

# **Thesis Project Portfolio**

**The Construction of an Automated Solar Panel Cleaner**  
(Technical Report)

**Creating a Nuclear Navy: A Social Analysis**  
(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science  
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Bachelor of Science, School of Engineering

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## **Table of Contents**

Sociotechnical Synthesis

The Construction of an Automated Solar Panel Cleaner

Creating a Nuclear Navy: A Social Analysis

Thesis Prospectus

## **Sociotechnical Synthesis**

The technical report details aspects of the ideation, drafting and completion of an automated solar panel cleaner. In the current market, most solar panel cleaning is done by hand using skilled workers and as such, requires significant amounts of labor, and upfront costs. In response, various cleaning methods have been proposed, including various automated solutions, some of which include novel debris clearing techniques. For the purposes of our technical project, we sought to optimize debris removal, with cost-efficiency, ease of construction, ease of assembly, and future product serviceability. Therefore, we outline our process of ideating various mechanisms and then the process of selecting an optimal solution from within the ideated variants. To this, we first selected a wiper mechanism consisting of a single wiper which moves over the surface of a panel. After having selected the panel mechanism, we then determined how to create the motion of the wiper using a single motor without imparting undue torque on the device so as to keep the wiper operation moving in a straight line. To do so, we derived a pulley mechanism which winches the wiper up and down with equal force on each side of the wiper blade. Having done so, we then devised a method to withdraw the wiper blade using tension springs. Upon actual construction, we used MDF boards as the construction material, and also used 3D-printed components, and aluminum rails. We replaced the tension springs with negator springs to ensure a long enough draw, and thus were able to produce a working model of the solar panel cleaner. This moves very slowly, however, and as of yet does not include any mechanism for lubricating the panel. These may be components that can be added for future work.

The STS report deals with an analysis of the creation of a nuclear-propelled, and eventually nuclear-armed US naval fleet, particularly focusing on the development of the US

nuclear submarine force. This is meant to act as a social history of the Nuclear Naval Propulsion Program supplementing the various technical, narrative, and biographical histories that already abound regarding the subject. To do so, the report first details a general narrative chronology of the events of the nuclear propulsion program from the first exploratory committees meant to investigate the viability of nuclear reactors for shipboard service up until the launch of submarine launched ballistic missiles, and their accompanying submarines. This provides a general overview of the history of the nuclear submarine fleet from nascence, to its establishment as a fundamental part of the nuclear triad. Having thus done so, the report then turns towards analyzing how this came about. This focuses on the distinct social tensions and circumstances which allowed for the program. In particular, it focuses on how an American public had to be primed to accept the program through a concerted propaganda effort centered around periodical publications. It then also examined the specific actors who were enmeshed within this propaganda, looking particularly at the role of periodical editors, naval contractors, Department of Defense officials, and Department of Energy officials. This report then turned towards other social dynamics, in particular, looking at that between the various classes within a military hierarchy, and focusing on the new dynamics brought about when switching from an old diesel-boat navy to a nuclear-powered submarine force. To do so, various frameworks from the field of Science, Technology and Society were consulted. This included such sociological frameworks as Actor-Network Theory, and the Social Construction of Technology. The former examines the various people and technologies which were directly affected, and affected the events which unfolded, while the latter examines the social contexts in which they existed. In this, I thus uncover the myriad social forces which came into play, and learned which ones had

particular salience. This can then be used to glean insight on how other seemingly impossible technologies might also be made possible given a favorable social context.

Having outlined both reports, I now have a balanced view of how a new technology — whether it be an automated solar panel cleaner, or else nuclear-propelled submarines — may be made implementable. The technical report provides a technical understanding of how this may be done, with insight of the technical challenges that must be resolved and then be overcome. The social analysis thus provides a social understanding of how this might be overcome using the correct combination of social forces. I hope that the reader can ascertain new insights into the development of new technologies.