

An Improvement of Diesel PM and NOx Reduction System

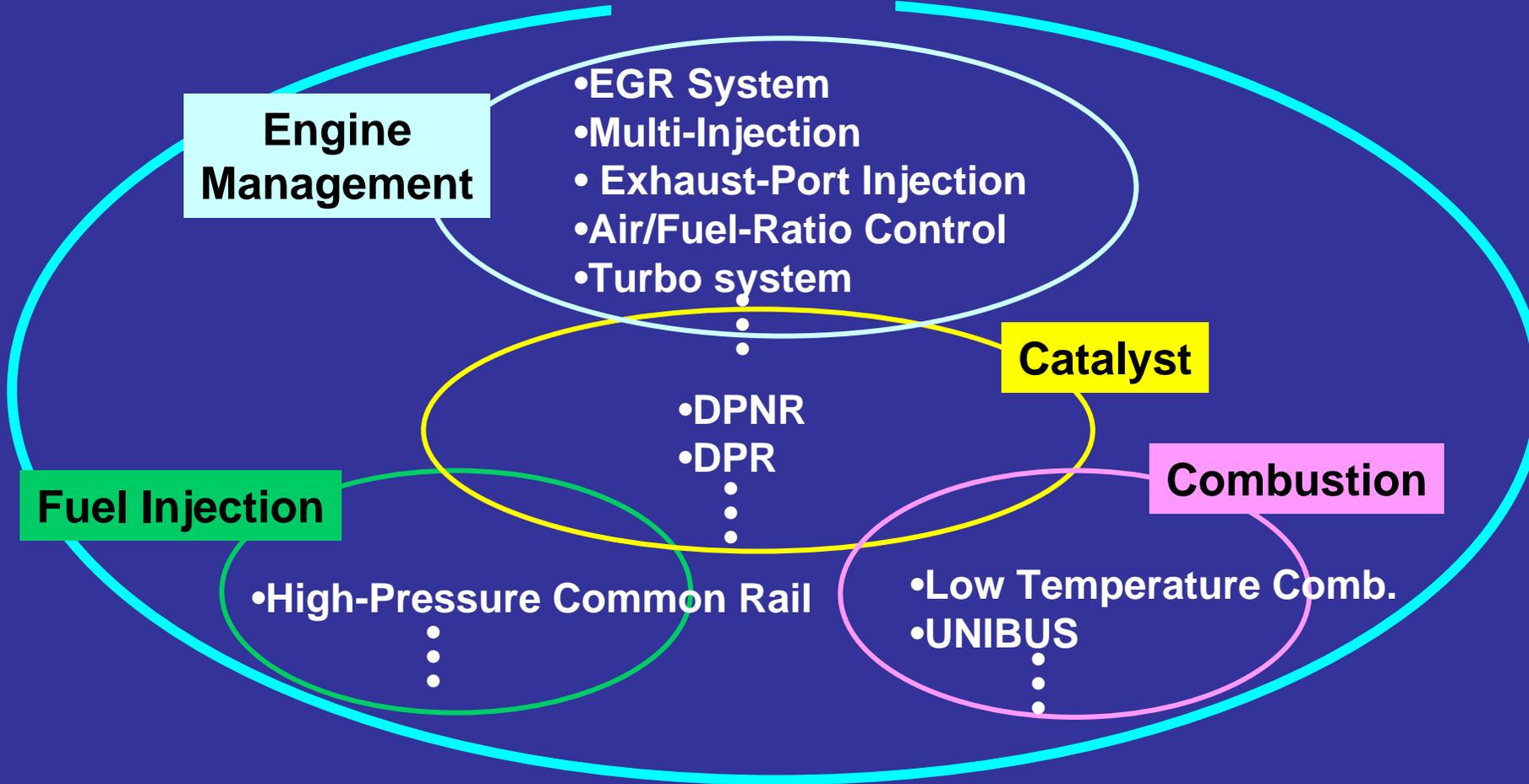
**Satoshi (Tetsu) Watanabe
Shigeru Itabashi
Kuniaki Niimi**

