FAMU-FSU COLLEGE OF ENGINEERING

SENIOR DESIGN I – EML 4551

DELIVERABLE: NEEDS ASSESSMENT

MECHANICAL DUMP VALVE – TEAM 3

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Date of Submission: September 27, 2013

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1.0 Problem Statement:

There is a need for mechanically monitoring the fuel pressure in a highly pressurized common rail diesel engine, as well as relieving the fuel in case of over pressurization. The means of achieving this should be inexpensive and the mechanical component should be lightweight and easy to install on an engine to allow for maintenance as well as easy replacement.

2.0 Background:

Cummins Inc Fuel Systems XPI (extreme pressure injection) department currently has an MDV (mechanical dump valve) operating in all their common rails as a mean of safely relieving the pressure in the rail in case of over pressurization. This valve is dormant while the rail pressure is within the limits desired for the engine and while the pressure sensor is able to regulate the fuel flow into the rail. In case of a failure of the pressure sensor the ECM (engine control module) has no way of telling the IMV (inlet metering valve) how much fuel it needs to allow to get pumped into the common rail, in which case over pressurization could happen. As a safety back up, a purely mechanical valve is installed on the common rail. The function of this valve is to allow the fuel out of the rail and therefore reduce the pressure within it, which ultimately avoids thermal events. The valve would then take over the system and act as a mechanical controller to regulate the amount of fuel in the common rail. The fuel the valve is relieving goes back into the fuel storage through a line to be reused.

This MDV is durable, as well as reusable. The part is designed to reset once the engine is turned off. After the engine is turned back on, if the pressure sensor continues to fail the valve will once again begin to operate until the driver can get to a location where the sensor can be replaced. If the sensor is in working status the valve will be once again dormant until it is needed. The engineers at Cummins FS XPI wish to obtain a valve that continues to do these tasks but it is also more lightweight, more inexpensive, and with improved functions.

3.0 Objective:

The main objective of this project is to design, test and prototype a working valve that achieves the requirements stated in the confidential technical profile provided by Cummins FS XPI.

4.0 Fall 2013 Goals:

- Complete a full materials analysis, cost analysis, patents analysis and other general background research needed.
- Fully design a mechanical dump valve that meets the specifications on the technical profile. This includes thermal-fluids analysis and CAD drawings.
- Submit prints to Cummins FS XPI for machining and then building the prototype. (Testing will take place on spring 2014).

5.0 Methodology:

The team in conjunction with the engineers at Cummins FS XPI has devised a plan of action to achieve the previously mentioned goals. The team is currently researching patent work from other companies that have MDVs so that no issues arise with a design. Once the patent study is complete, a complete materials and cost analysis research will be performed. This research will determine which materials are available to be used at a low cost. After the general background research and analysis is completed the design on CAD and thermo-fluids analysis will begin. Given that various ideas might arise at this point, a decision matrix and failure modes analysis will be completed on the designs that are being worked on, which will ultimately aid us in the selection of a model. The selected design will be reviewed once again and then submitted to Cummins FS XPI for machining and assembly will occur shortly after. During this period there will be constant communication between the faculty advisor Dr. Lou Cattafesta, the Cummins sponsor Christopher Besore, and the team to ensure the project is on track.

6.0 Expected Results:

As mentioned in section 3 of this report, the objective of this project is to design, prototype and test a working MDV. The Spring 2014 semester will be employed for testing of the valve and optimizing if time allows it. Cummins FS XPI wishes to make this valve a profitable component, which stresses the need of meeting all requirements on the confidential technical profile. At the end of the year 2013-2014 school year, the valve should be fully working and ready to be validated at Cummins Inc so it can be installed on an engine.

7.0 Constraints:

- Time: There are deadlines to be met at the end of this semester, including the finished drawings submitted to Cummins FS XPI for machining.
- Budget: Cummins will provide $2000. The cost of materials needs to be assessed throughout the duration of the project given that Cummins will be handling machining.
- Confidentiality Agreement: Various issues arise with the confidentiality of the material in this project, this affects presentations and information sharing on the team's website.