NRC says that normally the amendment will not be granted until the public comment period is over. This implies that while there is a mandatory comment period, there is some possibility that the NRC could grant the amendment before public comment has even been given. Also, if the NRC determines that the amendment is of "no significant hazards consideration", the NRC does not have to publish or a make a final determination unless it receives a request for a hearing on that specific amendment (10 C.F.R. § 50.91(a)(3), 2017).

The PSDAR must be made available for public comment (10 C.F.R. § 50.82(a)(4)(ii), 2017). However, there are no regulations on incorporating public

comment. Although the NRC does not approve the PSDAR, 10 C.F.R. § 50.82(a)(5) (2017), states that the licensee will not perform any major decommissioning activities until 90 days after the NRC has received the licensee's PSDAR. There are no regulations regarding when the PSDAR has to be made public, nor the timing nor the duration of the PSDAR public comment. Therefore, the public comment period and 90-day wait period may not even coincide. In conclusion, although the PSDAR has to be made publicly available and have a public comment period, there are no regulations as to the duration or timing of that comment period, nor are there any assurances that public comments will be read, reviewed, or incorporated into the draft. Ultimately, the draft does not even have to be approved by the NRC. The NRC has the power to disapprove of a PSDAR if the Commission believes it would have significant environmental and/or health effects (NRC, 2017a). So, the PSDAR public comment period has no integration frameworks into the report because the PSDAR does not require approval.

An LTP also must be made available for public comment. The document must be submitted to the NRC at least two years prior to the license termination date, and the NRC has to acknowledge receipt and make it available for public comment (10 C.F.R. § 50.82(a)(9)(iii), 2017). Once again, there are no regulations as to when the NRC must notify receipt of the LTP, when or for how long the NRC has to allow public comment on the LTP, and there is no mention as to the mechanisms or regulations of public comment reading, review, or integration into the LTP. Unlike the PSDAR, the NRC has to approve the LTP, and the Commission must approve the plan by license amendment (10 C.F.R. § 50.82(a)(10), 2017). However, because this license agreement is submitted by the NRC and not the licensee, the NRC is not required to hold a public comment period on this

license amendment. Therefore, if the NRC finds no issue with the LTP, they will approve it. Once the NRC approves the LTP, if they believe the remaining dismantlement is performable, and if the final radiation survey is within the limits of parts released for use before decommissioning, then the license is terminated and the licensee has no further responsibility to the site (10 C.F.R. § 50.82(a)(11), 2017). In conclusion, there is a mandatory public comment period for the LTP; however, there are no regulations on that process outside of where the LTP and comments will be posted. As long as the NRC approves, the license can be terminated regardless of public opinion or action.

Mandatory Public Meetings in NRC Decommissioning

The NRC has two mandatory public meetings throughout the decommissioning process. These public meetings have to be held after the PSDAR has been received by the NRC, and after the LTP has been received by the NRC. If a nuclear power reactor licensee has an opportunity for a hearing under subpart G of 10 C.F.R. part 2 due to a license violation, then no public meeting will be held after the PSDAR submission and instead the regulations of subpart G of 10 C.F.R. part 2 will take precedent (10 C.F.R. § 50.82, 2017; 10 C.F.R. § 2.700, 2018). Outside of this exemption, both public meetings are required to be held. Each of the public meetings must be held within the vicinity of the licensee's facility. In both cases, the NRC will publish notice of the meetings in the *Federal Register* and in some forum, for example the local newspaper, that is deemed accessible to those within the vicinity. This notice will announce the date, time, and location of the meeting, along with a description of the meeting's purpose (10 C.F.R. § 50.82, 2017). According to another regulation, 67 FR 36920-36924 (2002), the NRC is supposed to publish notice of meetings on the NRC website via the Public Meetings

Schedule webpage. For those unable to access the website, they can contact the NRC Public Document Room[4], by phone or email, for information on scheduled NRC meetings. This regulation also states that meeting announcement information is to be given to the public, "as soon as the staff is reasonably confident that a meeting will be held and firm date, time ad facility arrangements have been made". Generally, notice of meetings will be given no fewer than 10 calendar days before the event; but, if 10-day notice isn't possible, the staff will provide as much advanced notice as they are able (67 FR 36920-36924, 2002). Outside of this information, there is no mention as to when after the documents' submission periods the meeting is meant to be held. There is a 90-day wait period between the PSDAR's submission and when the licensee is allowed to begin major decommissioning activities; however, there are no regulations that state that the public meeting has to take place within this wait period or when the meeting is meant to occur at all outside of being after a PSDAR submission (10 C.F.R. § 50.82(a)(4)(ii)-(5), 2017). The LTP has to be approved by the NRC before the licensee can continue further action; however, there are no regulations as to when the public meeting is to occur except that it has to be after the LTP's submission – so there is no regulation as to whether or not the public meeting has to occur before the LTP has been approved (10 C.F.R. § 50.82(a)(9)(iii)-(10), 2017). If a meeting changes or a cancellation occurs, information will be updated on the NRC website via the Public Meetings Schedule webpage; however, it is unclear whether or not print sources or the *Federal Register* will be updated in the case of changes or cancellation. If you do not have access to the internet/the NRC's

[4] See Appendix II for information on how to contact the Public Document Room.

website, you must confirm the public meeting information with the NRC Public Document Room (67 FR 36920-36924, 2002).

According to the NRC, "A public meeting is a planned, formal encounter open to public observation and participation between one or more NRC staff members and one or more external stakeholders[5], with the expressed intent of discussing substantive issues that are directly associated with the NRC's regulatory and safety responsibilities" (67 FR 36920-36924, 2002). The Commission sees public meetings as efforts to provide information to the public and to seek public views on various issues within established ground rules for conducting the meeting.

There are different categories of public meetings and these categories define the people who will be present, the meeting purpose, the level of public participation, the type of information provided, and the follow-up measures for the meeting. For the NRC, there are three different categories of public meetings (Figure 7). In brief, Category 1 Public Meetings are typically with the licensee, vendor, applicant, etc. to discuss regulatory issues for their specific facility. The public is invited to observe the meeting and will have the opportunity to communicate with the NRC and the licensee (if this party so chooses) after the business portion of the meeting has finished (67 FR 36920-36924, 2002). Of the different public meeting categories, Category 1 provides the least opportunity for the public to speak or join in the discussion. Category 1 is more conducive to testimonials or specific questions than conversation after watching the meeting and exchanges between the NRC and the licensee. While no category is

[5] See Appendix II for a list of exemptions from the NRC's definition of external stakeholder.

specifically mentioned for PSDAR and/or LTP public meetings, the examples of what this category of meeting might include are most similar to the Category 1 Public Meeting because it is the only category that is meeting to discuss a particular site.

Depending on the interest in the meeting, members of the public may, in advance, request a meeting be reclassified as Category 2, particularly if they believe there is enough interest and think they would benefit from more of an active role in the meeting. Alternatively, NRC staff believe the meeting will generate high public interest, they can provide more than one opportunity for public comments and questions. The purpose of a Category 2 meeting is, "for NRC to obtain feedback from the regulated community and the external stakeholders on issues" (67 FR 36920-36924, 2002). The level of participation is described as the public is, "invited to discuss regulatory issues with the agency" (67 FR 36920-36924, 2002). However, this participation is, "at designated points identified on the agenda" (67 FR 36920-36924, 2002).

