Thesis Project Portfolio

Design of a Processing Plant for Direct Lithium Extraction from Geothermal Brine in the Salton Sea Region

(Technical Report)

The BP Texas City Refinery Explosion: An Actor-Network Theory Based Analysis of the Effects of the BP and Amoco Merger in 1998

(STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Sociotechnical Synthesis

My technical work and STS research are connected primarily through the STS framework of Actor-Network Theory. Actor-Network Theory provides a method for examining large-scale technological innovations as networks of both human and non-human elements. In my technical project, my team and I constructed a network of human and non-human actors while designing a processing plant for direct lithium extraction from geothermal brine in the Salton Sea region. To gain insight into how successful technology networks may become unstable, my STS research examines the failure of the BP Texas City refinery in 2005 and the implications of the decisions made by BP executives upon becoming the network builders.

My technical work explores the ability to efficiently scale a developing method of lithium extraction. That is, my group's final design directly extracts lithium from geothermal brines in Southern California using a novel sorbent currently being studied by a research team, Team TELEPORT, at the University of Virginia. The final design consists of three main units, Lithium Adsorption and Regeneration, Electrodialysis, and Crystallization, which collectively produce the final product of lithium hydroxide monohydrate. It was vital that our final product be at a battery-grade purity so that it can help meet the increasing demand for lithium varieties in the United States. Indeed, lithium varieties are utilized in the batteries for electric vehicles, and the increasing demand has led to lithium varieties being identified as critical to the economic security of the U.S. That said, the primary goal of our project was to improve upon traditional lithium extraction techniques, which are known to be highly land, energy, and freshwater intensive.

My STS research focuses on the explosion at the BP Texas City refinery in 2005 and how decisions made by BP executives caused the network to collapse. More specifically, I utilized the

Actor-Network Theory concept of translation to investigate the change in leadership at the Texas City refinery when BP and Amoco merged in 1998. It was found that perpetual budget cuts made by BP executives soon after the acquisition of Amoco progressively weakened the purpose of certain actors in the network. Furthermore, I argued that there were already vulnerabilities within the Texas City refinery before BP executives became the network builders, and the network eventually failed also in part due to BP executives failing to account for them when solidifying the network.

Working on my STS research while simultaneously developing my technical design provided great value. Indeed, my STS research provided insight on how successful technological innovations can fail by seemingly broad decisions made by those who formed the network. Upon the completion of our technical project, my group and I found that we did improve upon traditional lithium extraction techniques, meeting our initial goal. However, we observed that our water requirements were still quite large, especially for the area of design which experiences frequent droughts. Reflecting upon my STS research, I realized that this power instilled into freshwater may negatively influence other actors in our network. Thus, among other recommendations, our team suggested that our design must be further optimized to solidify the potential for this new method of lithium extraction.