

**Design of a Modular Cloud Chamber with an Internal Clock Mechanism**

**Investigating the Impact of the Nuclear Stigma:  
Encouraging a More Productive Discourse**

A Thesis Prospectus  
In STS 4500  
Presented to  
The Faculty of the  
School of Engineering and Applied Science  
University of Virginia  
In Partial Fulfillment of the Requirements for the Degree  
Bachelor of Science in Mechanical Engineering

By  
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May 9, 2023

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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## **Overview**

As a mechanical engineering student, I want to create robust, safe technologies that can be used to support society. I interned at a nuclear power company and gained firsthand experience with the technologies and safeguards used in the field today. I will use literature review in combination with interviews to examine the relationships between various nuclear technologies and society as a whole and better form methods of improving its perception. In particular, analyzing the societal perceptions of nuclear power, especially from those supporting green energy but opposing nuclear power, will allow policymakers and designers to better improve the public's opinion on these proven technologies.

## **Problematization**

Many people who want to improve societal infrastructure support green energy technologies: this usually encompasses wind, solar, hydropower, and geothermal energy. Even those who still support the use of fossil fuels justify it by pointing to its capacity factor and baseline energy generation and energy density. Some people in both these groups oppose nuclear power when it appears to have some of the best of both worlds. There are certainly valid concerns about nuclear power, mainly based in real historical events, but this ever-evolving, puzzling relationship between nuclear power and society must be examined in more detail.

## **Guiding Question**

How has society's view of nuclear power shifted to where it is today and how can it be shaped to better reduce our carbon footprint?

## **Projected Outcomes**

My research will examine the shifting of societal views on nuclear power over time to determine the root causes of the pervasive negative stigma around nuclear today. It will challenge that stigma and use its findings to suggest improvements in communications by the media, nuclear power companies, and in national policy to better improve the perception of nuclear power. By shifting the underlying societal views and clarifying misconceptions, it will allow for a more rapid and sustainable shift to cleaner energy sources.

## **Technical Project Description**

In the summer of 2022, I interned at Framatome Inc., which provides engineering services to nuclear energy providers in the US and several other companies. Before I even began actual work, I had to complete many trainings, which involved reading dozens of safety and policy documents, watching safety and other training videos, and taking assessments. The purpose of all of these training activities was to verify my understanding of the many safeties, technologies, and procedures in place not only at actual nuclear power plants, but in the engineering offices and training facilities. My main task was helping set up and analyze physical and fluid models of a new cooling assembly to keep the control rods from overheating and

exceeding operating temperatures. To do so, I created models from drawings and integrated them with existing computer-aided design (CAD) files to create an accurate replica of the real system. I then simplified the model so it could be analyzed without spending an exorbitant amount of time and computing resources. Simplifying it involved exercising sound engineering judgement to determine the most important features and other geometries that may affect the flow or region of interest. I consulted other engineers extensively to determine how to properly set up the model and eventually simulate it with computational fluid dynamics (CFD) software. Another project I worked on was for visualizing data with Python from a very complex model simulating various failures in the reactor barrel. I had to learn to process and visualize multidimensional data involving quantities like stress, displacement, time, and frequency, in addition to understanding the model itself. Doing so taught me a lot about the important considerations engineers make when analyzing nuclear power systems in order to provide accurate results and conservatively plan for safety in potential failure scenarios.

### **Preliminary Literature Review & Findings**

The literature and other sources I analyzed focused on smaller aspects of my research topic. For instance, some sources argued or demonstrated that nuclear power was viewed very favorably in the early days of nuclear, up until approximately the 1970s (Friedman et al., 1992; Banta & Luske, 1957). They show that even though the risks of nuclear were known and not hidden, the raw power and potential of the technology was viewed positively. Reporting of the topic was relatively fair, although public opinions began shifting around then. Previous research has also analyzed how media coverage of various nuclear disasters, such as Chernobyl and Fukushima, affected public perception of nuclear power and trust in both the technology and