The types of information provided for meetings is different for each category. Category 1 meetings require only an agenda or a list of items to be discussed, which are entered into the Agency-wide Documents Access and Management System (ADAMS). The ADAMS document accession number will be provided in the meeting notice posted on the NRC website, for access to any primary or background documents. Category 2 meetings require posting an agenda, names of participants, and background documents on ADAMS. As for Category 1, the ADAMS package accession number will be provided in the meeting notice. For this category, a website with links to other appropriate background information will be made available, at the discretion of the NRC.

The follow-up procedures for these two categories of public meetings are also

different. A Category 1 meeting has no formal follow-up process, while Category 2 has follow-up measures so that designated staff can respond to all questions that remained unanswered during the meeting. Both categories of public meetings require distributing feedback forms at meetings, and posting meeting summaries and participant lists in ADAMS after the meeting. Following a Category 2 meeting, a transcript is also posted in ADAMS (67 FR 36920-36924, 2002).

While there are only two mandatory meetings during the decommissioning process for power reactors, the NRC does allow the opportunity for a public hearing whenever a licensee submits a request for a license amendment, and allows the public to observe some meetings between the agency and the licensee (NRC, 2018c). Public hearings are different from public meetings. Hearings are adjudicatory proceedings on various types of licenses and licensing actions or to enforcement actions involving the imposition of civil penalties or orders to modify, suspend or revoke a license or take other appropriate action (67 FR 36920-36924, 2002). All rules surrounding NRC hearings are in included in part 2 of 10 C.F.R. (2017). The important thing to note is the only opportunity for a public hearing during the decommissioning process is when a licensee submits a request for a license agreement. Whether or not that hearing is held is up to the discretion of the NRC. Also, when the NRC holds meetings with licensees, "members of the public are allowed to observe the meeting (except when the discussion involves proprietary, sensitive, safeguards, or classified information)[6]" (NRC, 2018c). Given the content of these meetings, the protocol of these types of public meetings would be most in-line with a

[6] See Appendix II for a full description of exemptions to meetings between NRC staff that the public cannot attend.

Category 1.

Another important type of public meeting to note is held when the NRC and licensee hold meetings prior to the submittal of the LTP. These meetings are to discuss the format and content of the LTP. The NRC states that, "these meetings are open to the public and intended to improve the efficiency of the LTP development and review process" (*Status*…, 2017). These meetings, while technically not formal public meetings, are still public meetings and their announcements and information can be found on the Public Meetings Schedule webpage.

While there are only two mandatory formal public meetings that the NRC has to hold during decommissioning, there are numerous other meetings that the NRC holds with the licensee during the decommissioning process that are open for the public to observe. This is the main way for the public to be informed of how the decommissioning process is being conducted, as well as any changes to planned decommissioning activities. Given the limited communication between the NRC and the public during decommissioning, attendance at these meetings is integral to a more inclusive and informed decommissioning process for the public, NRC, and the licensee.

Chapter 4: Case Studies of Successful Public Involvement in NRC Decommissioning

Revisiting and learning from past decommissioning experiences can help to create a better future decommissioning regulatory framework for all involved parties. A lot can be learned from how past NRC licensees have or have not partnered, contacted, and/or communicated with external stakeholders throughout the process of decommissioning, especially the frequency and mechanisms of these interactions. These examples of

decommissioned power reactors can help inform future policy and regulation actions as well as potentially influence relationships between licensees and stakeholders or provide inspiration for communities to navigate this process.

Maine Yankee

The Maine Yankee Nuclear Power Plant was a single unit 900 megawatt PWR facility on the Atlantic coast in Wiscasset, Maine. Maine Yankee is the only nuclear power plant in the state's history. The plant began operations in late 1972 and throughout its operation accounted for one-third of Maine's electric power (Bisgaard-Church, 2011). The plant closed in 1997 after 24 years of operation. Maine Yankee was closed for economic reasons. Allegations of numerous environmental and safety violations were confirmed during a series of investigations by the NRC (EA-96-299, 1998). These investigations found that the plant was in desperate need of repairs. The costs of these repairs were not economically viable for the licensee and, after a failed sale attempt, the plant shut its doors. The decision to close the plant came in August 1997, eleven years earlier than the expected termination of its operating license. At the time of the plant's closing, only three nuclear power plants had ever been decommissioned in the U.S. Decommissioning required only eight years and was completed in 2005 (Maine Yankee CAP, 2005).

As is the case in many communities with nuclear power facilities, Maine Yankee has had a tumultuous history with the Wiscasset community as well as the state of Maine. The fight to close Maine Yankee began before the operating license was even granted. In 1971, many activist groups, government entities, and organizations from Maine and across the nation petitioned the Atomic Energy Commission (AEC) asking for the

suspension of the plant's operating license until environmental and safety assurances were made. The AEC held public hearings regarding the approval of the plant's operating license and gave those opposed to the plant a forum to present their concerns. The NRC worked with the community and, in 1972, held additional hearings where the State of Maine and a citizens' group, Safe Power for Maine, were the lead speakers. These hearings and the concerns of the stakeholders helped determine that Maine Yankee would not operate at full capacity for the first 18 months. The NRC also implemented stricter safety and environmental standards for the plant. As the Maine Yankee license was approved and operations began, active pro- and anti-nuclear citizens' groups continued to fight for the plant's continuance or closure through petitions, campaigns, and referendums until the day the plant permanently shut down (Bisgaard-Church, 2011).

This difficult relationship continued with the announcement of the plant's closure. The community felt betrayed by the licensee's lack of transparency and they were scared because of the economic security the plant had provided would be lost. To illustrate this point, in 1996, Maine Yankee had provided 91% of of the town's tax base. In order to address community concerns when the plant shut down, the licensee immediately established efforts to create a shared decommissioning vision that incorporated employees and the other community members in the creation of a mutually beneficial plan (Maine Yankee CAP, 2005). Maine Yankee ultimately chose the DECON method for decommissioning. The decision to return the site to a greenfield condition (except for during the fuel storage period) was made by the owner, community, and other stakeholders. Maine Yankee created a Community Advisory Panel (CAP) with stakeholders; the CAP was chaired by a locally-elected official (State Senator) and

included other local officials, residents, state representatives, educators, environmental activists, and the licensee. The first CAP meeting was held shortly after the shutdown announcement and additional meetings were scheduled every four to six weeks until decommissioning was completed (Maine Yankee CAP, 2005). The CAP was involved throughout decommissioning and worked to facilitate decision processes to ensure stakeholders could voice their opinions to Maine Yankee. As part of the LTP development process, the State of Maine and locals wanted more intensive environmental standards for radiation levels than the NRC requires; these stakeholders worked with the CAP to create a forum and work with the EPA to have these stricter standards included in the LTP, which was ultimately approved by the NRC (Taboas, Moghissi, & LaGuardia, 2004). The CAP helped change communication within Maine Yankee, the community, and the NRC to create more informative dialogues between the parties to share opinions, wants, and needs as well as to educate and learn from each other (Maine Yankee CAP, 2005). Maine Yankee decided to hire outside organizations for the decommissioning process, which had resulted in a large number of the plant's employees in losing their jobs. To offset these losses, Maine Yankee created an on-site career center that made a significant effort to place former employees in new jobs (Taboas, Moghissi, & LaGuardia, 2004).

