Controlling Risk in a Small HF Unit

Presented By:

Carson Howard – Unit Reliability Engineer

Craig Thygerson – Unit Area Inspector

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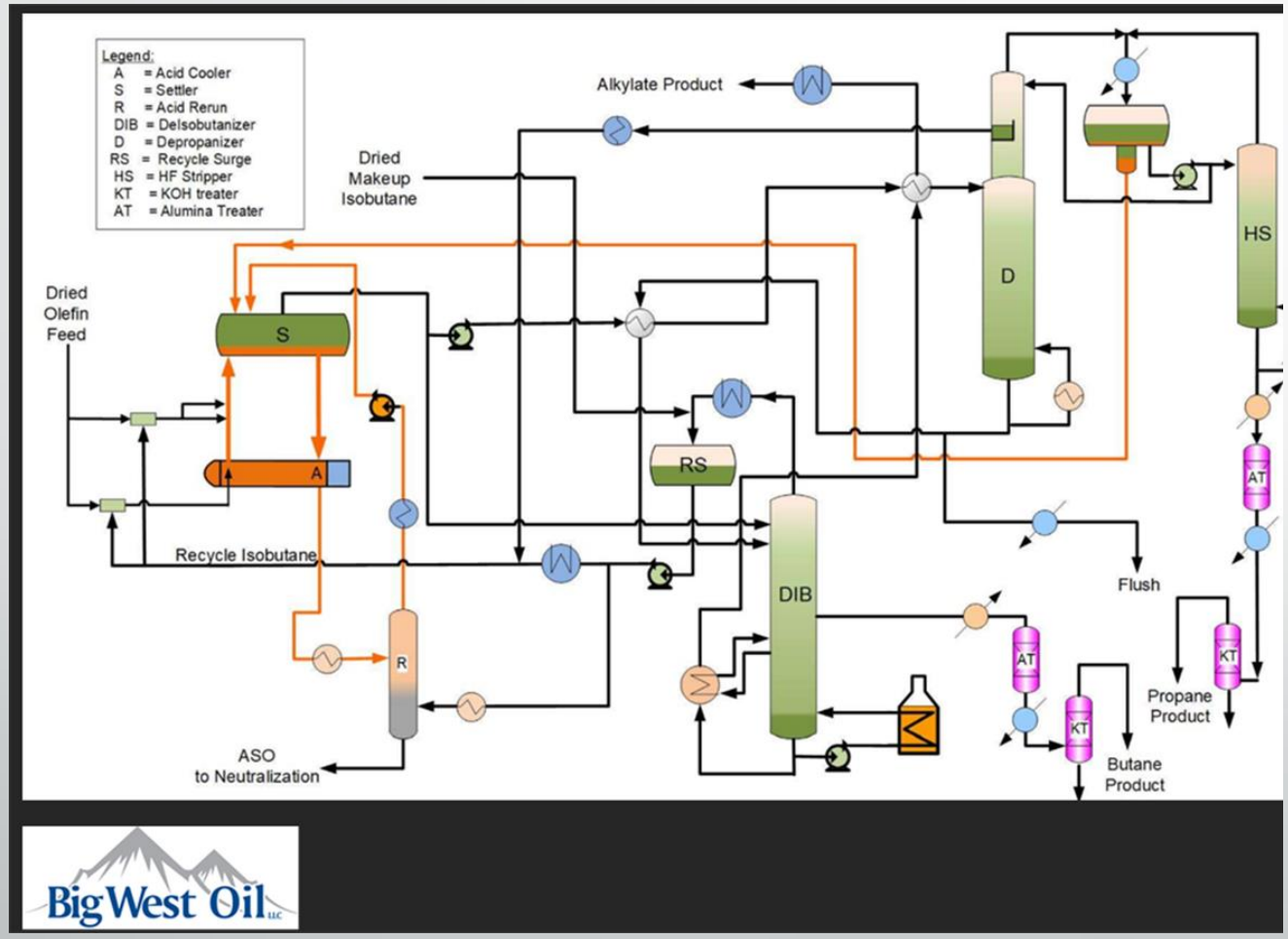
Introductions

- Carson Howard
  - BS in Mechanical Engineering From Utah State
  - Department Reliability Engineer
  - 2 Years in the Industry
- Craig Thygerson
  - API 510, 570, 580, and 653 Certifications
  - Department Inspector
  - 14 Years in Industry

Big West Oil HF Alkylation Unit



- 3000 BPD
- Split Feed Phillips Design
- 1962 Original Construction

Big West Oil Reliability Timeline

- Pre 2017 – UT data concentrated to problem piping vs systemic approach
- 2016 – Development of Unit corrosion diagrams to circuitize PIDs (CCP's)
- 2017 – Initial pass of consistent and reliable UT data for all Alky process piping
- 2017 – Extensive data gathering/570 inspections
- 2022 – Reliability Department Breaks from Projects Department
- 2022 – Inspection Database Management System (IDMS)
- 2023 – Major Reliability Department expansion

API 751 Audit

- Benefits of knowing where your liabilities/deficiencies
- Important for an independent refinery to bring in the outside expertise
- Worked with Becht to prioritize Audit Action Items
  - Highest amount of risk mitigation per dollar spent

