



STRATEGIC CHEMISTRY[®]

The timely use of chemistry and planning designed to improve client operating margins



Southwest Process Technology Conference

STRATEGIC CHEMISTRY

**PATENTED
CHEMISTRY**



**DETAILED
PLANNING**



**PROFESSIONAL
EXECUTION**

-  Unit Turnarounds
-  **Catalyst Changing Activities**
-  In-Situ Maintenance

Historical Methods for Clearing Reactors



Hot H₂ Stripping



Nitrogen Purging

Today I'll talk about the power of a solvent to accelerate this process.

QuikTurn[®]RX™

- Pure organic solvent (no H₂O)
- Injected into dry atmospheres (H₂, N₂, natural gas)
 - Non-water soluble; no downstream emulsions
- Residue free
- Compatible w/ catalyst
 - Catalyst can be re-used or replaced
 - Will not regenerate or poison catalyst
- Patented technology

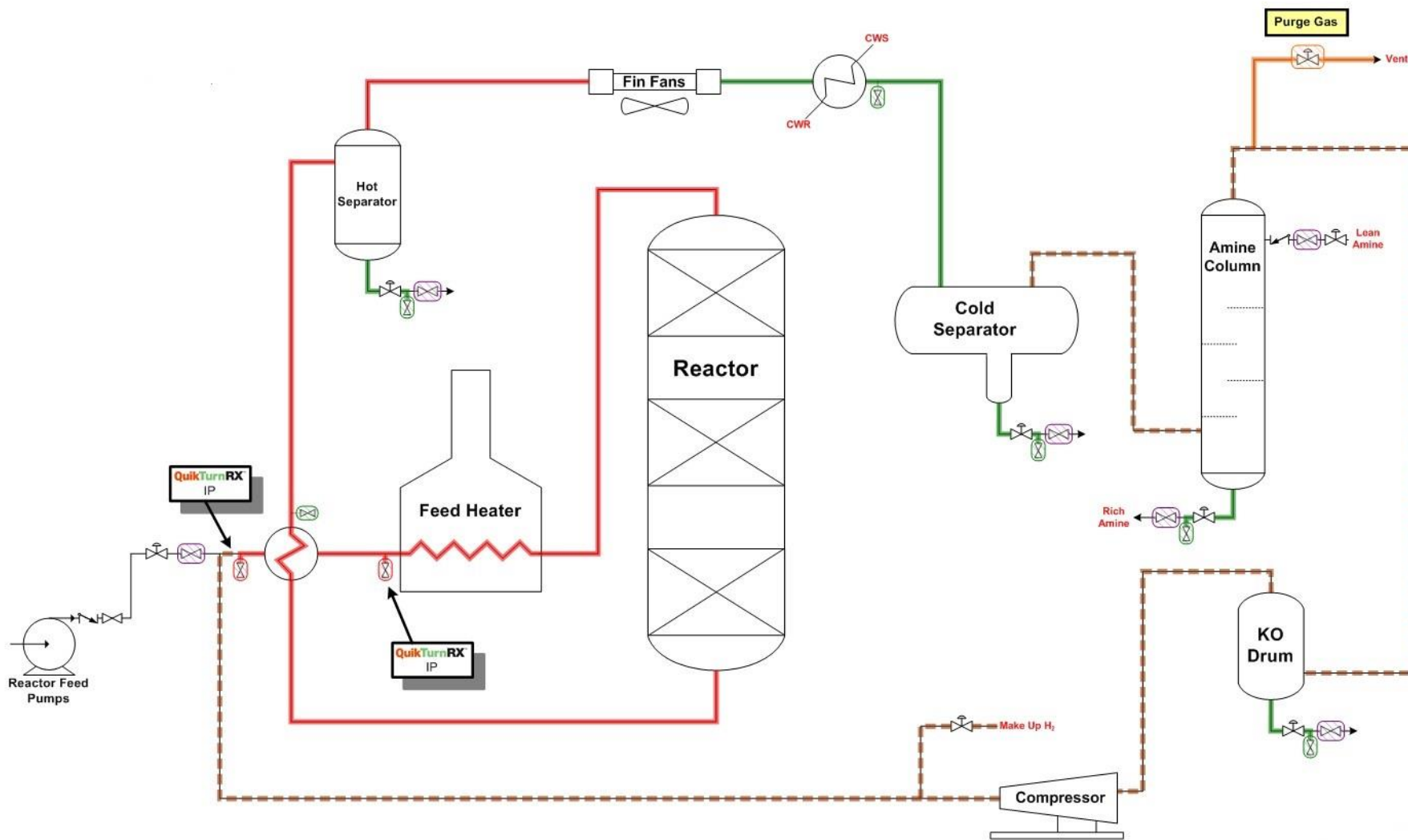
QuikTurnRX™ Lab Testing

- QuikTurnRX has been extensively tested by third party labs for:
 - Anions (F⁻, Cl⁻, NO₂⁻, Br⁻, etc.): <0.1 ppm
 - Cations (Na⁺, K⁺, Ca⁺, Mg⁺, etc.): <0.1 ppm
 - Metals (ICP): <1.0 µg/g
 - Other contaminants: As <1 ppb, Pb <5 ppb, N₂ <1ppm
- Distillation Range: 330°F - 380°F
- Vapor pressure: 1.4 mm Hg @ 20°C
- Full lab reports are available upon request

Typical Process Conditions

- Chemical injected during gas sweep (cool down)
- Reactor outlet ~ 450°F and ~ 450psig
- Maximum recycle rates with specified MU and purge
- Displaced hydrocarbons routed via typical shutdown systems (flare, FGRU, slop, LP equipment, etc)
