TEAM 3 : MECHANICAL DUMP VALVE (MDV)

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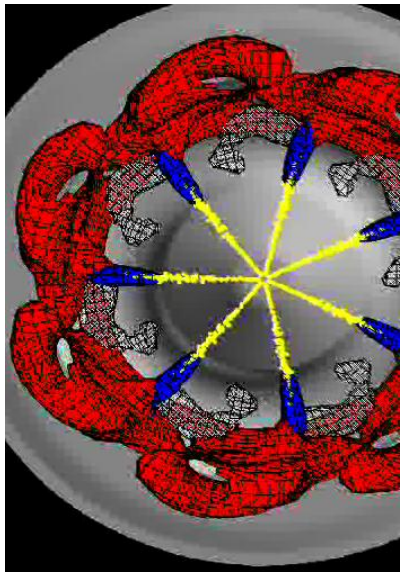

OUTLINE

- Problem Statement & Objective
- Background
- Non Disclosure Agreement
- Product Specifications (Technical Profile)
- Design Concepts (1, 2)
  - Detailed Concept Review & Evaluation
- Material Information
- Future Plans
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- Summary
- References
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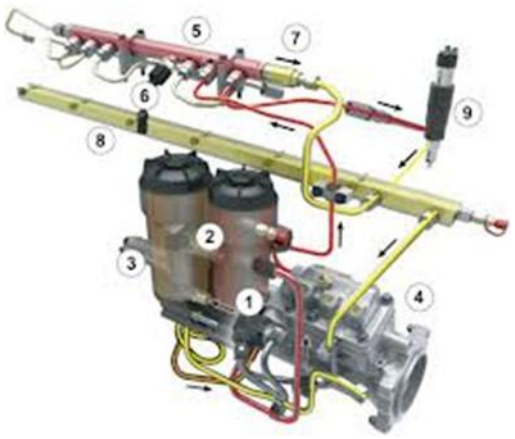
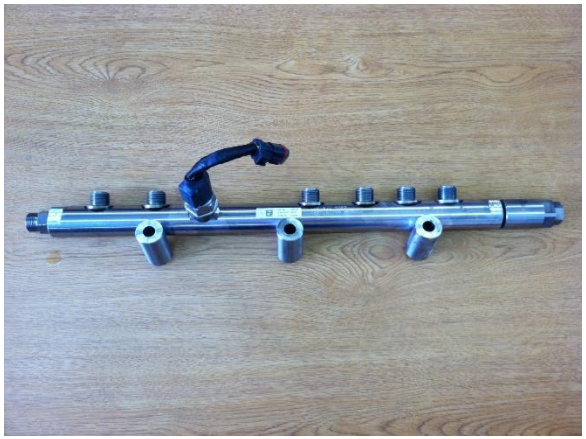
Problem Statement & Objective

- There is a need for mechanically controlling 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.
- To design a MDV that meets Cummins FS XPI Confidential Technical Profile.

Background

- Common Rail Overview
- Fuel Systems XPI (Extreme Pressure Injection)
- MDV Overview
- Current Cummins MDV issues, data availability, patents



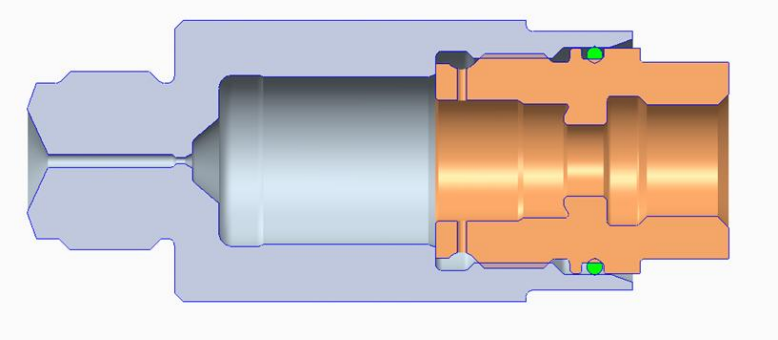


Non Disclosure Agreement

- Product potential for patenting and Competitors
- Intellectual Property
- College of Engineering NDA
- Information disclosed in presentations and reports

