

# NACE 2005 Coated Bundle Presentation

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 **Gulf Coast Refinery**

 **4/4/2005**

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# Water Cooled Exchangers

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- 420M BBL / Day refinery
- 768 total bundles in water service
- 317 brass
- 209 carbon steel have been coated
- 131 carbon steel still bare
- 55 alloyed up to 2205 material
- 28 - 304 or 316ss
- 28 - 70/30 Cu Ni

# Cooling Water Coated Carbon Steel Bundle Performance Update

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**Uncoated**



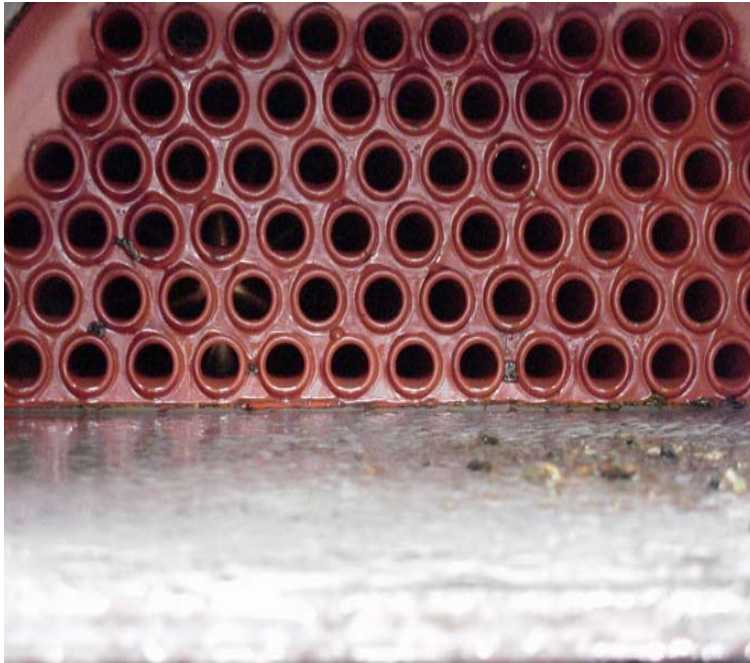
**Coated**



# Cooling Water Bundle Upgrade Program

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- C111A coated 8 months service
- C109A bare 8 months service



ALCOH 11/2000 – 3 years after clarifier start up



# Cooling Water Bundle Coating Priorities

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- Carbon steel coolers with high shell inlet temperatures – severe fouling & short life
- Bad actor bundles were targeted 1<sup>st</sup> - this has reduced fouling and process leaks due to tube side corrosion. Less hydrocarbons in the water makes the chemical treatment program more controllable
- Main reason for upgrades have been due to under deposit corrosion & fouling to c steel and MIC or ammonia corrosion to brass.



# Cooling Water Bundle Performance

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**The 209 bundles have been upgraded – mostly from bare carbon steel or brass**