TOYOTA MOTOR CORPORATION

TOYOTA

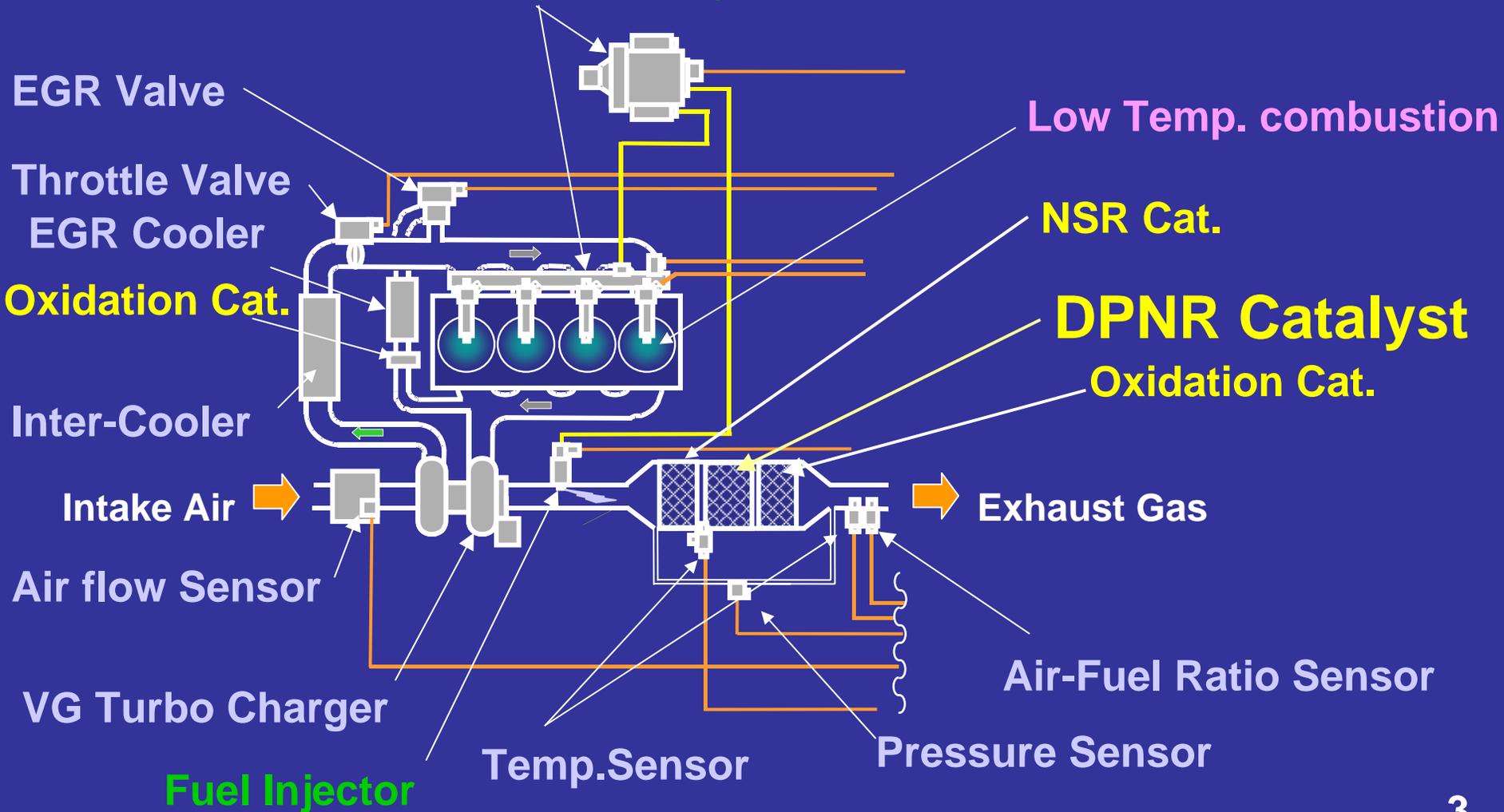
Diesel Clean Advanced Technology system

D-CAT



System Diagram of D-CAT for LDT Distributed in Japanese Market

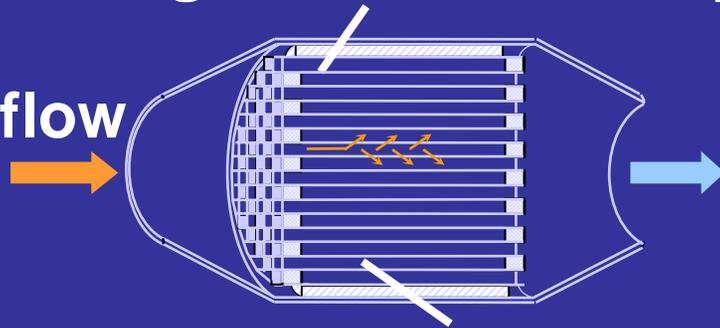
Common Rail Injection System



DPNR Catalyst

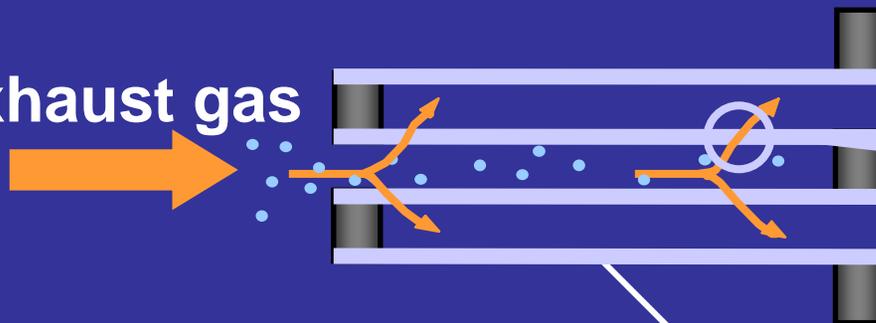
NOx storage reduction catalyst

Exhaust gas flow



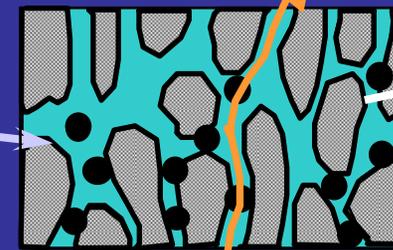
Fine porous ceramic structure

Exhaust gas



Fine porous ceramic structure

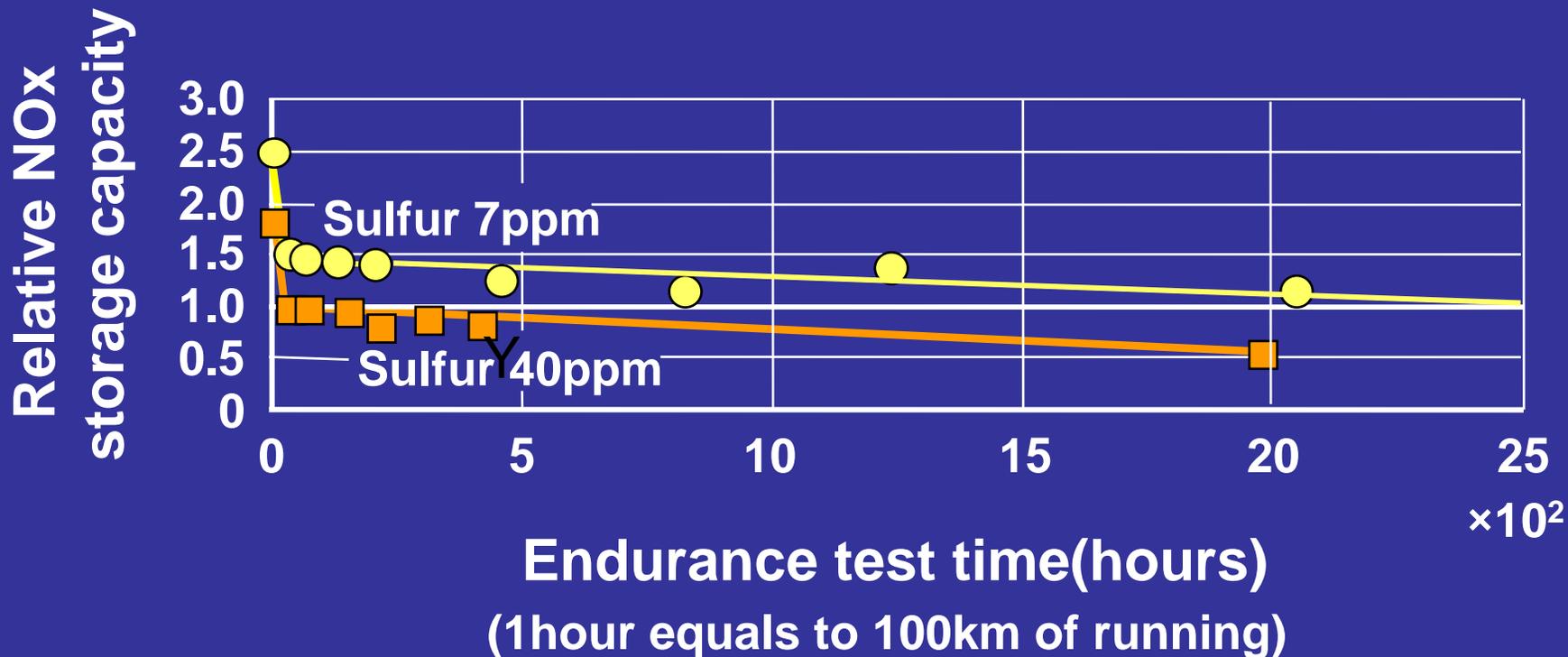
Enlarged view of exhaust gas flowing substrate wall



