

STREAMLINING THE FCCU SHUTDOWN PROCESS

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SETTING THE STAGE

Since 2001 RTI has been successfully preparing FCCU equipment ahead of maintenance work.

We have learned and accumulated many successful practices leading to quick, safe entry into very clean equipment.

Today, I'll be sharing some of these with you.



AGENDA



Objectives of preparing equipment for maintenance



Main concerns in equipment preparation



Historical cleaning methods



General strategies applied by RTI



Typical, repeatable results



Recent example



Summary

OBJECTIVES OF UNIT PREPARATION

- ⌘ Insure a safe environment by removal of all contaminants, e.g.
 - All Hydrocarbons
 - Benzene
 - H₂S
 - Pyrophoric substances
- ⌘ Timely completion
- ⌘ Predictable results
- ⌘ Minimize maintenance work using supplied air
- ⌘ No disruption of maintenance work once started
- ⌘ A clean environment in vessels for workers



CONCERNS IN PREPARING EQUIPMENT

Most FCCU have the following concerns in equipment preparation:

A very heavy oil (slurry, heavy cycle) to deal with...80% PNA

Pyrophoric substances in fractionator and gas plant

Fouled packed beds

Plugged heavy oil drains and/or piping

Catalyst in fractionator bottoms and slurry exchangers

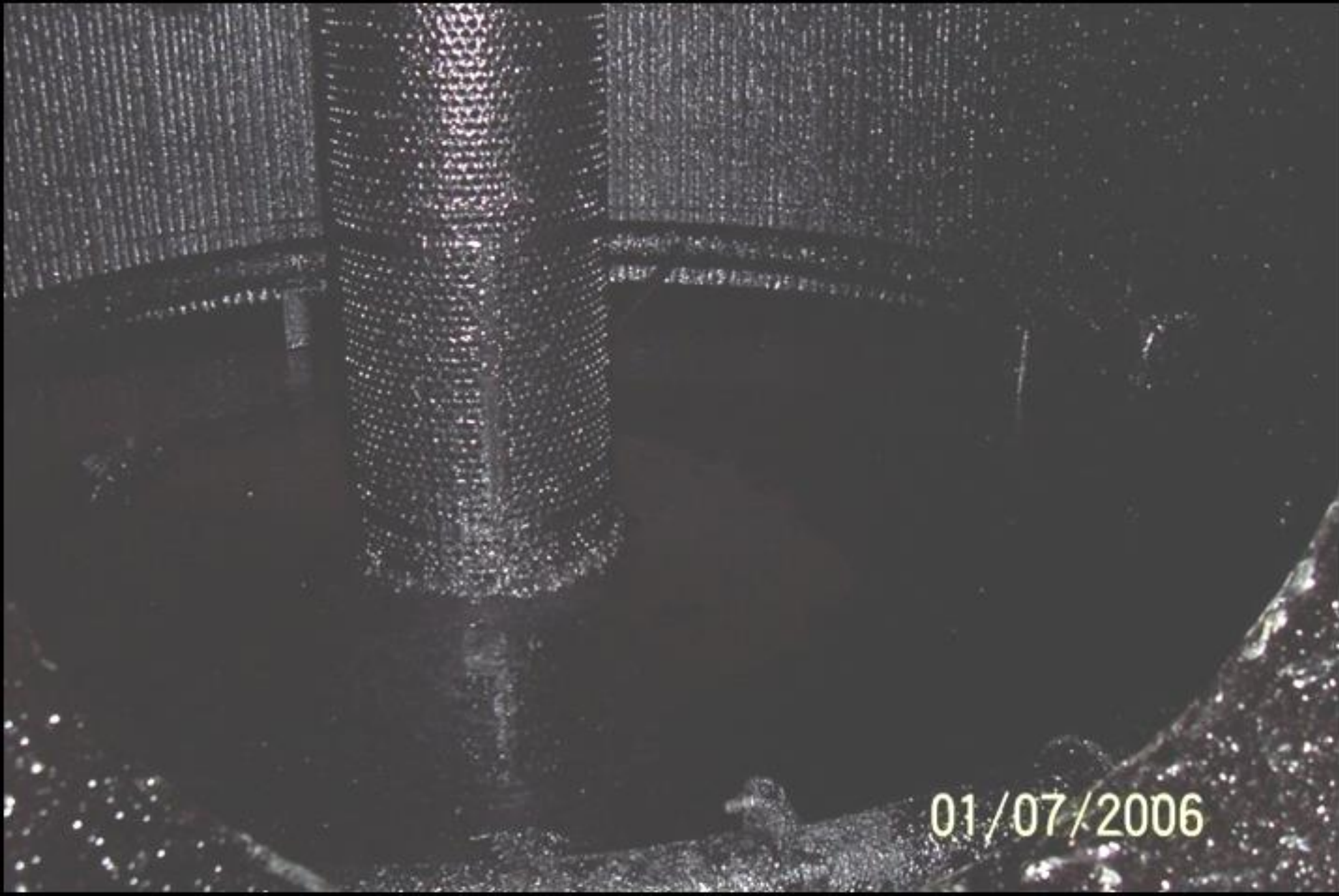
Removing very sour LPG from gas plant

HISTORICAL CLEANING METHODS

- ⌘ Traditional methods for preparing FCC equipment for maintenance involved some combination of **oil flushing, water flushing, steaming to flare** and **steaming to atmosphere**
- ⌘ The oil flushing step usually occurs before installation of the reactor OH blind
- ⌘ In some cases a diluted solvent is used in the vapor phase
- ⌘ Pyrophoric treatment of towers takes place either by filling or circulating a diluted oxidizing agent
