

# Ultrasonic Cleaning

# STRONGER TOGETHER

# Ultrasonic Chemical Cleaning

Ultrasonic Cleaning is a combination technique that uses both chemical and mechanical techniques to effectively remove stuck-on foulant from heat exchangers and parts.

Can be a stand-alone solution, but is often used in conjunction with high pressure water blasting techniques.



# Directed Technology

- Targeted Chemistries
  - Optimization of Surface Action for greater Ultrasonic Effect
  - Tailored to the Foulant for optimal removal
- Mechanical Action
  - Ultrasonic Transducer Technology delivers energy to the material surface, resulting in the formation of cavitation bubbles in the liquid





# How it Works

- Acoustic (Sound) Energy forms vacuum bubbles
- Bubbles form over the entire surface of the part
- Bubbles grow to a permitted size, and then collapse
- Upon collapses, a microjet is formed with a residual shockwave
  - Breaks up tough scales
  - pushes away sticky foulant
- Rapid change of the diffusion layer, increasing reaction rates limited by diffusion



[O. Supponen; P. Kobel ; M. Farhat \(2014\) Gallery of Fluid Motion \(aps.org\)](#)

# Ultrasonic Capabilities

## Heat Exchangers

- Two sides of a heat exchanger both contribute 50% to heat transfer
  - Reliable ways to clean the tube side (High-Pressure Lancing)
    - One to five tubes can be cleaned at a time
  - Shell side cleaning has traditionally been difficult (at the core)
- Ultrasonics can reach all interstitial areas of a bundle simultaneously
  - All tubes cleaned inside and outside
  - Every nook and cranny
  - Better shell side clean



## Parts Washing

- Degassing of valves and fittings for repair and reuse
- Treatment of Delicate parts
  - Demister pads, flame arrestors, filters
- Decontaminate scaffolding



# Safety and Process Improvement

## ▪ Safety

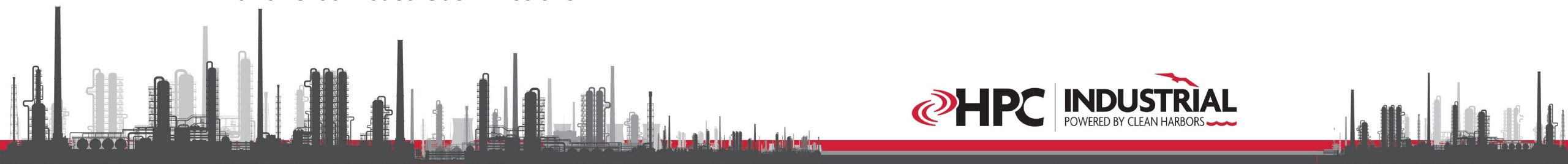
- Takes people out of the line of fire of HPWB
- Reduction of risk
- Engineered controls

## ▪ Sustainability

- Reduction of Water
  - *70-95% reduction in water consumed over HPWB alone*
  - *Water Recycling Services available to reduce wastewater production*
- Environmentally Friendly Chemistries
  - *Low-Toxicity blends can be treated by onsite API separators*
- Reduced Fuel Gas Consumption
  - *Lower Greenhouse Gas Emissions*

## ▪ Process Improvement

- Improved Heat Transfer Coefficient Rates
  - *Measurable results are evidenced once a heat exchanger is put back in service*
- Increased Volume Throughput
  - *Precision cleaning technique that returns optimal flow in heat exchanger systems*
- Extended Run-Time
  - *Eliminates Maintenance Pit Stops*
- No Re-Cleaning
  - *NDE ready the first time*





# Case Study - Water Conservation

## Scenario 1 –

Lightly Fouled Bundle, HPWB ONLY

- 5 Lance ID
  - 37GPM @ 20K (500HP)
  - 2 min/pass x 160 passes
  - Time To Complete – 320 min
  - 12,800 Gal Water Consumed
- Bundle Blaster
  - 80GPM @ 10K (500HP Pump)
  - Time To Complete – 240 minutes
  - 19,200 Gal Water Consumed
- Total Water Consumed = 32,000 Gal/bundle
- Time to Complete = 9.5 hours

## Scenario 2 –

Light to Moderate Fouled Bundle, U/S + HPWB

- Ultrasonic Dip – 2 hours
- 5 Lance ID
  - 37 GPM @ 10K (300HP)
  - 1 min/pass x 160 passes
  - Time To Complete – 160 min
  - 6,400 Gal Water Consumed
- Bundle Blaster
  - 50GPM @ 10K (300HP Pump)
  - Time To Complete – 60 minutes
  - 3,000 Gal Water Consumed
- Total Water Consumed = 9,400 Gal/bundle
- Time to Complete = 7 hours

