



UNION PACIFIC RAILROAD PLAN TO MEET INCREASING DEMAND, RELIEVE RAIL CONGESTION, AND REDUCE EMISSIONS

Lanny A. Schmid ~ Union Pacific Railroad Company

*Faster Freight Cleaner Air 2006 Conference
Long Beach, California
February 1, 2006*

BUILDING AMERICA™



UP AND THE ENVIRONMENT

"Union Pacific Railroad is committed to protecting the environment, for our customers, our employees and the communities in which we operate. Beyond compliance with laws and regulations, Union Pacific is committed to the development and use of new technologies to preserve the environment for future generations. Environmental protection is a primary management responsibility, as well as the responsibility of every Union Pacific employee."

-- Union Pacific Chairman, Dick Davidson



Go to: http://www.uprr.com/she/emg/attachments/whitepaper_0905.pdf



BUILDING AMERICA™

OVERVIEW – RAIL EMISSIONS REDUCTIONS

- ➔ **Options to Consider**
- ➔ **Evaluation Process - Criteria**
- ➔ **Successes**



OPTIONS TO CONSIDER

- ➔ **Shutdown Devices**
- ➔ **Locomotive Technologies**
- ➔ **Operational Aspects**
- ➔ **Innovations**



SHUTDOWN DEVICES

- ➔ **All are designed to maintain 'vital signs'**
 - ✦ Air, battery charge, and fluids
 - ✦ Typically achieves 1.5 - 2.5 ton/year NOx reduction
- ➔ **Automatic Engine Stop-Start**
 - ✦ Factory installed on all new locomotives post 2001
 - ✦ Very dependable and cost effective
- ➔ **Retrofits**
 - ✦ Use of auxiliary motors to replenish needs
 - ✦ Use of the prime mover/main engine to maintain 'vitals'



LOCOMOTIVE TECHNOLOGY - SWITCHERS

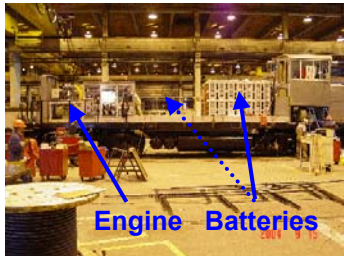
- ➔ **EPA Tier Requirements Apply**
 - ✦ Tier 0 in 2000; now at Tier 2; Tier 3 being developed
 - ✦ Includes in-use testing, rebuilds, retrofits
- ➔ **Used daily in yards to move cars**
 - ✦ Low HP, low speed, short distances
 - ✦ Typically achieves a 15- 20 ton/yr NOx reduction
- ➔ **Hybrids**
- ➔ **Generator Set or Gen-Sets**
- ➔ **LHP Retrofits**
- ➔ **LNG Retrofits**



Hybrid batteries & recharge diesel



Two lead-acid storage battery racks (each ~1000 HP equivalent) and a 290 HP Caterpillar diesel generator to recharge batteries



2000 HP rating is obviously not a “continuous” rating, but adequate for switching assignments with a lot of start-stop-start movement



Fresno & Mira Loma “Goats”

➔ UPY 2004 at Fresno since April 8, 2005



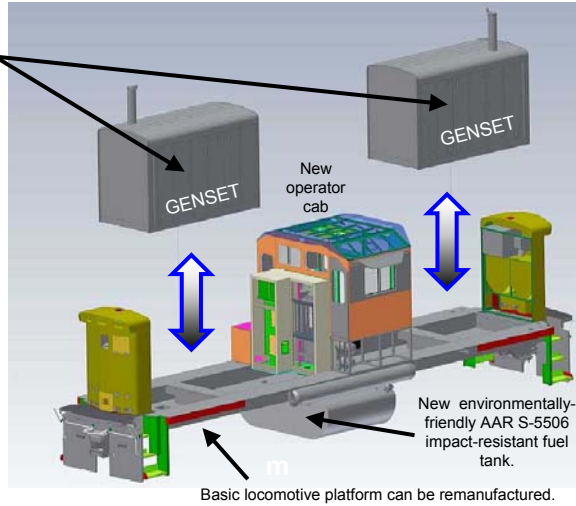
➔ RPRX 2403-04 loaners at Mira Loma since January (fill-in until UPY units arrive)



Gen-Set Switchers - Modular Power

Each genset is a modular self-contained package:

- low-emissions EPA Tier 3 nonroad diesel engine
- electrical generator
- cooling system with antifreeze (automatic idle-elimination by shutting-down to 20F)
- replaceable as a complete package (“plug and play”) when engine requires major repairs/overhaul



