

# “Engines of Change”<sup>SM</sup>

## PROOF of CONCEPT TESTING of the ADVANCED LOCOMOTIVE EMISSIONS CONTROL SYSTEM

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Faster Freight - Cleaner Air  
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Union Pacific

## Environmental Policy



*Union Pacific Railroad is committed to protecting the environment for our customers, our employees, and the communities in which we live. We strive to meet the highest principles of environmental responsibility in our role as a leader in transportation.*

**“Environmental protection is the responsibility of every UP employee.”**

Jim Young, Chairman, President & CEO



*Union Pacific employees accomplish this through:*

### Stewardship

- ☑ Protecting the natural resources where we operate
- ☑ Promoting the efficient use of energy
- ☑ Conserving resources through waste minimization, recycling and reuse of materials

### Relationships

- ☑ Building relationships based on common safety and environmental goals
- ☑ Openly communicating with government agencies and communities

### Process

- ☑ Assessing our environmental performance using measurable business objectives
- ☑ Using assessment results to guide environmental management improvement strategies

### Results

- ☑ Meeting and exceeding compliance standards of environmental laws and regulations
- ☑ Supporting development of effective and balanced environmental laws and regulations
- ☑ Practicing and continually improving healthy work activities



## ADVANCED LOCOMOTIVE EMISSIONS CONTROL SYSTEM (ALECS)

- Began installation in February 2006
- 'Proof of Concept' at Roseville 3Q06
- Successful public private partnership effort
- Total project cost of ~ \$ 2 million
- Unique application of existing treatment technology
- Need to develop new collection technology



## ALECS BACKGROUND

- ACTI's ORIGINAL DESCRIPTION . . . . .
- The system was originally designed for a marine application, the Advanced Maritime Emissions Control System (AMECS)
- The system is designed to capture exhaust emissions from Ocean-Going Vessels and Railroad Locomotives and direct the exhaust to an emissions treatment system.
- The system is based on existing technologies, enhanced by ACTI to remove harmful emissions from internal combustion engines burning various types of diesel fuels.



## PROOF of CONCEPT OBJECTIVES

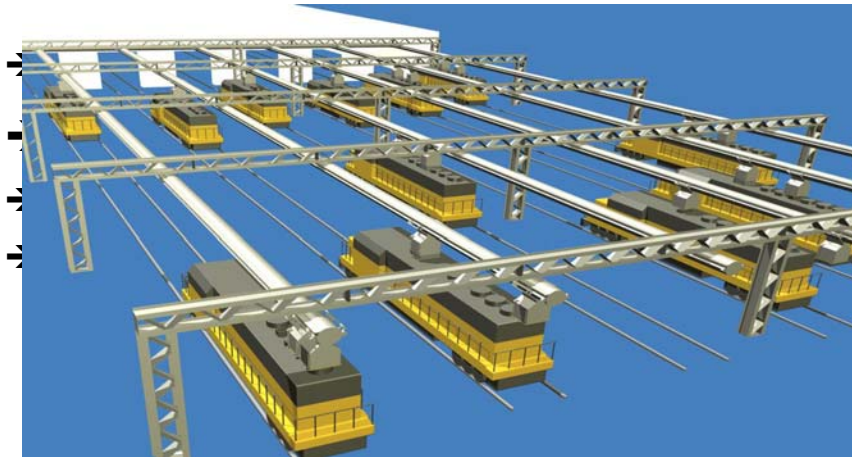
- Demo effectiveness of control equipment (ETS)
- Demonstrate attachment/detach/capture (ECS)
  - ✓ Recognized requirement to maintain fluidity
- Demonstrate capability of locomotive movement
- Develop cost information & data
  - ✓ Both capital & operating; ultimately cost effectiveness
- Document findings in a final report
  - ✓ posted at Placer Co APCD website
  - ✓ UPRR comment letter also posted; detailed letter pending [placer.ca.gov/upload/apc/documents/up/upletter0407.pdf](http://placer.ca.gov/upload/apc/documents/up/upletter0407.pdf)



## Emissions Treatment Subsystem (ETS)



## Emissions Capture Subsystem (ECS)



## General Summary of Findings

- Characteristics of Units Tested - Table 4, pg 3- 5
- Objectives & Accomplishments - Table 29, pg 7- 1
- ETS control of +/- 95% for NO<sub>x</sub>, PM, & SO<sub>2</sub>
- ECS attached/detached/captured for demo
- Demonstrated capability of some movement
- Capital cost @ \$8.7 MM, operating cost @ \$900K/yr
- Cost effectiveness of \$7,300 to 18,400/ weighted ton
- Need to optimize & prove ECS; evaluate site



## UPRR Concerns - Cost Effectiveness

- CE based upon principles & guidance of
  - ✓ Moyer Program
  - ✓ EPA's Air Pollution Control Cost Manual
- Believe the CE is understated by at least 25%
- Consistent use of discounted cash analysis
- Two 2 assumed scenarios utilized
- SCR Catalyst replacement frequency
- See Figs 29 & 30, Table 28, pgs 6-5, 6-6



## UPRR Concerns - ECS

- Test of single unit vs. multiple locomotives
- Not adequately demonstrated by this test
- Operation must be safe, quick & simple
- Must maintain fluidity of locomotive flow
- Develop & demonstrate an effective ECS
- Progress testing of ECS at > \$1.5MM



## UPRR Concerns - Site Evaluation

- Potential reductions depends on loading
- Estimated loads from assumed scenarios
- Assumes fully loaded for 8400 hours per year
- Evaluate load at each potential location/yard
- Account for key factors
  - ✓ Fleet mix . . . locomotives at the yard
  - ✓ New Tiers, ULEL's, rebuilds, idle controls devices, etc
  - ✓ Engine performance deterioration factors



## Questions & comments

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