Product Specifications

- Design Specifications
  - External Connection: M20 x 1.5-6g threads
  - Internal Drain Connection: M14 x 1.5-6g threads
  - Length: 30 – 60 mm
  - Sealing Pressure: 1.5 times operating pressure
  - Cost: <$20.00 per valve (Including man hours)

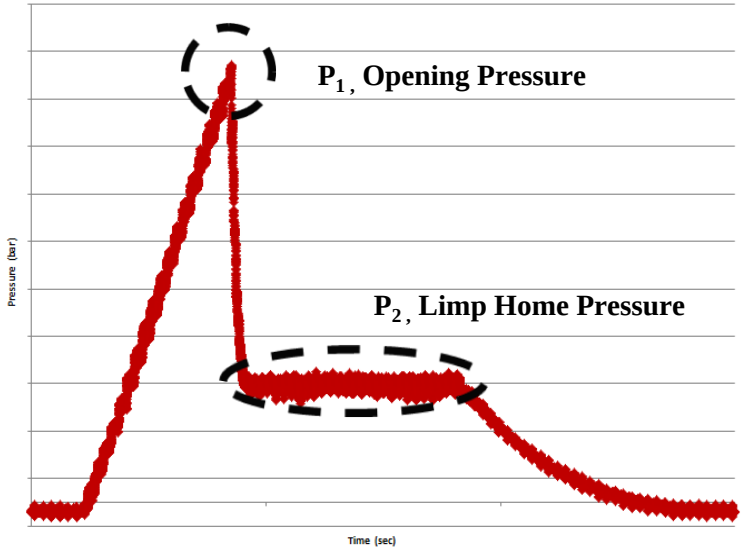


Product Specifications

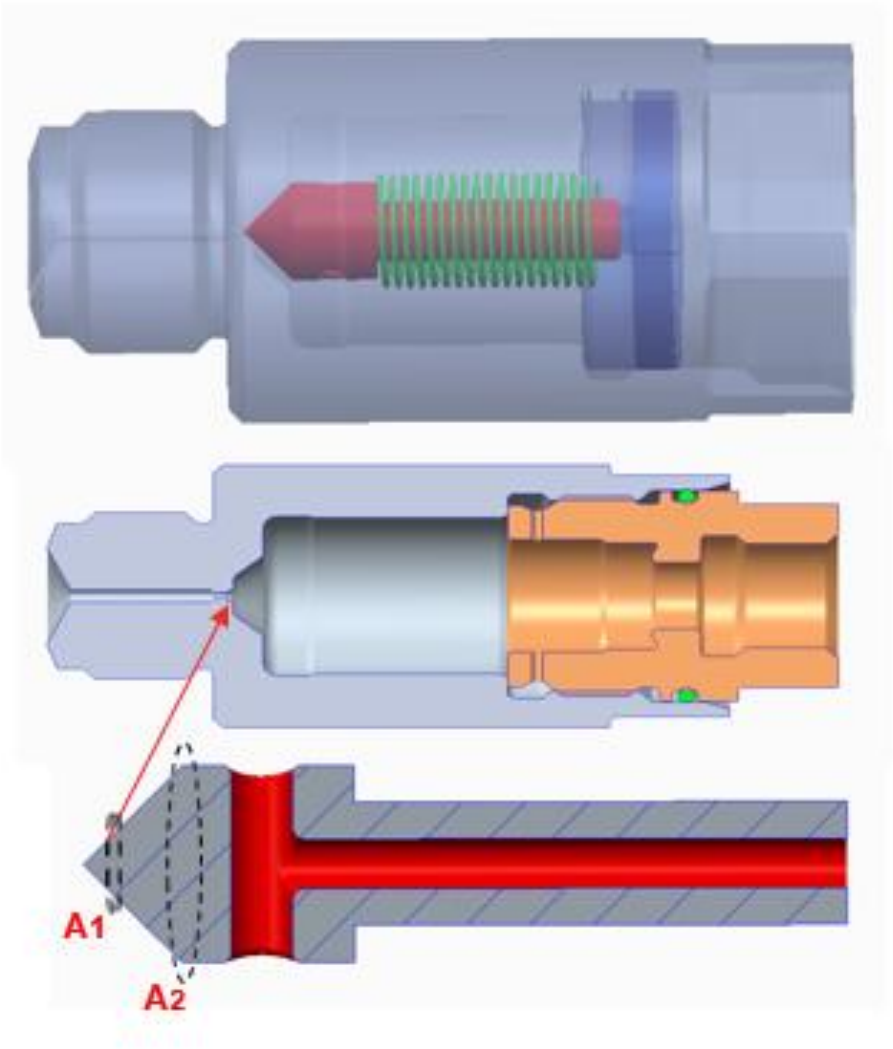
- Performance Specifications
  - Opening Pressure: 2400 – 2900 Bar
  - Limp Home Pressure Range: 200 – 1100 Bar between 0.15 L/min – 4.5 L/min flow rates
  - Minimum Limp Home