- ⌘ Circulation of bottoms circuits to loosen and remove solids is also a common practice

DO THESE METHODS WORK?

- ✦ Maybe, but...
- ✦ They are often very lengthy
- ✦ Equipment may be “decontaminated” but not “clean.”
There is a difference!



01/07/2006



01/20/2006

DO THESE METHODS WORK? (2)

Maybe, but...

Amount of oily water effluent to be disposed can be very high.

If all oil is not removed, pyrophoric treatment will not be successful.
Oxidizers consume available oil first.

GENERAL STRATEGIES EMPLOYED BY RTI (fractionator systems)

Pre Shutdown

- ⌘ Install as many mechanical connections as possible
- ⌘ Unplug drains

OIL OUT

Clearing

- ⌘ Conduct flushes of heavy oil circuits during the catalyst unloading window
- ⌘ Push fluid in pumparound loops back into the main fractionator starting with the tower top
- ⌘ Maximize circulation in bottoms circuits to sweep heavy oil and catalyst
- ⌘ Pump out levels in vessels
- ⌘ Using steam, pressure out remaining oil and clear low-point drains

GENERAL STRATEGIES EMPLOYED BY RTI (fractionator systems)

After installation of reactor OH blind

HOT: inject steam into the tower to heat up

DRY: empty low-point drains

CLEANING: inject organic solvent with steam

FULLY CLEANED: Hydrocarbon fouling dissolved and drained

PYROPHORICS: pyrophoric oxidation using vapor phase chemical

Displace steam with nitrogen or open to atmosphere

Cool tower and batch rinse with water to remove dissolved oil

Gas test, install spades, open equipment & begin maintenance work

12-16 hours

TYPICAL RESULTS

**Clean
equipment;
not just gas
free**

**Fast & safe
entry into
equipment**

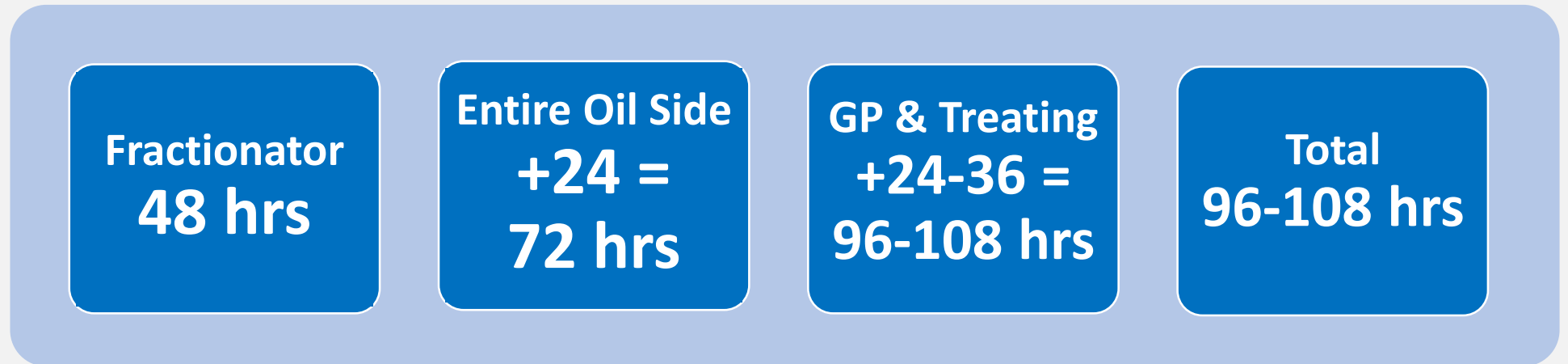
**No
interruption of
maintenance
work**

**Pyrophorics
oxidized**

**A fraction of
oily effluent to
get rid of**

HOW LONG DOES THIS TAKE?