## 20 bundles – Comparison

- Without Ultrasonics
  - 640,000 gal water consumed
  - 190 hour (8 days)
- With Ultrasonics
  - 188,000 gal water consumed
  - 140 hours (6 days)

## Savings

- 452,000 gal of water (70% water)
- 250 hours (2 days)

## Combined With Water Services

- Up To 95% Water Recycled Onsite

# Washpad Comparison

## Traditional Washpad Cleaning

- Additional costs beyond the HPWB quote
  - Crane & Riggers
  - Plant Personnel
  - Water Supply
  - Waste Disposal
  - Vac Trucks
  - Power & Fuel
  - Scaffold builders
- Schedule
  - Based on critical path items
  - Many bundles go back into service still fouled due to time constraints
- Total Labor Onsite
  - 15-20 people (incl. Riggers, Plant Personnel, etc.)
- Water Consumption onsite for 30-day TAR – 980,000 gallons

## Offsite Cleaning with Ultrasonics

- Offsite Cleaning Estimate includes Additional Costs
  - Transportation
- Schedule – timelines shortened
  - Simultaneous cleaning
  - More time on tools
  - Minimization of delays due to labor impacts
  - Minimization of weather delays
  - No recleaning (NDE ready)
- Total Labor Onsite
  - 3-5 people (incl. Logistics, Plant Personnel)
  - Elimination of risk
- Water Consumption onsite – 49,000 gallons
  - Steam on exchangers prior to pulling
  - 95% less water consumed

More Time  
on Tools

Elimination  
of Risk to  
personnel

95% less  
water



# Case Study – Twisted Tube<sup>®</sup> Hydrocracker Bundles

- June 2020 → Ultrasonic Cleaning of HC Reactor

## Tube Side Deposit

- Primarily Inorganic Metal Polysulfides (>75%)

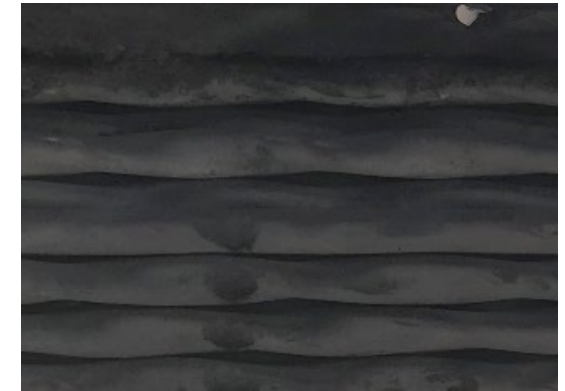
## Shell Side Scaling

- Primarily Organic Polyolefinic Hydrocarbons (35 – 65%)

Tube Side Service  
- Reactor Effluent



Shell Side Service  
- Reactor Feed



Case Study presented at HEFC 2022 in Salzburg, Austria

<https://heatexchanger-fouling.com/wp-content/uploads/2023/01/S11-1230-Thursday-Shank.pdf>

