



Petroleum Coke Drum Handoff Cutting Performance Best Practices

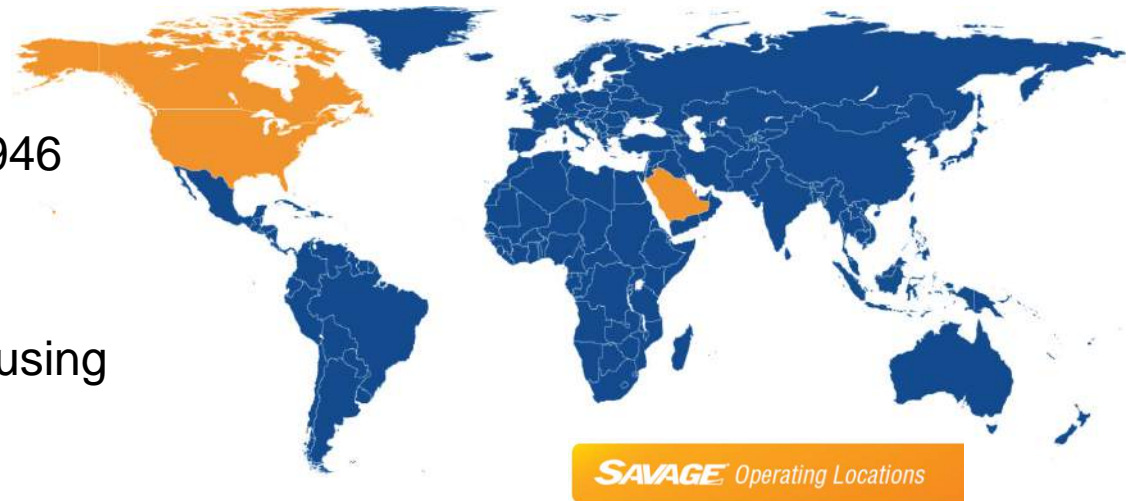
November 11th, 2015



Savage Overview

SAVAGE

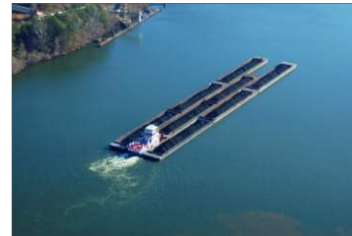
- Supply chain solutions
- Privately held, founded in 1946
- Headquarters in Utah, USA
- Create value for customers using the Savage System
 - Design and operate systems to solve unique logistics and materials management challenges
- 3,500 employees serving customers in over 200 locations
- Industries across: oil & gas (upstream, midstream, & downstream), electric power generation, chemical, mining, agricultural and manufacturing
- Capabilities span all aspects of transportation, facility operations and maintenance, and material handling



Petroleum Coke Solutions



Refinery
Services



Logistics &
Transportation



Facilities
Management

Savage's Industry Position



Number	Savage Services
19 Refineries	Coke Handling System O&M Services
9 Refineries	Coke Cutting & Coker Unit Operations
9 Refineries	Bridge Crane O&M Services
15 Refineries	Loading Coke Services
6 Refineries	Cutting Equipment Maintenance Services
3 Terminals	Terminal / vessel loading services
15 Refineries	Coke Transportation Services
16 - 18 MM Tons	Coke Handled Annually

Petroleum Coke Customers



Refinery Customers	Coke Handling	Coke Cutting	Cutting Maintenance	Coke Loading	Coke Transportation
Coffeyville Resources - Coffeyville	X			X	X
ExxonMobil - Baytown	X	X	X	X	
ExxonMobil - Torrance	X			X	X
HollyFrontier – El Dorado	X			X	
Marathon - Detroit	X	X	X	X	X
Marathon - Galveston Bay	X			X	X
Marathon – Garyville	X	X		X	X
Motiva – Port Arthur	X	X	X	X	
PBF – Delaware City	X			X	
PBF – Paulsboro	X			X	X
SATORP – Saudi Arabia	X	X	X	X	
Tesoro - Los Angeles	X	X	X	X	X
Tesoro - Martinez	X			X	
Valero – Corpus Christi	X			X	X
Valero – St. Charles	X	X		X	X
Valero – Texas City	X	X	X		
Terminal Customers	Coke Unloading	Stockpiling	Inventory Management	Maintenance	Vessel Loading
KCS – Port Arthur	X	X	X	X	X
SATORP – Saudi Arabia	X	X	X	X	X
Valero – Corpus Christi	X	X	X	X	