    Time: Unlimited.
  - Temperature Fluctuations:

    100 – 200 °C



New Design Concept D



Initial Pressure Force:

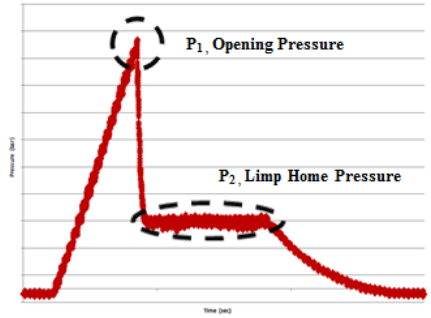
$F_1 = A_1 P_1$

For Opening Conditions:

$F_1 = K x$

Limp Home Conditions:

$F_2 = A_2 P_2$

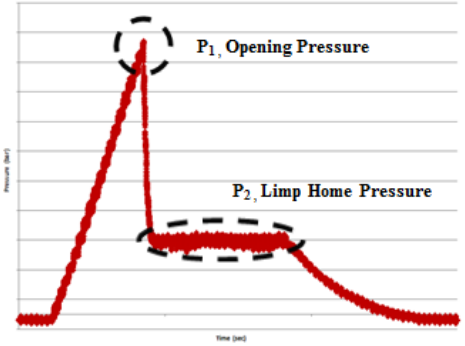


Design Concept D

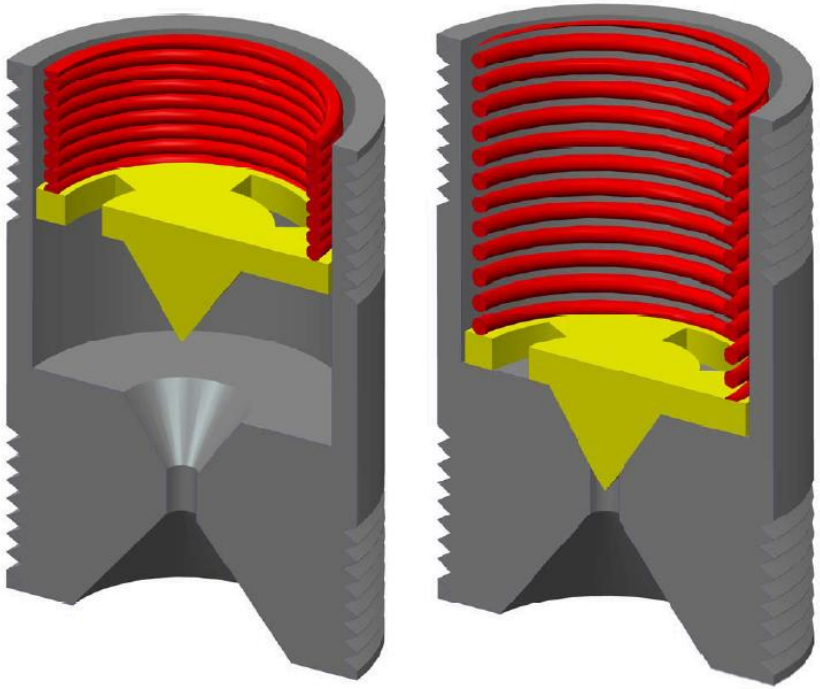
Pros	Cons
Easy to machine	Material restrictions for plunger due to high pressures
Few Components	
Low Cost	Plunger – High pressure seat beating could damage sealing surface creating a leak