The Maine Yankee decommissioning process had active local stakeholders, government officials, and a licensee that was willing and proactive in working with the community. Notably, Maine Yankee had violated federal regulations while in operation and were jeopardizing the safety of their employees and the entire community through negligence and dishonesty. However, the licensee's commitment to repairing community

relations was admirable through their creation of the CAP. While Maine Yankee's motivation for creating the CAP may require further scrutiny, the CAP itself greatly enhanced public involvement in the plant's decommissioning process. The CAP provided networks to connect stakeholders, community members, federal regulators, and the owner through proactive and focused communication. The CAP increased education of all parties, empowered community members through communication, and ultimately created real change based on community priorities (Maine Yankee CAP, 2005).

Maine Yankee also laid off almost all of their employees and did not employ them in the decommissioning process. The plant says that they hired a decommissioning contractor because it aligned with the community's shared vision for a fast decommissioning process. While the plant provided resources to place former employees in new jobs, this does not provide the job security had they employed staff through the decommissioning process (Taboas, Moghissi, & LaGuardia, 2004). In addition to firing most of the plant's staff, there was no employee representation in the CAP nor did any other civilian groups represent labor issues or fight for employee rights. Employees are a stakeholder group that needs to be actively targeted and included in public participation during decommissioning.

The NRC and federal government have consistently treated nuclear waste storage onsite as a temporary option, promising to remove the waste to a national geologic repository. The idea of a national repository has been discussed since the beginning of the nuclear industry in the United States. While there have been hundreds of millions of federal dollars invested in the project, no consensus has been made. As a result, former nuclear sites are forced to manage nuclear waste on land that was promised to be returned

for community use. Although Maine Yankee completed decommissioning nearly 15 years ago, and the federal government promised to remove all spent fuel in 1998, today 1,434 spent nuclear fuel rods in 60 steel canisters remain encased in concrete, and another four casks of irradiated steel (each weighing 100 tons) are still on site.. The Maine Yankee CAP has continued to meet all these years, and nuclear waste removal is now their top priority (Hamilton, 2017). Although Maine Yankee completed decommissioning in 2005, the company must cover the costs of operating, maintaining and providing security for the radioactive waste at a cost of $8 million per year (McCarthy, 2012). Maine Yankee has successfully sued the federal government three times, and is planning a fourth phase. Over the years, the federal government has been forced to pay Maine Yankee several hundred million dollars in damages (Hamilton, 2017). While this is the unfortunate reality of many former nuclear power plant sites, the networks of communication generated during the decommissioning process at Maine Yankee have remained important and helpful for over two decades and will hopefully continue for as long as the stakeholders feel is necessary.

Big Rock Point

Big Rock Point was a BWR facility built on the shores of Lake Michigan near the town of Charlevoix, Michigan. The plant closed in August 1997, after 35 years of operation, because the licensee, Consumers Energy (CE), found that the plant was no longer cost-effective. Big Rock Point ceased operations three years prior to its license expiration. The licensee chose to immediately dismantle the plant with the goal of returning the site to greenfield by 2005 (Taboas, Moghissi, & LaGuardia, 2004). CE completed site remediation in August 2006, which signified the end of decommissioning

for this site. The site has an ISFSI that contains eight casks of spent fuel. The IFSI was sold to Entergy Corp. in July 2006 as part of the sale of another nuclear facility (NRC, 2016a). In January 2007, CE received approval from the U.S. Nuclear Energy Commission to release 435 acres of the site, 87% of the total property, for unrestricted use (Petrosky, 2007).

Consumers Energy decided to announce the closure of Big Rock Point in June 1997, two months prior to the cessation of operations. It is unusual for licensees to announce closures more than a month in advance, because 30 days' notice is the NRC's minimum regulation and most plant owners merely follow the regulation. CE wanted to provide employees with as much information as possible about the plant's closure so as to, "leave them feeling proud of the work they had done"(Taboas, Moghissi, & LaGuardia, 2004, 5-40). On the day of the closure announcement, the company president, senior nuclear officer, and plant manager met with employees in group meetings about the plant's closure and decommissioning plans as well as supplying written information so that employees could give the materials to their families. All employees received an organizational chart with departments and jobs, a timetable for placement activities, instructions on how to bid for jobs, and numbers to call for information and employment policies so that they could receive their benefits, such as severance and bonuses. Meetings were held throughout the summer on outplacement activities, financial planning, employee assistance, as well as pension and savings plans. Various plans (severance, retention, etc.), salary increases, and concessions were described and offered to employees, based on whether they were non-union, union, or could not find positions with the company post-shutdown. These types of plans and packages are rare during

decommissioning, and although CE was struggling economically, the company offered ways to assist their employees during the transition. In the end, CE decided to keep 200 original staff and hire 200 to 300 specialty contractors for decommissioning. In an effort to create an integrated team that shared the knowledge bases of these two groups, all personnel were integrated into a unified management structure and performed assessments as a unified group (Taboas, Moghissi, & LaGuardia, 2004).

The relationship between Consumers Energy and the community in Charlevoix was generally positive and supportive throughout the plant's 35 years of operation (Taboas, Moghissi, & LaGuardia, 2004). Big Rock Point was the biggest taxpayer and employer in the city, so its closure brought economic distress for all community members (Harrison, 2001). During the closure, CE increased communication with the community to ensure they were informed about Big Rock Point restoration activities. CE created a quarterly community newsletter and expanded site newsletter provided to opinion leaders, speaker bureau activities, and the involvement and education of the plant's Citizen Advisory Board (Taboas, Moghissi, & LaGuardia, 2004). There was a lot of community concern and questions about radiation, so the plant brought in high school teachers to educate the stakeholders about the risks. CE incorporated many different outside sources in the education process so as to include as many stakeholders as possible while trying to build their trust (Harrison, 2001).

A Citizen Advisory Board (CAB) independent from CE was established in 1995. The CAB, which was made up of community leaders from Charlevoix County as well as the surrounding counties, was created to provide input and recommendations on decommissioning plans to plant officials (Tompkins, 2006). The Citizen Advisory Board

was disbanded with the completion of the first phase of decommissioning, marked by the release of the power reactor and associated land areas from the NRC's license with Consumer Energy (NRC, 2013). Another independent group, the Restoration Safety and Review Committee (RSRC), was formed in 1998. The RSRC consisted of three recognized nuclear experts who had experience decommissioning nuclear plants, radiological safety, and spent fuel storage. The RSRC met at Big Rock Point three times a year to review and critique the plant's decommissioning progress (WM Symposia, 1999).