UPRR Low Emitting Locomotives Commitments

| | GP15D's (leased) | GP20D's (leased) | MP20B'S | GSS Prototype | GSS's | GG20B's | TOTALS |
|-----------|------------------|------------------|---------|---------------|-------|---------|--------|
| Tier | 1 | 1 | 2 | ULEL | ULEL | ULEL | - |
| DFW | 0 | 0 | 0 | 0 | 46 | 5 | 51 |
| HOU | 10 | 40 | 13 | 0 | 43 | 5 | 111 |
| SAN ANT | 0 | 0 | 0 | 0 | 9 | 0 | 9 |
| FRESNO | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| LA BASIN | 0 | 0 | 0 | 1 | 60 | 10 | 71 |
| ROSEVILLE | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| TOTALS | 10 | 40 | 13 | 1 | 159 | 21 | 244 |



LOCOMOTIVE TECHNOLOGY – LINE HAUL

➔ EPA Tier Requirements Apply

- ✓ Tier 0 in 2000; now at Tier 2; Tier 3 being developed
- ✓ Includes in-use testing, rebuilds, retrofits

➔ Used to pull trains between terminals

- ✓ High HP, high speed, long distances

➔ Aggressive application of lower emitting locomotives by UPRR includes

- ✓ Acquiring more than 1,900 Tier 0, Tier 1 or Tier 2 units
- ✓ Retiring over 1,300 older units, and
- ✓ Rebuilding over 300 units to Tier 0 standards.



UP SD70ACe Tier 2 road locomotive



*115 EMD Tier 2 units ordered by
and delivered to UP in 2005*

**Built by Electro-Motive Diesel (“EMD”)
EPA Tier 2 certified
4300 HP16-cylinder diesel engine w/ EFI
Equipped with Automatic Engine Stop-Start (“AESS”)**



UP C45ACCTE Tier 2 road locomotive



201 GE Tier 2 units ordered by and delivered to UP in 2005

Built by GE Rail

EPA Tier 2 certified

4400 HP 12-cylinder diesel engine w/ EFI

Equipped with Automatic Engine Stop-Start ("AESS")



UP's "EPA" low-emissions loco. fleet

| Year: | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | Total '00-'06 |
|---|------|------|------|------|------|------|-------|------------------|
| EPA Tier level: | 0 | 0 | 1 | 1 | 1 | 2 | 2 | |
| Yard switch units acquired new: | 0 | 0 | 0 | 0 | 0 | 11 | 102* | 192 |
| Line-Haul units acquired new: | 405 | 515 | 516 | 218 | 300 | 321 | (TBD) | 2,275 |
| Line-Haul pre-T0 upgrades to T0: | 13 | 55 | 104 | 159 | 320 | 390 | (TBD) | 1,041 |
| Yard switch pre-T0 upgrades to T0: | 0 | 0 | 35 | 90 | 81 | 84 | (TBD) | 290 |
| AESS/SmartStart delivered/applied: | 156 | 98 | 612 | 459 | 561 | 422 | (TBD) | 2,308 |

* includes 10 hybrids for LA, 13 Cat switchers & 49 gensets ordered for TX and 30 gensets being negotiated for LA ... another 49 gensets on-order for TX and 30 gensets being negotiated for LA

55% of UP's "line haul" fleet, and 18% of the yard switch fleet, will be EPA Tier 0, 1 or 2 certified by year-end '06.

30% of the entire UP fleet will have idle-elimination technology by year-end '06.



OPERATIONAL ASPECTS

- ➔ **Shutdown Training**
 - ✦ Currently re-emphasizing
- ➔ **Fuels**
 - ✦ Biodiesel & emulsifications
- ➔ **Task efficiency/reconfiguration**
 - ✦ Moving or modifying test processes
 - ✦ Yard/terminal operations – building trains

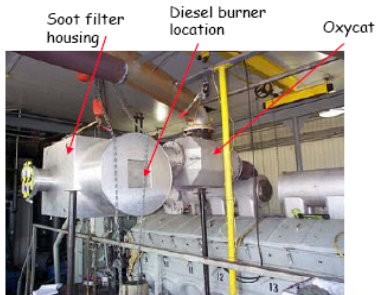


INNOVATIONS

- ➔ **Diesel Particulate Filter Research**
- ➔ **Advanced Locomotive Emissions Control Systems (ALEC's, or 'the hood')**
- ➔ **Coordinated, Long Range Planning**
 - ✦ The Governor's Goods Movement initiative
 - ✦ Create in Chicago
- ➔ **Electrification**
 - ✦ Extremely expensive
 - ✦ Extensive transmission and grid supply issues



Rail Funding Diesel PM Filter R&D



Two UP 1500 horsepower switchers will be equipped with DPF technology in 2Q '06 and tested for maintainability, durability and emissions performance in California

UP & BNSF have co-funded a 5-year R&D project investigating performance, durability and applicability of Diesel Particulate Filters ("DPF") to older switching locomotives