	Risk Index = < 8	Risk Index = 8	Risk Index = 9	Risk Index = 10	Risk Index = 12	Risk Index = 15	Risk Index = 16	Risk Index = 20
Insignificant Cost	• Review bolting and ensure all is B7M instead of B7. • Capilliary tubes are filled with Silicon 200, halocarbon fill fluid is recommended.	•	• Gusset small bore piping in vibration service in 2 planes. • Label HF sample stations.	• Electric trace or steam trace w/ standoffs caustic system.	• Add safety shower to maintenance shop where HF equipment is worked on. • Add PPE to maintenance shop where HF equipment is worked on.	•	• Remove monel bolts on select pumps & instruments	•
Minor Cost	•	• HF lab fume hood does not have a face velocity indicator or low alarm. • HF settler drain valve • Platform to step over ASO line • Segregated materials in warehouse	• Breathing air system needs to meet "Grade D" specs • Remote vibration monitoring • Interconnect truck E-stop button with site emergency shutdowns during acid unloading. • Backflow prevention, regulate pressure, PRV on N2 to HF Truck unloading. • Add ability for HF camera to pan	• Dirty pop PRVs prior to cleaning and rebuilding.	• Develop "Safety Critical" list of assets per API 751. PM assets to ensure availability. • HF sample stations need double blocks to drain / atm • Add flanges at dissimilar welds • Acid loading pump dual seals. • Purge acid flare with nat gas • Steam trace / electric trace monel line rerun to ASO sys.	• Replace bourdon tube pressure gauges with diaphragm gauges.	• Paint flanges w/ HF detecting paint • Add alarms (to DCS / house & plant audible) to safety showers. • Remove monel bolts on select pumps & instruments	•
Moderate Cost	• Ensure all glass / adjustable valves have been removed. Still open but no observations.	•	• Butane shutoff valve at tower to prevent HF accumulation in treater lines. • Propane shutoff valve at HF stripper bottom. Recirc back to settler. To prevent HF accumulation in treater lines. • Water mitigation runoff and pool management. • Install two different HF detection methodologies.	• Ensure all MOVs electrical and fail safe position are fire proofed.	• Install closed loop sample stations with appropriate block valves. • Remove use case for try-cocks in HF service. Install reliability level indication. • Add HF point source detection capability. • Add EBVs to acid pump discharges. Make check valves safety critical.	• Project to mitigate free phase HF carrying over to KOH treater (propane and butane systems)	• Remove all clamps at next available opportunity.	• High Consequence Damage Mechanism Program, 100% Component Inspection
Major Cost	•	•	•	•	• No established safe haven or shelter in place location. • Rapid acid transfer system • Water deluge system	•	•	•

The 751 audit really showed us how much we were behind the industry standard for safe and Reliable operation and got us making a lot of necessary changes.

The Audit pushed us to get the proper staffing into our refinery to help us make the necessary changes to our Alky unit.

Core Team Model implemented with Operations, Inspections, Reliability, and Process for each Department

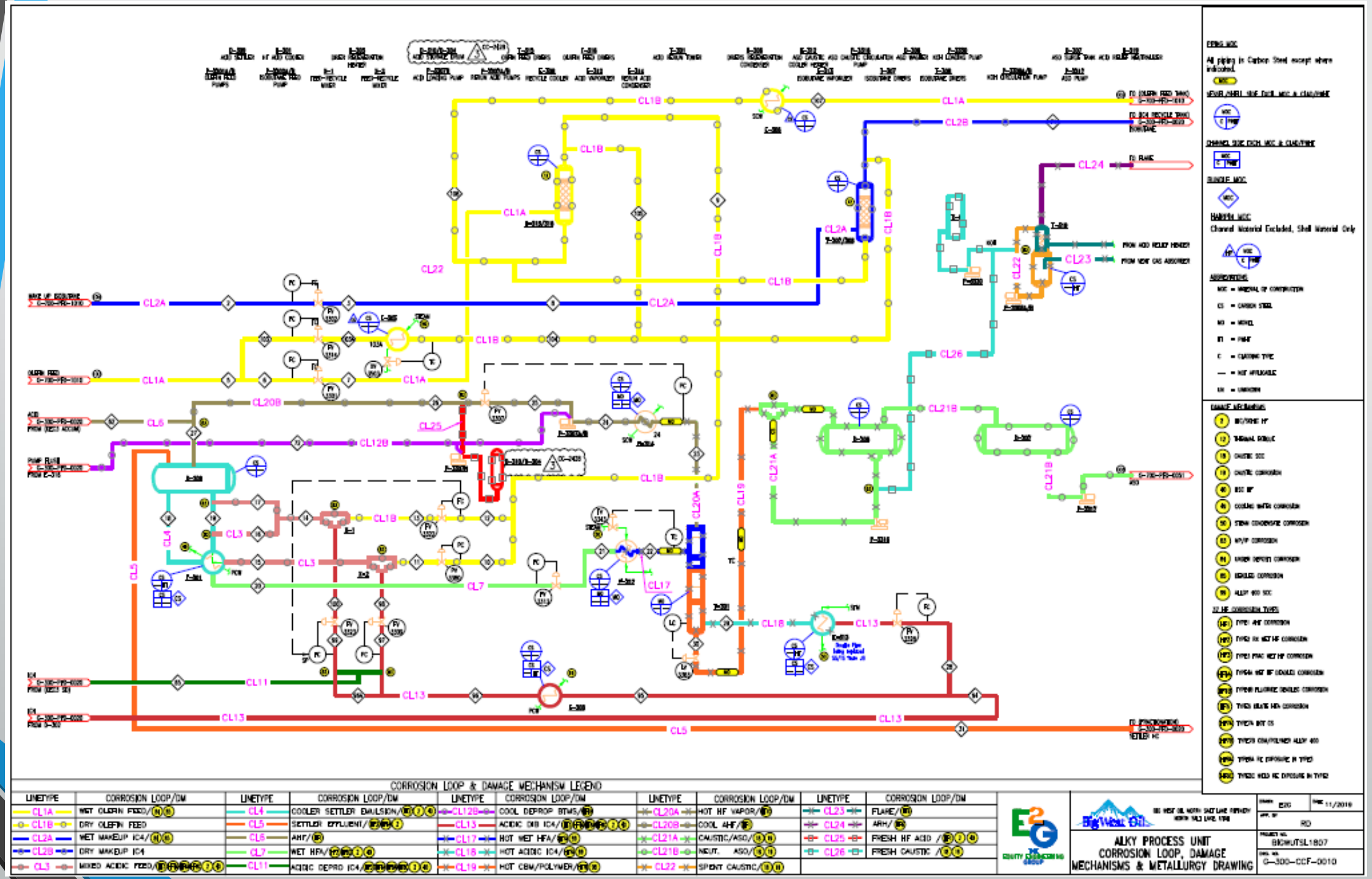
Immediate benefits noticed with less unit shut downs, less leaks, and less environmental exceedances