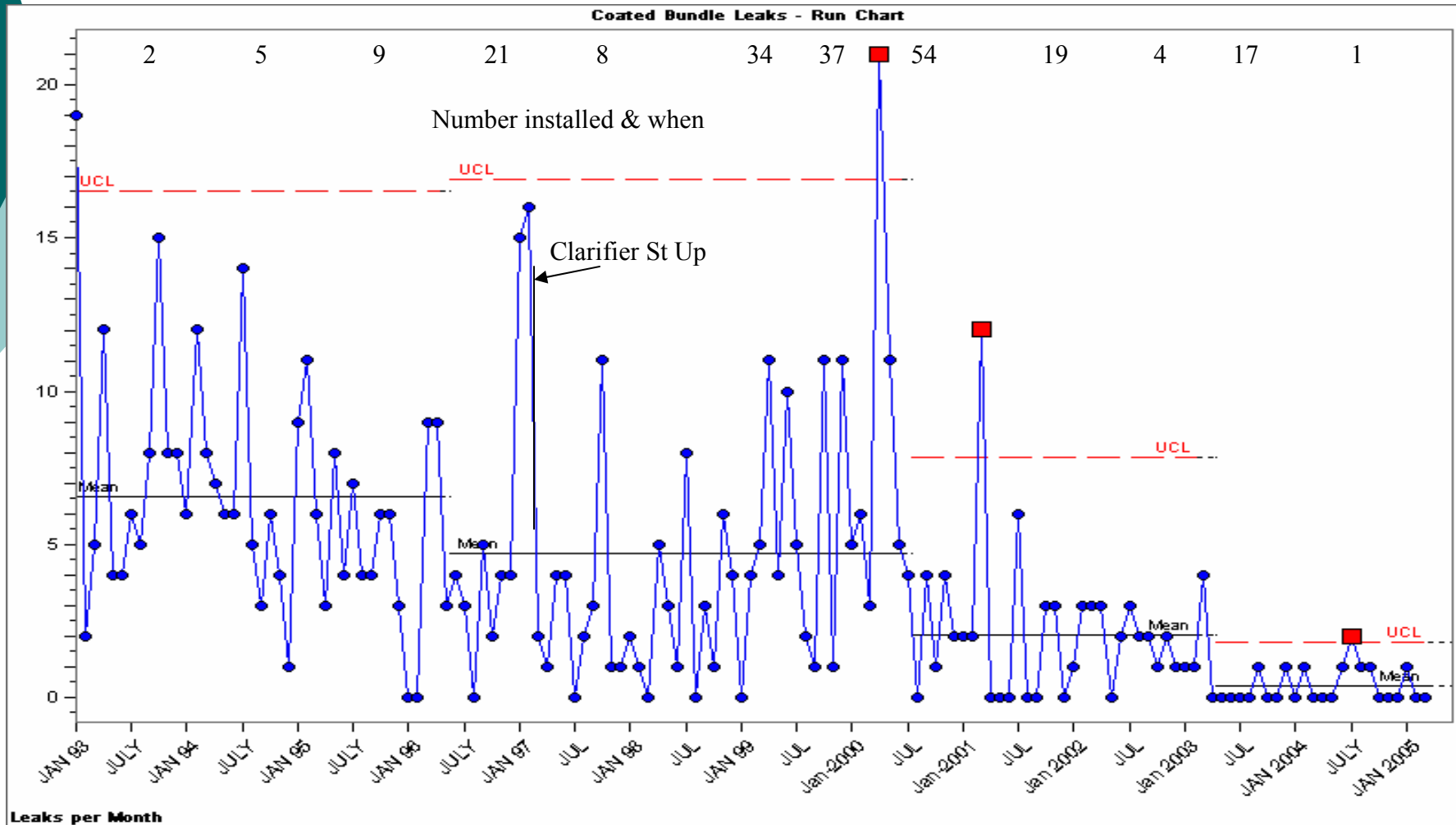
**The leaks per month on these 209 bundles have gone from 6.5 to 0.5 per month**

**The Mean Time Between Leaks on these 209 bundles has gone from 2.5 service years to 15+ service years since being coated**