Big Rock Point's decommissioning process involved major stakeholders from the beginning of the site to the license termination. However, one major stakeholder group that was not actively involved in the decommissioning process was the Little Traverse Bay Bands of Odawa Indians (LTBBOI). Since at least the mid-nineteenth century, Big Rock is a landmark that was used as a gathering place each spring for the Odawa (Petrosky, 2007). Although the Big Rock Point site, and the surrounding lands, are a historic gathering place of the LTBBOI, they were not consulted during decommissioning with regard to what they wanted for the future of their historic site. However, in 2006, a landmark was put at Big Rock Point with two plaques: one noted its significance as a nuclear power plant and the other as a site of spiritual significance for the LTBBOI (NRC, 2016a). At the ceremony to celebrate the landmark, the chairman of the LTBBOI came to discuss the site's importance and how its future belongs to nature and the promise of new life (Petrosky, 2007).

Another critique of the decommissioning process is the disbandment of the CAB at the end of decommissioning. Although decommissioning was completed in 2006, nuclear waste is still at the ISFSI. While this waste is now Entergy Corporations's responsibility

(they bought the land from Consumer Energy), this remains an unresolved issue. The CAB should be concerned with the waste at the ISFSI and would serve as an important communication bridge between the community and Entergy. However, since this group has been disbanded, a new community board should be created for Big Rock Point's waste to ensure that the ISFSI is in compliance with community's wants, needs, and concerns.

Discussion of Case Studies

Both Big Rock Point's and Maine Yankee's decommissioning processes actively involved stakeholders through networks that the licensees and stakeholders themselves created outside of the NRC's regulatory structure. There are some common takeaways from both case studies, including positive lessons to employ in future decommissioning as well as examples of what could be improved, given how similar situations were handled at these two plants.

Both licensees were adamantly supportive of community involvement and the fact that communication is critical, including the principle that communication must come early and often. For both licensees, communication early in the process led to a simpler and faster process to disseminate information about the shutdown and to hear and incorporate stakeholder input. In the case of Maine Yankee, this simplified conflict resolution, as stakeholders (including the State of Maine) came forward with complaints and issues that they wanted solved (Taboas, Moghissi, & LaGuardia, 2004). Big Rock Point's former plant manager, Ken Powers, was vocal about the importance of stakeholder involvement and communication with the public during the decommissioning process. In an interview in 2001, Powers said that, "Developing relationships with

stakeholders requires honest and authentic attitudes and behaviors. We must truly care about the stakeholders and their perspectives . . . Every project has different people with different issues. We all have to work together in order to make our decommissioning projects successful" (Harrison, 2001, 12). Powers' statements as the head of the plant say a lot for the licensee's actions during decommissioning and provide a model for how other licensees should view their commitment to the public during decommissioning, even when that commitment is not legally required.

A key element of both plants' decommissioning was the creation of citizen advisory panels/boards. Maine Yankee created their own CAP, while Big Rock Point's CAB was an independent organization. Both plants' citizen organizations were present throughout the entire decommissioning process and helped aid in communication and education between licensees and stakeholders. Maine Yankee's CAP benefited from having a panel that was created by the plant; because the panel members were selected by the licensee, communication may have been easier and more productive than a completely outside group, which likely would have been more contentious. While Big Rock Point's CAB was successful at communicating with Consumer Energy and provided an important role in the decommissioning process, this was a more difficult relationship to maintain and depended on the willingness of the plant to meet with communities. Once an owner ceases operations, the economic incentives for working with the community disappear, as they are not legally bound to foster a relationship with the community during decommissioning. Maintaining strong communicative relationships takes more time and resources, with no real benefits other than a feeling of moral obligation to employees and the broader community. Comparing the two case studies, there are clear benefits to

having a dependent and independent citizen decommissioning board, with different strengths and weaknesses. It is beneficial to the community to have both types of organizations to increase communication across all fronts and engage as many voices as possible. However, solely having a citizen group like Maine Yankee's may prevent the casual and frank conversations possible in a completely independent organization, and may alienate some people from taking part in these discussions because they mistrust the licensee. Maine Yankee's CAP is still in place today, which speaks volumes for its members' commitments to the community, as well as the success of this organizational format. Big Rock Point's CAB disbanded after decommissioning ended; however, as the site is still an ISFSI, communication with licensees is key to ensure that the property, which houses nuclear waste, is properly monitored and secured.

Big Rock Point's actions to inform and provide options to plant employees acknowledged how detrimental the plant's shutdown was to their lives. Not only were livelihoods and financial security taken away, but many plant employees were also community members, which means parts of their identity were changed or lost as a result of plant closure. Sometimes community members can pressure employees for information because it might be perceived that they have more insider knowledge as the licensee's plans. However, by creating more frequent conversations where all stakeholders are represented, this can alleviate that pressure on employees to ensure the public that all stakeholders have access to the same knowledge. There also expectations that plant workers will inform the community because it is assumed that they know what is going on inside the plant as well as the owners. This further highlights the importance of communication between the licensee to the community so that all information is relayed

so as to actively work to avoid conflict within and among different stakeholders. Former Big Rock Point plant manager Ken Powers recognized that most of his employees' whole careers were spent at the site. Because the plant had been open for nearly four decades, several generations had worked there. As a result, Powers said that plant workers, "have deep roots in the community, and when a site faces decommissioning, you are ripping the roots out from under them" (Harrison, 2001, 8). Compared to Big Rock Point, Maine Yankee did not offer as many forms of support to their employees, and released most of them prior to decommissioning in favor of outside contractors. While Big Rock Point also released a significant amount of the staff, they worked with those staff to provide financial support to offset for this major blow. For those that they kept employed through the decommissioning process, Big Rock Point restructured to create a unified workforce of the seasoned plant employees and new contractors.

Both plants went far beyond regulation to include their communities in the decommissioning process, creating avenues for education and frequent conversations with many different stakeholders, including local representatives, government officials, community members, and plant employees. These owners serve as positive examples of how licensees can actively involve stakeholders' concerns, observations, wants, and needs into an integrated decommissioning plan.

Chapter 5: Policy Recommendations for Public Involvement in NRC Decommissioning

In terms of public involvement in decommissioning, the NRC is legally required to do very little. The NRC has conducted studies of its own public involvement that find their methods of engaging local governments, tribal governments, civic groups, the general public, and all directly affected parties are inadequate, infrequent, and ineffective. The Public Communications Task Force published these results in 2003 (ML032740052, 2003). Sixteen years later, this task force has published no follow-up, nor has the NRC formally changed any of its public communication techniques. To review its legally-required engagement, the NRC publishes almost all documents from the decommissioning process so that they can be viewed and shared amongst shared stakeholders. They also include public comment periods for three of the main documents developed during the decommissioning process. As part of decommissioning, the NRC holds two public meetings so stakeholders can observe discussions between the Commission and the licensee to learn about how their plant is being decommissioned. Outside of these three mechanisms, the NRC is not legally required to involve the public in decommissioning in any other way.