# Schedule Reduction

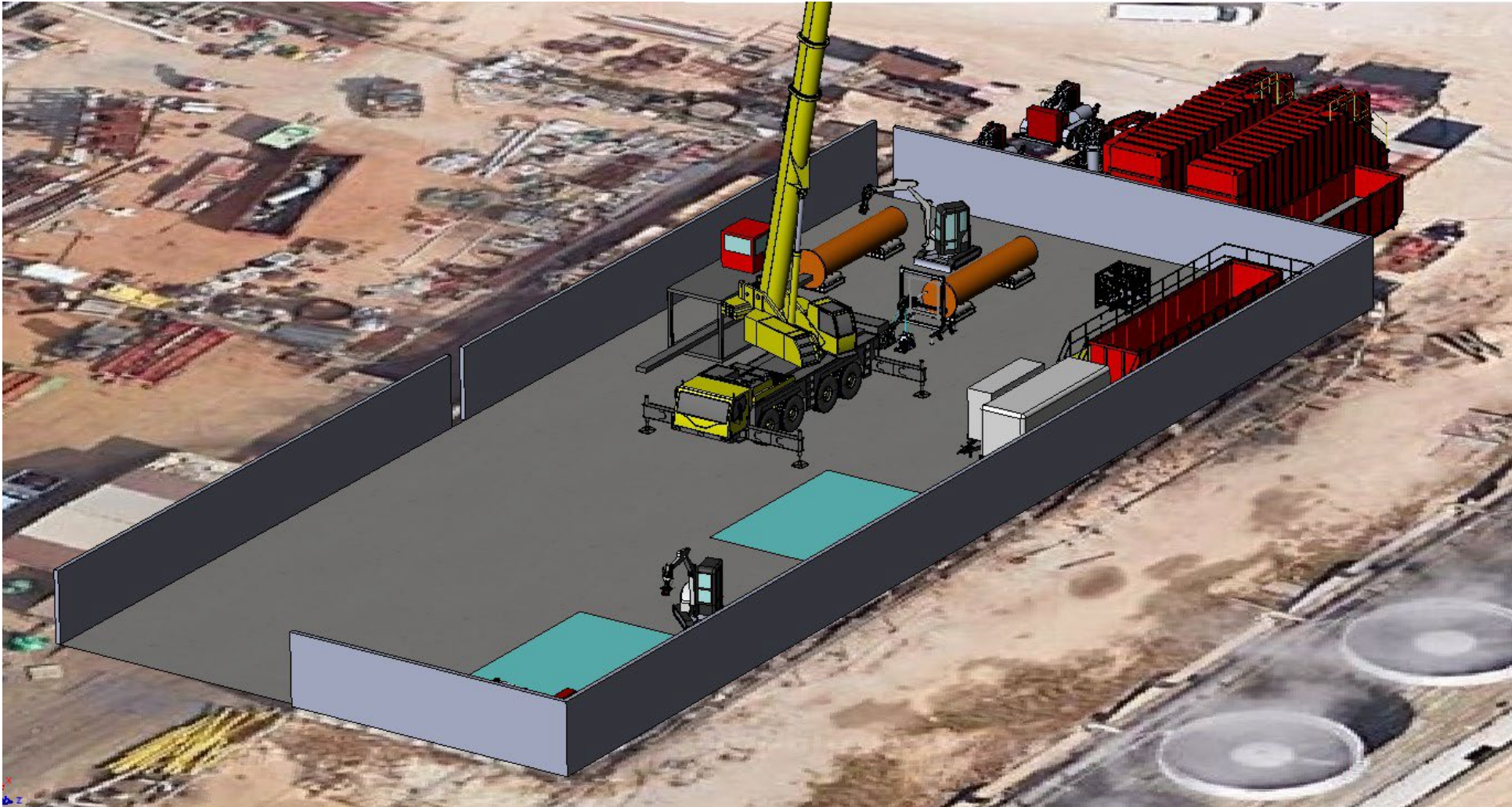
- Prior TAR – **Critical Path**
  - 4x Twisted Tube HC bundles were critical path for the unit
  - Pulled on day one, and resources spent hydroblasting for duration of outage
  - 21-day TAR – bundles returned to service in fouled condition
- 2020 TAR
  - Bundles were complete in 4 days
  - No tying up of resources