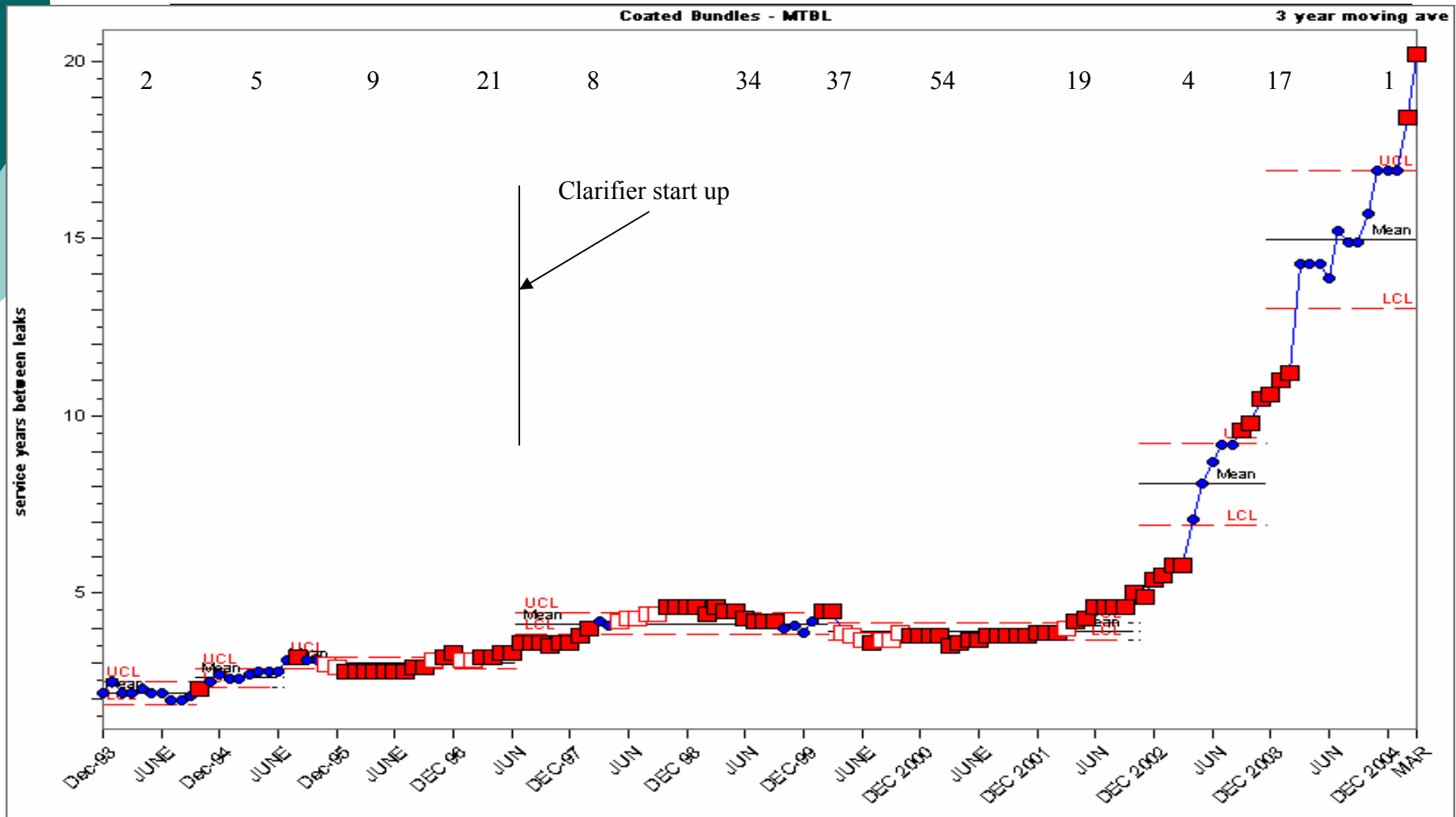
**Outages for cleaning or repairs these 209 bundles went from 14 per month down to 4 per month**