Safe Drum Isolation and Handover

Establishing Best Practice Lockout/Tagout



What is the Goal of Drum LOTO?



To ensure that all valves are secured in a manner that will prevent an inadvertent positioning of a valve that would send auto-ignitable hydrocarbon to an open coke drum.

- Successful LOTO of a Drum:
 - LOTO performed on the correct drum
 - All valves/LOTO points are identified and locked out in correct position
 - Verification of LOTO is performed by 2nd operator and documented on checklist

Best Practice Survey



Savage conducted a survey to compare and contrast existing LOTO processes used at Customer DCUs where coke drums are cut and recommend best practices to Customer.

Project Milestones

- Review existing written LOTO procedures
- P&ID review and verification of LOTO points at each DCU with Customer
- Field verify each LOTO procedure
- Communication of project results to Customer and recommended path forward
- Training of all involved personnel

Findings – Permits for Drum Handover



Permit System	
Positives	Opportunities
<ul style="list-style-type: none">• Electronic and Hand Written<ul style="list-style-type: none">○ Issued after joint job site visit○ Valve position, drum temperature and pressure verified at DCS prior to permit being issued.	<ul style="list-style-type: none">• Verbal Handover at one site• No joint verification of drum conditions

Findings – LOTO



Lockbox System	
Positives	Opportunities
<ul style="list-style-type: none">• Locks and tags placed at specified points by Customer DCU ops• Keys to locks placed in numbered lockbox• Savage DCU ops place individual keyed lock on lockbox and Savage master lock (keyed alike to allow for drum turnover across shifts)	<ul style="list-style-type: none">• Some issues found with missed lockout points• Missed joint walkthrough• No common lockbox

Findings – Equipment Isolation List



Equipment Isolation List	
Positives	Opportunities
<ul style="list-style-type: none">• Generated as part of the permitting process• List details action/position<ul style="list-style-type: none">○ De-energized and locked, open or closed.○ Lists products – i.e. steam, electricity, hydrocarbons• Joint walk through of lockout points with Customer and Savage DCU operator	<ul style="list-style-type: none">• No written permit• Does not detail action/position• No joint walk through of lockout points

Findings – Equipment Isolation List



Equipment Isolation List	
Positives	Opportunities
<ul style="list-style-type: none">• Both parties sign off on lockout list• Lockout of steam seals between valves• Valve position, drum temperature and pressure verified at DCS prior to permit being issued	<ul style="list-style-type: none">• Steam seals not on isolation list• Missing lockout points (field LOTO points do not agree with PI&D)

Findings – Training & Audits



Training

- Opportunities exist for both Customer and Savage DCU operations regarding classroom training and field verification of lockout points.
 - Example - operators should be able to demonstrate location and valve position for each lockout point
- Frequent refresher training should be instituted

Audits

- Frequent audits of the lockout process must occur to ensure system is not comprised by untrained or complacent activities by operators

Best Practices - Summary



- Use a permit systems for drum handover process
- Complete a written checklist for lockout verification
- Identify lockout points for drum cuts with phenolic tag or sign that references lockout point listed on checklist
- Review drum pressure, temperatures and valve positions on HMI prior to drum cut
- Operators review valve/lockout checklist in the field to ensure all lockout points are secured before cutting drum
- Develop one line drawing and/or map to assist in field verification of lockout points and training of new operators in lockout
- P&ID review and verification of LOTO points at each site with Customer
- Ensure that lockout process is a joint process between Customer and Savage DCU Operations
- Training and frequent audits