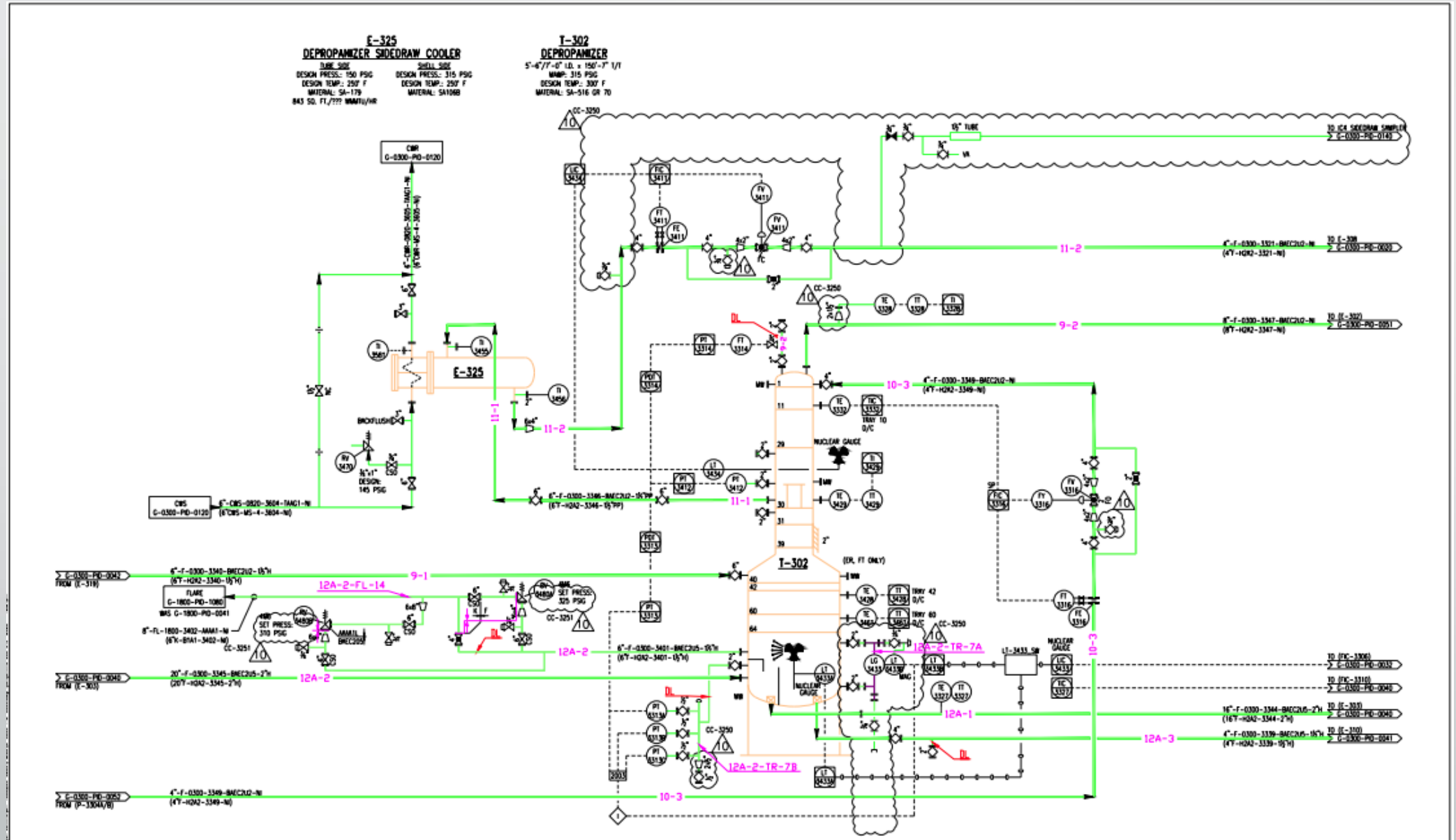
API 751 Gap Closure

- Bringing up Instrumentation to API 751 5th Edition
  - Alarms around KOH treaters
  - Additional SIS Instrumentation
  - Instrumentation Criticality
- Ensuring all new equipment is compliant with current standards
  - Mitigating hazards present in the unit

QA/QC Program Development

- Currently developing a sitewide policy and QA manual for all work completed on-site
- Will span welding, mechanical, civil, structural, instrumentation and electrical craft disciplines
- Mechanical and welding program actively in place. Mature Program anticipated before 4Q2025
- This program will span across TAR, maintenance, and capital projects starting in 2024 with immediate success


CL1A
CL1B
CL2A
CL2B
CL3
CL4
CL5
CL6
CL7
CL11
CL12B
CL13
CL17
CL18
CL19
CL20A
CL20B
CL21A
CL21B
CL22
CL23
CL24
CL25
CL26
PIPING MOC
All piping is Carbon Steel except where indicated.
ABBREVIATIONS
DamCF MECHANISMS
HF CORROSION TYPES
CORROSION LOOP & DAMAGE MECHANISM LEGEND
LINETYPE
CORROSION LOOP/DM
CL1A WET OLEFIN FEED/
CL1B DRY OLEFIN FEED
CL2A WET MAKEUP IC4/
CL2B DRY MAKEUP IC4
CL3 MIXED ACIDIC FEED/
CL4 COOLER SETTLER EMULSION/
CL5 SETTLER EFFLUENT/
CL6 AHF/
CL7 WET HFA/
CL11 ACIDIC DEPRO IC4/
CL12B COOL DEPROP BTMS/
CL13 ACIDIC DIB IC4/
CL17 HOT WET HFA/
CL18 HOT ACIDIC IC4/
CL19 HOT CBM/POLYMER/
CL20A HOT HF VAPOR/
CL20B COOL AHF/
CL21A CAUSTIC/ASO/
CL21B NEUT. ASO/
CL22 SPENT CAUSTIC/
CL23 FLARE/
CL24 ARH/
CL25 FRESH HF ACID /
CL26 FRESH CAUSTIC /
ALKY PROCESS UNIT
CORROSION LOOP, DAMAGE MECHANISMS & METALLURGY DRAWING
BIGWEST
RD
BIGWUTSL1807
G-300-CCF-0010



SYST-CIRC				MATERIALS	
9-1	11-1	12A-2	12A-2-TR-7B	CS	
9-2	11-2	12A-2-FL-14	12A-3	HASTELLOY	
10-3	12A-1	12A-2-TR-7A			

NOTE: ALL CIRCUITS IN THE ALKY UNIT WILL HAVE THE UNIT SPECIFIER "300" BEFORE THE CIRCUIT NUMBER UNLESS THE CIRCUIT IS FROM A DIFFERENT UNIT.