# Ultrasonic Cleaning Solutions



# On-Site Setup – TAR or Temporary Insite



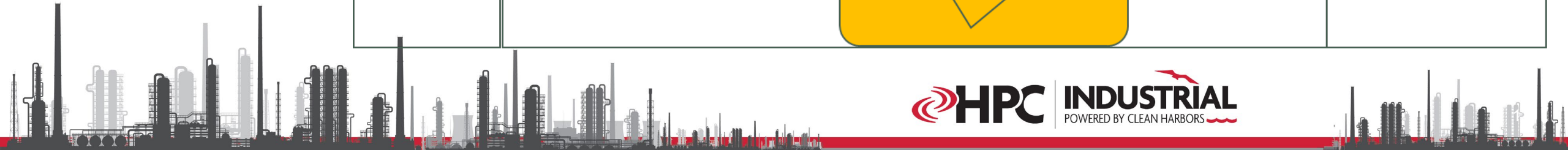
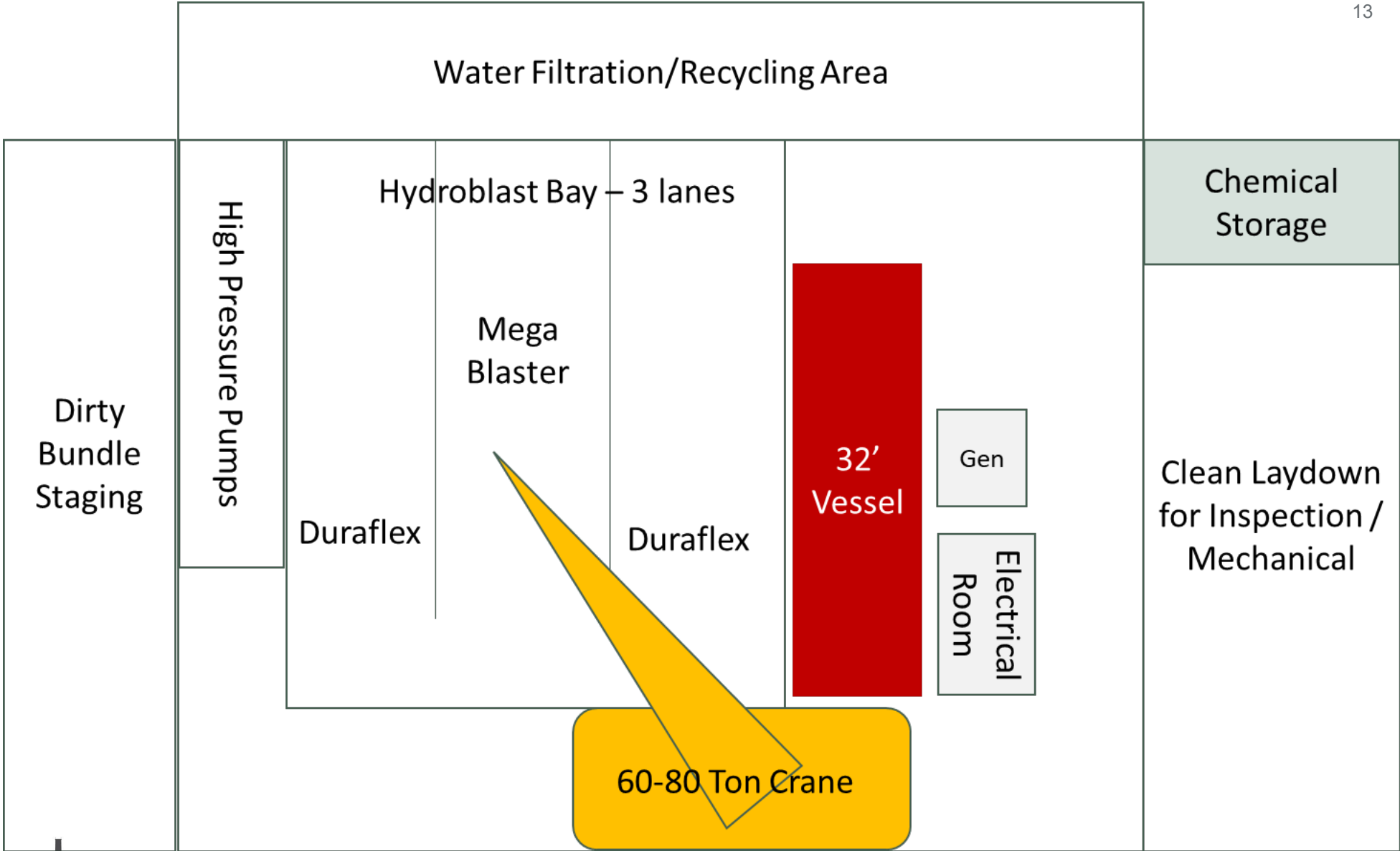
# Offsite Cleaning Facility – Temporary Setup