Design Concept S

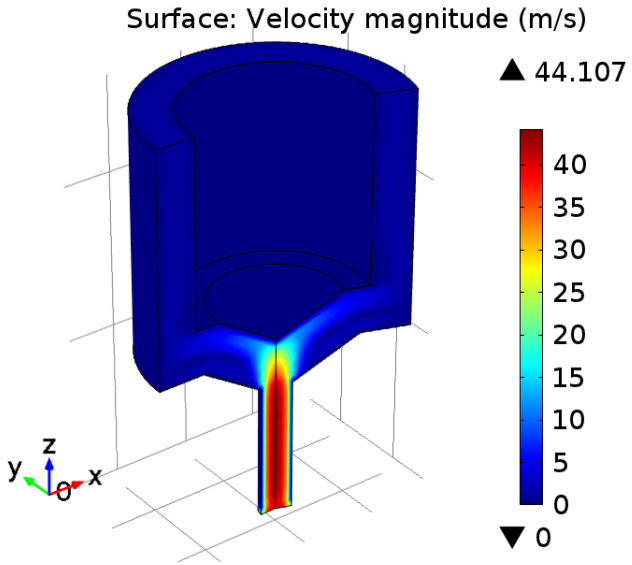
- 2-stage spring system
- At peak pressure High stiffness-spring compresses (stage 2).
- Lower stiffness spring will compress as soon as fluid flows in lower compartment.
- High stiffness spring stays open as fluid flows in and low stiffness will keep it at the required steady state.