NO.	REVISIONS	BY	CHK.	DATE
1	CC-3250	RAJ	-	06/22/21
0	CCD-ORG	E2G	BWD	08/2021

THIS CCP DRAWING IS BASED ON BWD PID: G-0300-PID-0050 rev. 10

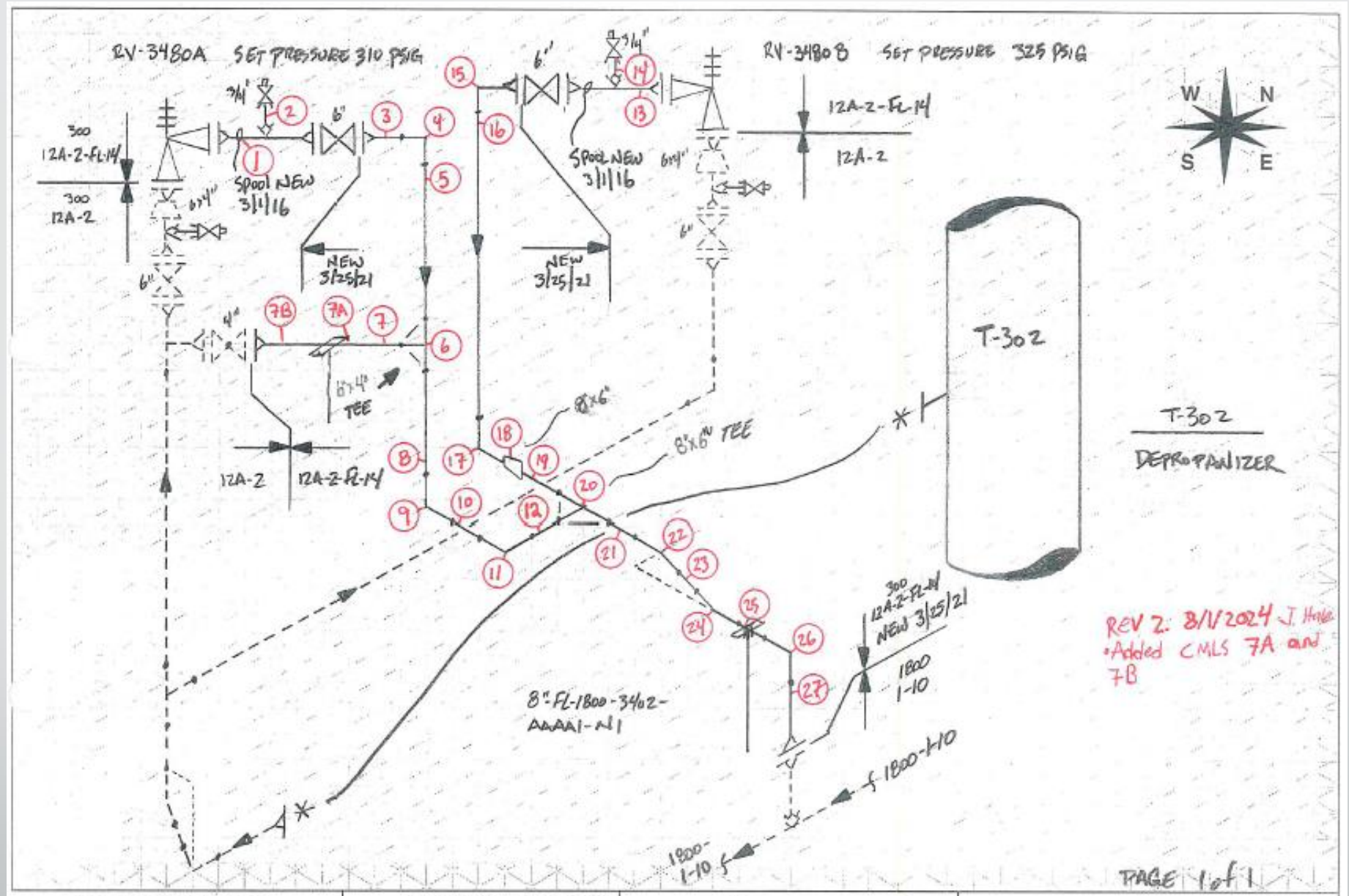
BIG WEST OIL NORTH SALT LAKE REFINERY
NORTH SALT LAKE, UTAH

drawn: E2G DATE: 07/2019

ALKY PROCESS UNIT
CIRCUITIZATION DRAWING
DEPROPANIZER AND PROPANE

PROJECT NO: BIGWUTSL-1504

DWG. NO: G-0300-CCP-0050 REV: 1



MISTRAS Services Division
A World of NDT Solutions
Mistras Services
786 West 600 North
Ph: (801) 683-3450
Fax: (801) 397-1019

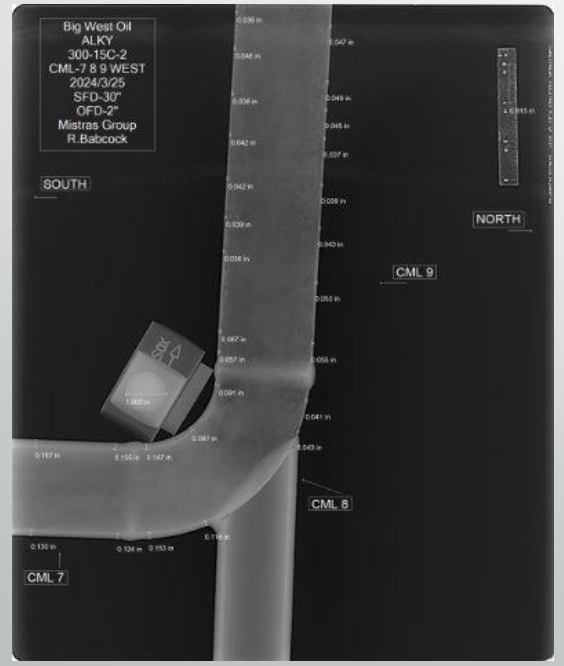
P&ID: A-0300-PID-0050 REV9, A-1800-CCP-1090 REV1	CL NAME: HOT DEPROP BTMS FLARE	DRAFTER/DATE: CRAIG THORGESON 7/1/2022
DWG/CIRCUIT: 300-12A-2-FL-14 REV 2		INSPECTOR/DATE:
NOTES: FLARE OFF T-302 BOTTOM. NOT INSULATED.		

