Key Energy Variable (KEV) Console Monitoring

Martine McDonald
Process Engineer
ExxonMobil
Texas Technology Showcase
December 7, 2006

ExxonMobil Chemical

Overview

ExxonMobil Chemical

- What is a KEV?
- KEV Development Process
- Baytown Chemical Plant Results
- Questions

What is a KEV?

ExxonMobil Chemical

- KEV = Key Energy Variable
  - Process variables that influence:
    - Energy consumption
    - Recovery
    - Capacity
  - Direct “handles” that can be acted on at console level

- NOT KEVs:
  - Feed composition
    - Not directly controlled by console in most cases
  - Furnace efficiency
    - Not a direct “handle”
    - Excess O_2, draft pressure, etc would be the KEVs
  - Total 150# steam flow to unit
    - Not a direct “handle”
    - Say tower reboiler is a 150# consumer
      - tower reflux, pressure, tray temps = potential KEVs

KEV Development Process

ExxonMobil Chemical

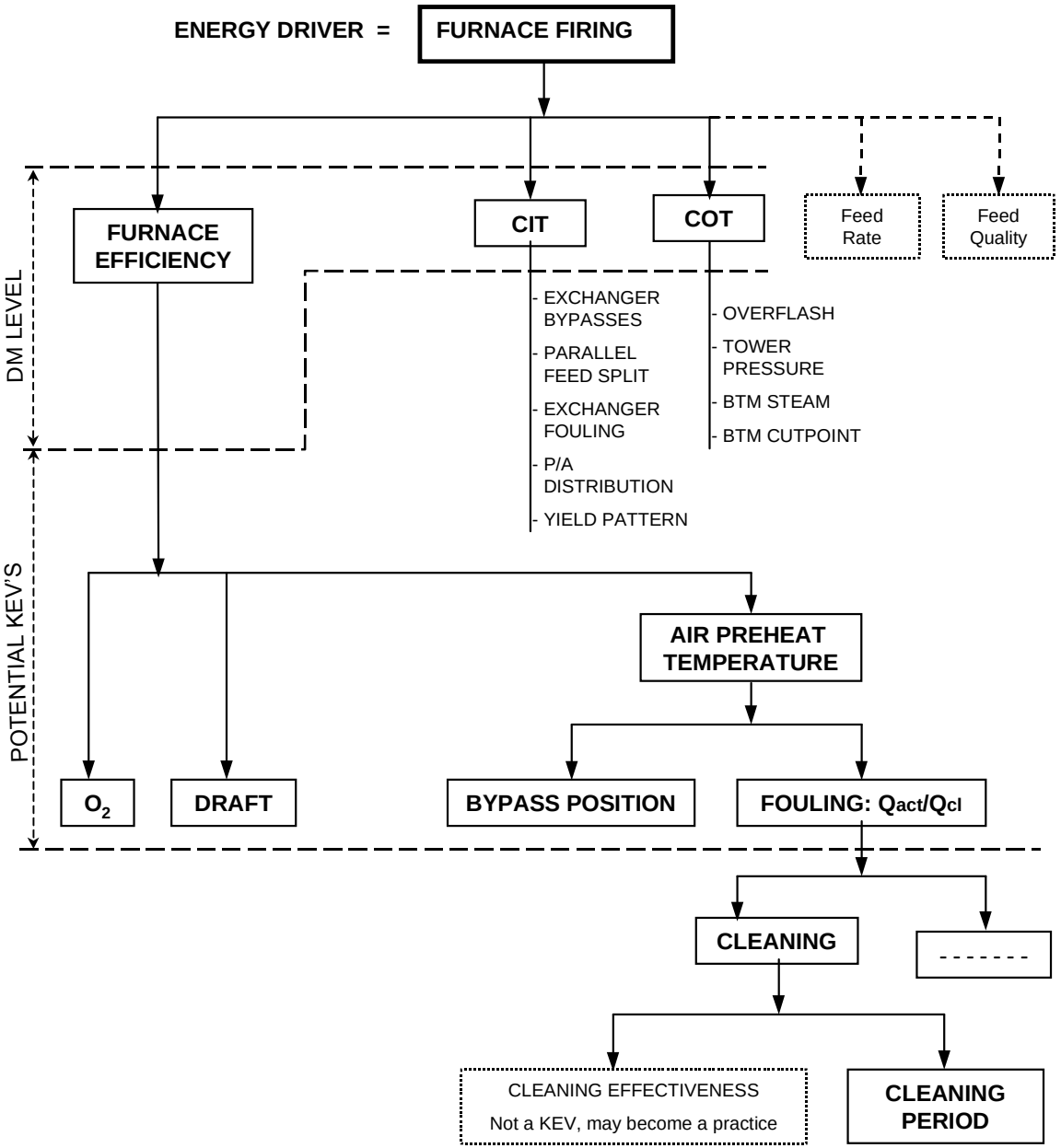
- STEP 1: Identify potential KEVs
- STEP 2: Define KEV targets
- STEP 3: Define KEV implementation incentives
- STEP 4: If sufficient incentive, define KEV attributes
- STEP 5: Select the KEVs to be implemented
- STEP 6: Implement KEVs

STEP 1: Identify potential KEVs

ExxonMobil Chemical

- **Materials**
  - Process flow diagram
  - Heat and material balance
  - Computer control applications list
- **Participants**
  - Unit lead engineer
  - Unit contact engineer
  - Applications engineer
  - Senior process console operator
- **Develop Influence Diagrams**
  1. Review PFD and H&MB to identify main unit energy drivers
  2. Ask for each energy driver:
     - *What directly influences it?*
     - *What directly defines it?*
  3. Continue until variable on console level reached (= Handle)
  4. Repeat for other strong influences
  5. Repeat for other high-impact energy drivers