Cutting Performance Tracking System

Using Cutting Data to Optimize Drum Cycle



Performance Tracking System



- Savage utilizes a performance tracking system for coke cutting activities that enhances the ability to optimize cycle times.
- Advantages of Savage's cutting database and performance reporting system:
 - Establishes long term performance history.
 - Provides critical data on identifying trends in delay causes.
 - Provides Operator specific performance feedback.
 - Accumulates cutting data that the Refinery can use in analyzing correlations with operating conditions.
 - Assists in establishing target cut times for new unit.
 - Basis for comparative analysis on drum performance within a DCU.
 - Basis for comparative analysis across operations (must consider DCU arrangements).

Operator Drum Logs



Refinery "A"

Date: _____ Time: _____ Shift: AM / PM Drum: A B C D Operator: _____

Outage: _____ Pilot Jet Pump Pressure: _____ Decoke Jet Pump Pressure: _____ Total Cut Time: _____

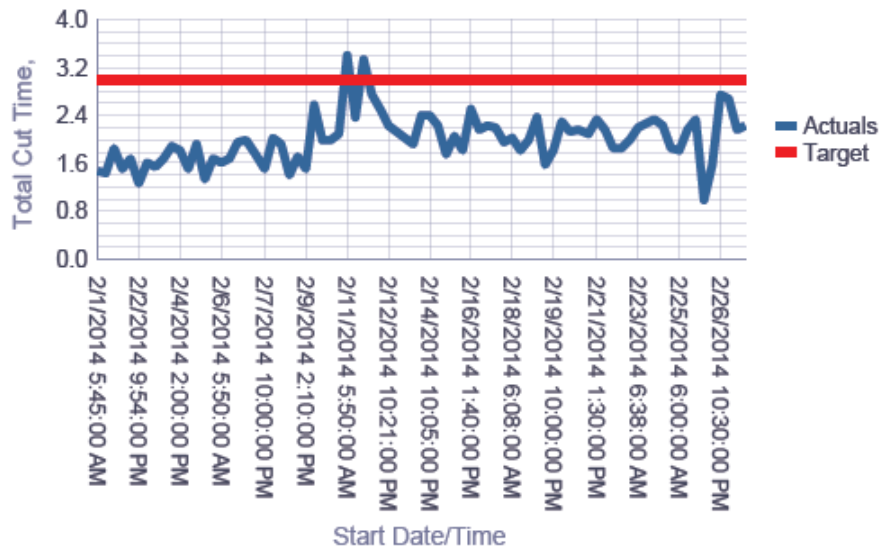
Unhead Information									
Start Time	End Time	Total Minutes		Target Minutes	Within Target Time		Total Delay Minutes		
				30	Yes / No				
Delay	Minutes	Exception	Delay	Minutes	Exception	Delay	Minutes	Exception	
Bad Drain		Y / N	Mechanical		Y / N	Top Head Bolts			Y / N
Electrical		Y / N	Operator Error		Y / N	Chute			Y / N
Other		Y / N	Other explanation:						
Pilot Cut Information									
Start Time	End Time	Total Minutes		Target Minutes	Within Target Time		Total Delay Minutes		
				20	Yes / No				
Delay	Minutes	Exception	Delay	Minutes	Exception	Delay	Minutes	Exception	
Hot Drum		Y / N	Drill Rig		Y / N	Hard Coke			Y / N
Jet Pump		Y / N	Drill Stem		Y / N	Drum Cave In			Y / N
Rotary Joint		Y / N	Hoist		Y / N	Free Arrestors			Y / N
Decoke Valve		Y / N	Operator Error		Y / N	Cutting Tool			Y / N
Cutting Water		Y / N	Mechanical		Y / N	Other			Y / N
Other explanation:						Mode:	Depth:		
Decoke Information									
Start Time	End Time	Total Minutes		Target Minutes	Within Target Time		Total Delay Minutes		
				85	Yes / No				
Delay	Minutes	Exception	Delay	Minutes	Exception	Delay	Minutes	Exception	
Hot Drum		Y / N	Drill Rig		Y / N	Hard Coke			Y / N
Jet Pump		Y / N	Drill Stem		Y / N	Drum Cave In			Y / N
Rotary Joint		Y / N	Hoist		Y / N	Free Arrestors			Y / N
Decoke Valve		Y / N	Operator Error		Y / N	Cutting Tool			Y / N
Cutting Water		Y / N	Mechanical		Y / N	Shift Change			Y / N
Other						Mode:	Depth:		
Rehead Information									
Start Time	End Time	Total Minutes		Target Minutes	Within Target Time		Total Delay Minutes		
				45	Yes / No				
Delay	Minutes	Exception	Delay	Minutes	Exception	Delay	Minutes	Exception	
Mechanical		Y / N	Operator Error		Y / N	Chute			Y / N
Electrical		Y / N	Planned Maint.		Y / N	Inspection			Y / N
Other		Y / N	Other explanation:						
Lubrication Information									
Equipment	Oil Type	Amount Used		Equipment	Oil Type	Amount Used			
Winch	Chevron 68			Rotary Joint	Chevron ISO 68				
Rotary Gear	ESI SAE 80W-90			Impact Guns	Marvel Mystery Oil				
Air Motor	Chevron 32								
Wench Inspection Information									
Cable Condition:	Good	Kinked		Spooled Correctly:		Yes / No			

