Abstract
The goal of this research is to test the efficiency of railroad track circuit detection systems. Railcar collisions are some of the deadliest accidents in the United States and are very under reported publicly. The research from this project will determine whether or not money should be invested towards track detection systems if the safety aspect passes or fails efficiency testing. Using electrical measurement instruments on the rails, the potential (voltage) and current (amperage) will be measured. Using the measured data and comparing to the data provided by the transportation companies, a conclusion will be made about the efficiency of railroad track circuit detection systems. Hundreds of lives can be saved with the research done as money can better be allocated towards other safety methods if the track circuit detection systems are proven inefficient and energy can be saved or redirected for an environmentally friendlier use.

Efficiency of Railroad Track Circuits in Relation to Safety and Energy Use
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Introduction
Since the year 2004, about 205,714 railroad related accidents and incidents have occurred in the United States with 13,335 of those being fatal (Overview reports, 2020). Even a single death or injury is too much and indicates that there is something wrong with methods of railroad safety and a problem does exist. Some of these accidents may be inevitable from the position of the transportation company, but not all are. These flaws in track circuits can include power supply failure, failure of relay, nature related problems, loose cable from vibrations, and many more (Patra & Kumar). If this research is conducted, private transportation companies will have a better understanding of where their allocation of time and money will be most effective. The railroad safety measures are not efficient enough in the United States and this research will provide crucial data on whether or not track circuit detection systems are contributing to the decrease accidents or not contributing at all. With track circuits proven to be inefficient, energy related expenses can be determined. Using electricity on something that does not do its only purpose is a poor investment and a waste of environmental resources.

Materials & Methods
First rail car transportation companies will be contacted seeking approval to be onsite and to obtain data sheets of their installed track circuits. Once approval is achieved, proper attire is worn such as long pants and safety training will be conducted. Once on site, experimentation will begin using multimeters and extra-long test leads in order to measure the current and potential between two rails. Multiple sites will be chosen to obtain precise and accurate data. The study will be done during freezing and summer temperatures in order to account for the nature aspect. Five trials are conducted in total for each site and then the interpretation of the data will be key. Interpretation of the data will be compared to the data sheets provided by the rail car company in order to determine where track circuits are working properly which leads directly to the results.

Results
If potential and current averages are measured to be much lower than what the data sheets provided by the transportation company, then we can say that a material with much lower resistance would be able to set alarm the track circuit detection system. If potential and current averages measure much higher, then there is an error in the experiment. This step should be noticeable during experimentation and not after. If potential and current averages are near identical to the data sheet, we calculate for the resistivity needed to close the circuit. This resistivity will help us determine which materials can easily short circuit the rails. A short circuit test (not in methods section) using the copper bars will help confirm the measured data and analyze the minimum conditions necessary to alert the track circuit detection system. With amperage and voltage both calculated, joules per second or watts can be calculated thus giving us a magnitude of energy. Using this, energy costs will be calculated in relation to the local electricity companies rate by kilowatt hour giving a net price of how much electricity costs are. Electrical costs and energy will then be used to determine its significance in relation to track circuit efficiency.

References Cited

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Conclusions
The present understanding for the importance in research of railroad safety would be taken far more seriously if transportation companies knew that the existing system is not efficient. Testing for the quality of railroad safety would increase as a result. Harnessing electricity is not cheap, nor does it have zero effects on the environment. Where coal is primarily the source of electricity and track circuits are operated, an increased risk of polluting the air is present as harnessing energy from coal is not environmentally friendly. If inefficiency of track circuits is proven for this key region, electricity would be better used for other purposes. This project will help the applicant’s professional development as a scholar as the research will help improve the scientific process methods used. The applicant will gain much skill and lesson on how the process can be done in the quickest and easiest way then be able to convey the knowledge to other scholars in a subtle, easy to understand method.