# Water Spray System for Water Intrusion Testing



Group 17: Scott McMurry Justin Collins Shane Boland



### Overview

- Project Scope
- Product Design
- System Control
- Risk Assessment
- Expenses
- Future Work



Diagram of current system at Cummins

# **Project Background**

#### Problem

• Water intrusion in the electronic fuel systems on engines

#### Objective

Design a water spray system

#### Motivation

 System to be used during endurance tests on various engines to simulate the effect of driving over puddles

### **Product Specifications**

- Adjustable spray settings
- Simultaneous coverage of entire spray area
  - Spray area: 6 ft long x 3 ft high
- Robust Structure
- Portability
- Ease of assembly
- Flow rate: ~ 1 gpm



Block diagram of spray coverage area (6 ft x 3 ft on each side 3 ft above the ground)

### **Product Design**





#### Structural

- General structure made from extruded aluminum
  - Slotted beams allow for easy assembly
  - Lightweight
- Wide base provides ample stability



- Sharkbite Fittings
  - Approved for CPVC and PEX Tubing
  - Ideal for easy assembly
  - Disconnect Clip provides for easy disassembly
  - Result in secure, rigid joints



- Nozzle array
  - Square-pattern brass spray nozzles
    - 75° spray pattern
  - Each side of structure features 6 nozzles arranged into 2 rows of 3 nozzles wide
  - Provide complete coverage of 18 sq ft spray area





- Piping Design
  - "H"-configuration
    - Mechanism to encourage uniform filling across width of array
  - PEX Tubing
    - Allows for more flexibility in system



#### Ball Valves

 1" CPVC Ball Valves for manual closing of either side of structure



- Solenoid Valves
  - 24 VAC
  - Adjustable flow control
    - Can be manually calibrated using attached flowmeter
  - Each activated at appropriate times using micro controller





 Pump Selection

 1/3 HP Centrifugal Pump with motor





#### Pump Recirculation System

- City water source does not provide ample flow rate
- 15 gallon reservoir used to maintain water supply
- Float valve within reservoir to prevent overflow
- Water recirculation back to reservoir between sprays





# **System Control**

- Embedded system
  - Performs dedicated functions
  - System is self-reliant
- Micro controller
  - DRAGON-12 USB Board
  - Receives program from PC, executes program functions
- Solenoid valves
  - 24 VAC adjustable flow valves
- Pump
  - 24 VAC Relay for 110 VAC at 10 A





#### Expenses

Part	Quantity	Price
Solenoid Valves	2	111.83
Centrifugal Pump	1	374.55
Versa-Mount Water Flowmeter	1	64.23
Additional Valves	2	114.9
MicroDragon Project Module	1	55
Misc. Electrical Components	3	29.35
Brackets for extruded Aluminum	12	98.88
CPVC Piping	40 ft	53.16
Flexible Tubing	8 ft	44.24
Sharkbite Fittings	23	333.67
Misc. Pipe Fittings		200
	Total	1478.54

## Safety/Risk Assessment

#### Mechanical

- Pump runtime/fatigue failure
- Water Interaction with electrical components

#### Environmental

- Cummins facilities use separators to remove possible oil from water
- Water waste significant for extremely long tests

### Future Work

- Water Collection/Separator
  - For a 1000 hour test spraying for 15 seconds every 15 minutes
    - Results in approximately 284 gallons of water per day
  - Incorporate water collector/separator to eliminate or reduce significantly water waste
  - Was not required in product specifications
  - Budget constraints would not allow for incorporation into current design

#### **Functionality Testing**



#### **Full System Test**



#### Hyperterminal Simulation



### Acknowledgements

- Mr. Alex Dugé
  - Cummins- Experimental Mechanics
- Mr. Andrew Zac-Williams
  - Cummins- Structural Analyst
- Dr. Kareem Ahmed
  - Faculty Advisor
- Dr. Rob Hovsapian
- Dr. Srinivas Kosaraju

#### Questions