- Injection takes 2-4 hours
- Process implemented at a wide variety of conditions:
 - Reactor pressures up to 1000 psig
 - Temperatures up to 550°F; min fn of reactor conditions
 - Once through systems (no compressor)

Example Single-Reactor High Pressure Loop



QuikTurn[™]RX Technology Benefits

- Shortening the shutdown timeline
 - Reduced or eliminated hot H₂ sweep
 - Reduced “Huff-and-Puff” and sweeping
- No residual LEL
- Reduction in N₂ Cost
- Clean hot high pressure circuit during cool-down – maintenance cost, safety and timeline benefits
- Reduced flaring
- Predictable Results

August 2017 MACT 1 Amendment

- Deals with standards for maintenance vents that apply during startup, shutdown, maintenance, or inspection.
- Decision protocol:
 - Vessel Hazardous Air Pollutants (HAP) > 20ppm?
 - Vessel VOC content > 72#?
 - Vessel contain pyrophoric catalyst?
 - Pure H₂ available at vessel?
 - If no, can purge to atm if LEL<20%. Once/yr. if LEL<35%
 - If yes, can purge to atm if LEL<10%

QuikTurnRX process assures LEL levels are met.

Results Have Been Excellent

- Reactor entries in record time
- Acceptable LEL levels with ~2 pressure/dump cycles
- Reduced or eliminated most hot hydrogen strips
- Elimination of recurring LEL and H₂S issues
- Reductions in N₂ usage
- No environmental, effluent or safety issues
- All hot high pressure equipment is LEL, H₂S free