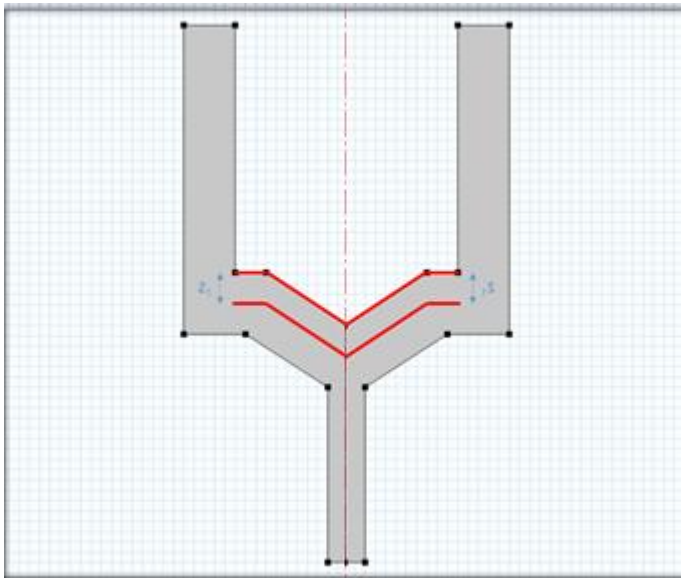


Stage 1 **Stage 2**

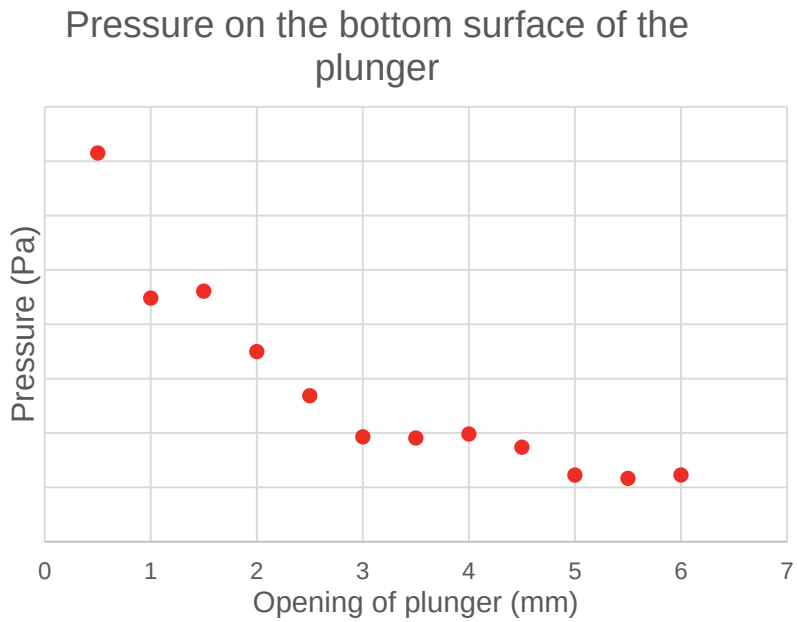


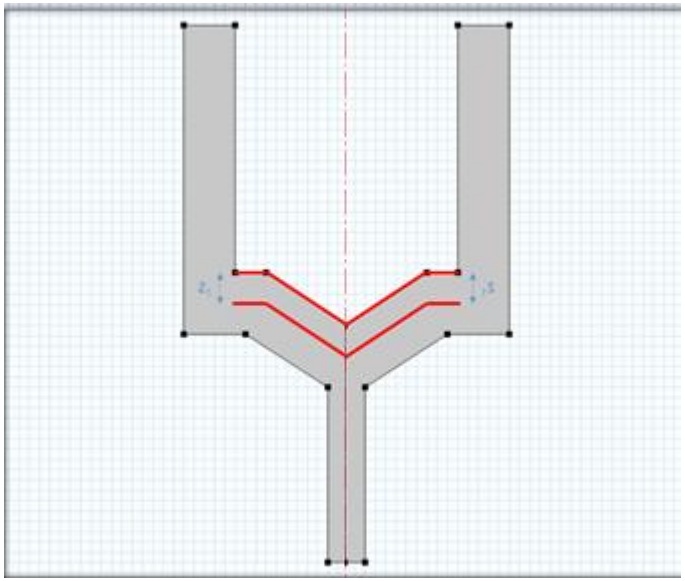
Design Concept S





Design Concept S





Design Concept S

Pros	Cons
Easy to manufacture	May not work appropriately with required response.
Easy to assemble	Might not seal properly
Low Cost	

Material Information

- Current MDV Materials:

