

## Making ULSD: A Practical Refinery Discussion of Hydrotreating, Plant Operations, and Product Handling



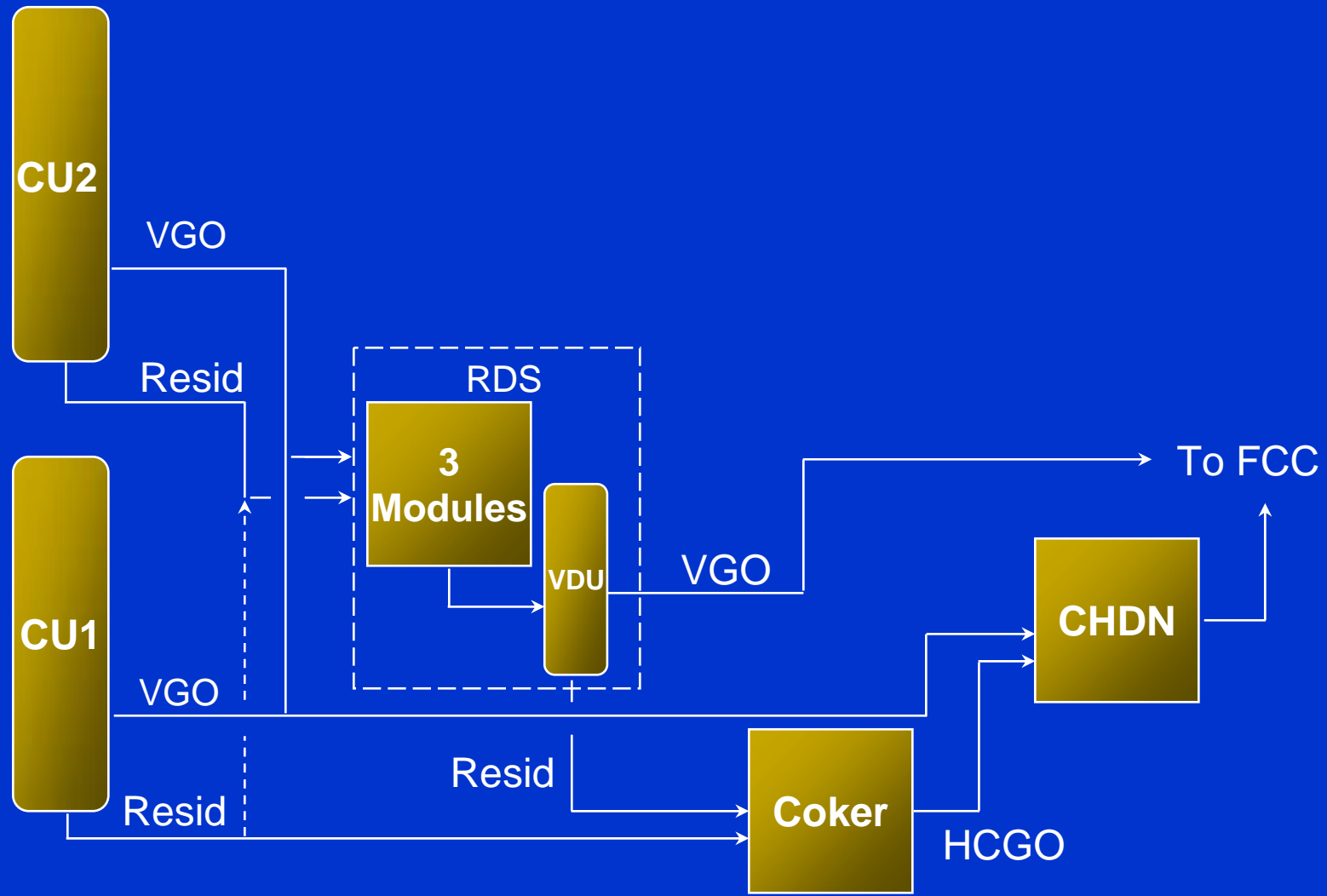
API ULSD Implementation Workshop

November 15, 2004

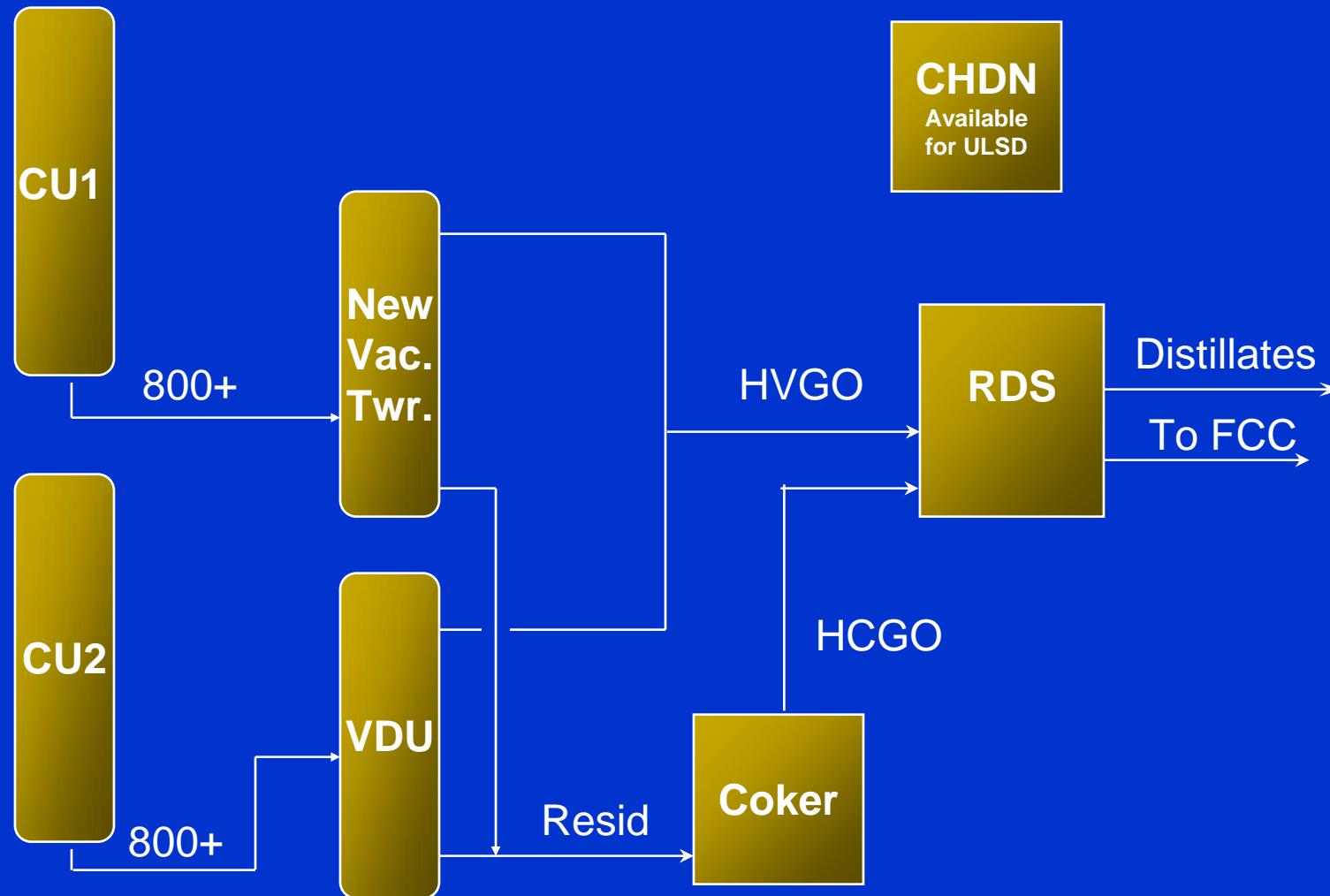
# Pascagoula Clean Fuels Project Overview

- Pascagoula underwent a major refinery reconfiguration to produce clean fuels—for both gasoline and diesel.
  - Refinery had a somewhat unique heavy crude processing scheme
  - Refinery was able to utilize high pressure hydrotreater for ULSD production.
- Since mid-2003 and depending on market conditions we have produced over 2 million barrels of ULSD.
- Will share some of the experiences and challenges that we faced and continue to face.