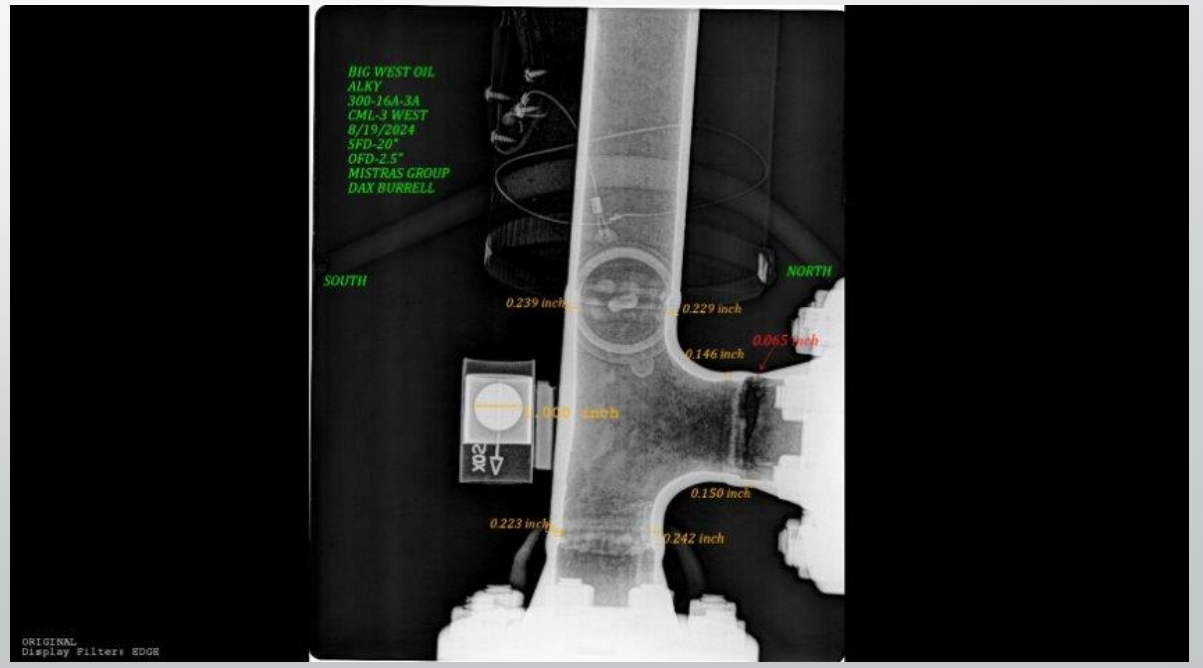
100% Component Inspection

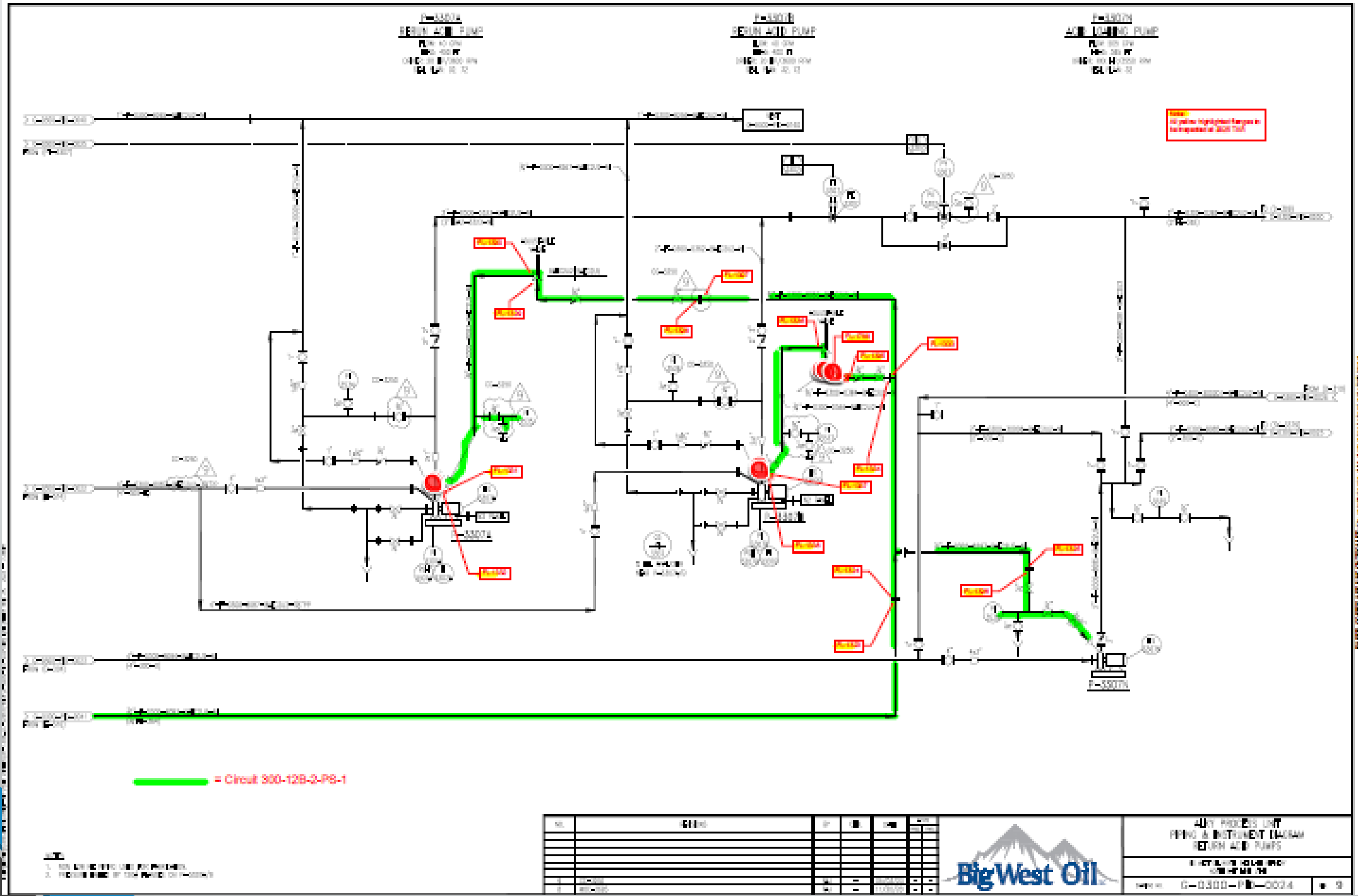
- Ranked as the highest risk to the facility according to our most recent 751 Audit
- Main & Trace acid pipe/component currently inspected at 100% using a combination of straight beam UT, Phased Array UT (PAUT), Computed X-ray (CR), and visual inspections