Body: 4140

Hardness:43-47 HRc

Plunger: A2 Tool Steel*

Hardness: 58-62 HRc

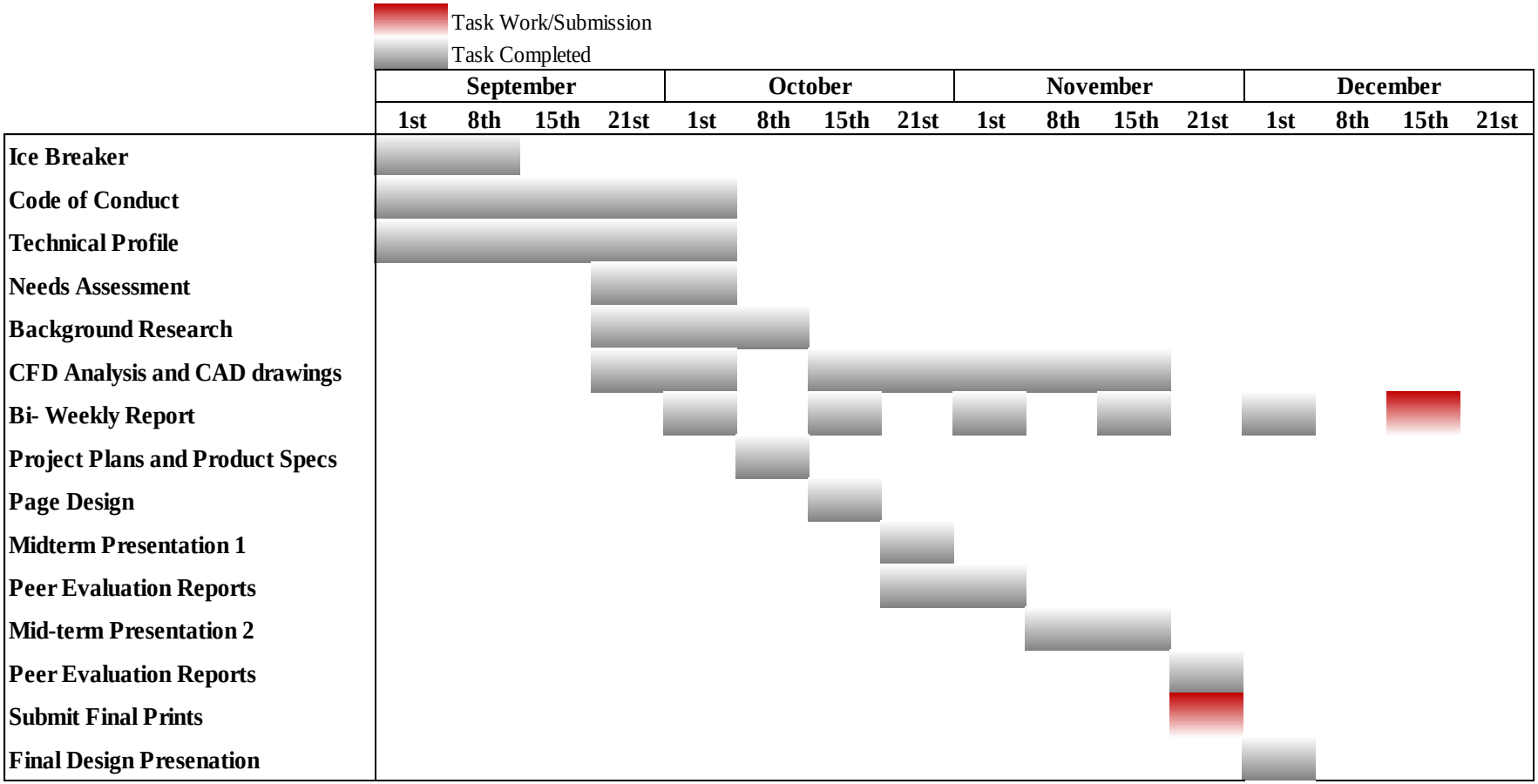
Retainer: 4140

Spring: Stainless Steel

Future Plans

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

Gantt Chart


Task Work/Submission
Task Completed
September
October
November
December
1st
8th
15th
21st
1st
8th
15th
21st
1st
8th
15th
21st
1st
8th
15th
21st
Ice Breaker
Code of Conduct
Technical Profile
Needs Assessment
Background Research
CFD Analysis and CAD drawings
Bi- Weekly Report
Project Plans and Product Specs
Page Design
Midterm Presentation 1
Peer Evaluation Reports
Mid-term Presentation 2
Peer Evaluation Reports
Submit Final Prints
Final Design Presenation

Summary

- Problem Statement and the need of creating an affordable MDV
- Non Disclosure Agreement
- Product Specifications
- Design Concepts (1, 2)
- Material Information
- Future Plans and Gantt Chart

References

- http://www.motoringmatters.com.au/news/cummins-announces-new-global-heavy-duty-engine-platform
- www.dieselnet.com
- www.cummins.com

Questions… Comments?