

Wall-Flow DPF system to replace Existing Wet Element Filter Systems used in Underground Coal Operations

Project Outline

ACARP project C25073 was proposed by industry stakeholders seeking an exhaust aftertreatment solution that:

- Enhances worker health through improved underground air quality; and
- Reduces operational costs associated with currently implemented diesel particulate emissions systems.

2017 will see the industrialisation of the system for commercial trials.

Approach to Development

Given explosion risks for product innovation in a working coal mine an alternate approach to development was adopted.

Characterisation of LHD operations in a working mine were used to develop a series of real world engine cycles for use during development.

Development was then undertaken off-line using a state-of-the-art engine test facility, with hardware transferred to the mine for confirmation testing of results.

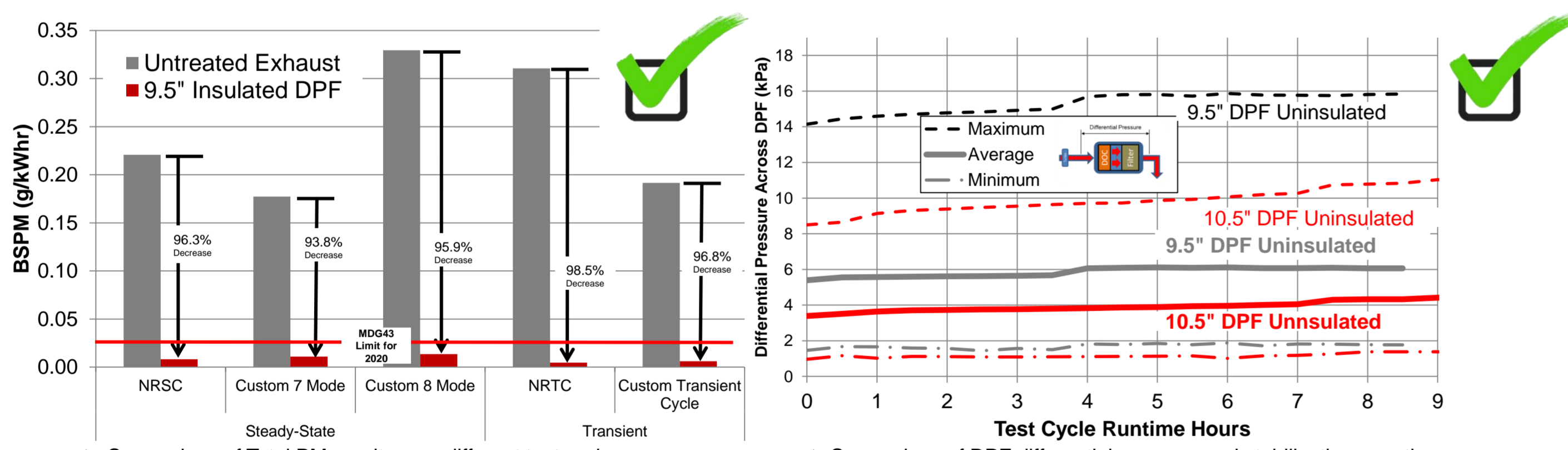


▲ Orbital's Heavy Duty, transient capable, certification grade facility

Proof-of-Concept Results

The rapid development project delivered PM reductions in excess of 95% over both regulator and real world cycles with the selected DPF.

Operation over continually repeated real world cycles showed that exhaust back pressure was stabilised confirming satisfactory regeneration was possible despite low exhaust gas temperatures (EGTs).