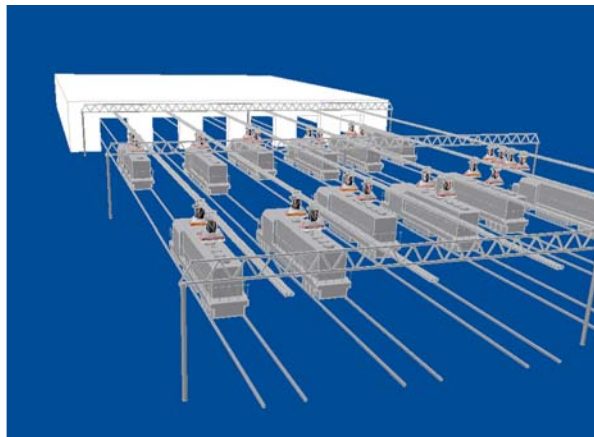
R&D work being performed by *Southwest Research Institute* ("SWRI") through Association of American Railroads ("AAR")

**There is no technical precedent for this work ...
*European locomotives have NO in-service testing due to type of locomotives equipped***



ADVANCED LOCOMOTIVE EMISSIONS CONTROL SYSTEM (ALECS, or the 'hood')

**Maintenance
Yard and/or
Test Facilities**



ALECS SUMMARY

- ➔ ALECS will substantially reduce harmful emissions exhausted by locomotives at rail-yards, seaports and railroad repair facilities.
- ➔ The system (ALECS) would reduce:
 - Oxides of Nitrogen (NO_x) by 95%,
 - Particulate matter (PM₁₀) 90%, sub-micron particulates (PM_{2.5}) and Ultrafine particulates (PM_{0.1}) by 98%,
 - Sulfur dioxide (SO₂) by 99%,
 - Water-soluble volatile organic compounds (VOCs) by 50%, including 90% of volatiles that condense at 135°F,
 - With an ammonia slip of 5ppm or less.



CREATE IN CHICAGO

CREATE Program

- Focuses operation on 5 key corridors
- Builds 6 passenger/freight rail flyovers
- Builds 25 road/rail separations
- Viaduct improvement program
- Grade crossing safety enhancements
- Improves train control system
- Automation of 14 interlockings
- 50 miles of new track on existing right-of-way
- 364 new switches



EVALUATION PROCESS – CRITERIA

- ➔ **Inventory activity**
 - ✦ What work is performed, by location and duration
- ➔ **Identify the activity type by the fleet**
 - ✦ Testing, idling or moving
 - ✦ Switcher or road locomotive
- ➔ **List the options**
 - ✦ Consider the array of possibilities
- ➔ **Screen for feasibility**
 - ✦ Verify that all criteria are met



| Option Number | Description of Option | Is the Option Feasible for UPRR?? | | | | | | Go? |
|---------------|--------------------------|-----------------------------------|---------|---------------|--------------|--------|-------|------------|
| | | Technically | Legally | Operationally | Economically | Safety | Other | |
| 1 | Discontinue use of area | - | - | No | No | - | - | NO |
| 2 | Dedicate Tier 2 units | Yes | Yes | No | No | - | - | NO |
| 3 | Dedicate Green Goats | Yes | Yes | No | Yes | Yes | - | YES |
| 4 | Dedicate GSH's | Yes | Yes | Yes | Yes | Yes | - | YES |
| 5 | Dedicate CAT Switcher | Yes | Yes | Yes | Yes | Yes | - | YES |
| 6 | Dedicate MK Switcher | Yes | Yes | Yes | Yes | Yes | - | YES |
| 7 | Dedicate Tier 2 Retrofit | ? | Yes | Yes | ? | - | - | ? |
| 8 | Retrofit w/ AESS | Yes | Yes | Yes | ? | - | - | ? |
| 9 | Enforce shutdown policy | Yes | Yes | ? | Yes | - | - | ? |
| 10 | Use LNG units | No | Yes | No | No | ? | No* | ? |
| 11 | Use CARB diesel | Yes | Yes | No | - | - | - | NO |
| 12 | Electrify the hump | Yes | Yes | ? | ? | No | - | NO |
| 13 | Use control cars | Yes | Yes | ? | ? | - | - | ? |
| 14 | Use specialty fuels | Yes | Yes | No | - | - | - | NO |
| 15 | | | | | | | | |



SUCSESSES

➔ Voluntary commitments

- ✓ CARB Fleet Average Agreement (1998)
- ✓ Roseville Emissions Reductions (2004)
- ✓ Houston Galveston (2002)
- ✓ CARB PM Agreement (2005)



SUCSESSES

➔ Incentive grants

- ✓ SMAQMD funds for idle reduction retrofits (2003)
- ✓ SJVAQMD & EPA funds for idle reduction (2004)
- ✓ Texas Emission Reduction Program (2004 & 2005)
- ✓ Sac Metro & PCAQMD funds for Gen-Set humper (2006)



Questions & comments

Lanny A. Schmid
Director Environmental
Operations

Union Pacific Railroad
1400 Douglas Street,
STOP 1030
Omaha, NE 68179
402-544-2262
laschmid@up.com

Michael Iden, P.E.
General Director
Car & Loco Engineering

Union Pacific Railroad
5050 W. Lake Street
Melrose Park, IL 60160
708-649-5899
meiden@up.com

