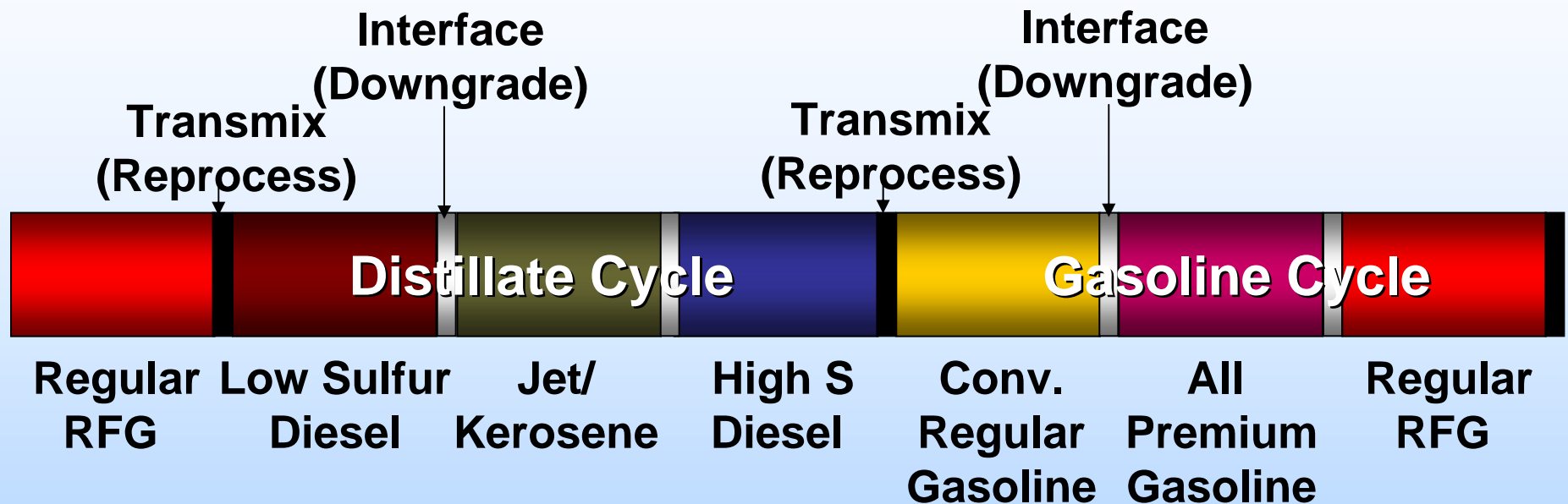


Ultra-Low Sulfur Diesel Fuel Workshop Pipeline Testing Results

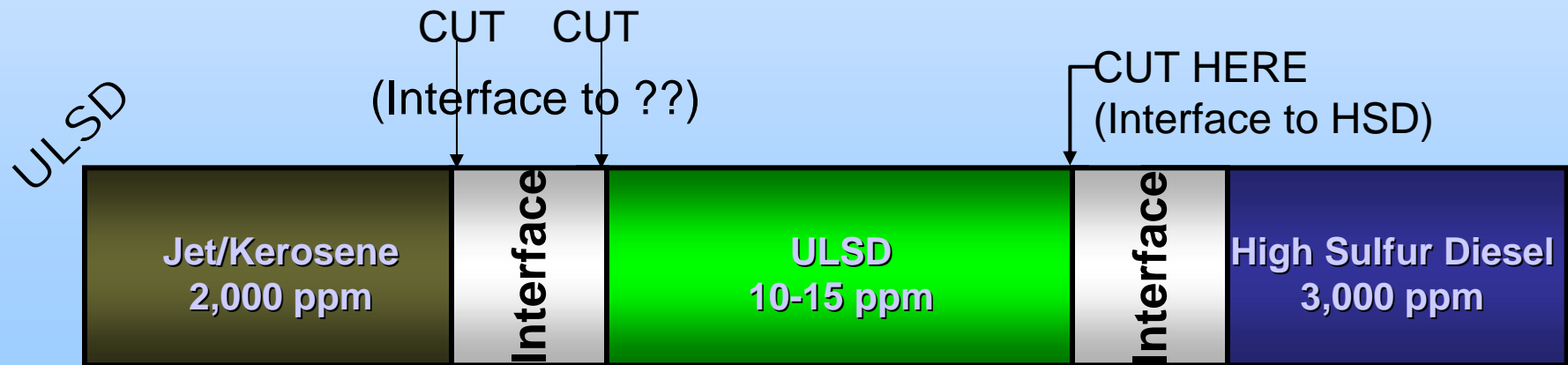
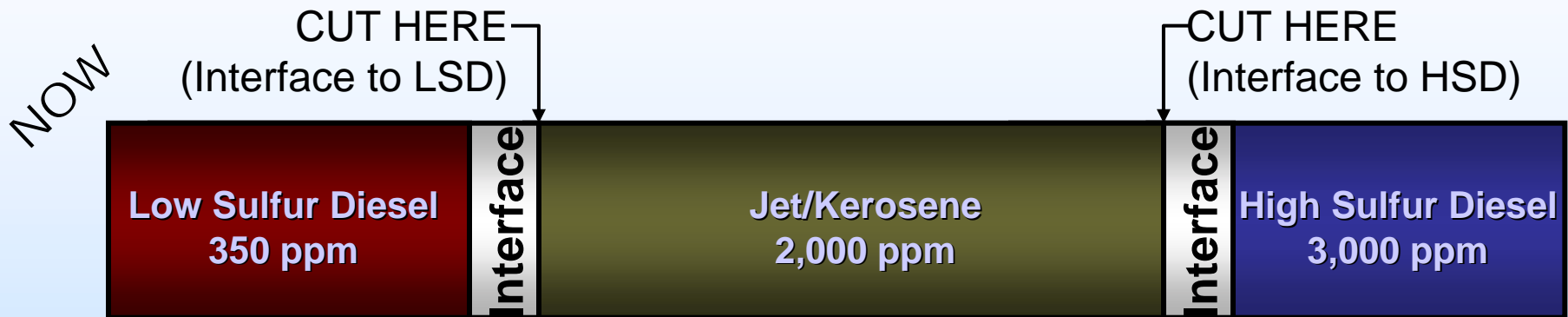
Industry/EPA Ultra Low Sulfur Diesel Workshop
Astor Crowne Plaza
New Orleans, LA
November 15, 2004
Walter Stasioski, BP Pipelines NA

Product Integrity during Movement



- Batches of different products abut each other
- Turbulent flow minimizes interfaces (mixing zone)
- Optimum sequencing reduces contamination/downgrade

Batch Sequences, Interfaces



ULSD Test Participation

- **BP** 4 tests 8/10 inch line
- **Buckeye** 1 test 16 inch line,
Participated in 1 MAP test with 10, 12 inch lines
- **ChevronTexaco** 2 tests 8 inch line
- **Colonial** 4 tests 36, 32 inch main lines
16 tests on 8, 12, 16 inch spur lines
- **ConocoPhillips** additional test to share
- **KinderMorgan** additional test to share
- **MarathonAshland** 4 tests 1 ea. 10, 12, 16, 20 inch lines
4 tests barge to terminals, via multiple pipelines, through tankers to retail stations
- **Shell** 1 test 6 inch line using alkylate (0 ppm S)
1 test 12/14/16 inch line (0 ppm S)
- **Valero** 1 test using raffinate (0 ppm S)
- **Wolverine** Participated in 1 MAP test with 16 inch line

Test Objectives

- Determine capability to successfully move ULSD through distribution system
- Identify contamination sources
- Identify physical and procedural modifications required
- Evaluate gravity, sulfur, and other interface correlations
- Determine optimal batch size and best sequencing options
- Use test results to define the impact to ULSD sulfur levels and set receipt sulfur specs