Sample Performance Reports



Cut Time Trend Graphs

Drum **All Drums**



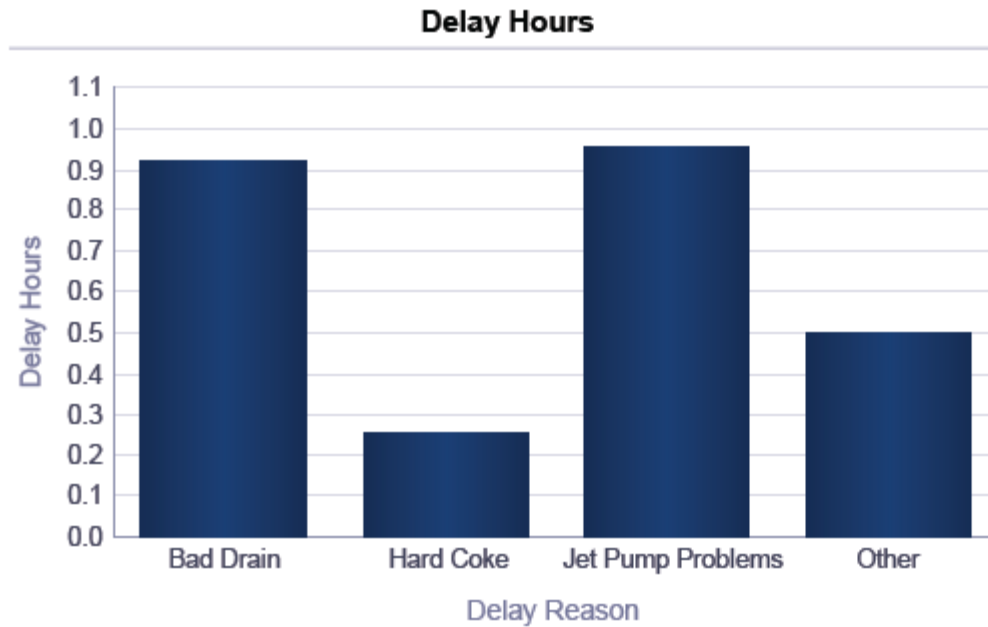
Drum	Average Cut Time
A	2.0
B	1.8
C	1.9
D	2.2
All	2.0