The NRC's postings of decommissioning documents to their website as well as to the *Federal Register,* usually within 24 hours of the documents having been received, is important because it quickly provides information to stakeholders. However, there are no regulations that mandate that these documents remain on the NRC website and, as a result, they are often removed. For example, Maine Yankee's PSDAR report has been removed from the NRC website, while Big Rock Point's PSDAR is still available at the

time of writing (NRC, 2005). These documents are important to local communities, so allowing those communities to review them at any time should be required of the NRC. While the NRC does keep some documents available, there is no requirement for them to keep an PSDAR and LTP online after decommissioning. Since hard copies of these documents are not distributed to the entire community, for some people this is one of the only ways to access them. Ensuring that these documents are available after decommissioning has ceased should be considered a right of local communities. Maintaining the availability of PSDAR and LTP documents on the NRC website is also important for other communities facing decommissioning of their own nuclear power plants to view past decommissioning plans so that they can participate in decision-making during their own decommissioning process based on what they have learned.

New regulations should require the NRC should require the agency review and respond to public comments, as well as discuss them with licensees and, whenever possible, integrate them into the decommissioning planning. Currently, the only requirement of the NRC is that the PSDAR, LTP, and license amendments must be open to public comment. New regulations should ensure that the public comment period is complete before the NRC can approve the documents. Right now, the NRC can approve license amendments before the public comment period ends, resulting in low confidence that public comments are considered in the approval processes (10 C.F.R. § 50.91(a)(2), 2017). The NRC's Public Communications Task Force Report (2003), suggests that the Commission, "should consider communications issues and their impacts before decisions are made and actions taken" (ML032740052, 2003). Further regulations should mandate the NRC will respond to public comment. As of now, there is no assurance that public

comments are read, let alone considered in decision making. Protocols already exist in the NRC's public meeting format for NRC staff to respond to comments and questions raised during public meetings, so the same system could be applied to public comments (67 FR 36920-36924, 2002). Such a requirement would restore confidence that stakeholders' concerns are being taken seriously. In a letter addressed to the NRC's Chairman, Senators Ed Markey from Massachusetts, Kirsten Gillibrand from New York, Bernie Sanders from Vermont, and Kamala Harris from California voiced their dissatisfaction with the NRC for their lack of response to public comments on a proposed decommissioning rule and urged the Commission to more seriously consider public input in rulemaking processes. The Senators stated that the proposed rule notes that the NRC staff "considered" public comments; however, there is no documentation, since they did not respond to any public comment (U.S. Senate, 2018). By comparison, the UK's Nuclear Decommissioning Authority is required to update documents following public comment periods to reflect the comments that have been received (IAEA, 2009). A similar rule in the United States would be an important step for the NRC to integrate public comments into the decommissioning process.

The NRC should be required to approve each post-shutdown decommissioning activities report (PSDAR). Although this document is the one that begins the decommissioning process, it does not require the approval of the NRC. As of now, the licensee waits 90 days after submission of a PSDAR to begin major decommissioning activities. While there is a public comment period for the PSDAR, the NRC does not need to approve the report, so there is no mechanism to integrate those comments into the report. It is necessary that the NRC review and subsequently approve this document to

increase the level of oversight. Until recently, the NRC has avoided the issue of PSDAR approval, but now the issue has been raised by numerous Senators and the general public (U.S. Senate, 2018). At an American Nuclear Society Conference in 2016, the NRC stated that they received feedback on an Advance Notice of Proposed Rulemaking (ANPR) that they should be required to review and approve each PSDAR (NRC, 2016).

The NRC must communicate with stakeholders outside of the public meeting context and generally improve the methods, frequency, and timeliness of their communication with stakeholders. The two public meetings are the only communication required of the NRC has with stakeholders. In the NRC's Public Communications Task Force Report, they interviewed local civic groups, the general public, local and tribal governments, and directly affected parties across the country. All of these groups ranked their communication with the Commission as poor, inadequate and ineffective. Local governments, tribal governments, local civic groups, and directly affected parties all said that the NRC had failed to contact them outside of a public meeting context (ML032740052, 2003). This means that the NRC only contacts the stakeholders twice throughout the entire decommissioning process – the minimum of what they are legally bound to do. Local governments, civic/social groups, and tribal governments all said that there is no coordinated communications strategy to reach them outside the public meeting. Local governments said that the NRC does little to maintain communication in general. They note that the NRC occasionally arranges a separate briefing for them before a scheduled public meeting, but this is rare. Tribal governments made similar comments, and added that the NRC does not communicate nearly as well with them as they do with local governments. Furthermore, the NRC does not routinely meet with tribal officials,

and when meetings are organized, they are never held on tribal land, which makes learning about and attending those meetings difficult. Local civic and social groups/organizations feel that while they communicate well with the NRC, these communications are inconsistent and infrequent. Directly affected parties are people living near an NRC-licensed facility and medical patients who receive diagnostic or therapeutic radioisotopes. Directly affected parties said that the NRC has few, if any, targeted communications with them. The same comment was made by the general public, who reported that the NRC does not have a targeted communications strategy to ensure that they have the necessary information about its activities (ML032740052, 2003). Clearly, communication with stakeholders needs to be frequent and reliable. The NRC needs to develop different communication methods based on the needs of each stakeholder group, and make a concerted effort to improve communication with tribal governments and the directly affected parties. According to the NRC's task force, "the agency should move away from a decide, announce, defend strategy and embrace practices that support a proactive, open, and responsive decision-making process consistent with our policies" (ML032740052, 2003). To actively accomplish this goal, the task force advocated for the integration of public affairs officers and/or communication specialists within all program offices at the NRC (ML032740052, 2003). Communication with stakeholders needs to be more of an exchange or discussion so that all parties can listen and learn from each other, to ensure everyone is educated about the various aspects of a plant's decommissioning status. There should be, at a minimum, mandatory public meetings held before the submission and after the comment periods of every document that is submitted during the decommissioning process. This way, stakeholders can be

involved in the beginning of document development, through the drafting process, and hear the results of the approved/final documents so as they can know what next steps to take with all key parties, including the NRC and licensee. Anytime that a health or safety concern is voiced by stakeholders, the NRC should hold a Category 3 public meeting to ensure that the community is heard, and their concerns addressed through proactive action by the Commission. After all, the role of the NRC is to regulate the nuclear industry to the benefit all people.

All mandatory public meetings held during decommissioning should be Category 2 or 3 public meetings. Category 1 public meetings are a discussion between the licensee and the NRC, to which other stakeholders are able to listen but not respond. Throughout the decommissioning process, stakeholders need to be active members of the discussion because they all have important and valuable knowledge that can inform a more equitable decommissioning process. Category 2 and 3 public meetings enable more active public participation in a variety of settings, from town halls to roundtable discussions, that can be tailored to address the community's wants and needs. Most importantly, both categories of meetings require follow-up to questions, and meeting summaries or transcripts are provided to participants and posted online so that those who are not able to attend can be informed about the process.

The NRC should be required to form Citizen Advisory Boards (CABs) during decommissioning. Citizen Advisory Boards provide a much-needed communication pathway during decommissioning so that all stakeholder groups are represented, and information is disseminated to the whole community. The NRC also said that the requirement of a Citizen Advisory Board for each decommissioning was a common

response in the feedback they received on the ANPR (NRC, 2016). While there are both pros and cons to having a CAB that was created by members outside of the community, a CAB is a necessary tool. CABs provide new methods and mechanisms for stakeholder involvement and information sharing that target the most affected stakeholders to be members of the board. The case studies of Maine Yankee and Big Rock Point both had citizen panels/boards that were influential during decommissioning and were essential to stakeholder representation. Regardless of whether a CAB is independent or not, their creation should be required in the NRC decommissioning process.