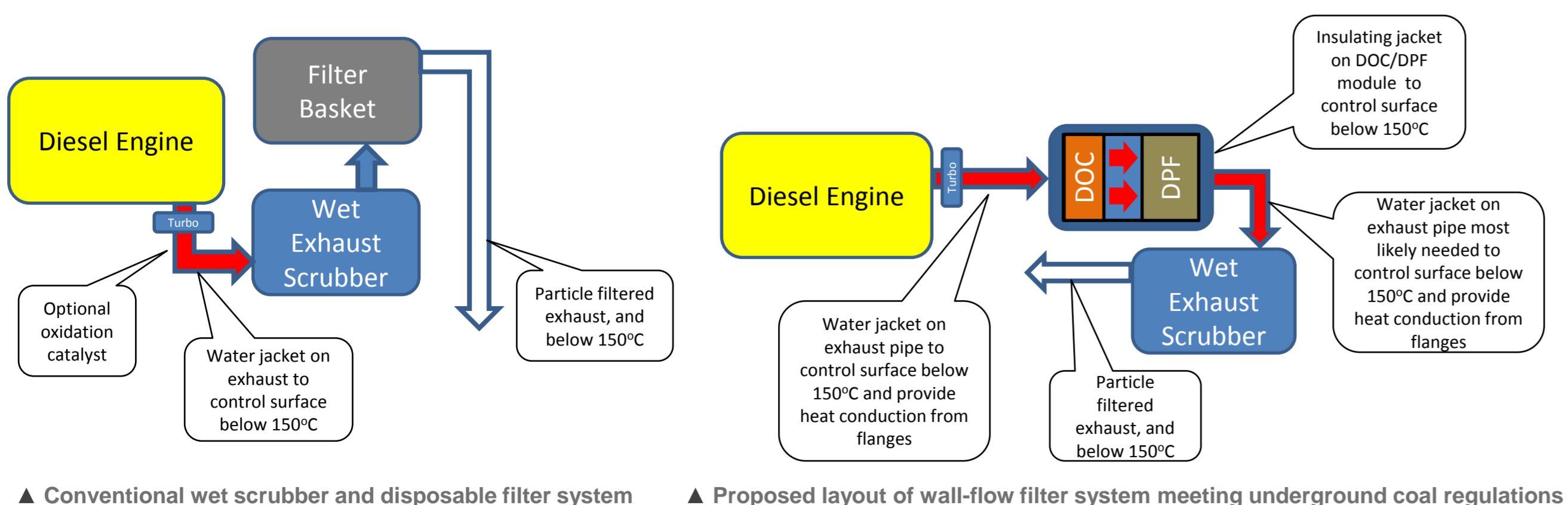
System Changes

The coal industry has to date mostly used wet exhaust scrubbers and disposable filters to address tailpipe emission and temperature requirements.



▲ Typical Load-Haul-Dump (LHD) vehicle used in underground coal operations

The revised system uses a specially packaged wall-flow diesel particulate filter (DPF) with a platinum based pre-catalyst.



▲ Conventional wet scrubber and disposable filter system ▲ Proposed layout of wall-flow filter system meeting underground coal regulations

Industry Challenges

Underground coal mining has largely electrified many operations, but diesel engines are still used for multipurpose load-haul-dump (LHD) vehicles and man transporters.

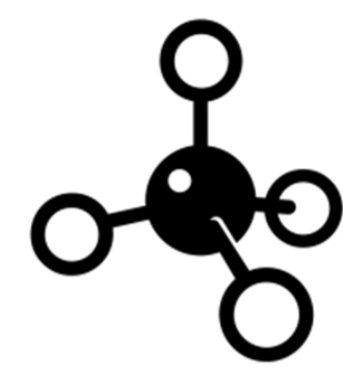
Diesel engines operating in underground coal mining need to comply with additional flame and explosion protection measures due to the presence of elevated ambient methane and highly combustible coal dust.

The health of underground workers is at risk without appropriate exhaust emission controls for particulates and gaseous pollutants.

Compounding this situation, the low operational duty cycle of the diesel LHD engine results in a very low average EGT which works against the performance of conventional DPF solutions.