Test Results

Mainline Contamination Points

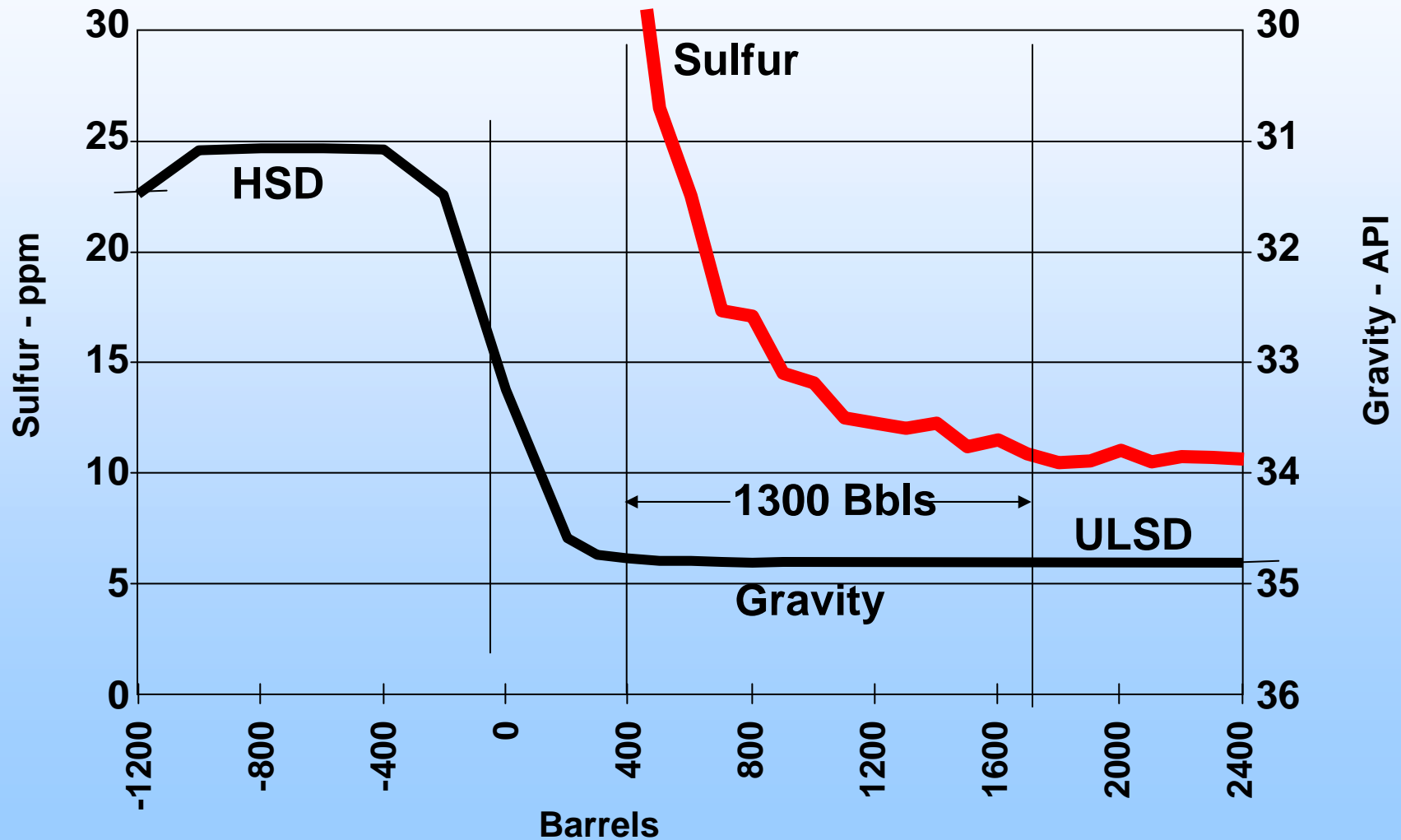
- Between the interface zones, the sulfur does not appear to increase during pipeline shipment
- Testing includes optimal handling practices
 - Additional displacements and purges to protect ULSD
 - Automated sumps are locked out and do not pump into ULSD batch
 - Pumps are not restarted during a batch of ULSD
 - Minimal active taps and dead legs exist along the mainline

Test Results (cont'd)

- In the interface, the sulfur will begin to change before, and continue to change after, the detectible gravity change
- The ULSD batch must be protected by making more conservative cuts than cuts based on gravity
- The sulfur interface will be 50-100% larger than the gravity interface.
- The larger interface will be additional down grade to LSD, HSD, or transmix depending on available tankage