NOx,
storage
reduction
catalyst

Exhaust gas

Results of Endurance Testing of DPNR - History of NOx Storage Capacity



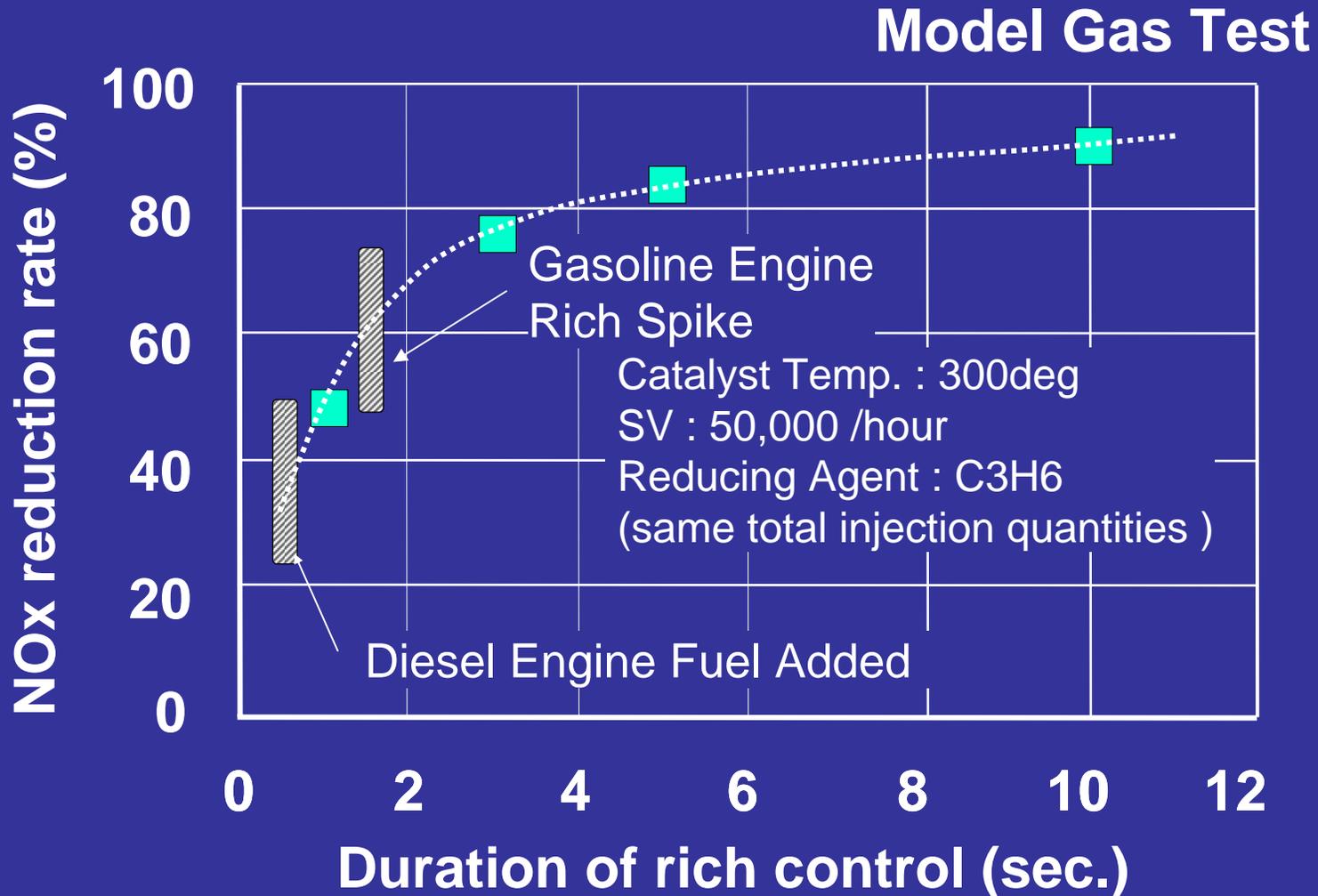
Priority Issue of DPNR improvement

According to the endurance testing of DPNR, it has become clear that NOx storage capacity of DPNR can be maintained at a certain level even after 250 thousand km running when ULSD is used.

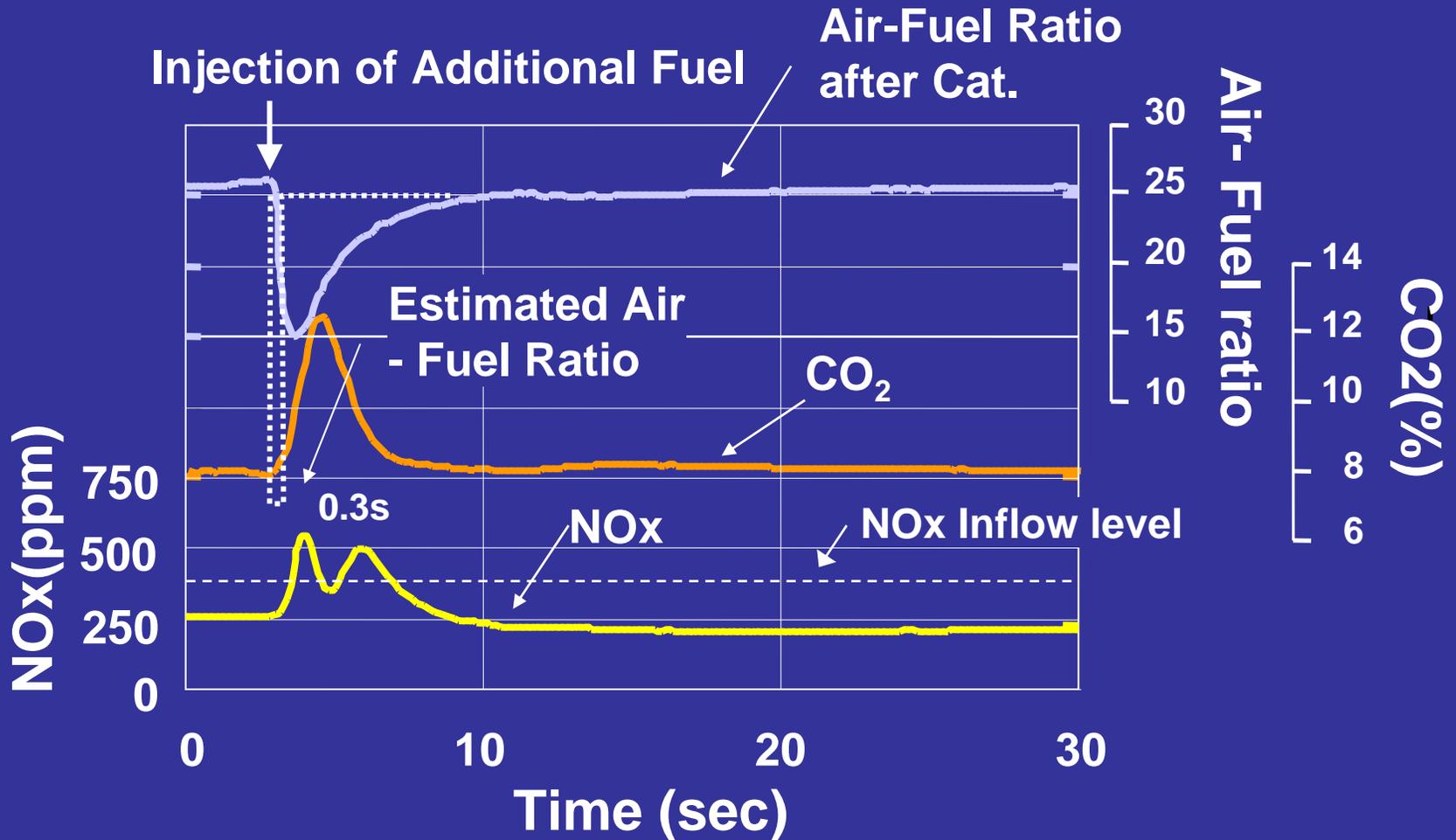
Consequently priority issue to be improved is