Mitigated Thinning Due to Expanded Inspection

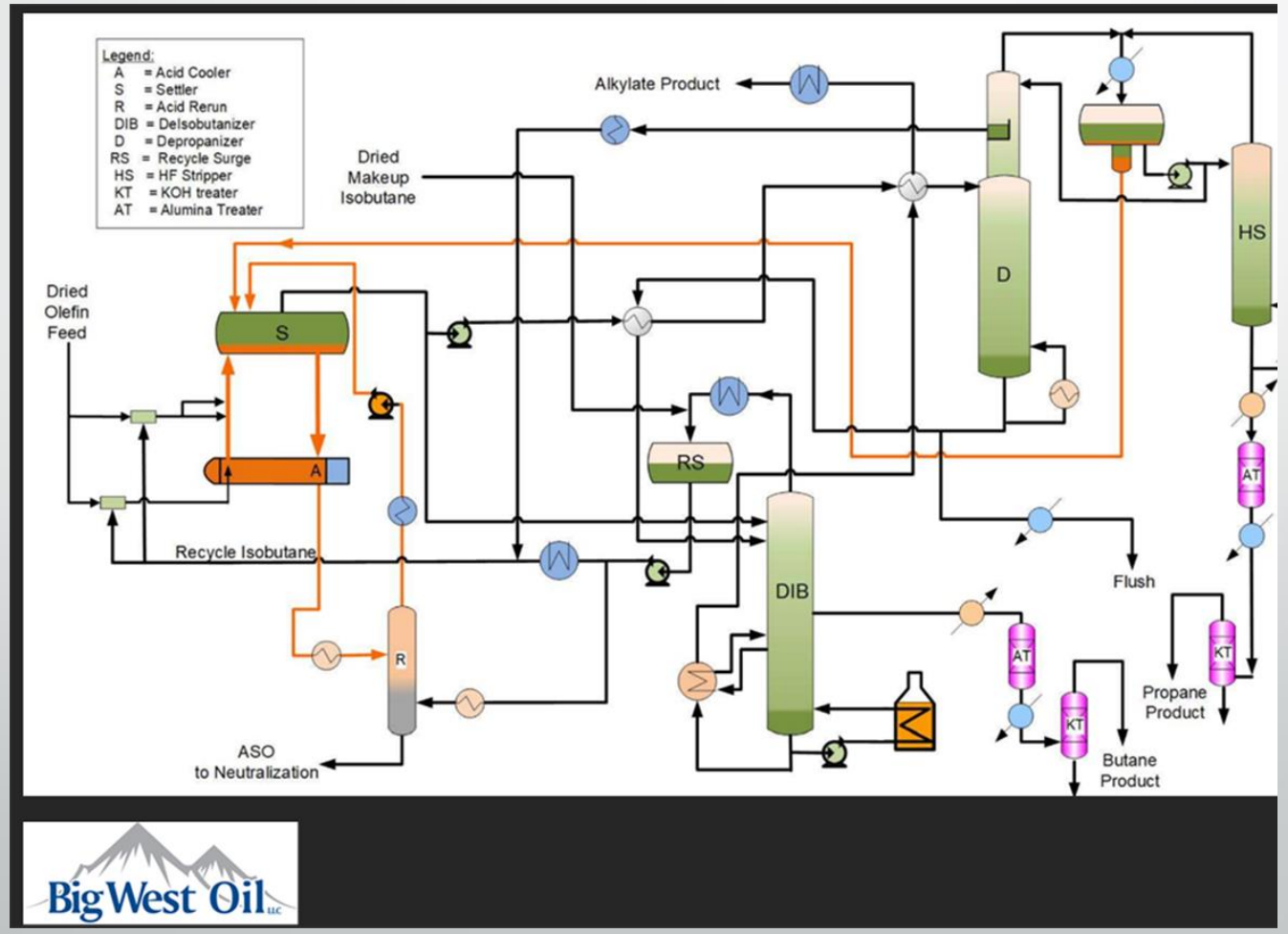
- Full time radiography (CR) inspection crew brought on-site in 2024 to integrate into daily work
- CR capability has been responsible for locally thin finds that would likely would not have been found with UT





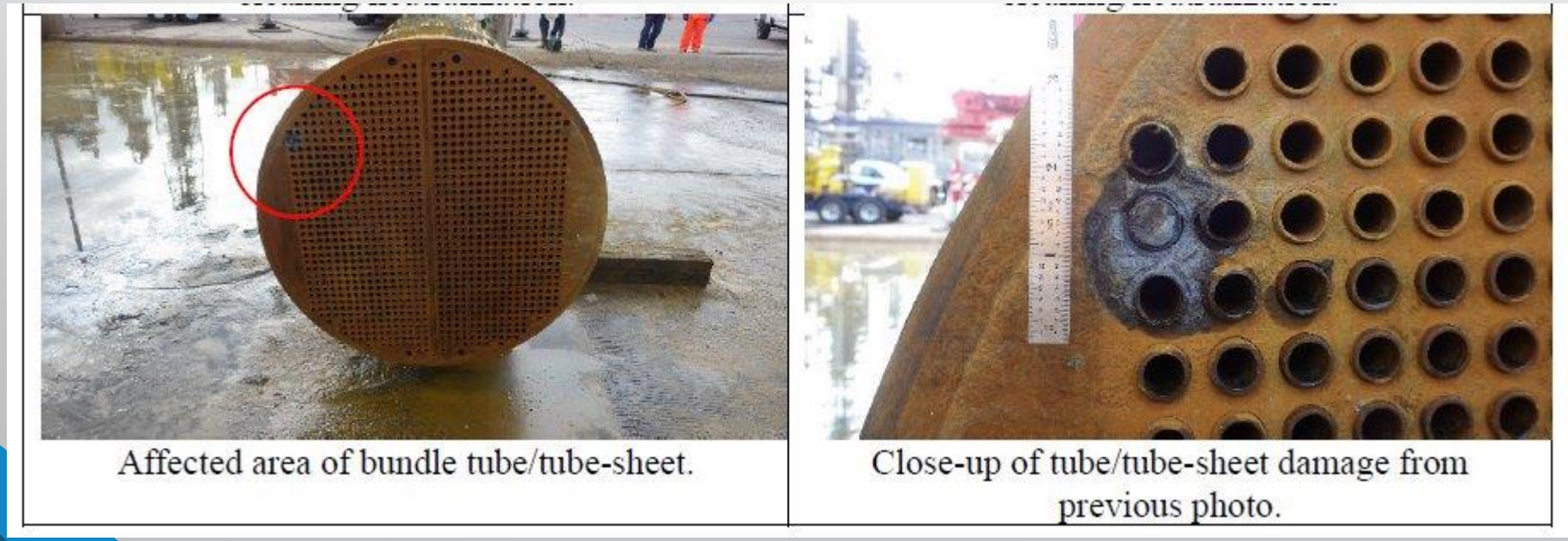

= Circuit 300-12B-2-PS-1
BigWest Oil

DePropanizer OVHD Cooler Incident Investigation



Summary

- Tube leak was identified due to low PH in the cooling water tower
- Excessive iron fluoride scale in bundle that made the bundle difficult to extract