Conclusion

The decommissioning of nuclear power plants is expected to accelerate over the next several decades, as the United States' aging nuclear power plants reach the end of their license period. It is increasingly important to consider how local communities and other affected stakeholders will be involved in and informed about these decommissioning processes. The Nuclear Regulatory Commission (NRC) is the main regulatory body that oversees nuclear decommissioning, and there are a number of regulations regarding public involvement in the decommissioning processes. NRC regulations for public involvement require the Commission to make all formally submitted decommissioning documents available to the public. The NRC must provide comment periods for three of these documents: license amendment requests, the post-shutdown decommissioning activities report (PSDAR), and the license termination plan (LTP). There are only two required public meetings in NRC decommissioning: one occurs after submission of the PSDAR, and the other after submission of the LTP.

According to surveys conducted by the NRC itself, a majority of stakeholders feel that the NRC's public involvement methods are inadequate, ineffective, and infrequent. New regulations of the NRC are necessary to enhance public participation in decommissioning based on stakeholder feedback and examples from facilities that have completed decommissioning. In general, the NRC needs to 1) provide more frequent communications that target key stakeholder groups, 2) actively respond to public comments and integrate them into decommissioning planning, 3) increase the frequency of public meetings as well as making a more collaborative environment for the public,

licensee, and the Commission, 4) require approval of the PSDAR before decommissioning activities, and 5) require a Citizen Advisory Board during decommissioning. It is a pivotal time for Congress and the NRC to reexamine decommissioning policies and find ways to involve the public in this process so as to create a more informed and egalitarian decommissioning process.

Appendix I: Figures

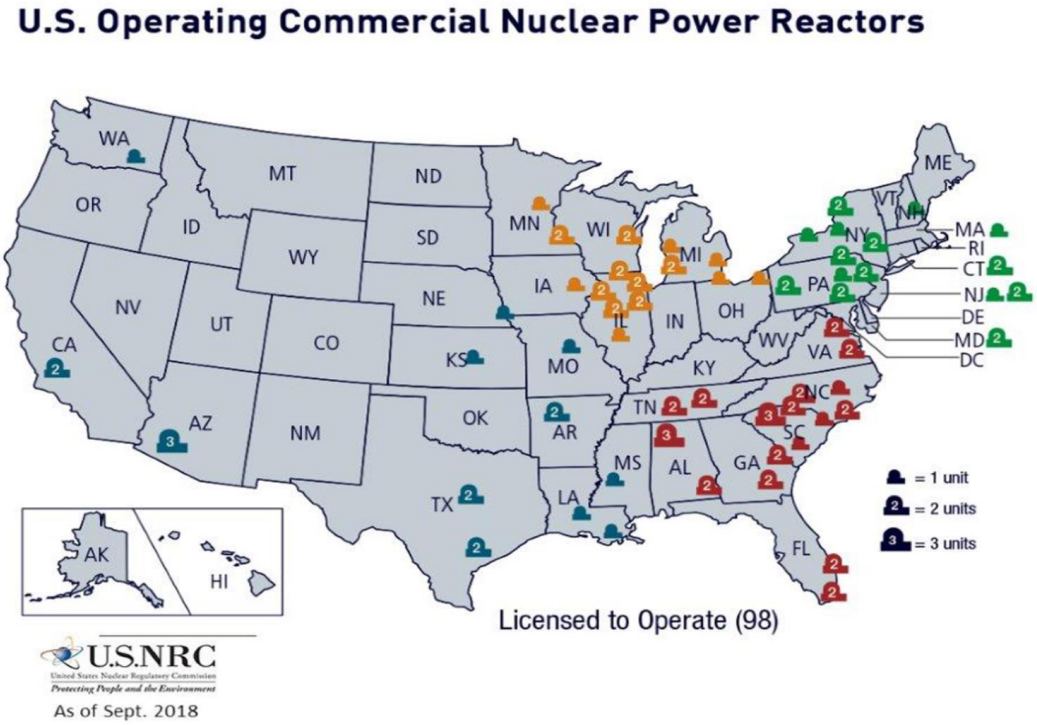

Figure 1. Map of operating commercial nuclear power reactors in the U.S. The legend shows how many reactors are operating at each site. The different symbology colors are by NRC region, of which there are four. (Retrieved from https://www.nrc.gov/reactors/operating/map-power-reactors.html)

U.S. electricity generation by source, amount, and share of total in 2018[1]		
Energy source	**Billion kWh**	**Share of total**
Total - all sources	4,178	
Fossil fuels (total)	2,651	63.5%
Natural gas	1,468	35.1%
Coal	1,146	27.4%
Petroleum (total)	25	0.6%
Petroleum liquids	16	0.4%
Petroleum coke	9	0.2%
Other gases	12	0.3%
Nuclear	807	19.3%
Renewables (total)	713	17.1%
Hydropower	292	7.0%
Wind	275	6.6%
Biomass (total)	63	1.5%
Wood	41	1.0%
Landfill gas	11	0.3%
Municipal solid waste (biogenic)	7	0.2%
Other biomass waste	3	0.1%
Solar (total)	67	1.6%
Photovoltaic	63	1.5%
Solar thermal	4	0.1%
Geothermal	17	0.4%
Pumped storage hydropower[3]	-6	-0.1%
Other sources	13	0.3%

Figure 2. 2018 U.S. electricity generation by source. Nuclear is currently the second largest sector producer of electricity in the United States, after fossil fuels. (Retrieved from https://www.eia.gov/tools/faqs/faq.php?id=427&t=3)

Figure 3. Basic outline of NRC decommissioning processes before, during, and after cleanup. (Retrieved from https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/decommissioning.html#_ftnref1)