“NOx reduction efficiency of the system”

The Effect of Duration of Rich Atmosphere to NOx reduction Rate

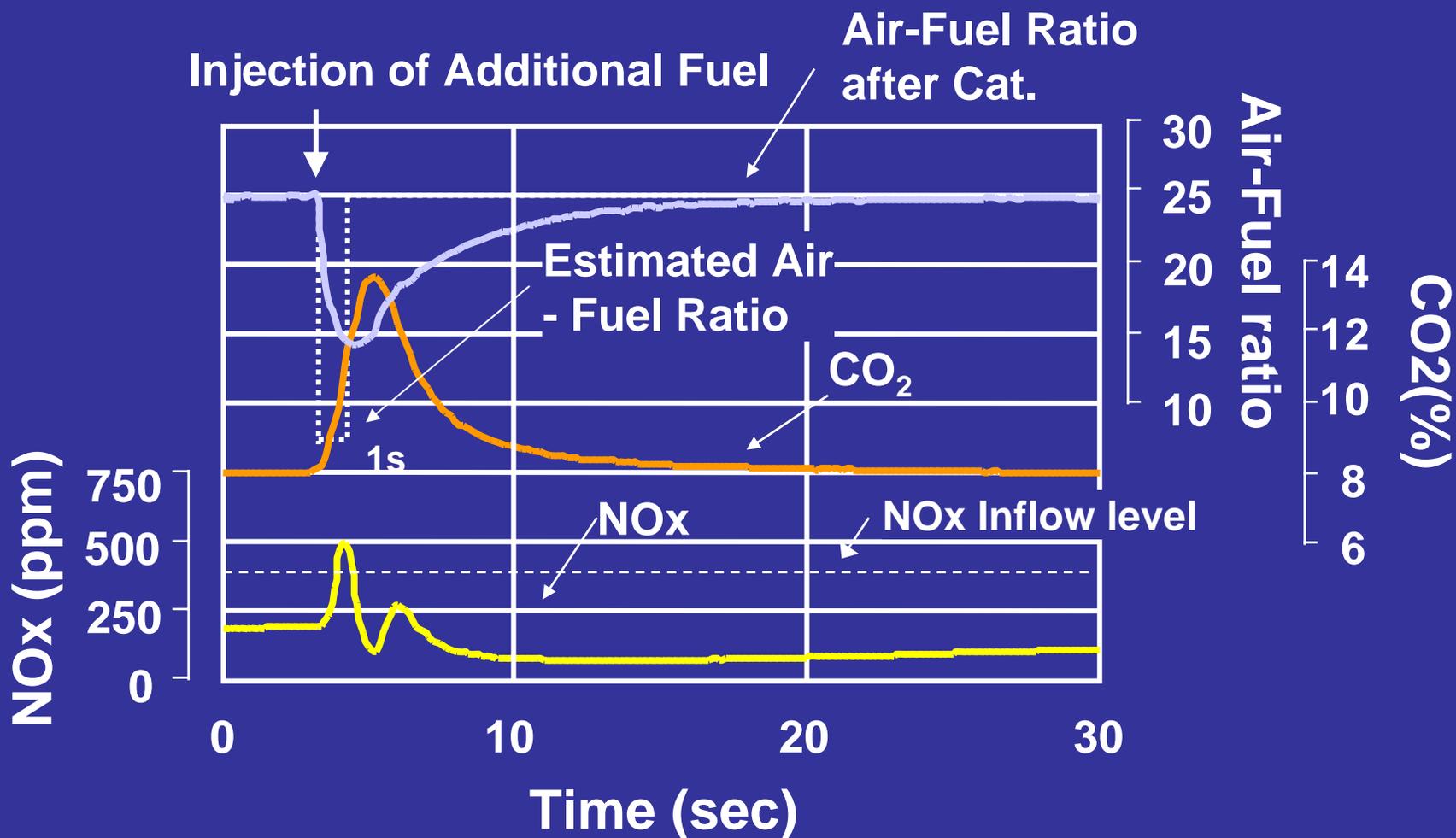


Behavior of Exhaust Gas Air-Fuel Ratio by Additional Fuel Injection for Rich Condition