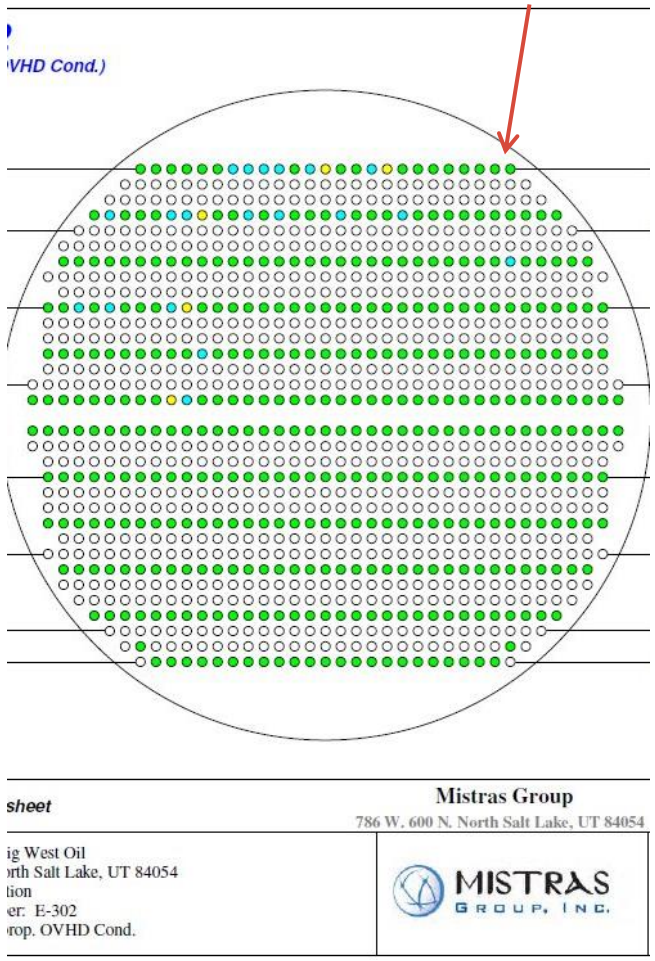


Affected area of bundle tube/tube-sheet.

Close-up of tube/tube-sheet damage from previous photo.

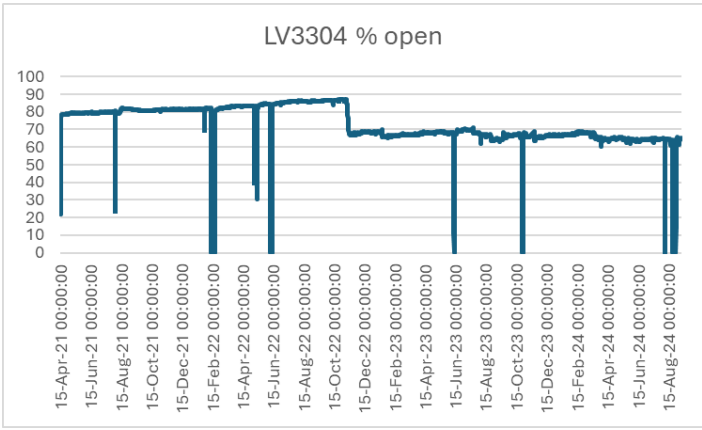
Investigation Notes

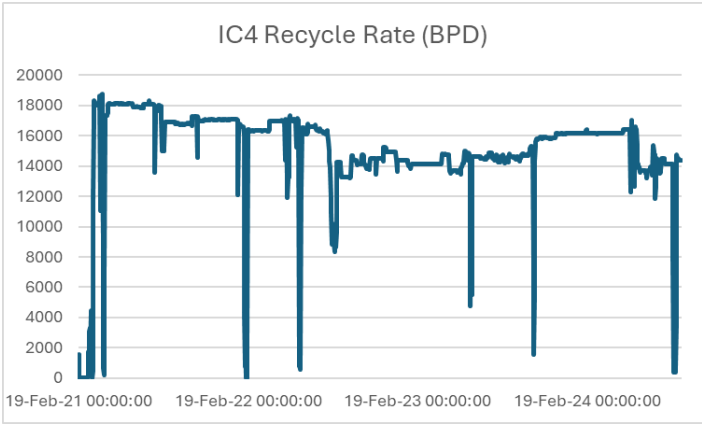
- Exchanger was replaced in 2016
- 30% inspection coverage in 2021 TAR
- Tube metallurgy was compliant with API 751



Contributing Factors

- Operationally changed Settler level
  - From ~28% to 20% acid in the settler
- Recycle IC_4 purity was always above 80%
- Had acid strength above 90%
- A few excursions above 1.5% water in acid but always less than 2%





Lessons Learned

- Importance of key process variables with mechanical integrity
  - Shows value in creating IOWs
- Ensuring Reliability in Critical Equipment
  - Instrumentation
  - Heat Exchangers
    - TAR Inspection Coverage
    - Acid Service VS Non-Acid Service