# Pre-Clean Fuels Configuration



# Post-Clean Fuels Reconfiguration



**ChevronTexaco**

Pascagoula Refinery

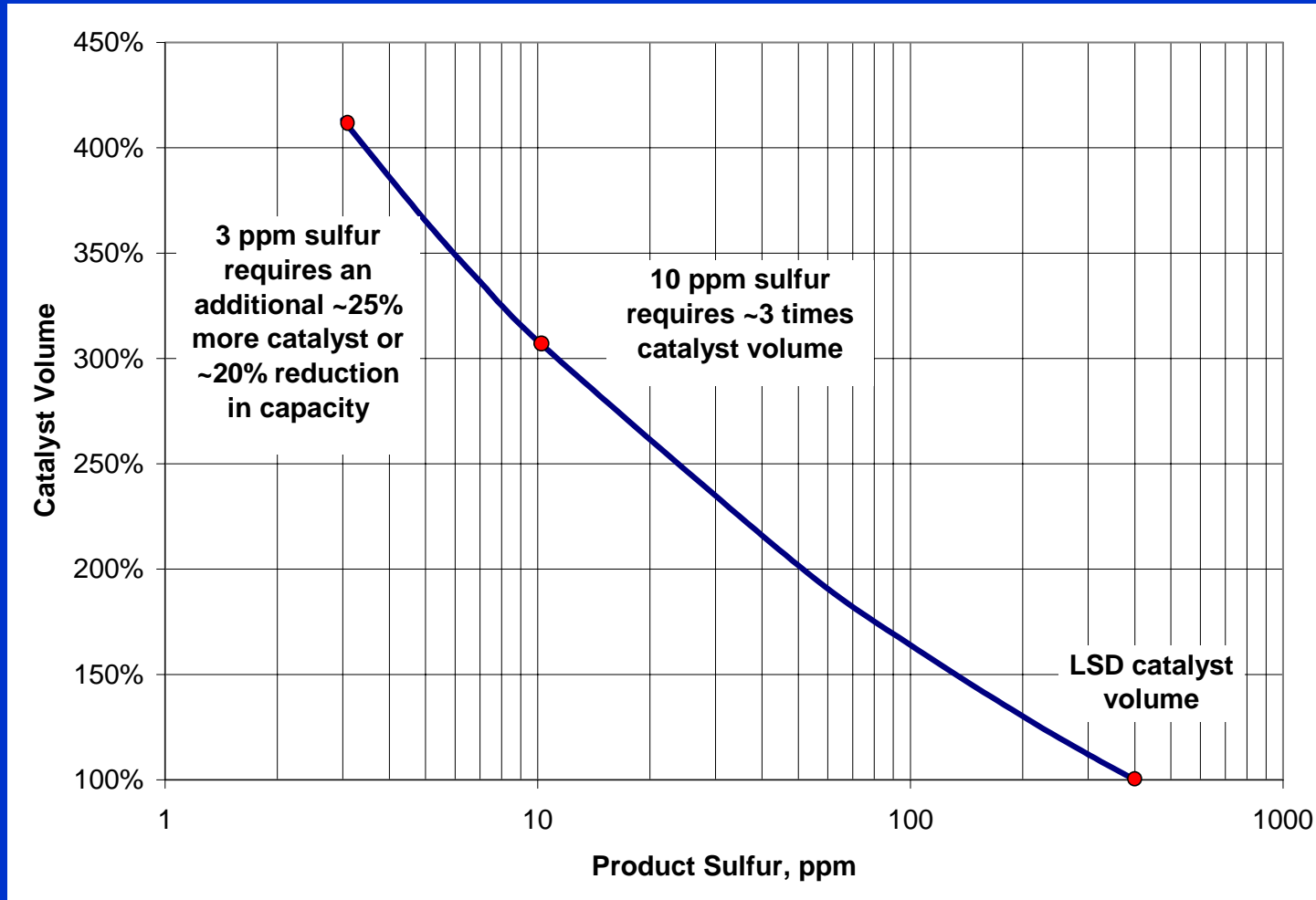
# Feed Management

- All feedstocks (straight run, coker, FCC) need to be flow controlled into diesel hydrotreater for predictable and steady feed qualities
- Feed quality from tankage need to be predictable and the flow rate reasonably steady
- Difficult to remove (sterically hindered) sulfur species from upstream units (i.e. crude units, coker, and FCC) may need to be controlled or even reduced to achieve ULSD sulfur levels
  - Control and possibly reduce distillation “tails”
  - Consider need to reduce cut points