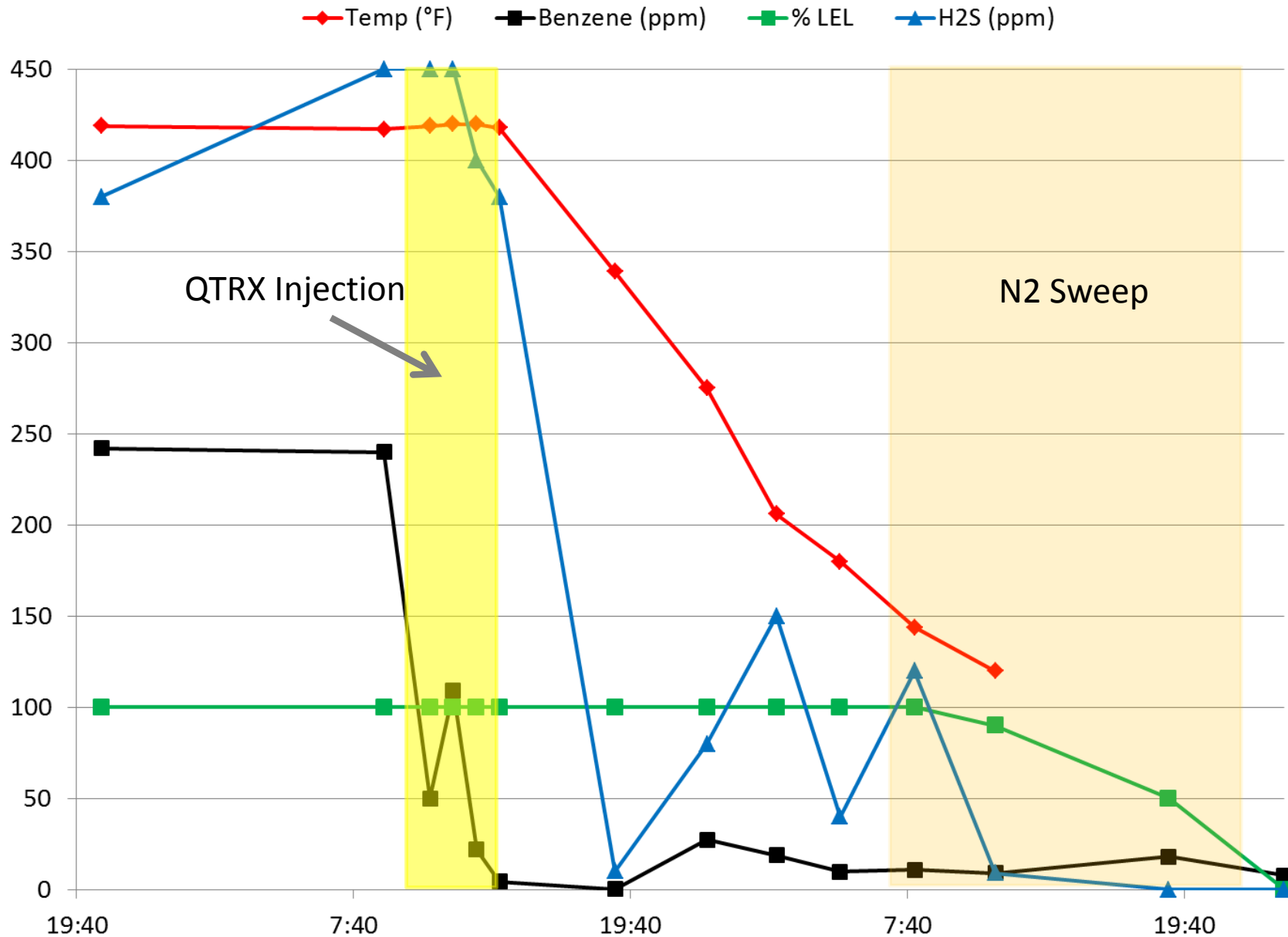
Spent Catalyst from 2006



Spent Catalyst after QTRX application 2011



Actual Gas Tests from Hydrotreater Project



HDS Actual Time Savings

100K bbl/day HDS Unit - Previous Shutdown Timeline

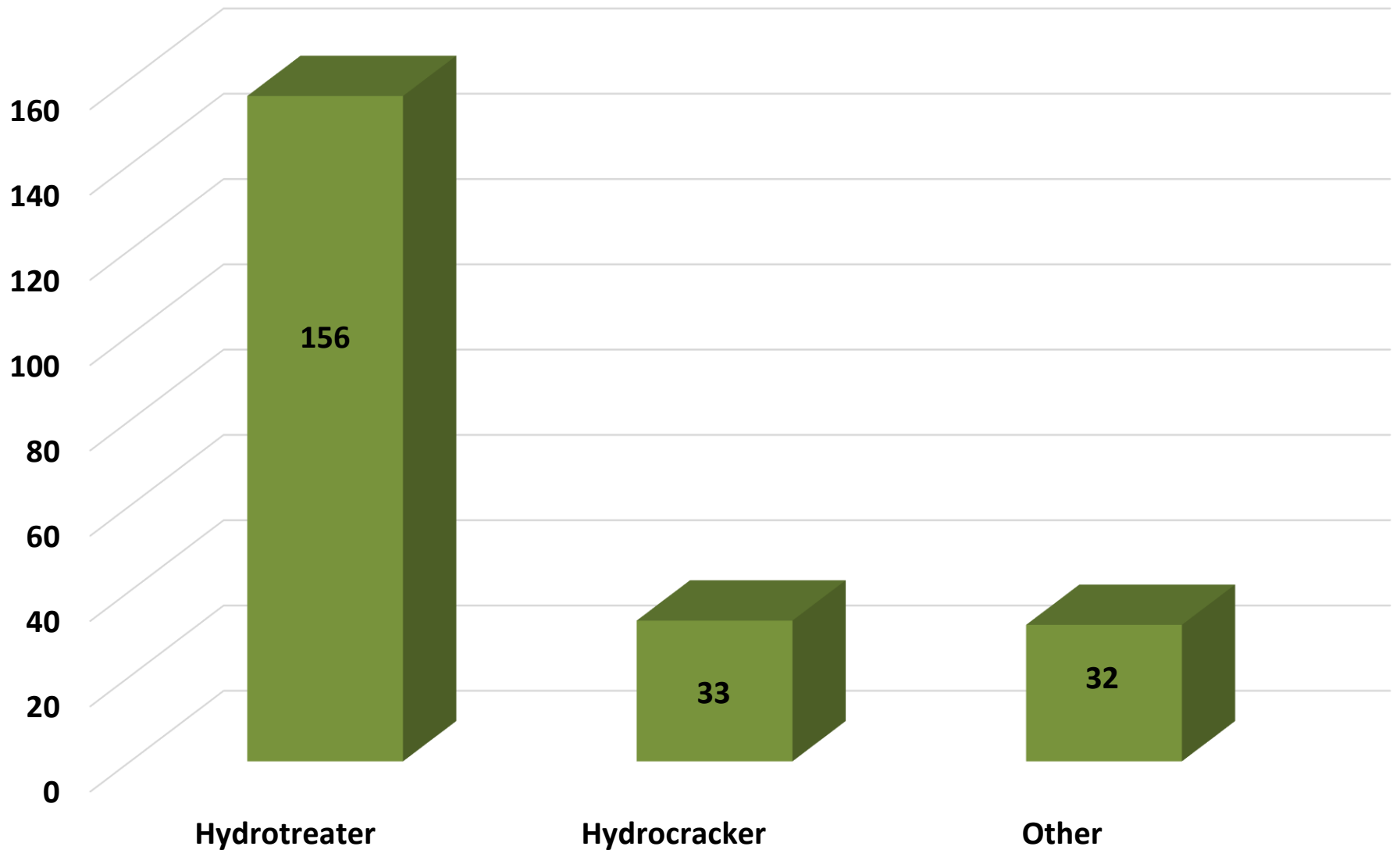
TASK	HRS	Day 1		Day 2		Day 3		Day 4		Day 5	
		Days	Nights	Days	Nights	Days	Nights	Days	Nights	Days	Nights
		Stop feed, flush and prepare for hot strip	26	■							
Hot Strip min of 16 Hrs - or until no more liquid accumulation	16			■							
Cooling to 350° and lowering pressure to 1 psig	18				■	■					
Pressure dump and fill with N2 and restart compressor	10						■	■			
NiCool Injection until bed temps below 150°F and skins below 250°F	48							■		■	
Total Shutdown Duration - 118 Hours		■		■		■		■		■	

TASK	HRS	Day 1		Day 2		Day 3		Day 4		Day 5	
		Days	Nights	Days	Nights	Days	Nights	Days	Nights	Days	Nights
		Stop feed and perform diesel flush	8	■							
Sweep reactor loop and cooldown to 500°F	6		■								
Cooldown to 450°F, pressure to 450psig and connect injection and drain piping	12		■	■							
Refined Technologies Chemical Injection	4				■						
Cooldown with H2 to >120°F Bed / >300°F Skin temperatures	30			■		■					
Shut down RGC, depressure system and perform two N2 pressure sump and fills	10						■	■			
Shutdown NiCool - Depressure system - Test LEL & H2S)	4										■
Total Shutdown Duration - 68 Hours		■		■		■		■		■	