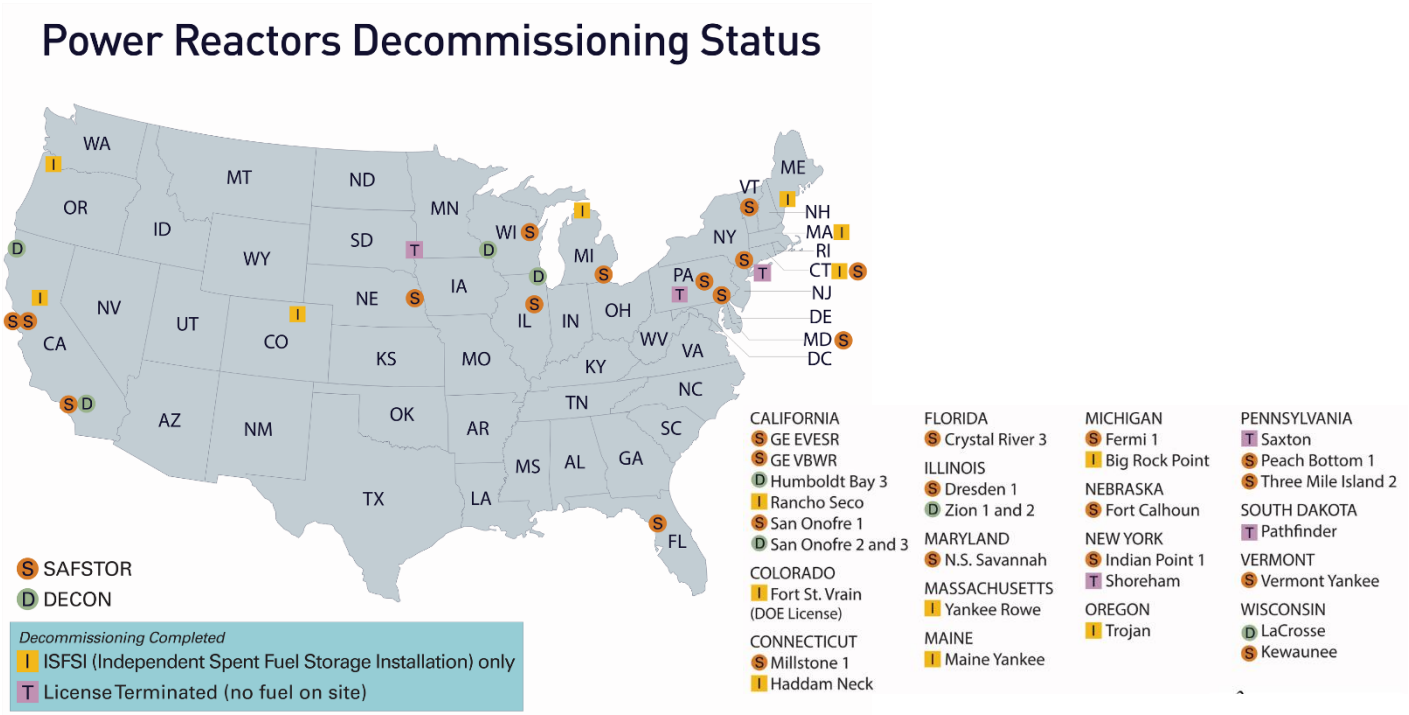

Figure 4. NRC power reactors decommissioning status map as of 2018. (Retrieved from https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/decommissioning.html#_ftnref1)

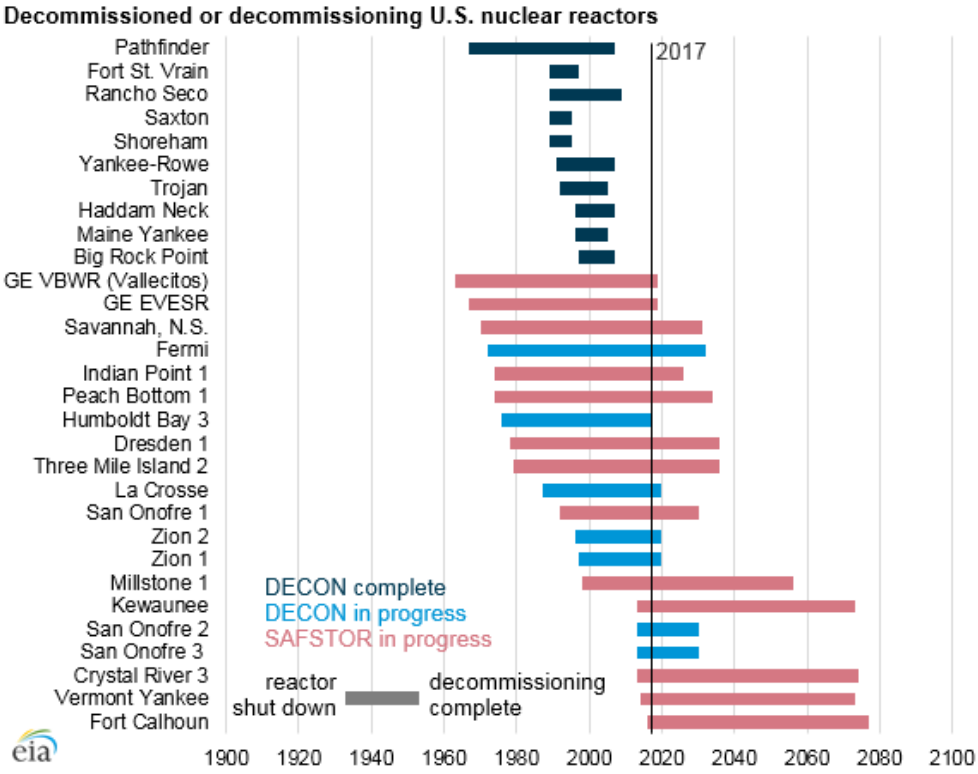

Figure 5. U.S. power reactors decommissioning timelines as of 2017. (Retrieved from https://www.eia.gov/todayinenergy/detail.php?id=33792)

Appendix II: Glossary

External Stakeholder
According to 67 FR 36920-36924 (2002), an external stakeholder is anyone who is not:

- An NRC employee;
- Under contract to the NRC;
- Acting as an official consultant to the NRC;
- Acting as an official representative of an agency of the executive, legislative, or judicial branch of the U.S. Government (except on matters where the agency is subject to NRC regulatory oversight);
- Acting as an official representative of a foreign government;
- Acting as an official representative of a State or local government or Tribal official (except when specific NRC licensing or regulatory matters are discussed).

Greater-Than-Class C Waste
The NRC classifies low-level radioactive waste (LLW) as Class A, B, C, or Greater-Than-Class C (GTCC). GTCC nuclear waste is LLW with radionuclides that exceed the limits that would have classified it as Class C waste. As Class C is the most hazardous waste on this scale, it could not be classified as something higher (NRC, 2018b).

Meetings the Public Are Not Allowed to Attend
According to 67 FR 36920-36924 (2002), "meetings between the NRC staff and external stakeholders will be designated as public meetings unless the NRC staff determines that the subject matter or information to be discussed meets one or more of the following criteria:

a) Is specifically authorized by an Executive Order to be withheld in the interests of national defense or foreign policy (classified information) or specifically exempt from public disclosure by statute;
b) Contains safeguards or other protected information;
c) Contains trade secrets and commercial or financial information (proprietary information);
d) Is of a personal nature where such disclosure would constitute a clearly unwarranted invasion of personal privacy;
e) Is related to a planned, ongoing, or completed investigation and/or contains information compiled for law enforcement purposes;
f) Could result in the inappropriate disclosure and dissemination of preliminary, predecisional or unverified information;
g) Is a general information exchange having no direct, substantive connection to a specific NRC regulatory decision or action. However, should discussions in a closed meeting approach issues that might lead to a specific regulatory decision or action, the NRC staff may advise the meeting attendees that such matters cannot be discussed in a closed meeting and propose discussing the issues in a future open meeting.
h) Indicates that the administrative burden associated with public attendance at the meeting could interfere with the staff's execution of its safety and regulatory responsibilities, such as when the meeting is an integral part of the execution of the NRC inspection program".