**The mean time between outages for cleaning or leaks went from 1.3 service years to 4+ service years**

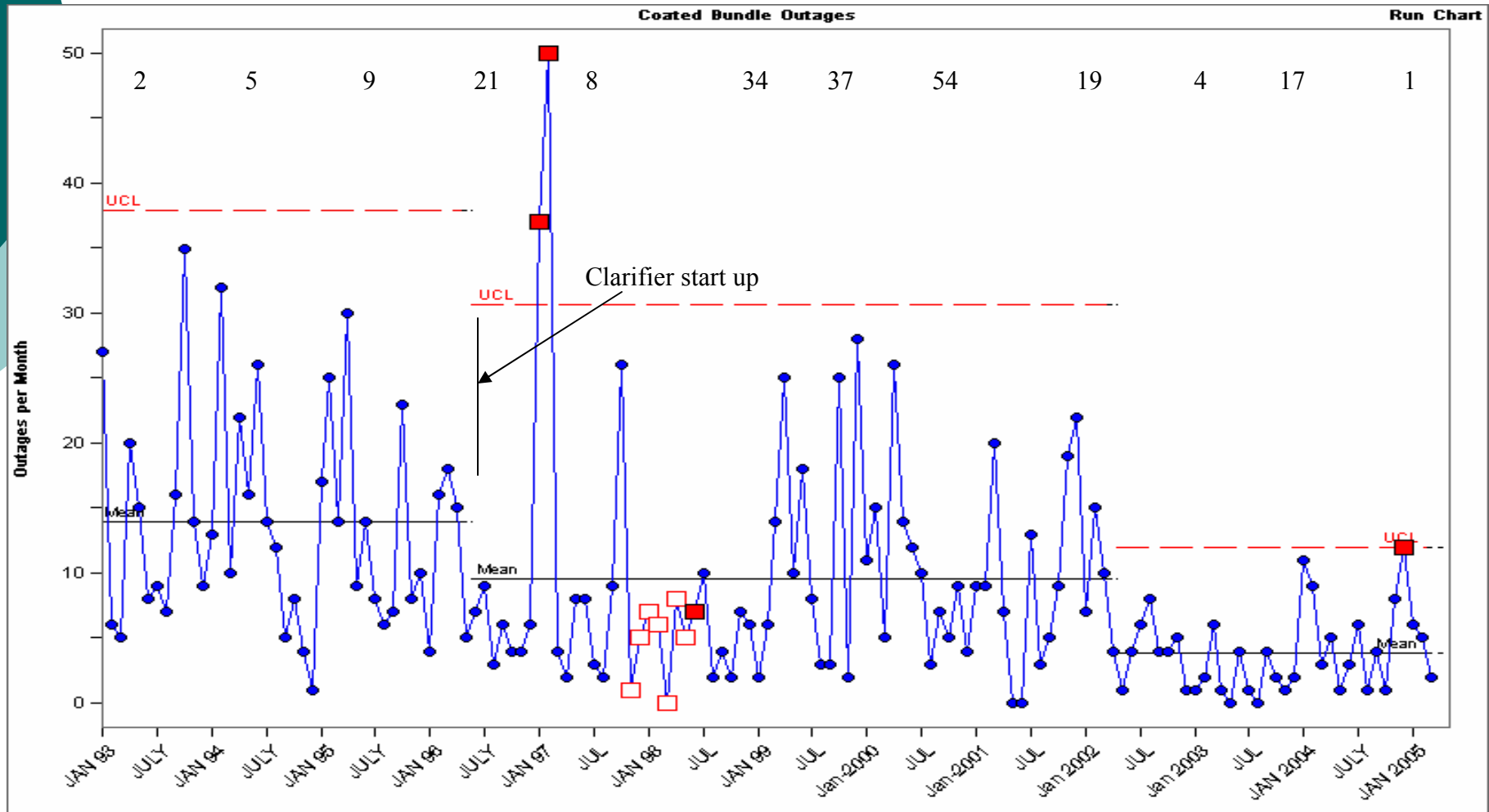
# Cooling Water Coated Steel Bundle Leak Run Chart