policymakers (Friedman et al., 1992). These articles found that the media contributes to public misconceptions and general knowledge of nuclear power in various forms, such as by making simple factual errors to varying in levels of elaboration and discussion (Ho & Chuah, 2022). Many of these articles analyzed not just Western or American societal views towards nuclear, but also residents of other countries, including Japan, Singapore, Korea, France, and China, which have all had nuclear incidents or similar energy-related newsworthy events. Many of the previous studies mentioned obtained similar results regarding the presence of a nuclear stigma, suggesting addressing these universal concerns may be widely applicable to increase nuclear support worldwide (Fang, 2013; Horlick-Jones et al., 2010; Im et al., 2021; Marques et al., 2021; Orui et al., 2020; Sugiman, 2014; Topçu, 2022). The less technical sources provide overviews of nuclear power and provide general details relevant to my topic. Several other articles I analyzed also took a more general approach and analyzed what factors can affect public opinion on nuclear power, such as its proximity to nuclear weaponry, fear of the unknown, and general uncertainty similar to those relating to global warming (Palfreman, 2006; Doble, 1995; Baron & Herzog, 2020). Other research has shown that in past decades, young Americans across a variety of socioeconomic factors are more opposed to nuclear power than the general public (Pifer, 1996). This certainly warrants further research and comparison to present-day attitudes. Many of these articles focus on only very small aspects of the nuclear perception and stigma, with only one even indirectly suggesting methods of improving that perception in society. My research will synthesize the technical knowledge and background and historical information to make an informed proposal on policy changes to better improve nuclear power's outlook.

## **STS Project Proposal**

STS is the study of the intersection of technology and society that examines the impact technologies have on society, ranging from both end users to designers and those tangentially involved. My project involves examining how nuclear power affects society, and consequently, how society has viewed nuclear power over time. While technical details are necessary to provide important background information, it focuses heavily on the greater effects of those technologies. I will link my topic to its societal impact over many different eras and geographic locations; while I am focused on American society, other countries and societies will be included in my analysis as well.

I am approaching my research topic most broadly from a policy point of view. The analysis I conduct about nuclear perceptions and the changing role of nuclear power over time will all culminate in a synthesis of knowledge that can allow policymakers, the media, and nuclear companies to better promote nuclear power. Here, I take policy to not just mean literal governmental and regulatory policy, but general guidelines followed by various stakeholders of nuclear power. In order to form pertinent policy suggestions and improvements, I will also be analyzing nuclear power from ordinary peoples' perspectives. This will involve safety, trust, risk, and environmental factors, since these are the primary values people consider when thinking of nuclear power. The authors I will use will primarily be STS researchers or scientists involved with nuclear power. Many of these authors will already have conducted analyses in the past about public perception of nuclear, whether qualitative or quantitative, and compiling these results over time will provide a timeline of the evolving state of nuclear power in society. Public opinion is necessarily driven by real-world events, so the more technical authors will also provide more technical information about disasters (like Chernobyl), mechanisms of power

generation, and other relevant details. These will supplement the broader STS analyses of the past to better indicate where current studies and policies are lacking.

I will primarily use actor network theory to investigate my research topic. Actor network theory positions everything and everyone within a shifting network of relationships, which is exactly what is needed to analyze the complexities of societal behaviors and technologies surrounding everything nuclear-related. Because so many stakeholders, technologies, people, and other natural forces (like the literal physics behind it) are involved, actor network theory is well-suited to analyze and describe these relationships. While it may not be the best choice to analyze historical data and vast changes over time, this network view of nuclear power is still important to link all these complex variables together. With some modification, it will allow me to link people, events, technologies, countries, and more together into a cohesive view analysis of nuclear power and its societal impact.

I plan on analyzing my topic primarily using literature review because of the broad period of history I plan to cover. Nuclear power has existed for about 80 years and many studies and surveys have already been conducted on aspects of my research topic. I also plan to supplement the literature with interviews and personal surveys to get a better understanding of how the public currently feels about nuclear and to provide a more direct glimpse of peoples' views on nuclear from various time periods.

## **Barriers & Boons**

A potential blind spot is that I've lived in clean neighborhoods with no significant issues with radiation or pollution, so have not been directly impacted by any of the fallout

(metaphorical and literal) from major energy sources. Most of my knowledge of nuclear power prior to my internship has been through reading outside sources on the topic. This gives me a more positive bias towards nuclear power, though this is not necessarily bad, because the people with the strongest views towards nuclear (such as people in disasters like Fukushima) would most likely be biased against it. I am relatively inexperienced with STS analysis as a whole and may make generalizations or miss some aspects of the nuclear presence in society today. Because I am primarily analyzing literature, much of my analysis will have already been done on people, not necessarily with people and understanding individuals' viewpoints. To combat this somewhat, I plan to supplement my literature with interviews with various University-affiliated people to get a direct sense of at least one community's views on nuclear power.



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