Example Influence Diagram



STEP 2: Define KEV targets

ExxonMobil Chemical

- Utilize:
  - Unit simulation
  - Plant test data
  - Industry benchmarks (i.e. furnace excess O_2)
- Consider:
  - Economic tradeoffs
    - Net energy consumption
    - Margin credits
    - Operating costs
    - Effect on downstream units
  - Unit constraints
    - Safety
    - Reliability
    - Capacity

STEP 3: Define Incentive

ExxonMobil Chemical

- Incentive
  - Average deviation between target and actual past daily averages
  - Translate into lost opportunity
    - Define incremental energy consumption
    - Use actual cost per unit of energy
- Decide what incentive amount is sufficient
  - Consider 80/20 principle
  - If incentive too low, put the KEV on a back-up list

STEP 4: Define KEV attributes

ExxonMobil Chemical

- Description
  - Clearly identify variable
  - Explain its effect on energy and other unit objectives
- Incentive
  - Quantify net energy impact resulting from the KEV being off target
- Handle
- Lost opportunity calculation
- Instrumentation required to measure and control KEV
- Constraints to KEV target
  - Use as reference when considering future target mods
- Minimum Frequency of KEV monitoring
  - Consider the magnitude of the KEV impact
- Target
  - If target varies, specify frequency for updating target
- Console Instructions
  - Concise instructions how to control to the target
  - Should enable console to act without engineer assistance/approval

STEP 5: Select KEVs to be implemented

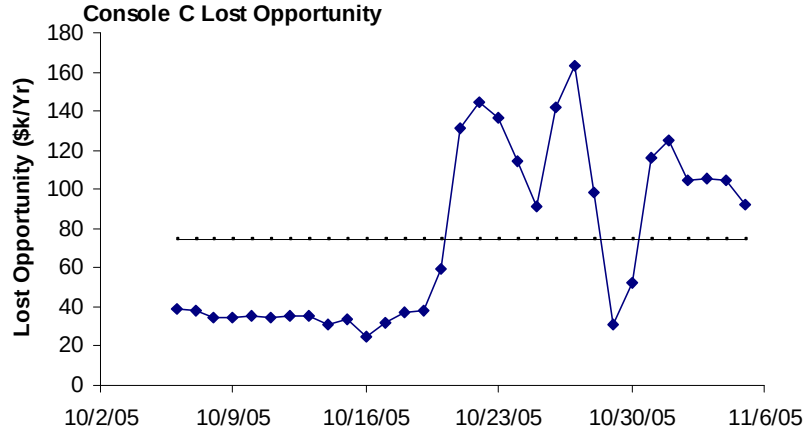
ExxonMobil Chemical

- Only include variables that have all attributes properly defined
  - If attributes missing, identify additional work/investment required
- Prepare summary list for cost/benefit analysis
  - For each KEV:
    - Show incentive
    - Show required actions & investment

STEP 6: Implement KEVs

ExxonMobil Chemical

- Daily Monitoring Sheet
  - Automatically prints each morning at control center
  - Reviewed at daily morning operations meeting
  - Intended for console operator optimization
  - Includes only variables with Lost Opportunity > set threshold
  - Lists Variable and Lost Opportunity for last 3 days
  - Sorts KEVs:
    - By console
    - From most to least Lost Opportunity
  - Excel template allows for easy addition of new KEVs



Console C Opportunities

KEV Title	Unit	UOM	Min Target	Max Target	Today - 3D	Today - 2D	Today - 1D	Today	Today's LO ($/Yr)
Wash Water	LXU	GPM	-----	85.0	93.3	93.0	91.3	88.5	$28,828

Not actual plant data. Illustration only.

STEP 6: Implement KEVs

ExxonMobil Chemical

- Weekly Monitoring Sheet
  - Generated by energy coordinator
  - Reviewed at weekly technical team meetings
  - Intended for engineer optimization
  - Includes all Lost Opportunity, sorted by priority
  - Lists Variable and Lost Opportunity for last 3 days
  - Sorts KEVs:
    - From most to least Lost Opportunity
  - Excel template allows for easy addition of new KEVs

KEV Title	Console	Unit	UOM	Min Target	Max Target	Today - 3D	Today - 2D	Today - 1D	Today	Today - 7D LO ($/wk)	Today's LO ($/D)
T-466 Btms Temp	C	LXU	deg F	-----	217.00	222.90	223.29	222.89	222.76	$2,771.7	$399.6
Wash Water	C	LXU	GPM	-----	85.00	93.30	93.00	91.30	88.50	$554.4	$79.4
F-9C O2	B	Post	vol%	-----	2.00	3.75	4.25	3.55	3.62	$334.8	$47.3
150# Steam	A	MCU	klb/hr	-----	0.00	0.00	0.00	0.55	4.29	$298.8	$0.0
F555 Draft Pressure	A	PDU	inH2O	-----	-0.10	-0.25	-0.45	-0.43	-0.39	$256.0	$35.3

Not actual plant data. Illustration only.

Baytown Chemical Plant Results

ExxonMobil Chemical

- Cost
  - KEV development duration 2 months
  - Installation and implementation 1 month
  - Used existing spreadsheet and process data collection tools
  - Negligible investment required
- Savings
  - 0.6% annualized energy savings per production unit
  - 113,000 MMBtu/yr total energy savings
  - 6547 tpy net greenhouse gas reduction realized
- Other benefits:
  - Created ownership of energy efficiency at operator level
  - Saved engineer time/resources
  - Allowed for increased frequency of energy monitoring

Questions?

ExxonMobil Chemical