

Dual Liquid Electrical Sensing System for Railroad Lubricant Tank

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ECE480 Design Team 8

Design Issues

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Wednesday, November 19th, 2008

Introduction

New designs have detailed and explicit specifications in which the engineer must take into consideration when proceeding through the design process. These specifications will not only include what the customer wishes to obtain from the product, but they also consist of considerations that protect the environment as well as the consumer. Other items to keep in mind are the product life as well as liabilities of the product. Having a foresight on potential issues with the design will strategically make for a more successful result, both with the product and with the consumer. The Dual Liquid Electrical Sensing System must be designed with these things in mind to produce a quality product that will meet its expectations.

Product Lifecycle Management

Product Lifecycle Management is the process of managing the entire life of a product from start to finish. This process consists of the conception, design, testing, manufacturing, servicing and disposal of the product at the end of its lifecycle. For this remote sensing system, extra care has to be taken into consideration to ensure that the design is very robust so that it will be virtually maintenance free, and will work for years to come.

The benefits of well executed product lifecycle are reduced development time, improved quality, reduced cost, materials optimization, and a good framework for future operations. Since this is a unique prototype design that has not been mass produced, the lifecycle of the product cannot be expanded from a previous product is based entirely on this system. Any quality, reliability, manufacturing, or maintenance information for this sensing system must be gathered from the purchased sensors or other devices that are present in the system, as this new idea has not been documented before. This will make things more difficult in utilizing the benefits of improving on any past product lifecycle management that is related to the project.

There are many different aspects of Product Lifecycle Management. Product Lifecycle Management techniques have been utilized to reduce cost and time to development a unique and sophisticated design by focusing most of the effort on the purpose and not on the features. The purpose of this system is to measure how much liquid is inside a metal tank in multiple

ways to achieve an accurate system that prevents system failure. The purpose could be misinterpreted as the features that achieve the goal, such as ultrasound or resonance frequency detection, but these are only ways to achieve its purpose. Since ultrasound has proved to not be a viable option for liquid level detection, the fact that an RFID system has replaced it has shown that the project is on track and proceeding successfully. Also, the design of a system that needs little or no maintenance is essential because of the inconvenience of the location of these systems. Since the product will be placed inside the tank and must be powered by a battery solar panel, frequent maintenance is not an option.

When a system unique as this is implemented in its remote location, it must be a quality design. Part of the sensor will be submersed in a corrosive substance and needs to be able to work without deteriorating. With the design, the RFID tag must be protected to stand up to the environment inside the tank and ensure it remains fully functional. This protection must be able to be repeatable with ease so that the production of the sensing system can be produced without much cost. Given all of these specifications, it still must be completed on time and manufactured so that it will not corrode and reduce the lifetime of the product.

Product Liability

Liability is commonly defined as legal financial obligations or responsibilities of a business enterprise or other party for the damages that arise from using the product. With products that are designed, liability must be taken into account in case there ever is an incident with that product. The type of liability that relevant is strict liability, which focuses on the product itself rather than an individual. Under strict liability, a team of designers can be considered liable, even if negligence was not directly involved in the development of a faulty product.

Product liability is very important, especially for a product that is going to be mass-produced. It is our teams overall responsibility to develop a product that is safe and will not place any one in danger or a risk of injury. In order for risks to be avoided the wiring of the circuit, overall operation, instruction, and the installation of the design will need to be considered. If one piece of the entire process is overlooked it can cause a chain reaction of defects.

Proper instruction information is critical for the installer to have along with knowledge of the system as a whole to prevent accidents. Voltage and current will be properly regulated from the car battery into our circuit by means of insulation and proper grounding. The operator should be informed of any frequencies that are being used so no interference with future implemented devices could cause defects. A schematic with all data and detailed circuit design should be made readily available to the sponsor. Also, all electronic circuitry will be covered so it will only be exposed when maintenance must occur on the electronics. If one of the mechanical pumps fails, then the electronics will not get in the way to prevent damages.

Product Safety

Product Safety can be considered a subset of product liability because safety is the designer's responsibility. Systems must be designed with preventative safety measures, especially electrical circuits. The possibility of electric shock is greatly increased if wires and circuits are not protected. This is why the sensor inside the tank will be contained and covered. Also all of the circuitry will be enclosed in its own container so that a maintenance worker will not accidentally touch it. This prevents injury to the worker as well as an easy way to deploy the sensor upgrade to the tank.

Product safety is not just protecting people around the sensing system, but it is protecting what is hooked to it. In this situation, product safety is the extreme case when the system stops being reliable and effects its surroundings. If systems are not properly designed and protected, the electrical system could spark and destroy the whole system and keep burning. Since these tanks are close to train tracks, if a fire would start, it could ruin the railroad ties and ruin the tracks. If a passenger train was to cross on a faulty track, it could endanger many lives.

Environmental Issues

When dealing with new additions to an existing product in use, one must think about the ways it will affect the environment. Many new additions can cause the product to accomplish the task at hand but can also cause it to be harmful to the environment. The safety of the environment is an important issue that must be taken into account. The reason that

environmental issues are a concern is that the substance inside the tank, called Kaltrak, can be harmful to the environment. The reason for this is that Kaltrak is an oil based material. If Kaltrak were to leak from the system and possibly absorb into the soil, it could cause drastic damage to its surroundings. If this happened, Norfolk Southern and the designers of the system could be held accountable for the damaging effects to the environment.

To make sure this does not happen, the team must think of ways to accomplish the objective without external leakage. The first way to accomplish this is by creating a system that never touches the Kaltrak. By never modifying the container where the Kaltrak is contained or having any hole for the Kaltrak to leak through prevents possible damage to the surroundings. The second method is by developing a simple way to attach a device internally without the Kaltrak escaping. Another way is by mounting the system internally to the side of the wall using magnets. Using magnets makes the system easily attachable and effortlessly maneuverable without drilling holes or spending a lot of time on the inside of the tank. This decreases the likelihood of any Kaltrak leaking out. In addition to making the system easily attachable, careful considerations to size of the object have been taken into account. When the system is smaller, less of the Kaltrak can attach to it. If it needs to be removed, there will be no concern that the liquid will escape the tank. When dealing with any system, one must not only think about how the problem can be solved but they must also consider how their solution can affect outside sources.

Summary

When designing products, product lifecycle management, product liability, product safety, and environmental issues are concerns that need to be discussed to make the design reliable. Because this is a unique product, careful design, manufacturing, testing, maintenance and overall project monitoring must be enforced if this product was to be mass produced. Product liability and safety must always be a concern because one failure can be devastating to a company. Also, making sure that anything from the product to the process does not affect the environment is an upcoming key issue that might be more enforceable in the near future. If all of these are taken into consideration, the sensing system would be very successful.