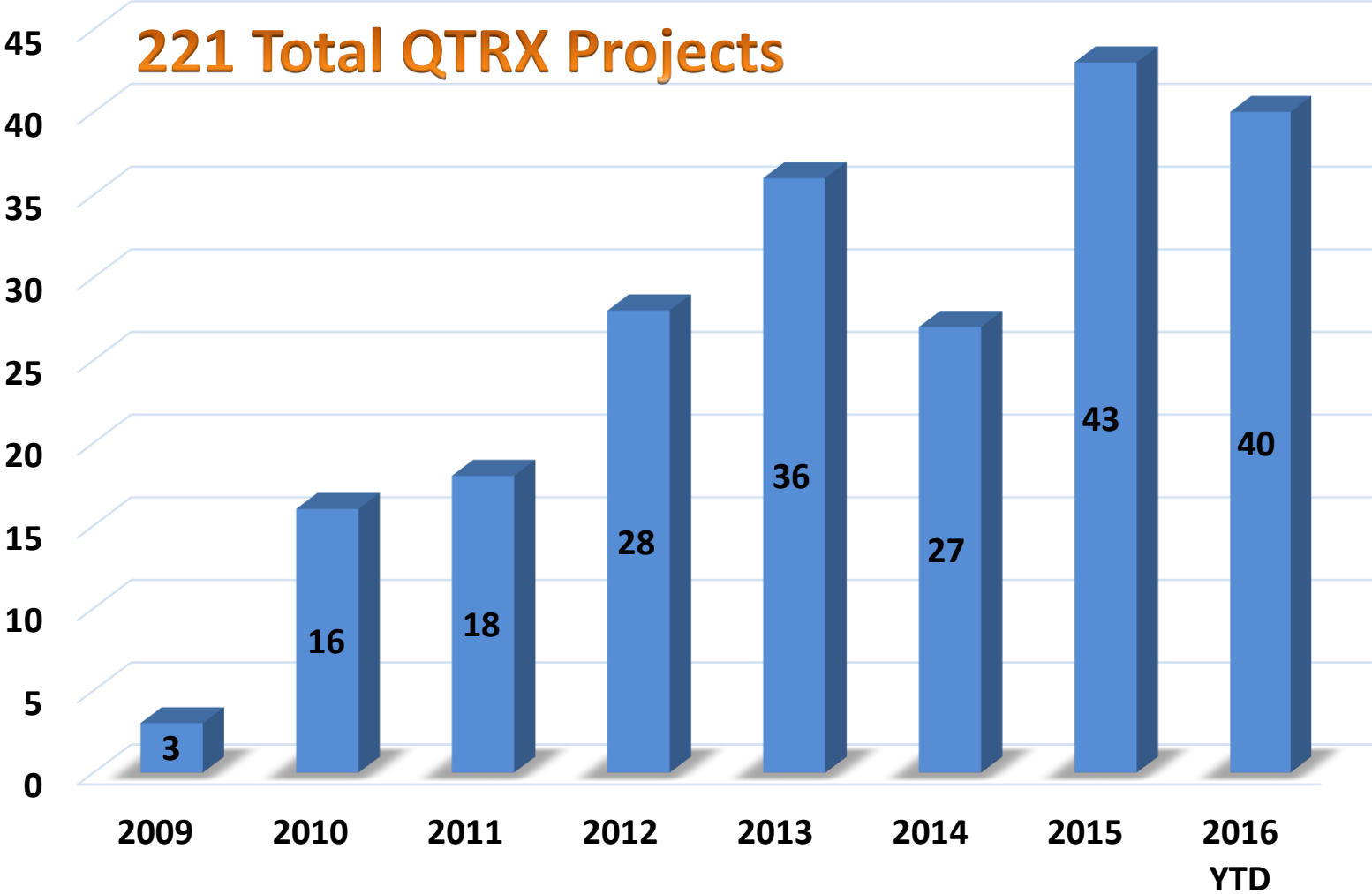
Learning Events

- Gulf Coast Hydrocracker
 - Unaware of quantity of polymeric anti-foulant added
 - Reactor full of long-chain polymers – goo – and sheen
 - **LESSON:** discussions on additives and quantity
- Midwest Diesel HTU
 - Plan was to use make-up PSA Hydrogen source, but used reformer due to plant issues
 - Unaware of C6+ content (~3%). LEL and benzene post cleaning.
 - **LESSON:** GC sample of make-up H₂. C6+ <1%.
- Gulf Coast GOHTU
 - Project awarded a month before TA; no completed procedure.
 - Plant resistance to hooking up or draining low points
 - H₂S levels stayed high – liquid in effluent train
 - **LESSON:** Must drain low points

QuikTurnRX Projects by Unit Type



Completed QuikTurnRX Projects



Catalyst Compatibility Study

- QuikTurnRX was tested with DHT catalyst at a major oil refinery hydrotreating pilot plant
 - Catalyst was baselined with normal feed and hydrogen
 - Normal feed was removed from reactor system
 - QuikTurnRX was injected into the reactor with hydrogen at 450°F and 450 psig at 20X the normal commercial rate
 - After QuikTurnRX injection, normal feed was pumped back into reactor
 - Catalyst activity was measured when target rates and temperatures were achieved

Compatibility Study Findings

- Catalyst activity decreased slightly, but was well within the experimental error for repeatability
- The results are quite impressive considering the QuikTurnRX dosage rate
- The refiner has confidence that QuikTurnRX does not hurt catalyst activity
- Full report of pilot plant study is available upon request

Summary

- RTI QTRX process has been proven to expedite reactor entries since 2009. Record entry times achieved.
- Hot hydrogen strips and long nitrogen purges or huffs and puffs greatly reduced.
- Technology applied (221) in many unit types and sizes without any adverse effect on catalyst.
- The entire high pressure loop is hydrocarbon-free, speeding entry into piping, exchangers and other equipment.