DESIGN OF A THORIUM EXTRACTION PROCESS FROM MONAZITE SANDS

DIGITAL COMMUNICATION AND ITS INFLUENCE ON NUCLEAR ENERGY

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SOCIOTECHNICAL SYNTHESIS

The looming energy crisis plaguing society today is centered within reliance on hydrocarbon fuels, whose emissions have contributed to detrimental trends such as global warming and climate change. Nuclear energy currently exists as a powerful yet controversial solution to this problem. It is the goal of this project to improve the status of nuclear power such that it becomes a more viable alternative for global energy production as a whole. The technical report emphasized a shift to more efficient and safer thorium fuels by increasing its production and overall prevalence in industry such that nuclear fuels will be lessened as a security and safety issue, improving its public opinion and standing as a whole. The STS report further determined why nuclear technology has constantly met widespread opposition in its implementation and how novel digital communication techniques can be used to remediate these setbacks. Ultimately, it is the hope of this thesis to both highlight the importance of nuclear power and serve as a call to action to place a greater emphasis on their implementation.

The technical research report aimed to improve nuclear fuels with the mass-production of thorium oxide. Nuclear power plants are carbon-neutral energy producers, but economic and safety concerns inhibit their widespread implementation. Many of these issues are centered on the use of uranium fuels, which are both scarce and easily weaponized. Thorium nuclear fuels are an attractive alternative to their currently used uranium counterparts because of their higher natural abundance and safer disposal options. A continuous process to extract thorium from monazite sands and convert it to its oxide at a nuclear fuel grade purity (>92 %) is described with the aim of making safer nuclear fuels more accessible.

The proposed process consists of thorium isolation, thorium purification, and thorium oxide formation blocks. All of these processes were designed with their relevant equipment,

techniques, and balances. Ultimately, the proposed plant consumes 300,024 kg of monazite sand per year and produces 30,513 kg of thorium oxide annually. After a startup cost of $2.7 million, economic analyses indicate the plant is profitable at its designed scale in two years with an annual non-discounted cash flow of $8.2 million. This scaled-up extraction process provides a pathway towards utilizing this largely untapped resource, and was concluded to be effective both technically and economically.

When thinking about the history of nuclear energy, the mind is immediately drawn to tragedies such as Chernobyl and Fukushima. The STS report aimed to determine why through the investigation of previous incidents and the use of Pinch and Bijker's Social Construction of Technology theory. This theory was employed in the analysis to better understand the role of the various actors and actants associated with nuclear technology, with a special focus on the role of media as the primary method of information dispersion and the main factor influencing public opinion. Once this understanding was established, the report jumped forward to more recent communication techniques mired within the advent of the Digital Era. Through pathways such as social media and forums, it was theorized that information could be disseminated that better improved social standing of nuclear technology.

The STS report developed a few key conclusions surrounding the media and its effects on nuclear technology. Much of the negative information surrounding Fukushima and Chernobyl was widely exaggerated by the media. This has developed a historically anti-nuclear opinion that has continued to last until today. However, with digital communication many channels have opened that can remedy this. Social media has proven to be an excellent way of reaching the general public, and can be used to spread truths and positivity surrounding nuclear power. Additionally, making nuclear information more accessible and utilizing more emotional

arguments have proven to be effective ways of currying favor, and should be a key aspect in the pro-nuclear campaign moving forward.

By no means is nuclear energy a completely safe technology. Yet, history has shown time and time again that the best innovations are not without their risks. To solve the looming energy crisis and to reduce emission-reliant energy, it is clear that technical innovations alone will be insufficient. Nuclear technology has always been both a technical and social issue, and needs to be addressed on both fronts to become a truly viable solution.

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