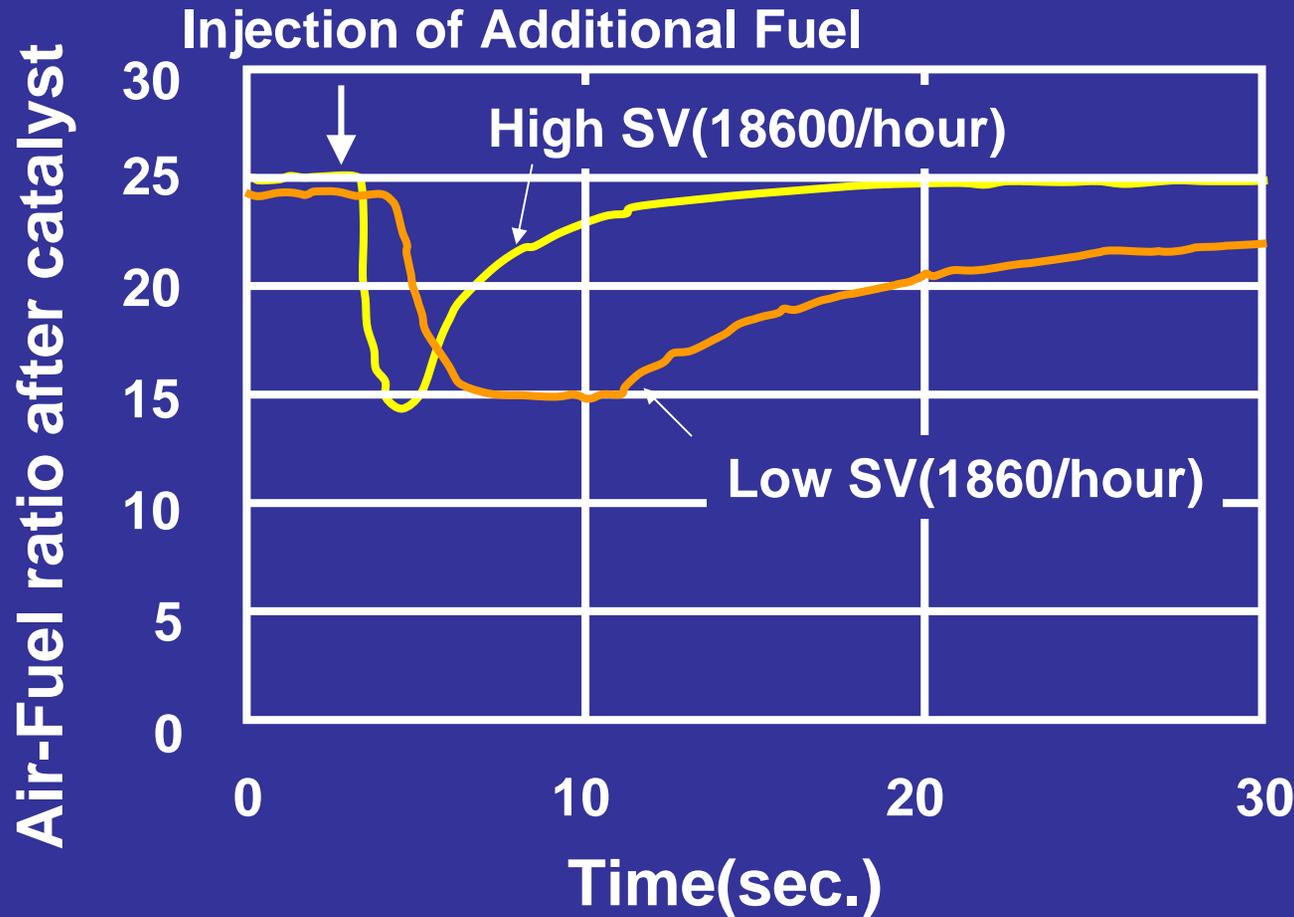
SV : 18600/hr, Inlet Gas Temp. : 300deg

Behavior of Exhaust Gas Air-Fuel Ratio(2) - Prolonged Injection Duration



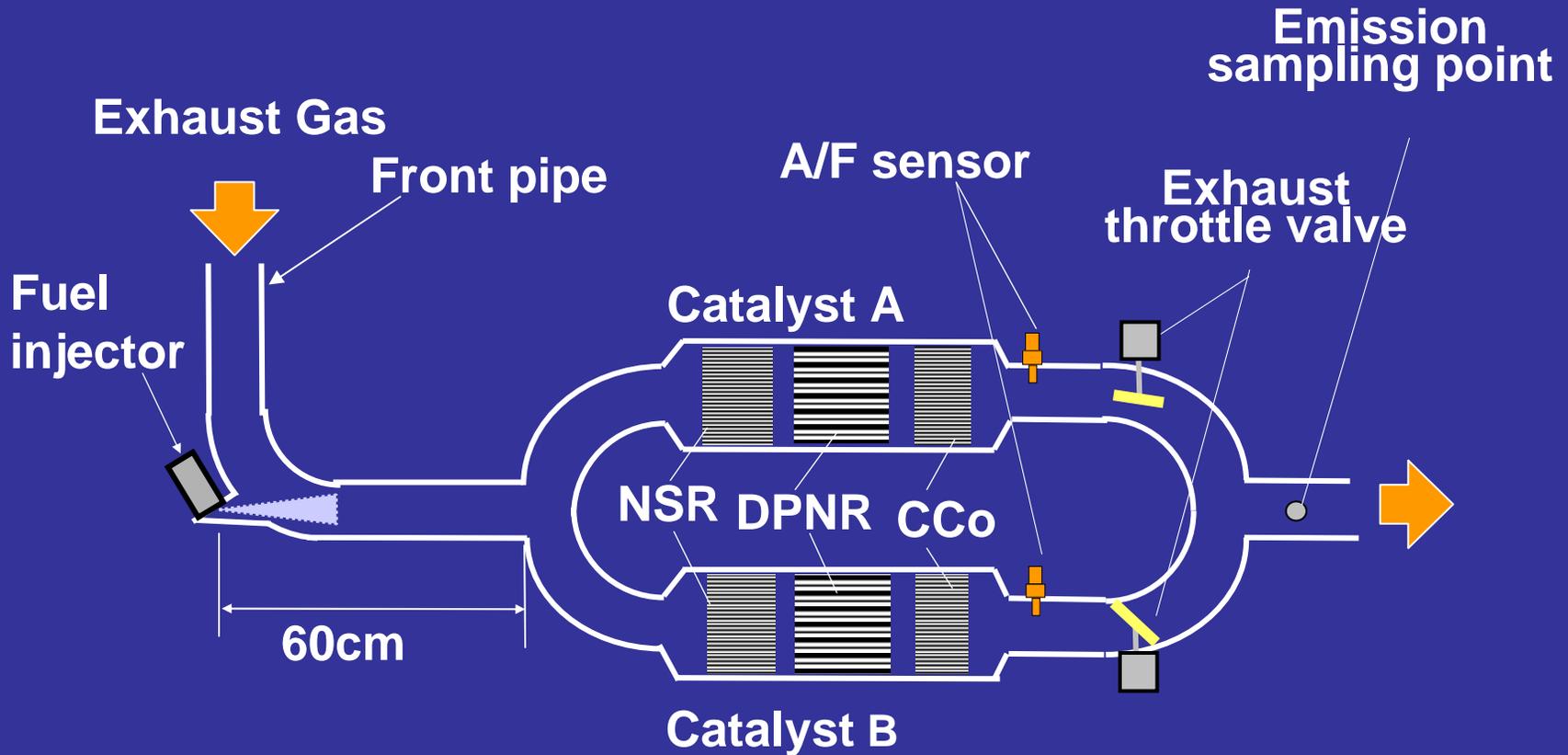
SV : 18600/hr, Inlet Gas Temp. : 300deg

Behavior of Exhaust Gas Air-Fuel Ratio(3) - Reduction of Space Velocity