Criticality Assessments

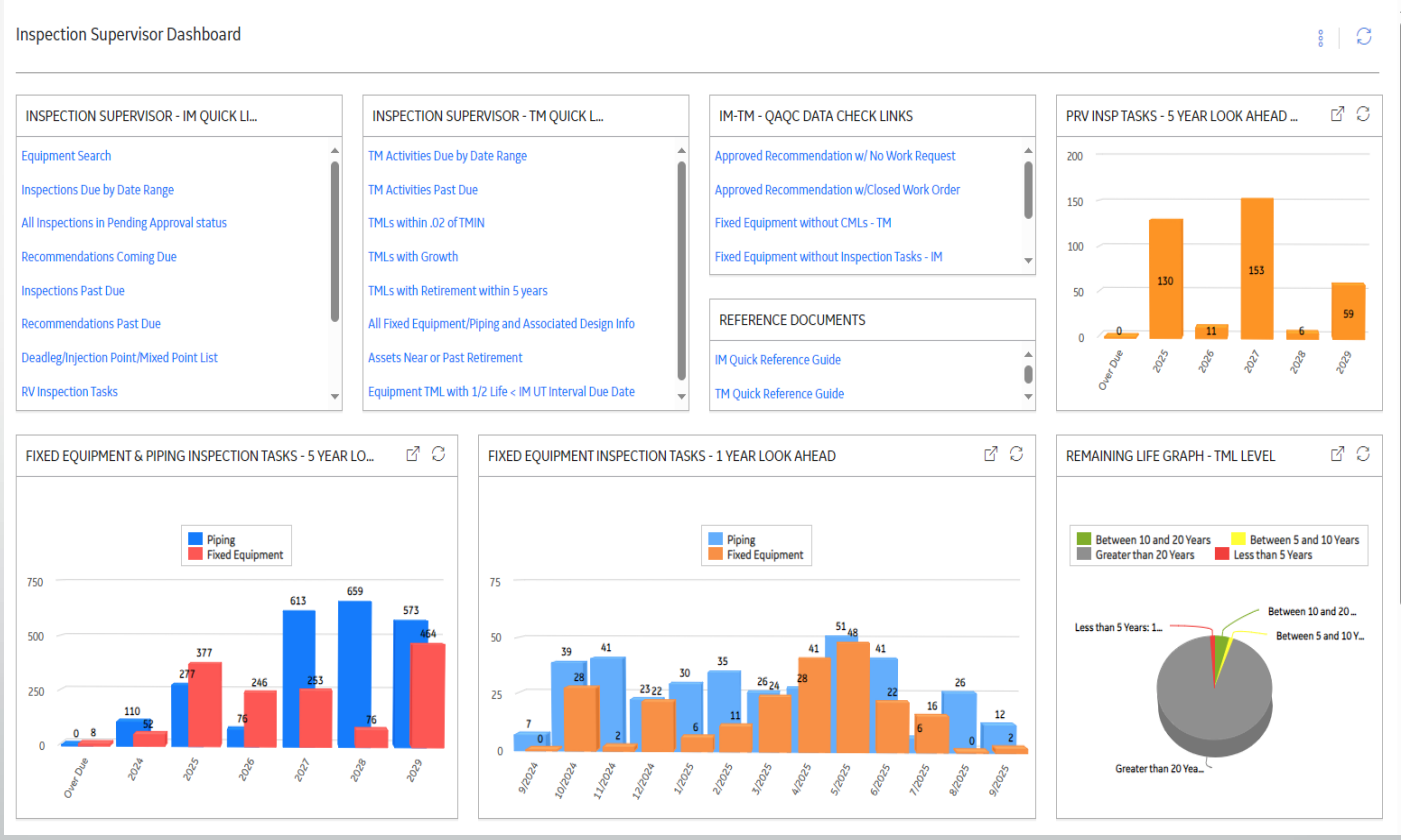
Location Description	Health and Safety Critical	PSM / RMP Critical	Environmental Critical	Business Critical	Risk Remarks
IC4 Feed Flow from P-302A/B to T-307 / T-308	No	Yes	No	No	PHA Safeguard
DIB Reboiler Flow	No	Yes	No	No	PHA Safeguard
DIB Reboiler Flow	No	Yes	No	No	PHA Safeguard
TRANSMITTER, FLOW, D/P, FRESH FEED FROM STORAGE TO T-307/308 DRIE	No	Yes	No	No	PHA Safeguard
Deisobutanizer Bottoms to Deisobutanizer Reboiler	No	Yes	No	No	PHA Safeguard
TRANSMITTER, LEVEL, T-304 DEISOBUTANIZER LEVEL	Yes	No	No	No	Use to prevent vapor driven liquid relief case.
Depropanizer and HCL Stripper Accumulator	No	Yes	No	No	PHA Safeguard
Stripper Accumulator Level Valve	No	Yes	No	No	PHA Safeguard
Stripper Acid Boot Level Valve	No	Yes	No	No	PHA Safeguard
Depropanizer and HCL Stripper Accumulator	No	Yes	No	No	PHA Safeguard
TRANSMITTER, PRESSURE, T-304 DEISOBUTANIZER BOTTOM PRESS C	No	Yes	No	No	PHA Safeguard
GAUGE, PRESSURE, T-309/310 PROPANE CAUSTIC TREATERS BACK PRESS C	No	Yes	No	No	PHA Safeguard
VALVE, SOLENOID, CONTROL AIR TO XV-3320	Yes	Yes	No	No	Needed to bring the heater to a safe state.
VALVE, SOLENOID, CONTROL AIR TO XV-3321	Yes	Yes	No	No	Needed to bring the heater to a safe state.
ELEMENT, TEMPERATURE, T-301 ACID RERUN TOWER OVERHEAD TEMP	No	Yes	No	No	PHA Safeguard
ELEMENT, TEMPERATURE, H-301 DIB REBOILER STACK TEMP	Yes	No	No	No	SIS Initiator
TRANSMITTER, TEMPERATURE, E-324 DIB INTERHEATER TS OUTLET TEMP	No	Yes	No	No	PHA Safeguard
TRANSMITTER, TEMPERATURE, T-309/310 PROPANE CAUSTIC TREATERS INL	No	Yes	No	No	Used free HF headed to the KOH treater.
T-319 Bottoms Outlet EBV	No	No	Yes	No	Used to prevent caustic release which would make its way to WWT causing a Env. Permit exceedance.
D-301 HC Outlet EBV	Yes	No	Yes	No	Used to prevent hydrocarbon/acid release from accumulator.

Looking Forward – Continual Improvements

- Trainings for Operations and Engineering
- Damage Mechanism Review (DMR) validations
  - IOWs will quickly follow validation of DMRs
- Inspection Data Management System (IDMS) Documentation
- Large Cap Risk Mitigation
  - RATS system
  - Water Curtain System

IDMS Documentation

- Evergreening of known piping commission dates
- Ensuring we stay in front of inspection due dates



Questions?