**Locations:**

East Chicago, IN  
Edmonton, AB

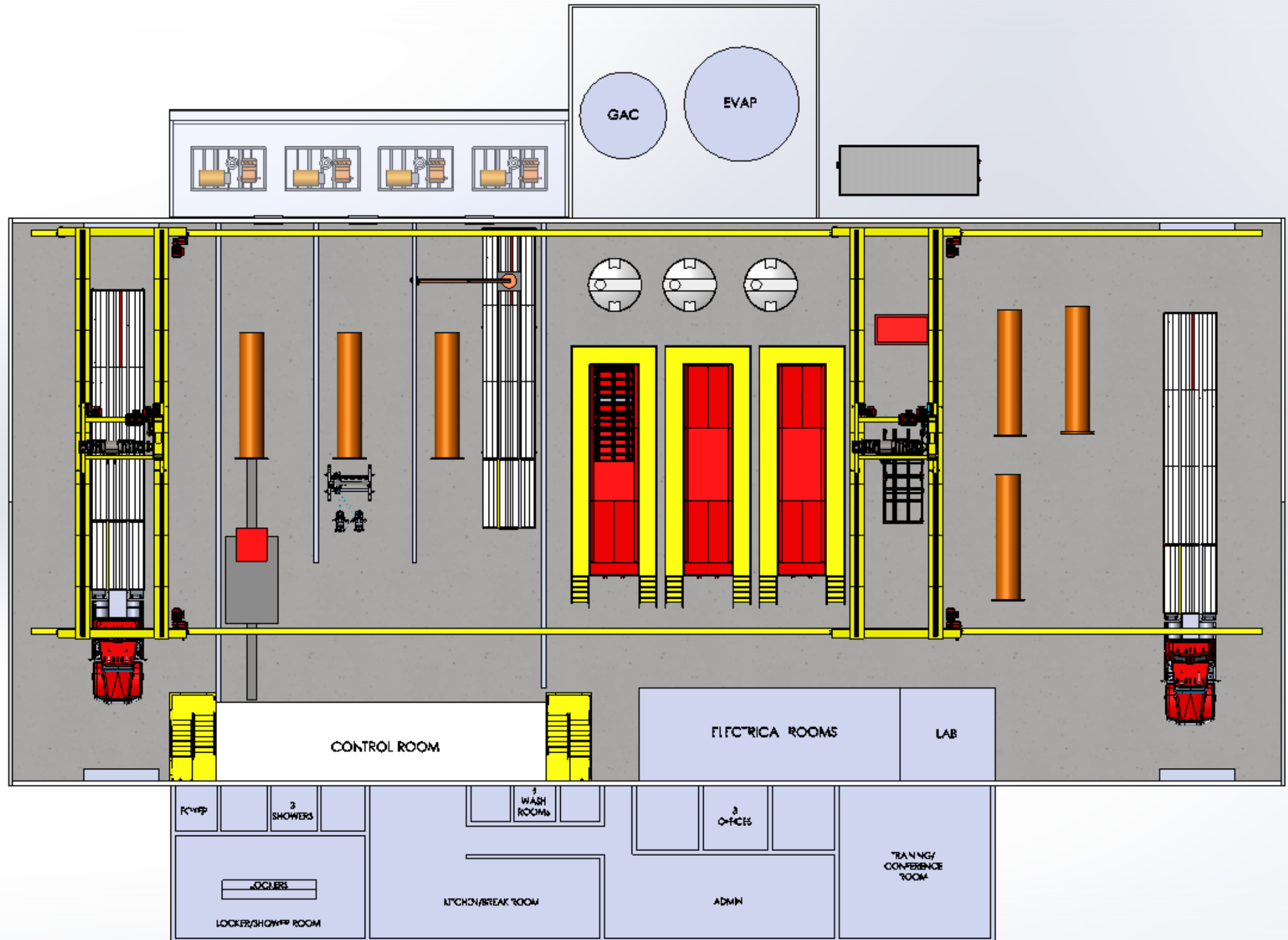
**Coming Soon:**

Baton Rouge, LA



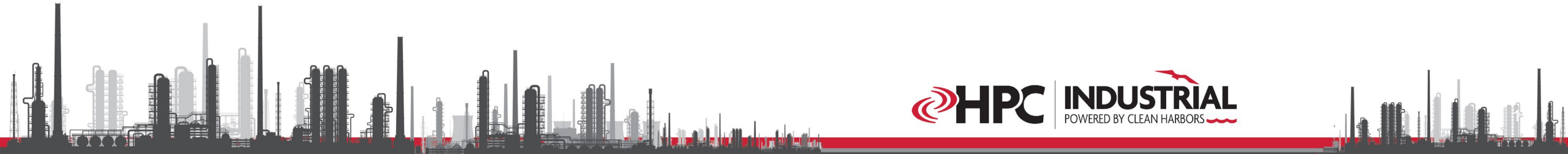
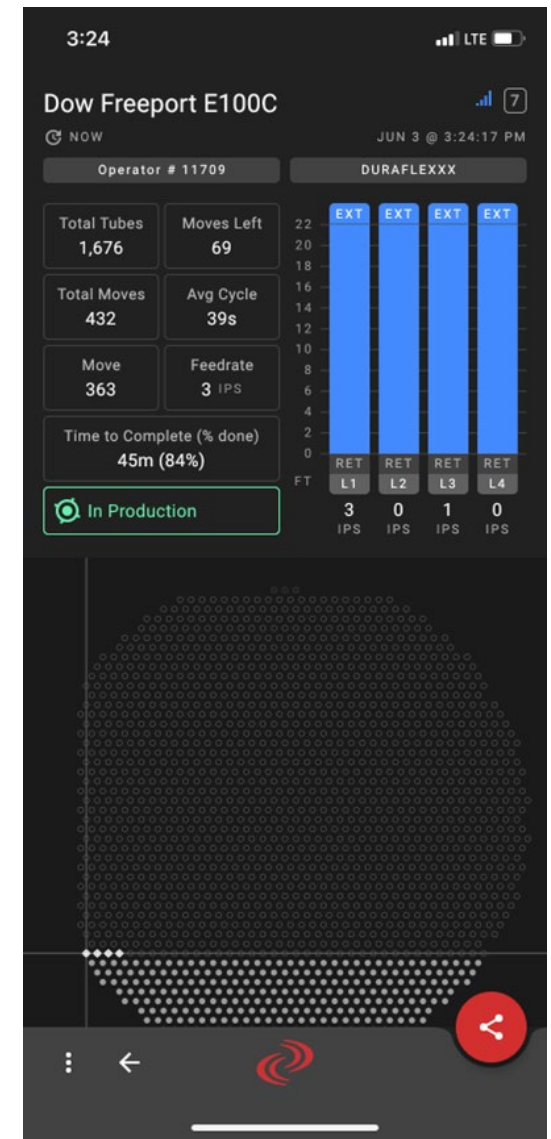
# Turnkey Offsite Cleaning Facility – Plan View

Coming Soon!