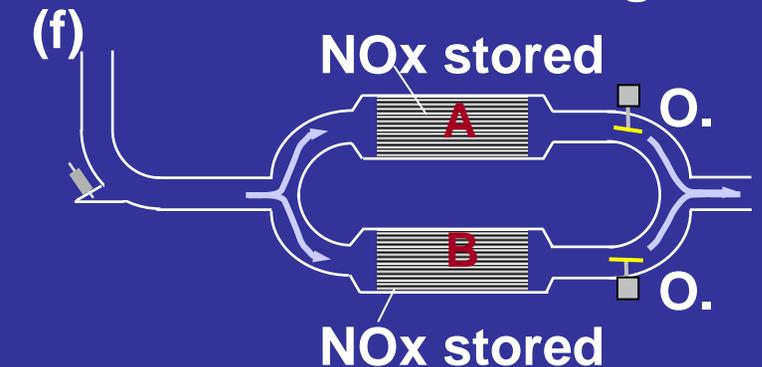
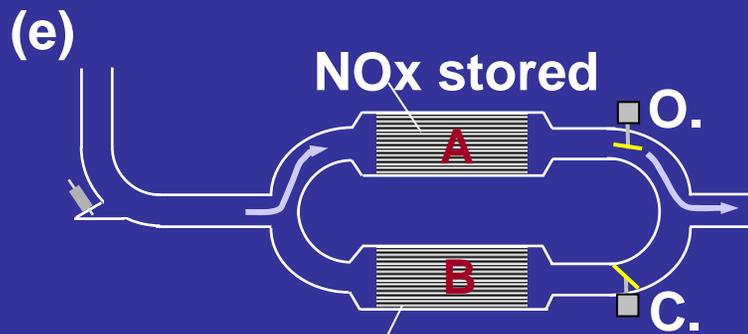
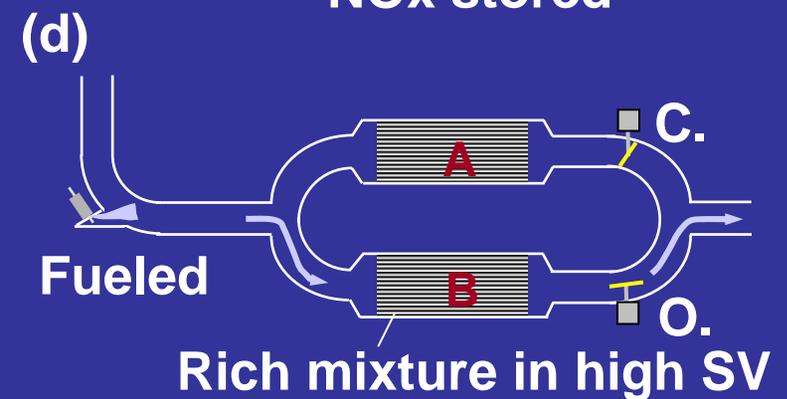
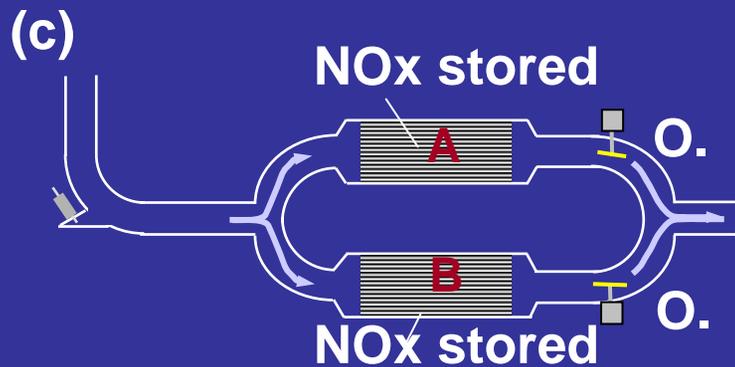
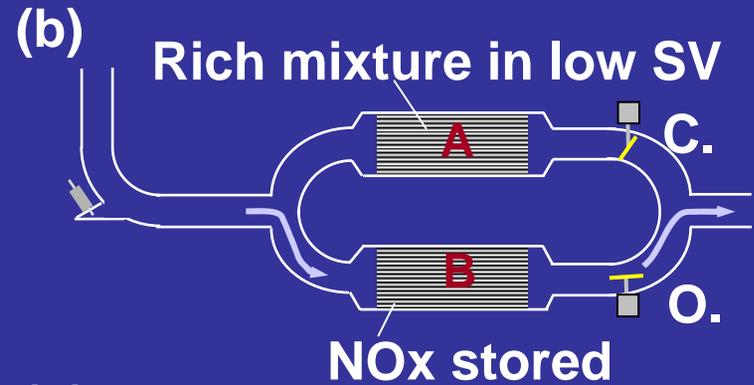
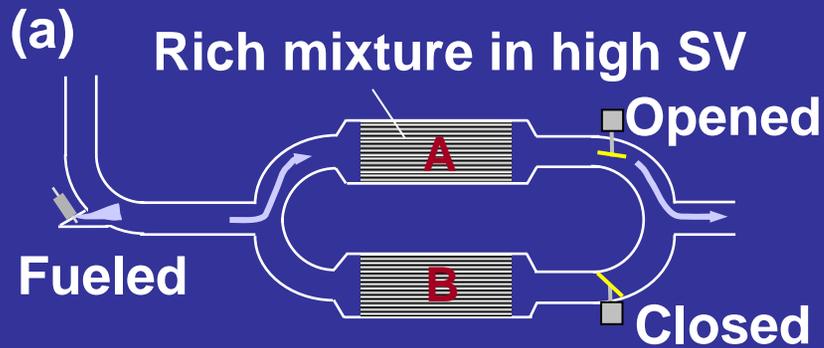


