MATC Summer Internship Program
Final Report

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MID-AMERICA
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My internship through the MATC Summer Internship Program was as an undergraduate research assistant at Midwest Roadside Safety Facility (MwRSF) under the supervision of my faculty sponsor, Dr. Cody Stolle. My research was funded and supported by the Nebraska Center for Energy Sciences Research (NCESR) and the Nebraska Public Power District (NPPD) through the Darrel J. Nelson Summer Undergraduate Internship in Energy Sciences Research.

I was incredibly lucky with my internship in the fact that I was exposed to much more through my internship at MwRSF than I would have been at most internships. This internship provided me with firsthand experience in two fields of which I had high interest but little knowledge: Roadside Safety and Energy Sciences. Though most of my time was spent with Roadside Safety, the NCESR hosted a meet-and-greet for the students who received the same Energy Sciences research internship that I did. At this event, I was able to hear about current developing projects and an interest was sparked for me in Energy Sciences. Since this event, I have been inspired to continue following developments technologies in the field. I was also given the opportunity to witness a MwRSF barrier crash test, which was an exciting experience that outlined the high necessity for engineering in Roadside Safety. Additionally, I believe the requirements of this internship pushed me to grow as both an engineer and an individual, developing skills that I hadn’t realized I was lacking.

My internship started like most: learning about the company and reviewing guidelines and manuals that the company follows. After being acquainted with all the necessary information, I began reviewing the data available for this project. The goal of my project was to identify differences in crash characteristics between battery-electric

vehicles (BEVs) and both internal combustion engine vehicles (ICEVs) and hybrid-electric vehicles (HEVs) nationally to evaluate the crashworthiness of BEVs.

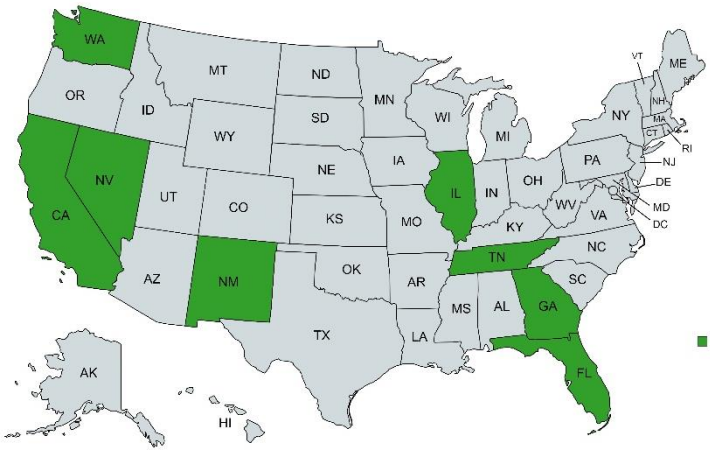

Figure 1: States that Contributed Crash Data

Data was requested from the eight state Departments of Transportation (DOTs) shown in Figure 1, including California, Florida, Illinois, New Mexico, Tennessee, Washington, Georgia, and Nevada totaling nearly 21 million crash records. With these crash records, the goal was to separate the vehicles according to their electric vehicle (EV) class by decoding their vehicle identification numbers (VINs). A modified version of the National Highway and Traffic Safety Administration's (NHTSA) VIN decoder was used to accomplish this.

Another undergraduate researcher, Samantha White, began the effort for this project last summer, and I was tasked with finishing the research she started. To do this, I taught myself the basics of Structured Query Language (SQL), a coding language used in most relational databases, as well as familiarized myself with Microsoft Access, a database program I had never used before. Once I felt comfortable enough to begin working with the raw data, I began the process of extracting VINs from the Access databases, decoding them, importing the vehicle data back to Access, assigning crash characteristics to accidents, filtering the data set for recent years and for records that included vehicle information, and then exporting the data to Excel for a detailed

comparison between the three EV classes. Each state was analyzed, each with their own reporting systems and new obstacles to overcome. After finishing all the individual state analyses, I compiled all the states' data to generate both a state-weighted and an unweighted national analysis. These analyses were used to generate summaries to send back to the state DOTs as an update from the information they provided us and were also formatted for submission to a refereed journal next month. Furthermore, as a requirement of the Energy Sciences Research internship, I summarized and presented my research and findings in a poster format at a symposium.

I was fortunate with the general completeness of my efforts on this project; I was given an objective and the necessary data, with which I was able to develop a work plan, perform critical and timely research, draw conclusions, and present the results. The months spent analyzing millions of crash records were invaluable for personal and professional growth. Some of the trends that we found and the conclusions we drew are as follows: (a) EVs are not "smarter" than average cars and nothing about the crashes is particularly unique; these vehicles aren't space-age autonomous machines. Humans are still the primary fault in crashes, and humans drive ICEVs, HEVs, and BEVs. (b) Based on a distribution of posted speed limits of roads with BEV and ICEV/HEV crashes, as well as time of day, weather, number of vehicles involved in crash, road type, road geometry, and all other observed crash characteristics, it is reasonable to assume that impact conditions for BEVs are also the same as other vehicles too; they don't need to be considered separately or have different impact conditions than national recommendations, i.e., the Manual for Assessing Safety Hardware (MASH). (c) The safety of occupants in BEVs is comparable to other vehicle types based on crash data

received. Since crash events and conditions are comparable, a comparable injury distribution suggests that BEVs are safe for their own occupants. (d) Fires are among the greatest concerns, seconded by electrocution. Fire risk around point-of-impact (POI) is not substantially different than ICEVs, but subsequent fire risk is not yet quantified. More study is needed for a conclusive evaluation of subsequent fire risk.

This summer, under the Darrel J. Nelson Summer Undergraduate Internship in Energy Sciences Research at MwRSF, has been the most formative work experience I have had to date, and I am exceedingly grateful that I was selected to receive it. I was able to truly experience the engineering process in a welcoming and helpful environment. It was crucial for me to be able to apply knowledge from my previous coursework, but even more so to genuinely struggle with issues and spend hours researching the quickest and most relevant solution. Although Dr. Stolle was always willing to provide his knowledge and assistance, he encouraged me to make mistakes and find solutions myself. This approach promoted more growth in my engineering skills than any previous experience I have had. Furthermore, I am extremely thankful that I was able to have a research internship because I have been pleasantly surprised by the researching process. I was ill-informed on what research entailed and have come to appreciate the process as well as the satisfaction of reaching a conclusion, regardless of the results. Additionally, the poster symposium was a pivotal conclusion to the internship and helped me to develop professionally. I had not previously had experience compiling a project into a poster format, and I had not had a significant amount of presentation experience; the poster symposium helped in both regards, and I will continue to expand these skills to become an adaptable engineer by the end of my

education at UNL. I look forward to continuing to develop as an engineer utilizing the experiences I have had in the past few months.

Acknowledgements

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- “Figure 1: States that Contributed Crash Data” was created via mapchart.net.
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