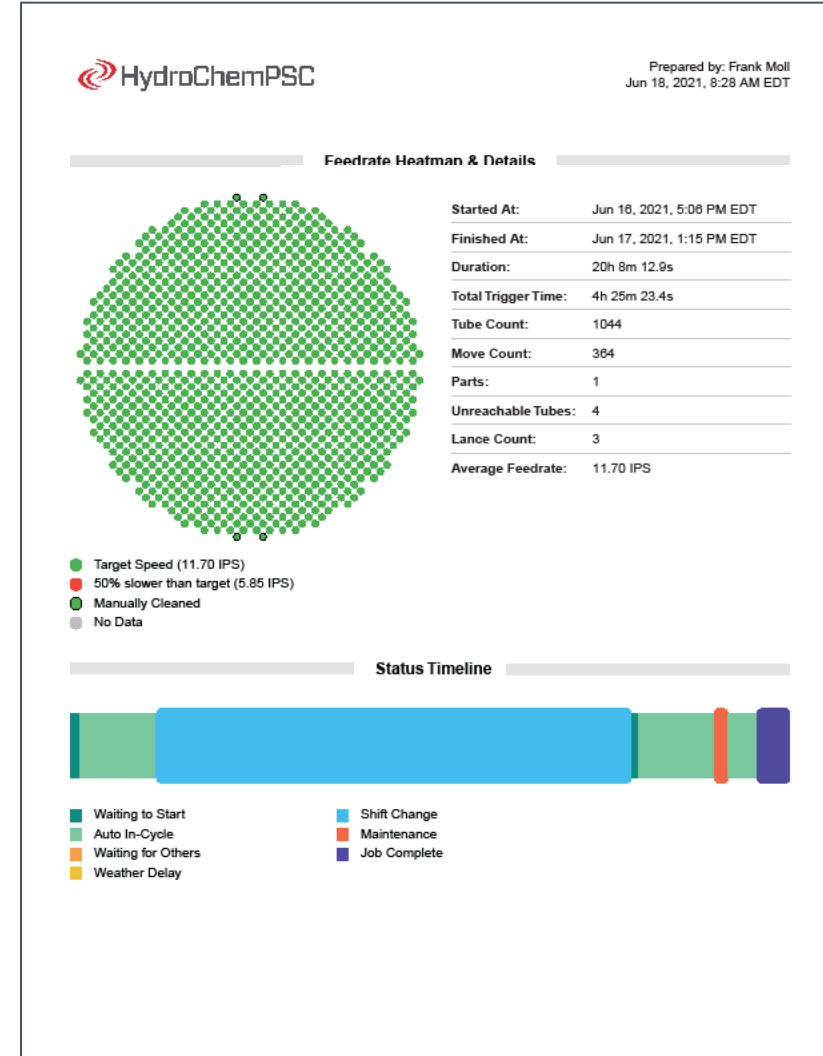
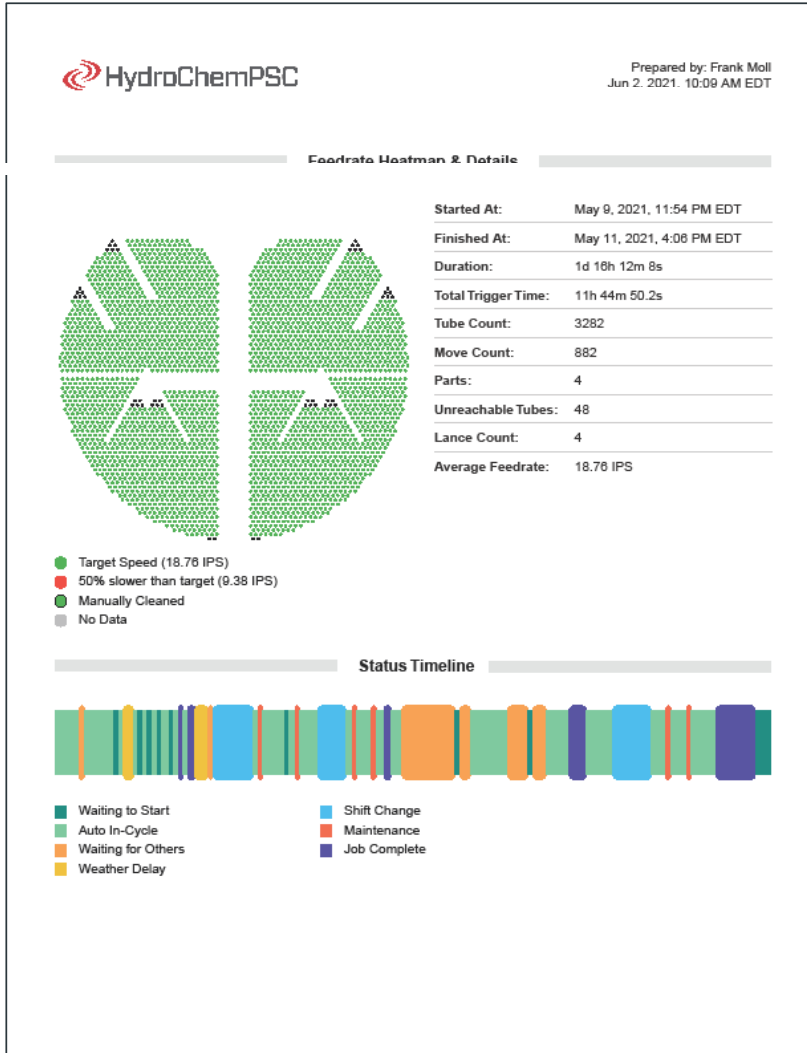