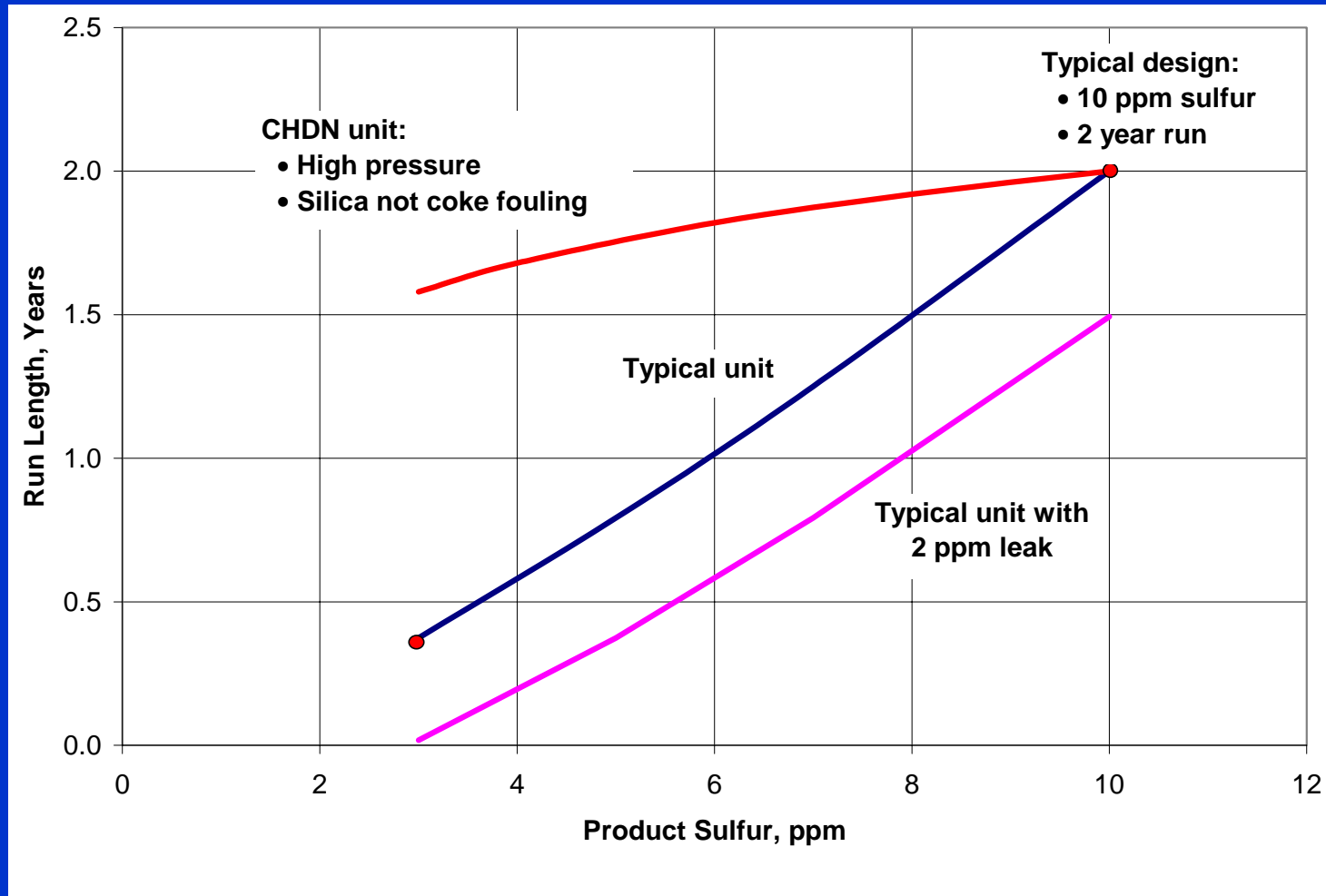
# Reactor System

- Leaks -- 0.01% (1 out of 10,000) leak or bypass of feed containing 2 wt% will result in a 2 ppm increase in product sulfur
  - Reactor internals may need to be upgraded to prevent maldistribution and channeling, which may make it extremely difficult to achieve the near zero sulfur specification.
  - Feed/Effluent heat exchanger gaskets and seats may need to be repaired/upgraded to minimize leakage of feed to product.
- Appropriate catalyst system and operating conditions should be confirmed in pilot plant test or by a unit test run. Feed stocks used should be full boiling range expected during maximum diesel production.