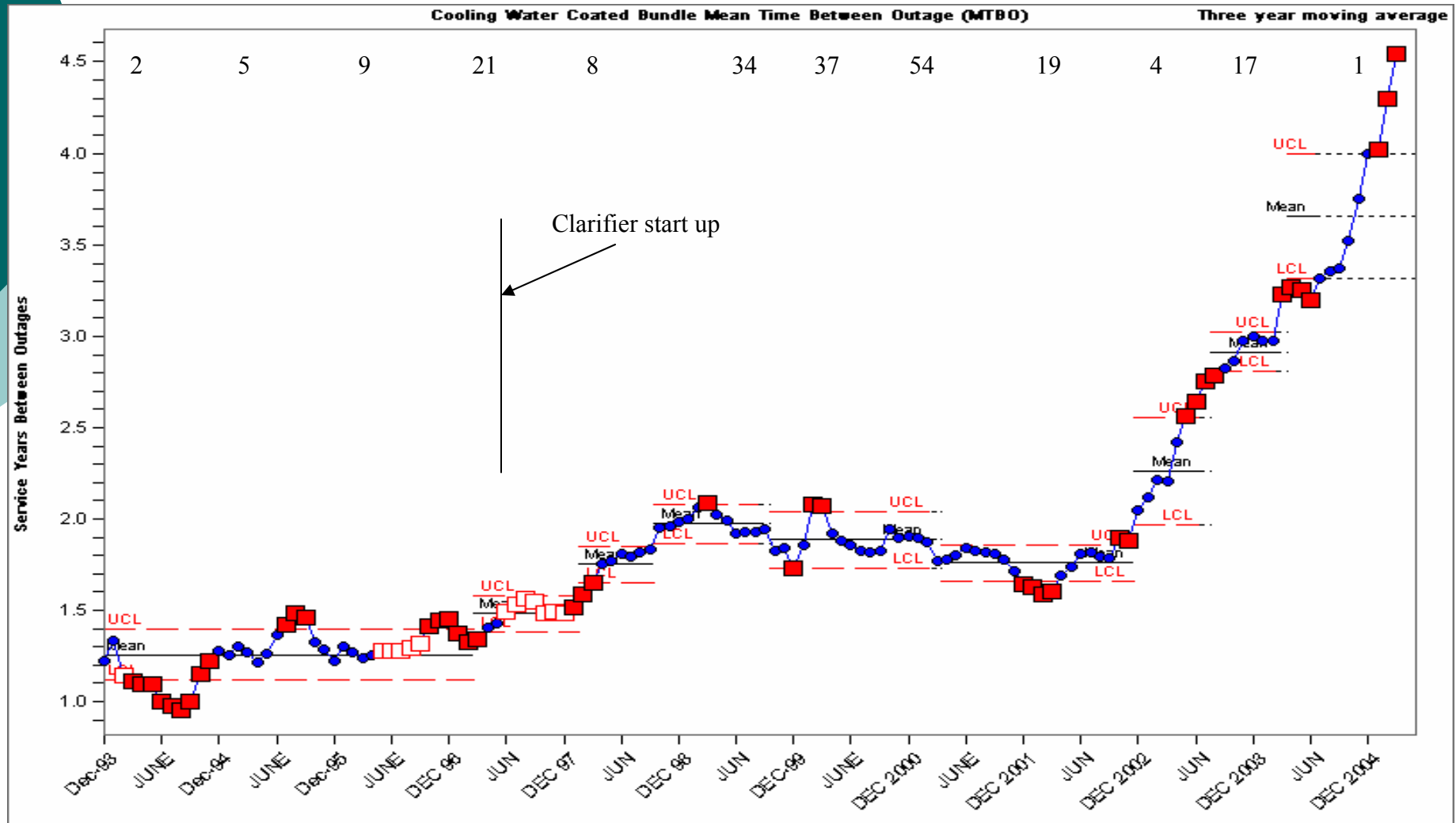
### **service years between leaks**



# Coated Cooling Water Bundle Outage Run Chart



# Coated Cooling Water Bundle Outage MTBO Chart



# Coated Cooling Water Bundle Savings

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This is a savings of 120 fewer outages & 72 fewer repairs / year

- Outage Cost \$5K/bdl for an outage = \$600,000 per year
- Repair/replacement cost \$20K/bdl = \$1,440,000 per year
- total of \$2,040,000 savings per year.
- This does not include the savings from repeated bundle retubes which would probably be another \$500,000



# Coated Bundle Issues

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- Bad News 1<sup>st</sup>
- Low Water Flow
- Coating Selection – Shell side temp
- Throttling valves by operations – more heat
- Debris from Cooling twr
- SS Coated – tough to get adhesion
- Mechanical handling – not used to being careful
- Roll leaks – baking out oils & curing coating