# Real Time Data



# Post Job Data

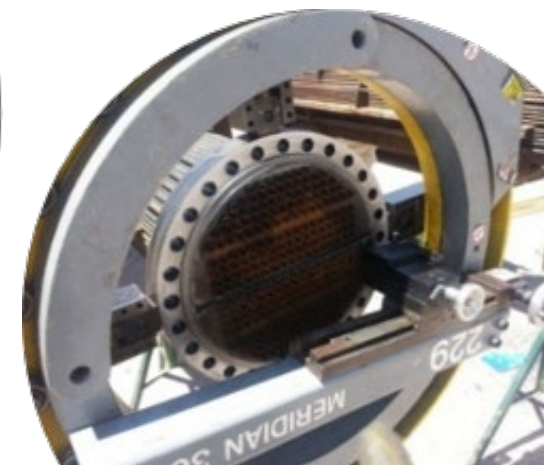




# Value-Added Proposition

## What Role can Specialty Mechanical Services (SMS) Support in this Opportunity

- **Un-Bolt** the exchanger and drop the head
- **Pull** bundle
- **Inspect** bundles, sealing surface, and shell
  - Client Inspection of shell and sealing surface (API 510 – Visual Inspection)
  - NDE contractor inspect tubes (Eddy Current Inspection)
- **Repair** sealing surface, shell, and tubes
- **Plug** blocked tubes
- **Re-tube** damaged or blocked tubes
- **Push** bundle back into exchanger shell
- **Hydrostatic testing** of the bundle
- **Bolt-Up** exchanger