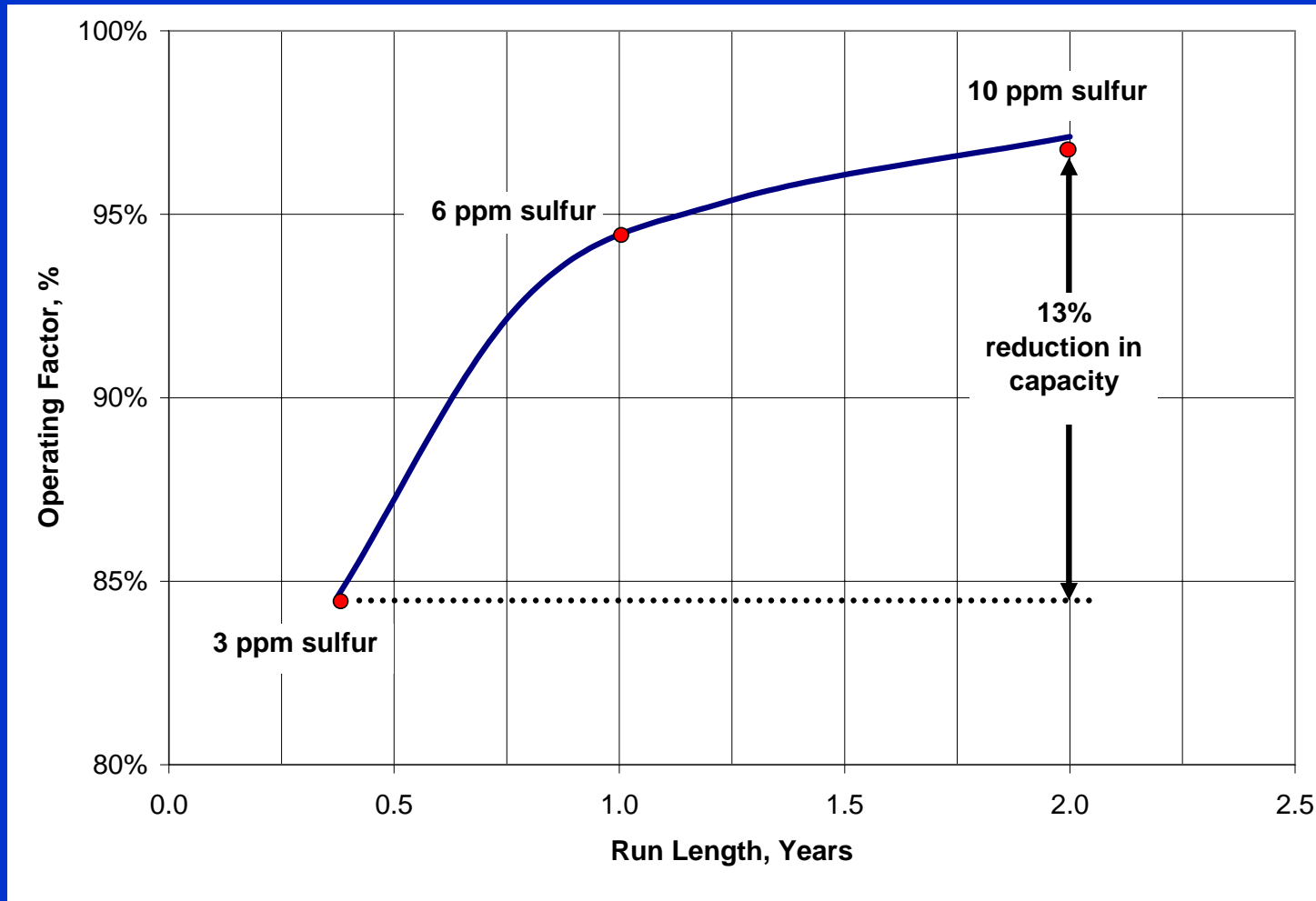
# Catalyst Volume Factor vs. Product Sulfur