Our common best practice timeline, **oil out to spading...**



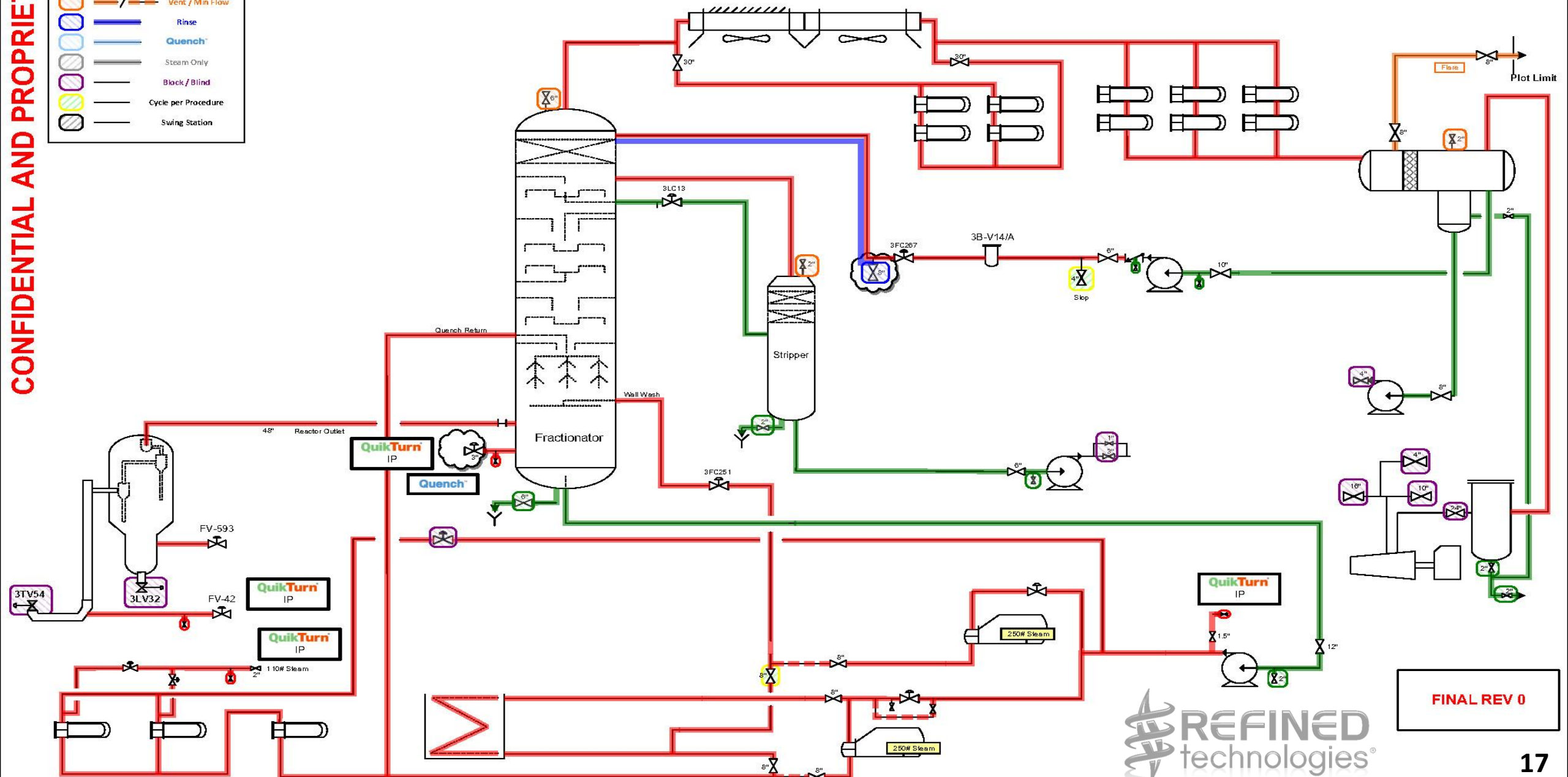
But, a novel approach in February 2019 resulted in an **entire FCCU** ready for maintenance in **~58 hours** from oil out.

HOW DID THIS HAPPEN?

- ⌘ Great plan developed and followed!!
- ⌘ Proposal issued 15 months before SD; project awarded 14 months out. Plenty of time to develop an excellent plan!
- ⌘ Client and RTI committed resources to the plan and aggressive schedule. This did not happen by chance!
- ⌘ Client willing to accept novel approach (not first time for RTI)
- ⌘ Shutdown, clearing and cleaning procedures integrated
- ⌘ Client staff trained on the plan
- ⌘ 99% of mechanical connections completed before SD
- ⌘ All low point drains cleared before SD
- ⌘ Sequencing of activities optimized

Chemical Cleaning Legend

- QuikTurn Injection (Cleaning / Min Flow)
- Effluent / Min Flow
- Vent / Min Flow
- Rinse
- Quench
- Steam Only
- Block / Blind
- Cycle per Procedure
- Swing Station



IN SUMMARY

- ⌘ Proven for close to 20 years in preparing FCCU for maintenance, use of a fully **organic solvent** followed by pyrophoric treatment, both in the vapor-phase
- ⌘ Equipment is **clean** not just decontaminated
- ⌘ “Best-in-class” performance is possible; a number of **safety**, **economic** and **time** benefits are associated with this method!
- ⌘ Significantly less oily-water effluent is generated
- ⌘ The vaporphase process is simple, predictable and less mechanical equipment intensive

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