- **<150°C**
- Tailpipe exhaust
- All surfaces



- **Ambient CH₄**
- Comply at elevated levels
- Shutdown at excessive levels

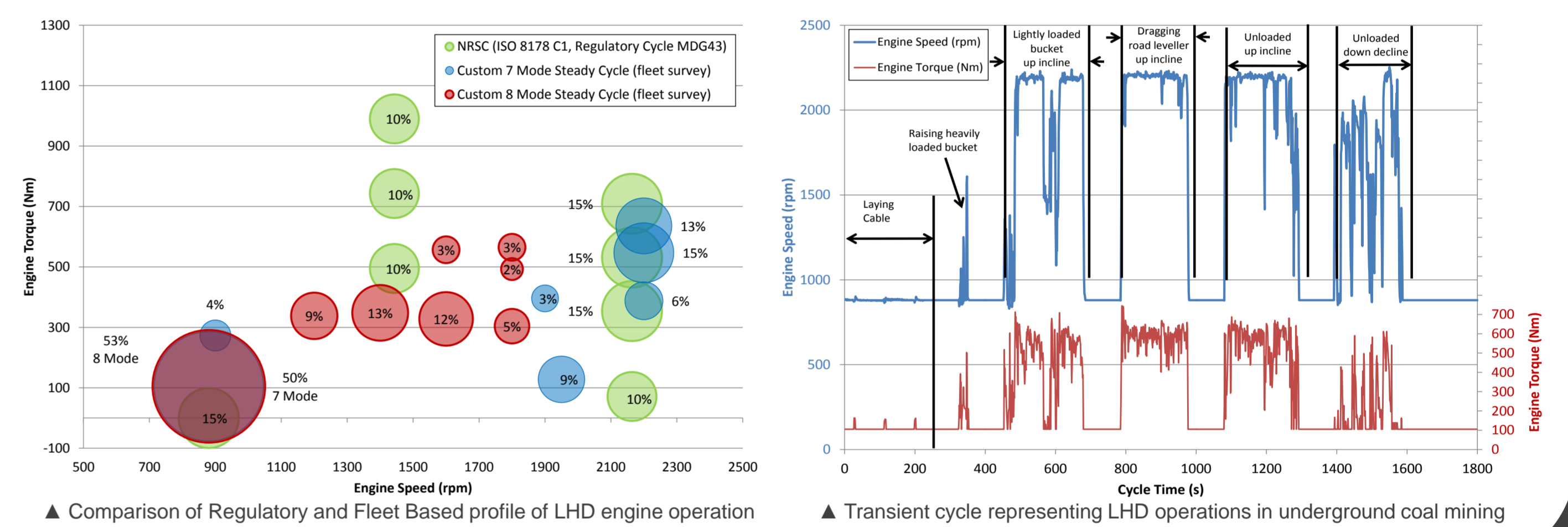


- **Explosion Proof**
- Certification



- **Pollutants**
- Particulate
- Gaseous

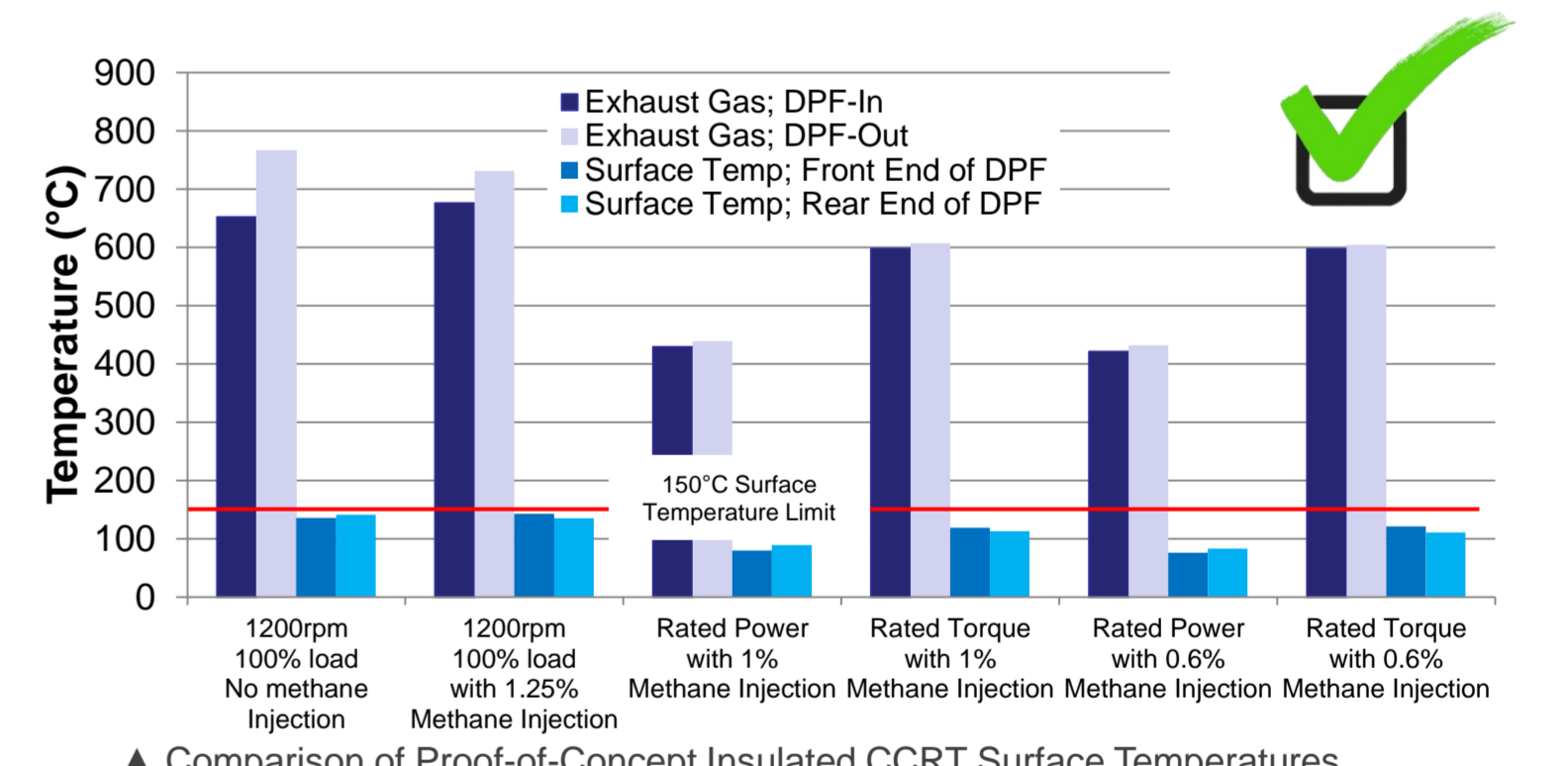
Developed Test Cycles



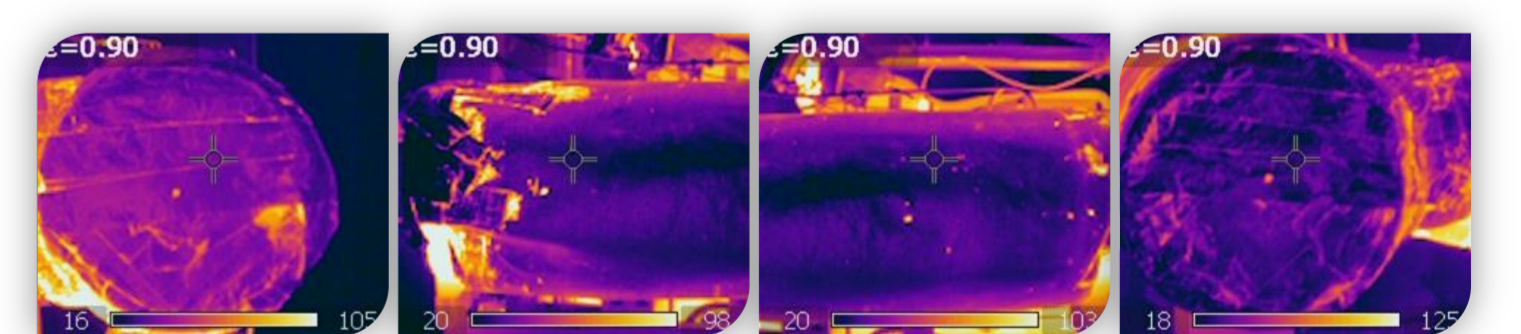
▲ Comparison of Regulatory and Fleet Based profile of LHD engine operation ▲ Transient cycle representing LHD operations in underground coal mining

Surface Temperature

Despite exhaust gas temperatures in excess of 600°C, external surface temperatures were measured to be controlled to less than 150°C through the use of an insulated DPF.



▲ Comparison of Proof-of-Concept Insulated CCRT Surface Temperatures



▲ FLIR thermal images for 9.5\"/>

The industrialised system will use a combination of an insulated DPF and water-cooling.

What is ACARP?

AS\$0.05 per tonne collected from all black coal produced in Australia



- Nominal ACR budget ~\$18m/year; 100% industry funded
- Fundamental research projects
- Applied research projects
- Commissioned projects

ACARP – Australian Coal Industry's Research Program; formerly Australian Coal Association Research Program

Access to R&D taxation rebates and generated research

- **UNDERGROUND**
Health and safety, productivity and environment initiatives.
- **OPEN CUT**
Safety, productivity and the right to operate are priorities for open cut mine research.
- **COAL PREPARATION**
Maximising throughput and yield while minimising costs and emissions.
- **TECHNICAL MARKET SUPPORT**
Market acceptance and emphasising the advantages of Australian coals.
- **MINE SITE GREENHOUSE MITIGATION**
Mitigating greenhouse gas emissions from the production of coal.
- **MINING AND THE COMMUNITY**
The relationship between mines and the local community.
- **NERDDC**
National Energy Research, Development & Demonstration Council (NERDDC) reports - pre 1992.