# Run Length vs. Product Sulfur



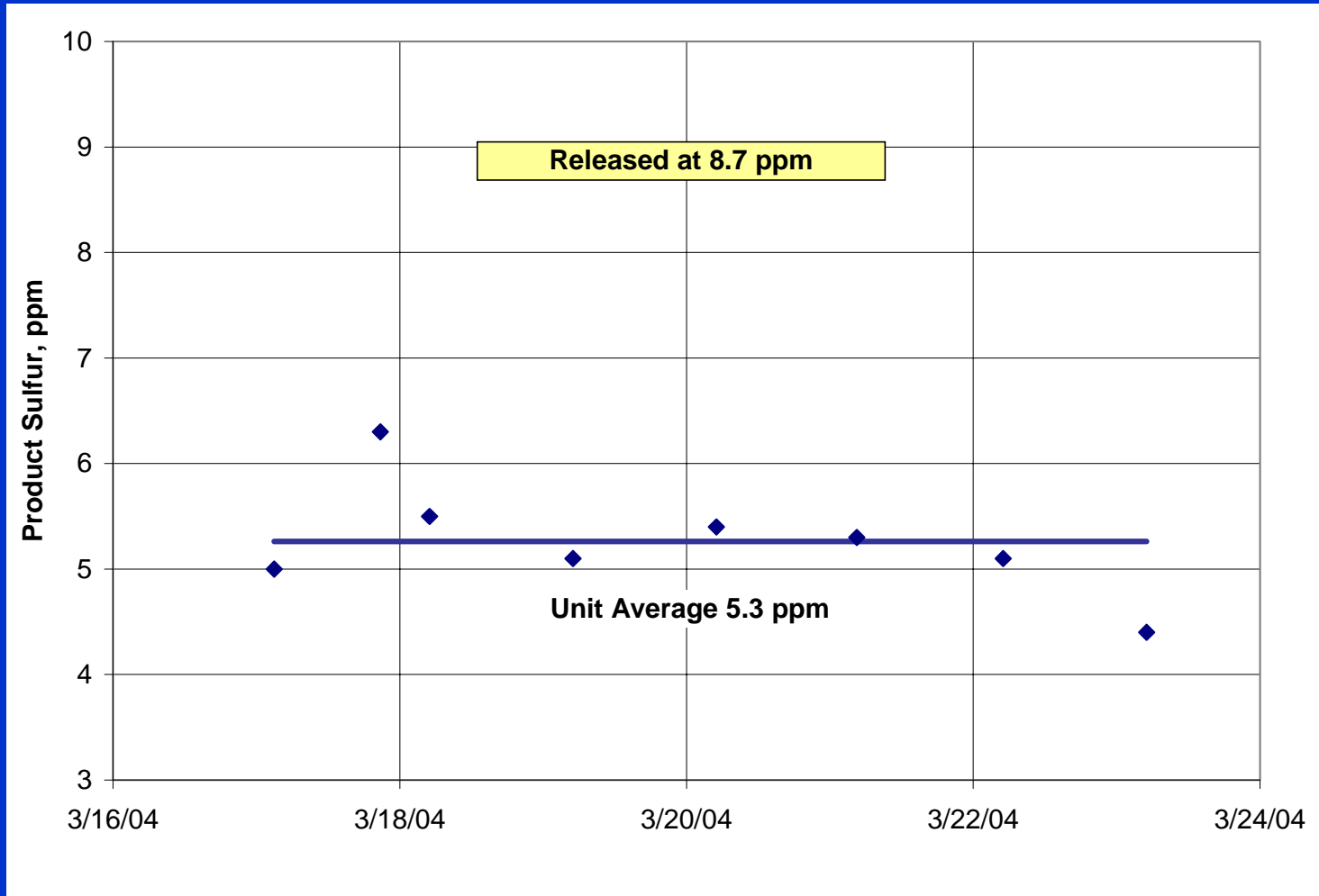
# Operating Factor vs. Run Length



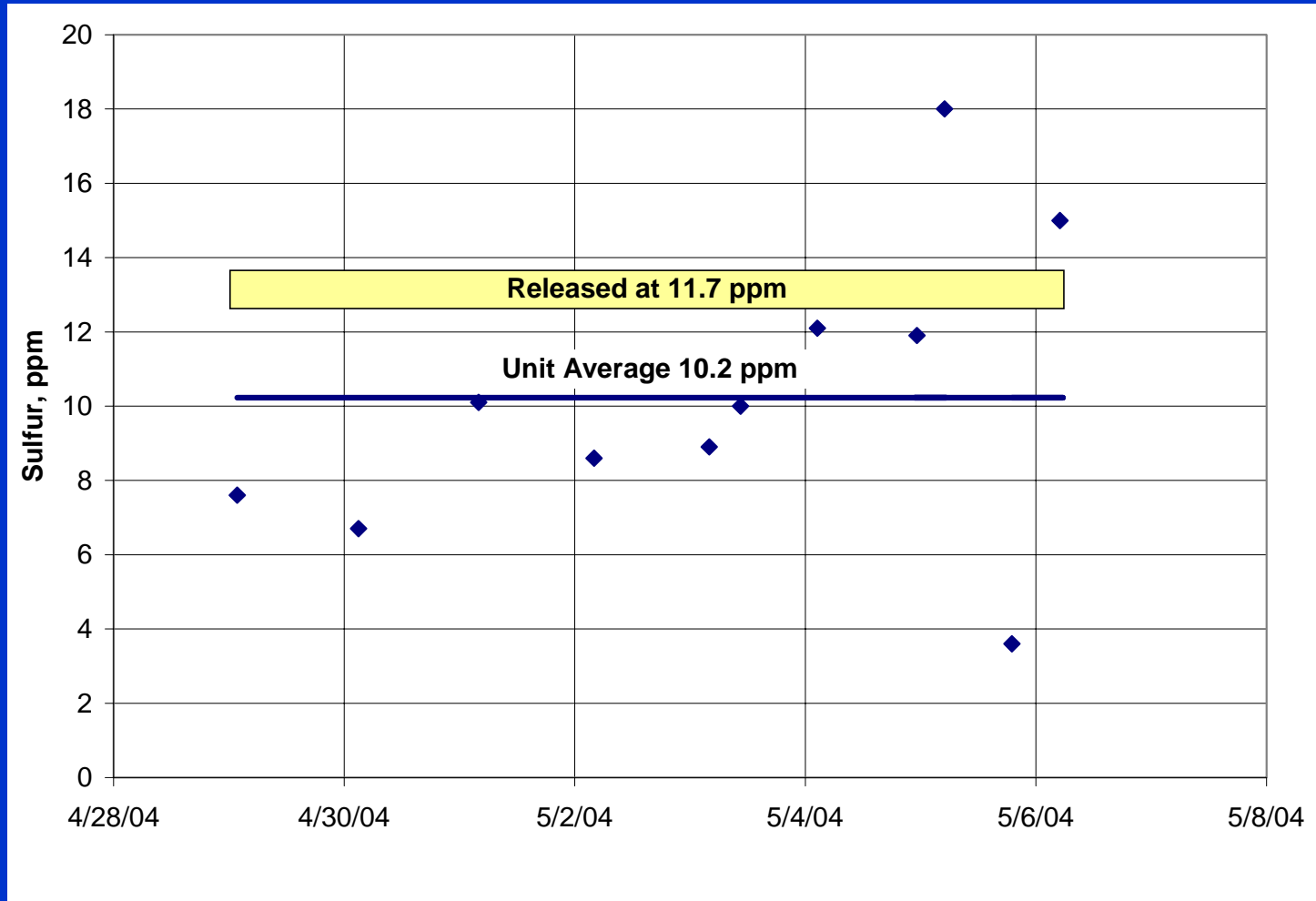
# Product Quality

- Sulfur Analysis
  - Must operate with a large margin to rely on offline measurement.
  - Online analyzer should be seriously considered.
- Diesel conductivity will diminish greatly.
  - Review safe shipping and handling practices to address static electricity hazards.
  - Static dissipaters are marginally effective.

# ULSD Production Example 1



# ULSD Production Example 2



# Product Integrity

- Current ULSD production uses a largely unmodified LSD system
  - Have cleaned up over a dozen component, wharf, and marketing tanks.
  - Simply strip and drain dry tanks before filling with ULSD
- Current LSD system is segregated from HSD system
  - Blinded and typically blocked with Twin-Seals
  - Separate tanks, pumps, and wharf lines and risers
- Plan to create a new HSD system--HSD, LSD, and ULSD will each have segregated systems.
- Off-test ULSD will likely be downgraded to LSD or perhaps rerun.

## In Summary...

- ULSD production requires significant investment in hydrotreating plants, product analyzers, and product segregation for integrity.
- Minor malfunctions or leaks as well as difficulties in sulfur measurement can easily result in off-test product.
- ULSD production will be reduced as the release specification is lowered.
  - Lower operating factor (more unit shutdown days).
  - More likely to produce off-test product which will be downgraded or rerun.