# Coated Bundle Issues – Pushed the Envelope

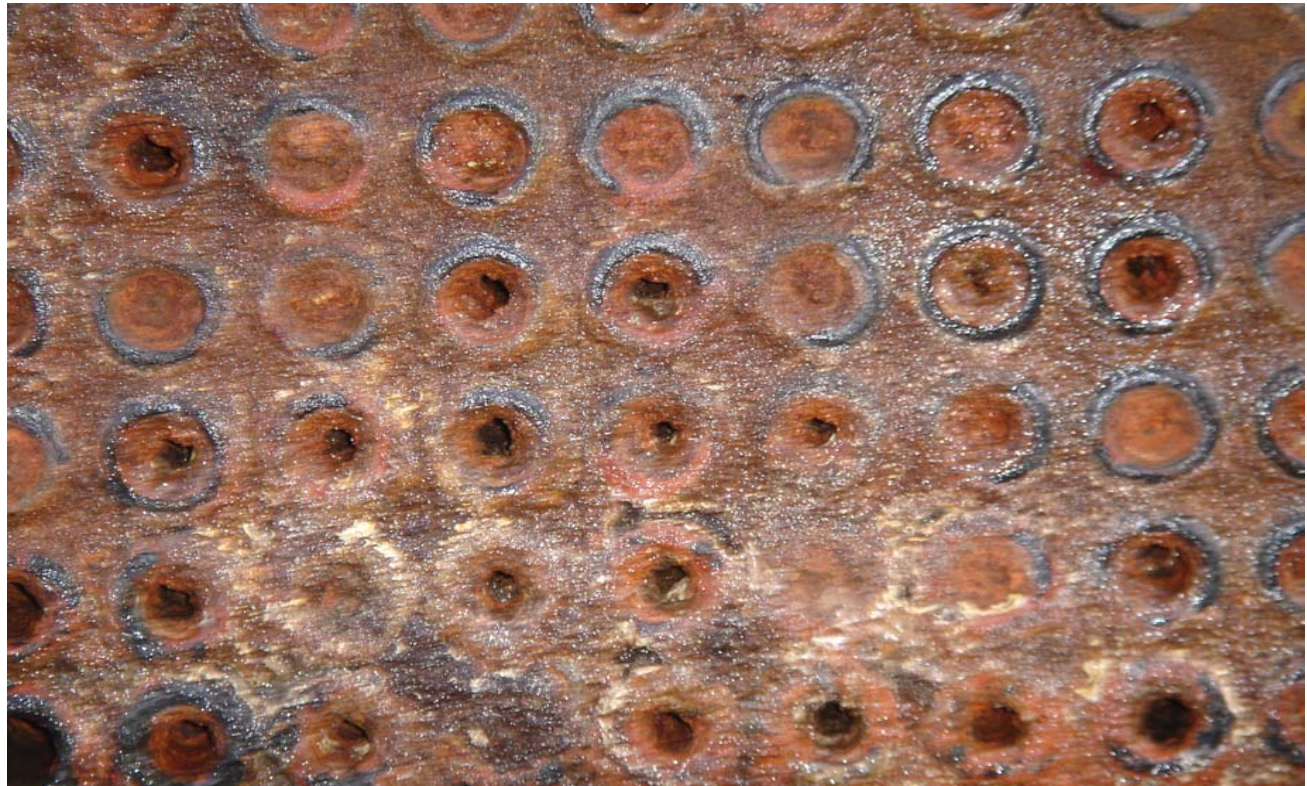
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- 59 coated bdl's are operating over 250F on the shell side - 37 are above 300F
- Low water flow, debris plugging tube inlet cause overheating and coating failure.
- Handling of the bundles – mechanical damage pushing the bundles in the shell – need to use padded pusher
- Shell side inlet temp above 250F – debris from cooling towers – rocks & wood chips – scales up some tubes
- Working on towers and no screens – need more frequent backwash
- Low water flow & high shell side inlet temperatures

# Coating Cannot Perform Miracles

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**350-400F Inlet on the Shell side with very low water flow – 2 yrs operation**



# Coated Bundles - Leaks

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- **20 of the 209 coated bundles have had a total of 41 leaks since starting to use them in 1994**
  - **4 bundles - C52's - were old bundles coated in place – fixed TS – tried to extend their life – old pits were too deep didn't get a good surface preparation**
  - **1 bdl 311C230 – sulfolane – coating had a pin hole in it.**
    - **Went to 100% holiday checking.**
  - **1 bundle was 316ss and the coating did not stick – Chemetics cooler**
  - **2 bundles were too hot so we tried a special Teflon coating – it did not stick to the tubes – we are not using this coating at present**
  - **2 bundles leaked due to OD corrosion – never lasted long enough before to corrode from the OD – need alloy**
  - **8 bundles damaged due to overheating**
  - **2 bundles – unknown reason – plugged & ran**