# Questions?

**Roxanne Shank**

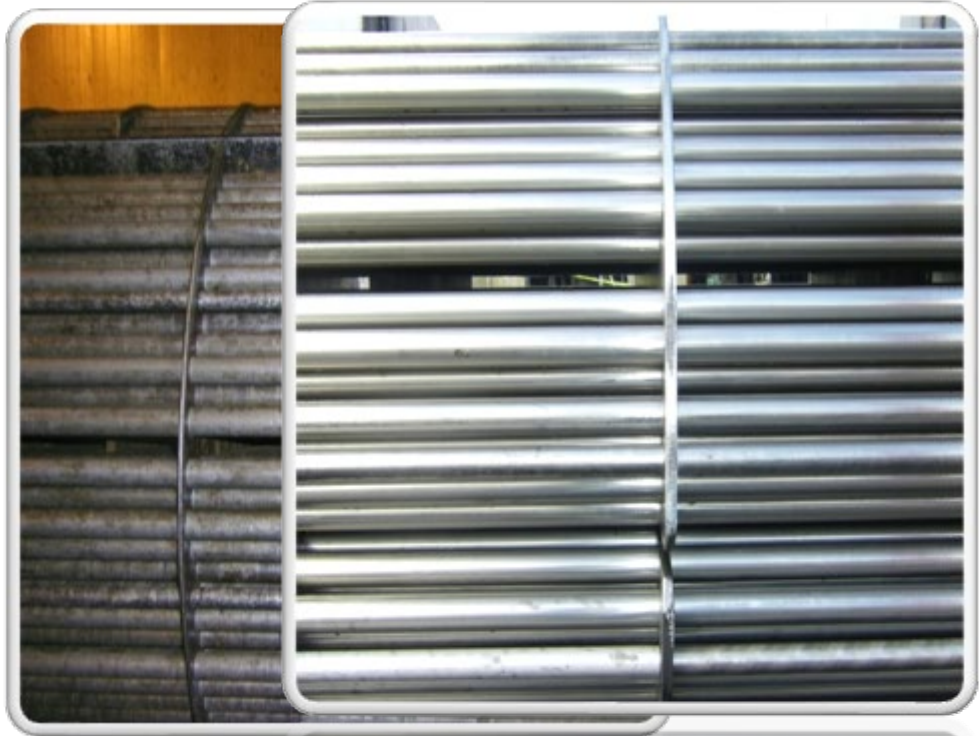
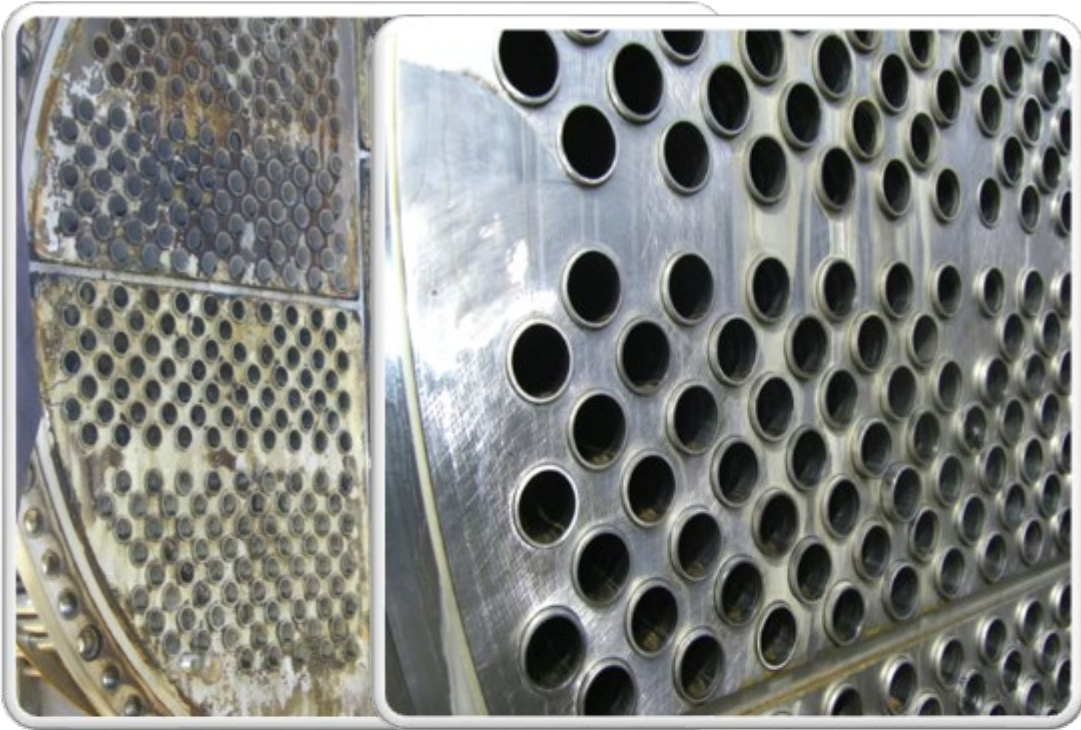
VP, National Product Line - North America

Ultrasonic Operations SME

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# Before & After





# Before & After



- Tube Face before and after Ultrasonic Cleaning, Prior to HPWB

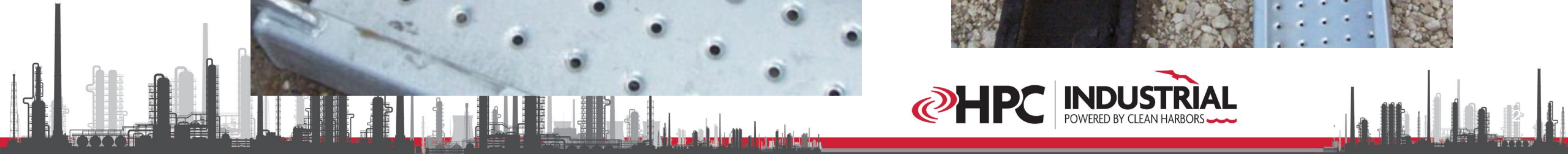


# Results – U-bends





# Return on Investment





# Parts Cleaning