Inlet Gas Temp. : 300deg

Dual Type DPNR

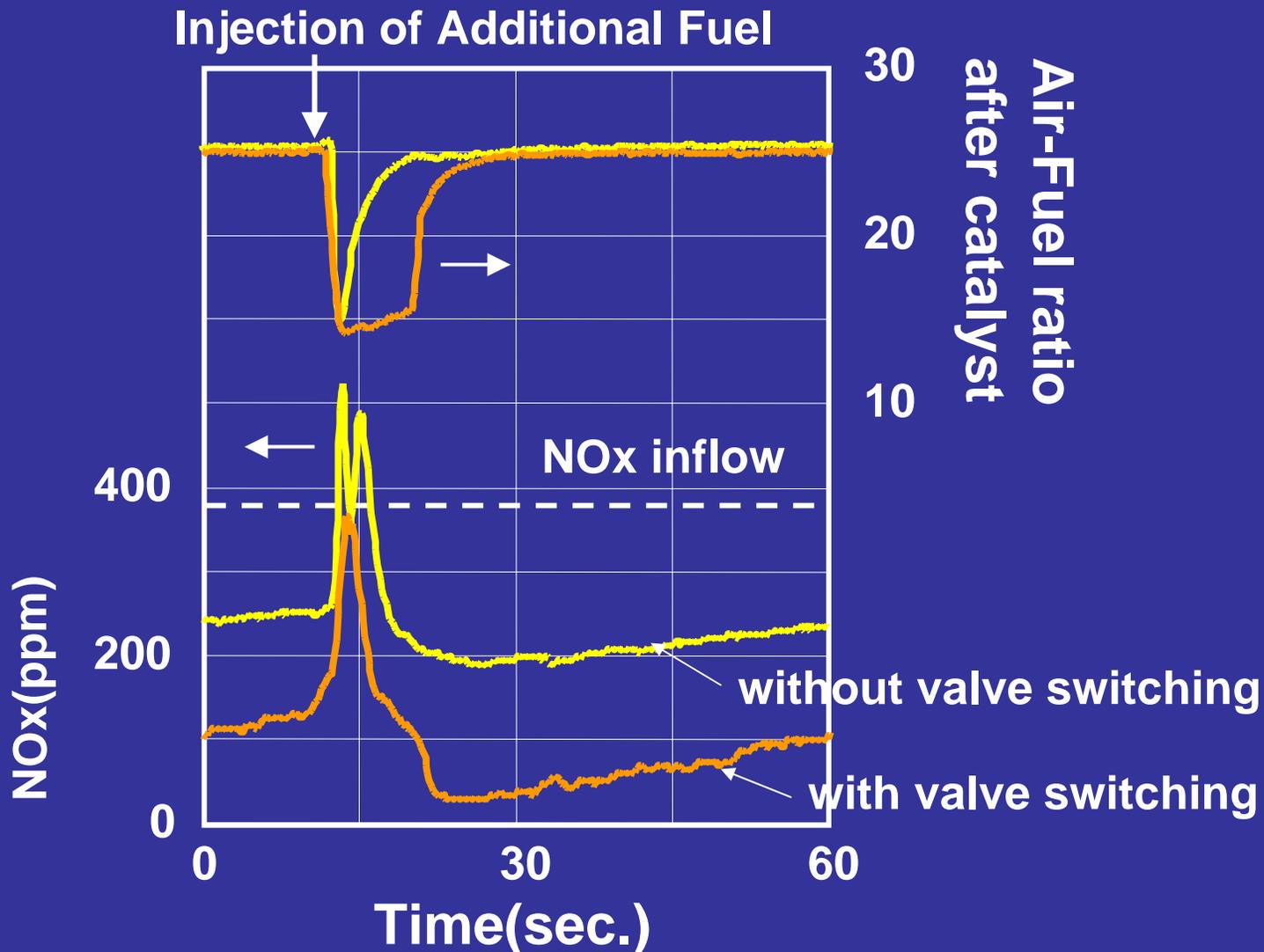


Sequence for NOx Reduction



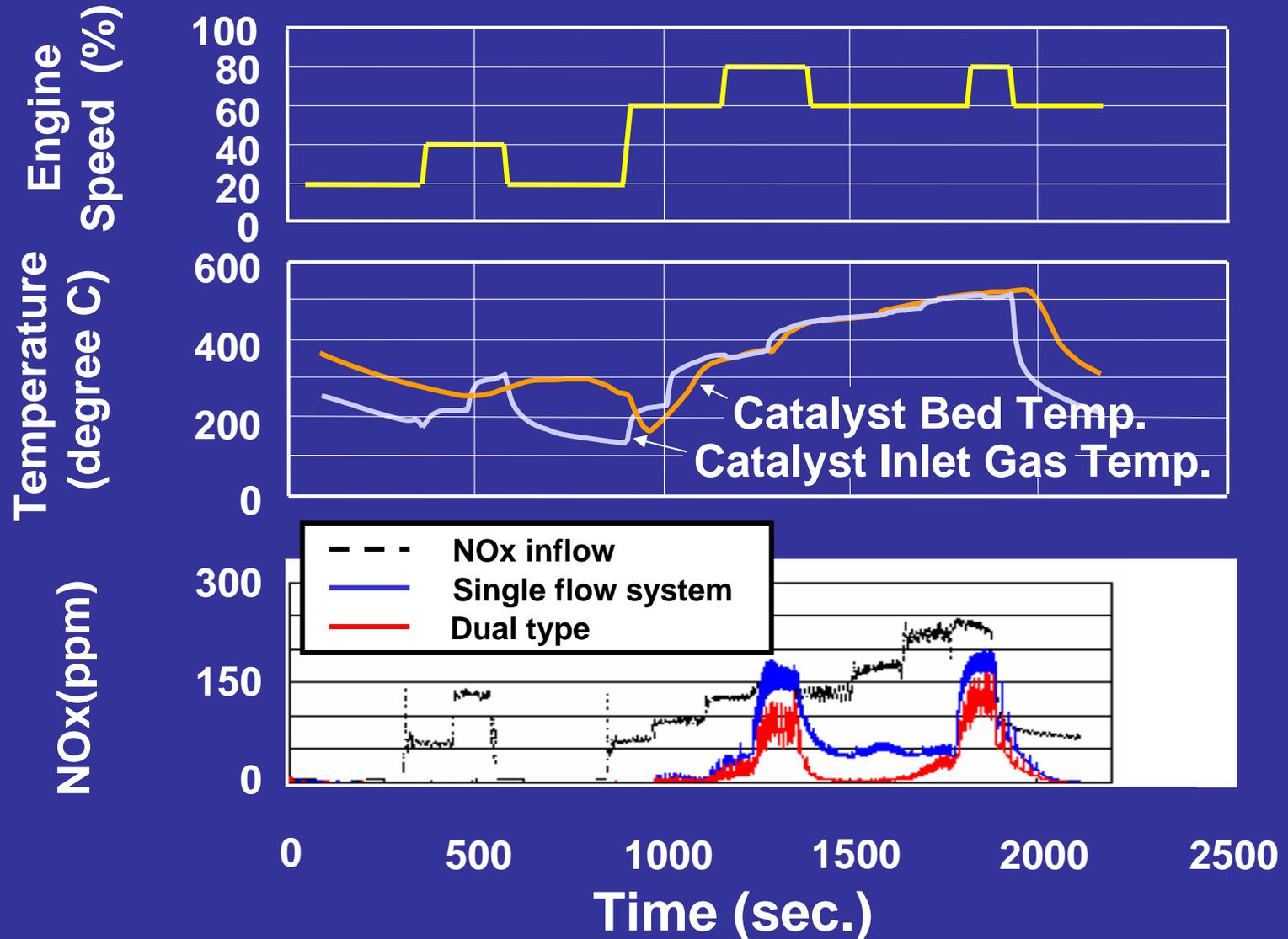
Rich mixture in low SV

Comparison of A/F Ratio and NOx Reduction between with and without valve operation