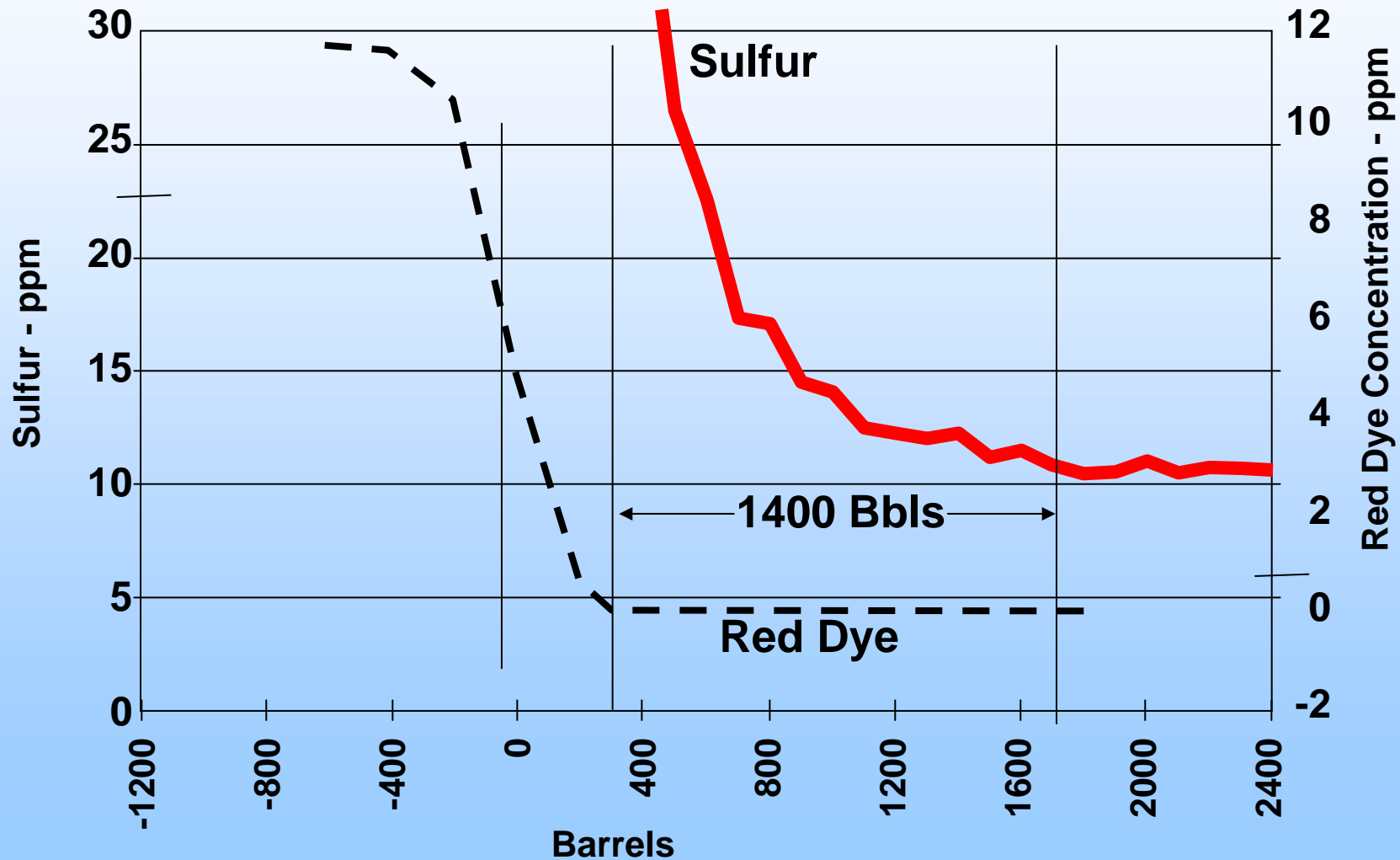
Interface Zone

ULSD behind HSD (“trail back” example)



Interface Zone

ULSD behind HSD (“trail back” example)



Test Results

Tank Farm Contamination Points

- After eliminating all contamination from the interface, tests indicate batch sulfur is increasing in tank farms. Some points of contamination identified:
 - Manifold piping
 - Dead legs
 - Valves
 - Multi-service tankage/tank residuals
- Each pipeline system is different

Pipeline Tankage Key Findings

- Residual sulfur in some tanks can lead to ULSD contamination
 - Tank design, low flow rates, and similar gravities may contribute to this
- Tanks should be dedicated.
- If not, tanks may need to be drained and flushed with 1-2 batches of ULSD
- Could limit current flexibility of drain dry tanks, or tanks whose service is changed regularly, reducing pipeline efficiency and capacity

Key Issues To Be Resolved

- Identifying the gravity interface between two distillates with similar gravities is high risk with current field equipment
- Future testing will help validate needed physical modifications
- Current on-line sulfur analysis equipment is slow to react and difficult to maintain calibration – requires making protective cuts resulting in additional transmix or downgrades
- Significant volume loss of ULSD to downgrade and/or transmix