Sample Performance Reports



Delay Pareto Graphs

Drum D



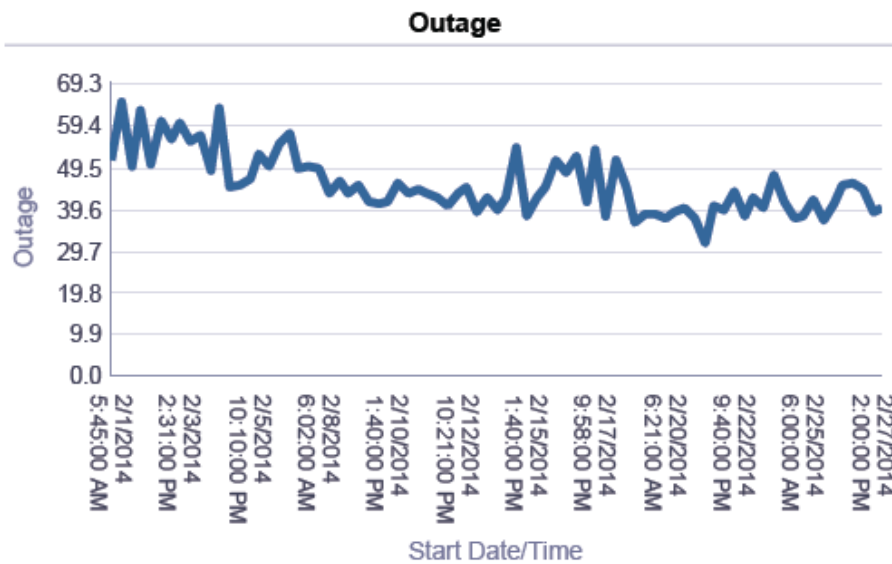
Delay Reasons	Delay Hours
Bad Drain	0.9
Hard Coke	0.2
Jet Pump Problems	0.9
Other	0.5

Sample Performance Reports



Outage Tracking

Drum **All Drums**



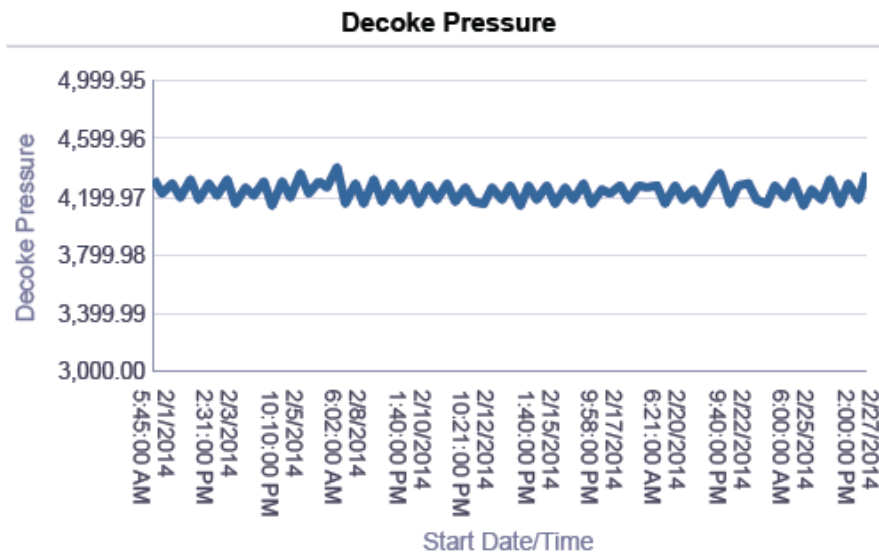
Drum	Average Outage
A	46.6
B	45.6
C	44.6
D	45.3
All	45.5