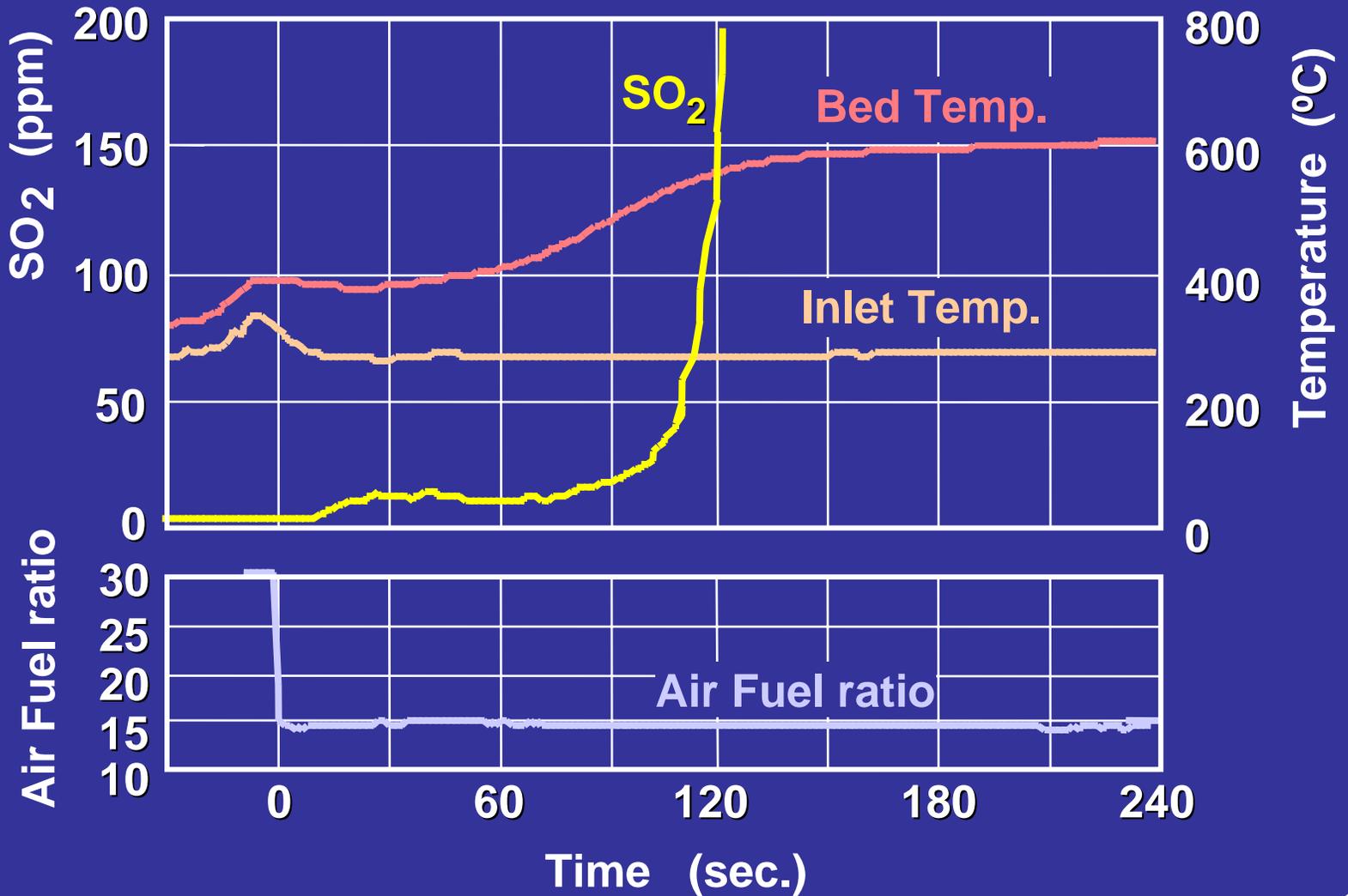


Inlet gas temp. 300deg. SV 18600g/hour

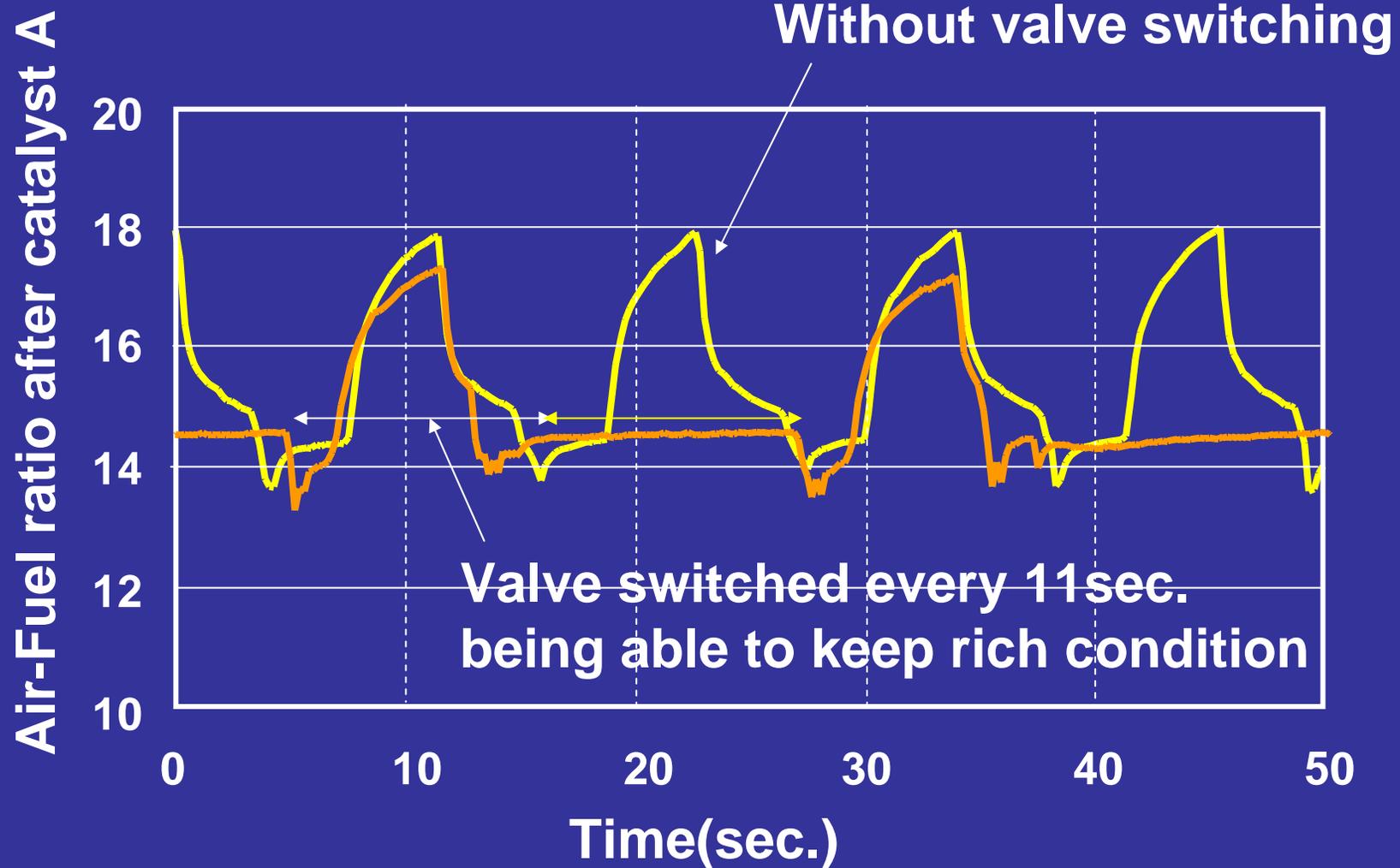
Emission Results of Japan D13 Mode



Sulfur Regeneration Control



A/F Control in Sulfur Regeneration of Dual Type DPNR



Conclusion

- (1) NOx storage capacity is remained to some extent even after 2500 hours endurance test which corresponds to 250,000km running distance. Therefore higher efficiency of aged DPNR can be achieved by improvement of rich control in the catalyst.**
- (2) Dual Type DPNR has so high potential to realize effective long-continued rich pulse that efficiencies of NOx reduction and sulfur regeneration can be improved drastically.**
- (3) For practical use of the system, transient control of valve switching should be developed.**

Thank you for your attention