NRC Decommissioning Strategies, Descriptions, Costs, & Benefits

Strategy	Description	Benefits	Costs
DECON	Under DECON (immediate dismantling), soon after the nuclear facility closes, equipment, structures, and portions of the facility containing radioactive contaminants are removed or decontaminated to a level that permits release of the property and termination of the NRC license.	• Facility license terminated quickly • Available, highly knowledgeable operating reactor work force • Higher possibility of a just transition for facility employees • Elimination of long-term security, maintenance, and surveillance (assuming no waste is kept onsite) • Greater certainty about available LLW* facilities that would be willing to accept the waste • Lower estimated costs than SAFSTOR (because won't have future price escalation)	• Higher doses of radiation exposure to workers and the public because there is no opportunity for radioactive decay • Larger initial monetary commitment • Larger potential commitment of disposal-site space than SAFSTOR • Potential for spent fuel to remain onsite indefinitely
SAFSTOR	Under SAFSTOR, often considered "deferred dismantling," a nuclear facility is maintained and monitored in a condition that allows the radioactivity to decay; afterwards, the plant is dismantled, and the property decontaminated.	• Substantial reduction in radioactivity as a result of radioactive decay • Reduction in radioactive dose exposure to workers (compared to DECON) • Reduction in public exposure because fewer shipments of radioactive material to the LLW site (compared to DECON) • Potential reduction in amount of required waste disposal space (compare to DECON) • Lower immediate costs • Storage period compatible with the need to store spent fuel onsite	• Shortage of workers familiar with the facility depending on time of dismantlement & decontamination • Low probability of a just transition for facility employees • Site unavailable for alternate uses • Uncertainties on the availability and costs of future LLW facilities • Continued need for maintenance, security, & surveillance • Higher total cost for decontamination & dismantlement period (assuming typical price escalation)
ENTOMB	Under ENTOMB, radioactive contaminants are permanently encased on site in structurally sound material such as concrete. The facility is maintained and monitored until the radioactivity decays to a level permitting restricted release of the property. To date, no NRC-licensed facilities have requested this option.	• Reduced amount of work for encasing the facility • Reduced radioactive dose exposure to workers • Should be reduced exposure to LLW radiation because waste wouldn't be transported • Low cost	• Because of radionuclide concentrations, will not be available for unrestricted use for at least 100 years • Continued need for maintenance, security, & surveillance • Limited opportunity for a just transition

*LLW = low-level radioactive waste.
Description data: Taboas, Moghissi, & LaGuardia, 2004.
Cost and benefit data: NUREG-1628, 2000.

Public Document Room

Contact the Public Document Room (PDR) if you don't have access to the NRC website and/or want further clarification on public meetings in your facility (67 FR 36920-36924, 2002). The PDR is open Monday through Friday between 8:00 a.m. and 4:00 p.m., EST (NRC, 2017c).
Phone: 1-800-397-4209 (toll free) or 301-415-4737
Email: pdr.resource@nrc.gov

Public Meeting Categories

	Category 1	**Category 2**	**Category 3**
Description	Meetings in this category are typically held with 1 licensee, vendor, applicant or potential applicant rulemaking to discuss particular regulatory issues regarding their specific facility (or facilities), certificate of compliance, license or license application.	Meetings in this category are typically held with a group of industry representatives, licensees, vendors or nongovernmental organizations.	Held with representatives of non-government organizations, private citizens or interested parties, or various businesses or industries (other than those covered under Category 2) to fully engage them in a discussion on regulatory issues.
Meeting Purpose	To discuss 1 particular facility or site, or certified system or device, with an applicant or licensee. At this type of meeting, NRC anticipates that the public would obtain factual information to assist in their understanding of the applicable regulatory issues and NRC actions.	For NRC to obtain feedback from the regulated community and other external stakeholders on issues that could potentially affect more than 1 licensee. The public would obtain factual information and provide the agency with feedback on the analysis of the issues, alternatives and/or decisions.	To maximize discussions with the public to ensure their issues and concerns are presented, understood and considered by the NRC. The public would work with the agency to facilitate the widest exchange of information, views, concerns and suggestions with regard to license-specific or generic regulatory issues.
Examples	• Annual public meetings to discuss plant performance • Regulatory conferences • Predecisional enforcement conferences • Meetings held prior to a facility restarting • Meetings held on licensing actions (or applications) • Renewals and amendments • New facilities • Away-from reactor storage sites • Large or complex fuel cycle facilities • Waste disposal sites Certain inspection exit meetings such as those for Incident Investigation Teams, Augmented Inspection Teams, or others, as appropriate, would also be included in this category.	• Task force groups • Industry groups (such as the Nuclear Energy Institute or owners' groups) • Public interest and citizen group discussions that focus on issues that could apply to several facilities	• Town hall or roundtable discussions • Environmental Impact Statement scoping meetings • Workshops • The Regulatory Information Conference • The Nuclear Safety Research Conference • Proposed rulemaking meetings

Level of Public Participation	Public is invited to observe the meeting, they will have the opportunity to communicate with the NRC after the business portion of the meeting, but before the meeting is adjourned. The licensee may respond to questions if they so choose. Different formats for questions exist depending on the meeting's length and the public's interest in topics. In advance of the meeting, members of the public may request that the meeting coordinator consider changing the meeting to a Category 2.	The public is invited to discuss regulatory issues with the agency at designated points identified on the agenda. Generally, there will be more opportunities provided for the public to ask questions and provide comments at a meeting of this type than at a Category 1 meeting.	Public participation is actively sought at this type of meeting, which has the widest participation opportunities and is specifically tailored for the public to comment and ask questions throughout the meeting.
Types of Information Provided	At minimum, an agenda or a list of items to be discussed will be entered into the Agencywide Documents Access and Management System (ADAMS).	An agenda, names of participants, and background documents will be entered into ADAMS.	An agenda, names of participants and background documents will be entered into ADAMS.
Follow-Up	No formal follow-up will be provided. Informal follow-up (telephone or e-mail) may be done for certain questions that cannot be answered at the meeting. Members of the public also have the option of writing or emailing the staff about particular concerns. These concerns will be considered by the staff as it deliberates on the issue. Feedback forms will be provided at the meeting. Meeting summaries and participant lists will be publicly available in ADAMS.	Staff will provide answers to questions as appropriate during the meeting. Questions that cannot be answered at the meeting will be assigned to a designated staff person as an action item. Meeting summaries or any transcripts and participant lists would be provided in ADAMS and on the Web. Feedback forms will be provided at the meeting.	Staff follow-up is similar to Category 2, but meeting summaries or transcripts and participant lists will be provided in ADAMS and linked to the Web site. Feedback forms will also be provided at the meeting.

(67 FR 36920-36924, 2002).

Site Characterization

According to 10 C.F.R. § 60.17 (2017), site characterization includes 3 main components:

(1) A general plan for site characterization activities to be conducted at the area to be characterized. There are five components that make up this plan including: a description of the area, planned site characterization activities, plans for decontamination & decommissioning, evaluation of the site to see if its suitable for a geologic repository, and to adhere to any other information the NRC requires.

(2) A description of the possible waste form or package for high-level radioactive waste to be in a geologic repository. A description of the relationship between such waste form or waste package and the host rock at the site. A description of the activities being conducted by DOE with respect to such possible waste form or waste package or their relationship.

(3) Conceptual design for the geologic repository operations area given the site's specific requirements.

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