Sample Performance Reports



Jet Pump Pressure Tracking

Drum **All Drums**

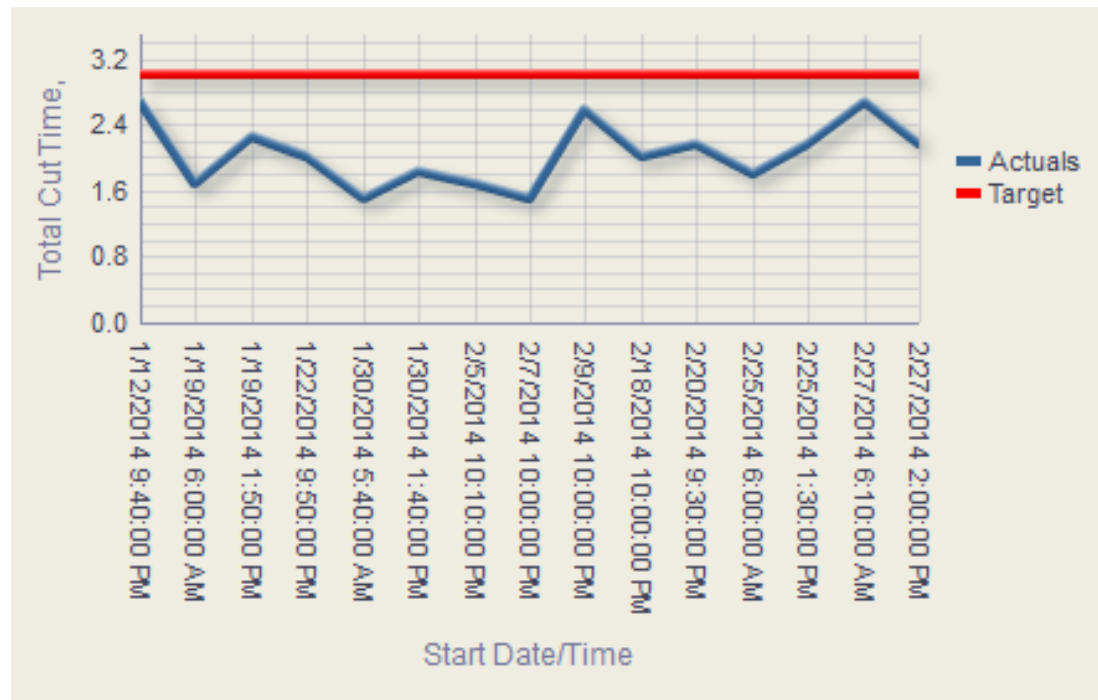


Drum	Average Decoke Pump Pressure
A	4,163.00
B	4,197.89
C	4,314.05
D	4,284.00
All	4,240.27