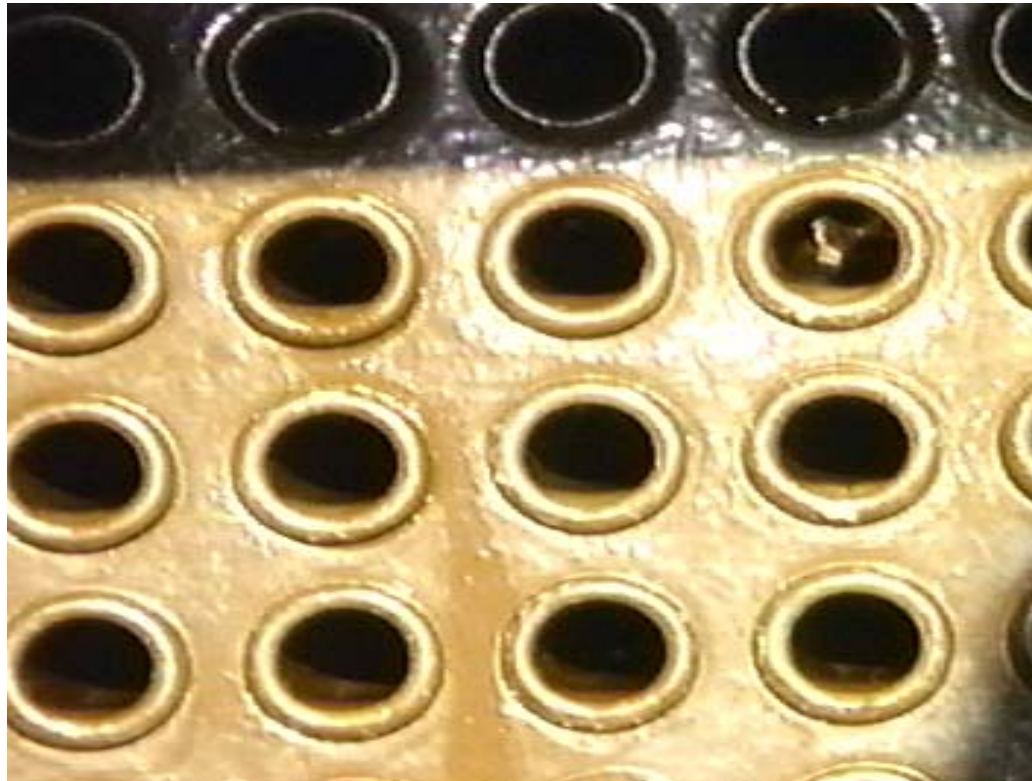
# Cooling Water Bundle Upgrade Program

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- Case Study #1
- BLCOH C-10 Stabilizer OVHD Cooler
- Before coating - 6 months between cleanings – 2 Unit shutdowns w/ duration of 4 days @ \$20M/day – Total production + Maint cost = loss of \$190M/year
- New coated bundle installed in '95 – initial cost \$25M
- 2 month payout
- Since '95 the bundle has worked flawlessly. No unscheduled outages. The only cleaning required during catalyst change-outs is washing cooling tower debris off with water hose. Inlet process temperature is 375-390 degF.

# Cooling Water Bundle Upgrade Program

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C-10 @ BLCOH - WATER OUTLET {HOT} PASS - UNCLEANNED  
NOTE THE LACK OF TUBE ID DEPOSITS  
WITH CARBON STEEL THESE TUBES WOULD BE PLUGGED SOLID

\*\* THE DEBRIS IN THE UPPER RIGHT TUBE IS PLASTIC FROM THE  
COOLING TOWER WORK

# Cooling Water Bundle Upgrade Program

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- **Case Study #2**
- **C-4 Recovery – C-23 Feed Flash Condensers, C-151 Deethanizer OVHD Condensers, C-53 Ammonia Condensers**
- **'90-96 these exchangers (combined) averaged 10 outages per year for either cleaning or leak repair. These bundles would foul and slowly cut the Cats back due to high front end pressure @ C-4.**
- **Each outage averaged 4 days.**
- **Production loss during the outages would be 10M barrels per day – about \$20M/day**
- **Over that time, this was a production loss of \$4.8MM and maintenance cost of \$1MM – Total loss of \$5.8MM+**
- **Loss per year – about \$1MM**



# Cooling Water Bundle Upgrade Program

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- Case Study #2 continued
- Cost to build new coated bundles = \$1MM
- One year payout
- Since installing coated bundles on these exchanger banks, there have been NO outages for cleanings and NO outages for tube leaks.
- The bundles do not foul and do not cause Cat Cracker production cut backs.

# Cooling Water Bundle Upgrade Program

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- **Case Study #3**
- **C-4-319C175's – EWR 366 – 2 banks of 2 exchangers**
- **Admiralty bundles failing due to MIC corrosion. 1-3 leaks per year.**
- **Cost per outage as high as \$650M due to maintenance (\$50M) and production loss (\$600M).**
- **EWR to replace w/ Saekaphen coated carbon steel. One-third cheaper than brass. CS can handle process side corrosion better and coating on water side keeps bundle clean.**
- **EWR life cycle cost savings in order of \$3MM.**
- **5 year run complete – no leaks to date. One cleaning done on one bank due to slime buildup (cooling tower upset) 6 months after start-up. No cleaning required or loss of capacity since that outage.**



# Cooling Water Bundle Upgrade Program

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- **Bottom Line – Coated Bundles can save you BIG \$\$ - Maintenance & Production**
- **Cost is 25-50% cheaper than alloy upgrading over the life of the bundle**