

Thesis Project Portfolio

Student Researched and Developed High Power Rocket (Technical Report)

**Improving Exclusively Through Technological
Development: Open Burns/Detonations at the
Radford Army Ammunition Plant** (STS Research
Paper)

An Undergraduate Thesis

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Bachelor of Science, School of Engineering

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Table of Contents

1. Sociotechnical Synthesis
2. Student Researched and Developed High Power Rocket
3. Improving Exclusively Through Technological Development: Open Burns/Detonations at the Radford Army Ammunition Plant
4. Prospectus

Sociotechnical Synthesis

Introduction

Both my technical project and STS research are related to the life cycle of propellant. My subgroup of the technical project originally focused on formulating propellant for an M-class rocket, while my STS research focused on the impact that the decommissioning process of waste propellants has on the community of Radford, Virginia. However, after the government said that we were not allowed to manufacture our own propellant, my role switched entirely to crafting a detailed plan of action rather than manufacturing.

Technical Project

At first, my technical project was a student designed M-class rocket. Our class was split into three groups—propulsion, aero-structure, and mechatronics/controls. I was a part of the propulsion group, which was further divided into propellant formulation, motor design, and thermal analysis. My subgroup's goal was to research and manufacture the propellant for the launch. The propellant we selected was based upon a formulation of ammonium perchlorate composite propellant (APCP) called "Cherry Limeade."

Unfortunately, following an overwhelmingly large change in requirements for our project, as well as the input of our advisors at Tripoli, the university, and the Virginia Department of Health, our project was stripped down to a shell of its intended self. We were no longer launching a rocket, but instead building the body and fins of the rocket, producing a rocket nozzle, and creating a circuit board which could provide avionic information to a rocket. These

changes resulted in my subgroup, propellant formulation, becoming obsolete, and so we pivoted to hydrostatic testing, a static fire test, and a detailed plan of formulation for the APCP propellant we intended to use. But with further limitations being placed on our group, we switched to just hydrostatic testing and a detailed plan of propellant formulation. Hydrostatic testing involves pumping large quantities of water through the rocket nozzle to gauge how it functions at the high pressures produced during combustion. However, my focus was the manufacturing plans, and I created a detailed document which provided step-by-step guidance on the creation of our variant of Cherry Limeade.

STS Research Paper

My research paper was a case study of the Radford Army Ammunition Plant (RAAP) and the effects that the open burning/open detonations that take place on site have on the surrounding community of Radford. The Radford Army Ammunition Plant is the sole manufacturing facility of military grade nitrocellulose in the United States, and it serves as a hub of propellant-based manufacturing and decommissioning for the military. The RAAP has been in use since the Second World War, and it serves as a vital facility for manufacturing nearly all propellant produced by the United States.

Due to the strategic importance of the facility and its relationship with the United States military, the RAAP has been granted special privileges by the government which have had incredibly harmful effects on the community of Radford. Despite being banned in the 70s, the facility is allowed to continue to destroy waste propellant by a process called open burning/open detonation. The process is exactly as it sounds, putting a large quantity of waste propellant onto a

concrete slab and lighting it on fire, and it releases massive quantities of pollution into the air and water around the plant.

Using Pinch and Bijker's "Social Construct of Technology" as a framework, I explored the different relevant social groups involved in the situation and their points of view. I detailed the disconnect between what the community views as acceptable and what the military finds acceptable by reviewing the correspondence between the two groups. Then I attempted to reconcile the two groups' views and provide closure on the disagreement.

Conclusion

Researching both methods of propellant manufacturing and the effect that destroying old propellant has on the surroundings allowed me to get a grasp of both sides of the coin. Without having researched the Radford Army Ammunition Plant, I would not have considered the harmful effects that manufactured propellants have at the end of their life cycle. I think that researching the harmful practices performed at the Radford Plant has opened my eyes to a different side of the field of propulsion. And on that end, I believe that the STS research section of my thesis was incredibly successful, and I am very proud of the way it turned out.

I believe that being able to actually do my technical capstone would have allowed me to grasp a deeper understanding, but the class was not effective at fulfilling a single one of the promises given to us at the beginning of the year. The unbelievable amount of misinformation provided to our groups about what we were able to actually do was incredibly unprofessional and downright rude, and it managed to ruin what should have been the culmination of our learning. I can only be glad that future years will never have to experience this class.