Sample Performance Reports



Individual Operator Performance Tracking



Refinery A Comparative Study

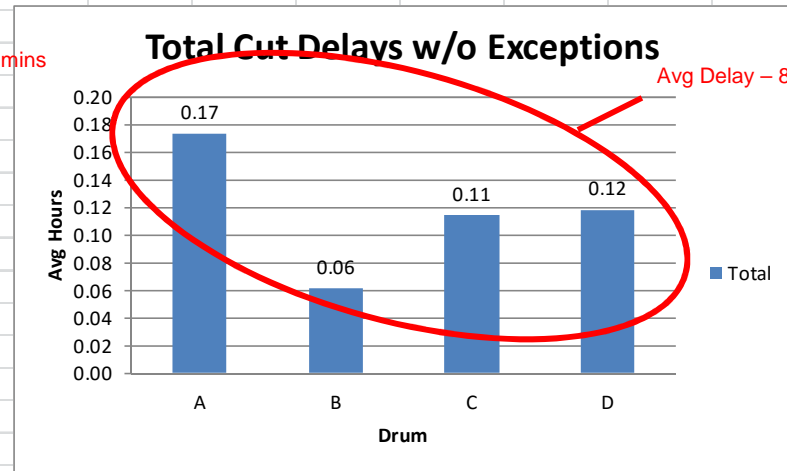
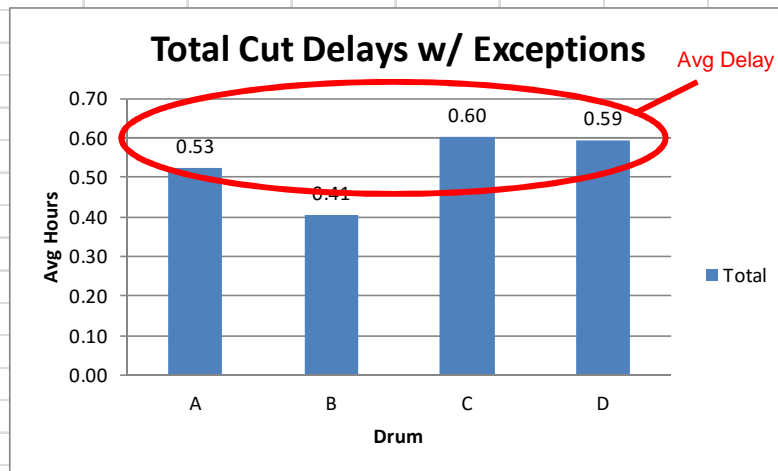
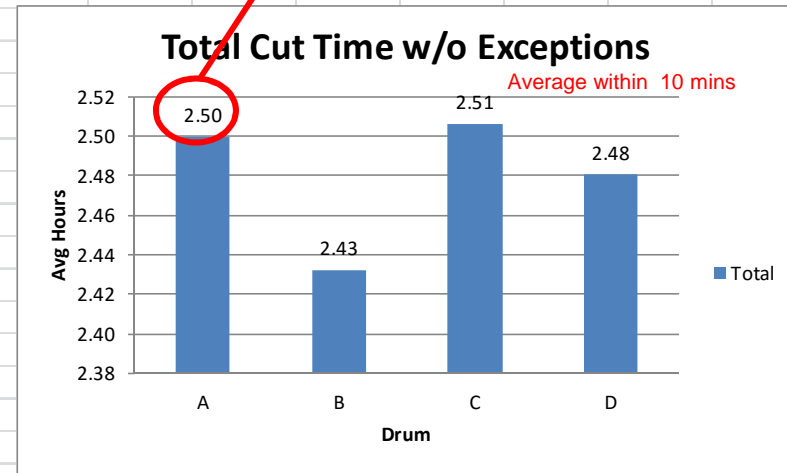
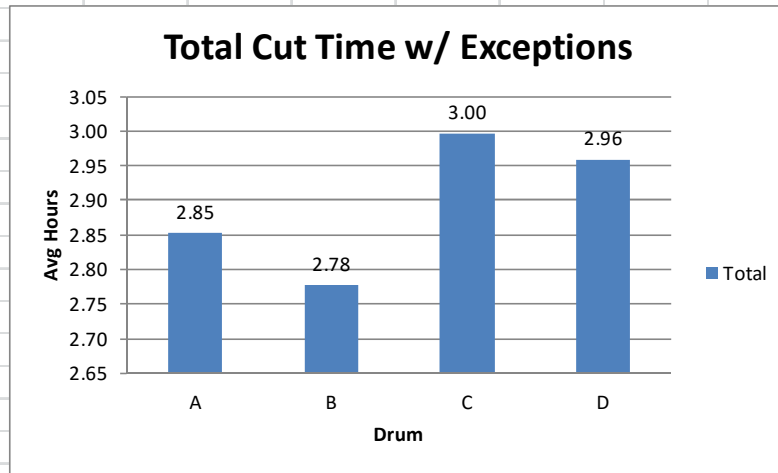


- Comparison of drum cutting data over an 8 month period
- Data was exported into Excel for analysis
- Number of cuts the study represents:
 - Drum A = 138 cuts
 - Drum B = 136 cuts
 - Drum C = 143 cuts
 - Drum D = 143 cuts
 - Total = 560 cuts
- Statistics reviewed by cutting segments & total cut
 - Average cut time (with & without exceptions)
 - Average delay time (with & without exceptions)
 - Standard deviations (cut & delay)
 - Median time (cut & delay)
 - Maximum time (cut & delay)
 - Minimum time (cut & delay)

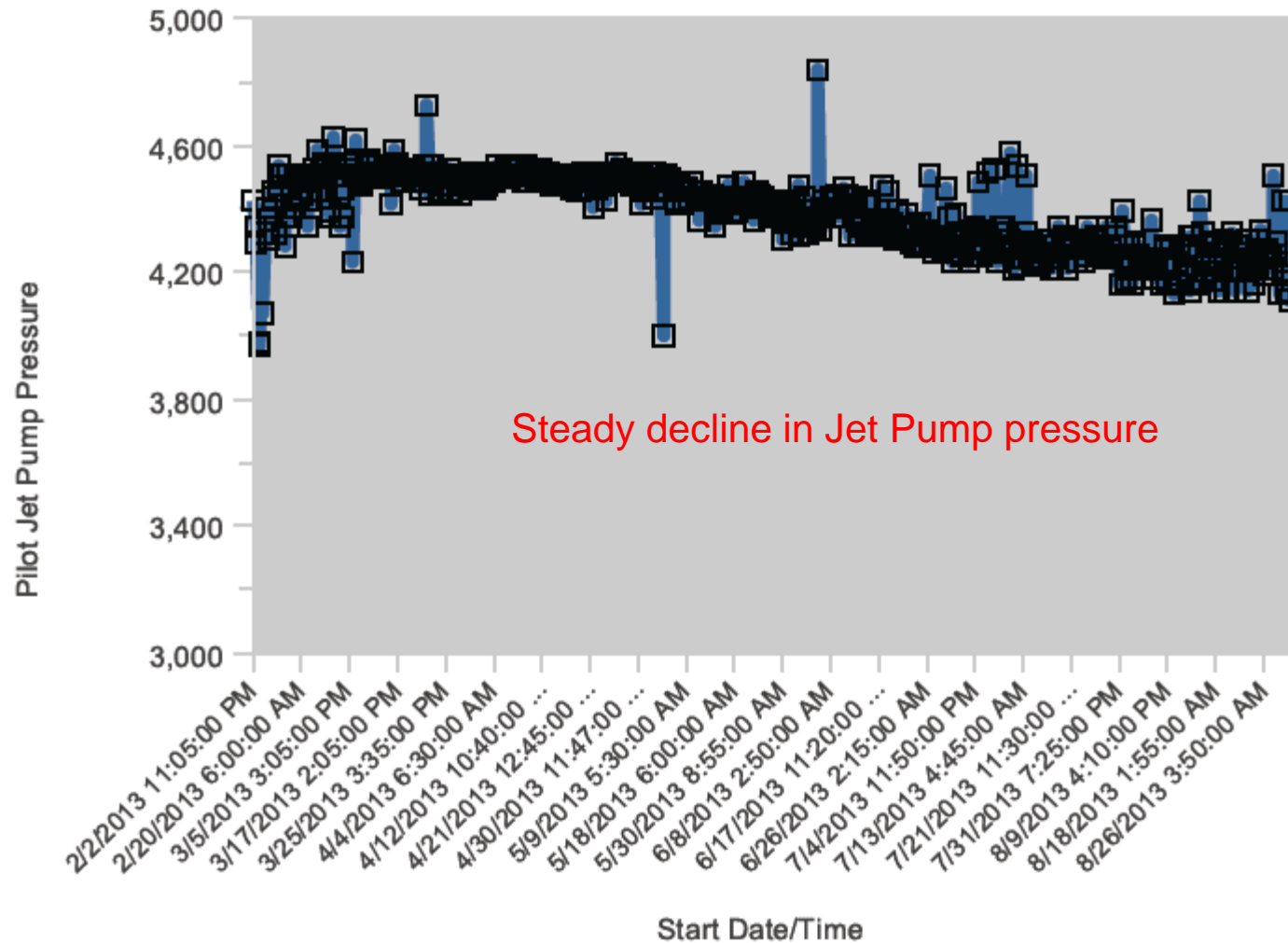
Data Analysis – Total Cut



Average Time (Hours)



Data Analysis – Pilot Jet Pump



Data Analysis – Decoke Jet Pump

