BOYLE ENERGY SERVICES & TECHNOLOGY, INC.

Accelerated ACC and Steam System Commissioning at a Large Gas-To-Liquids Facility

ACC Users Group -- 16 October 2013

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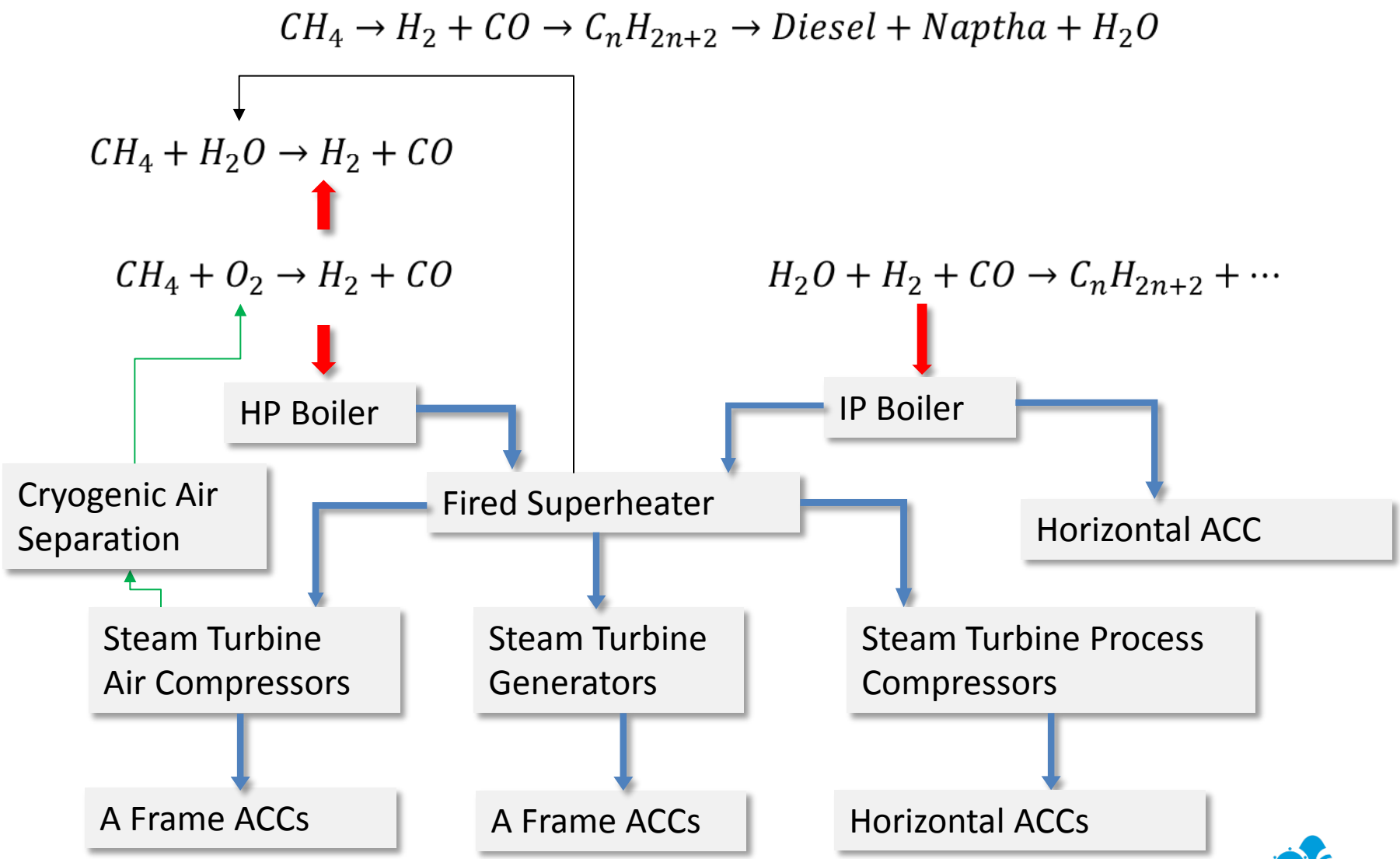
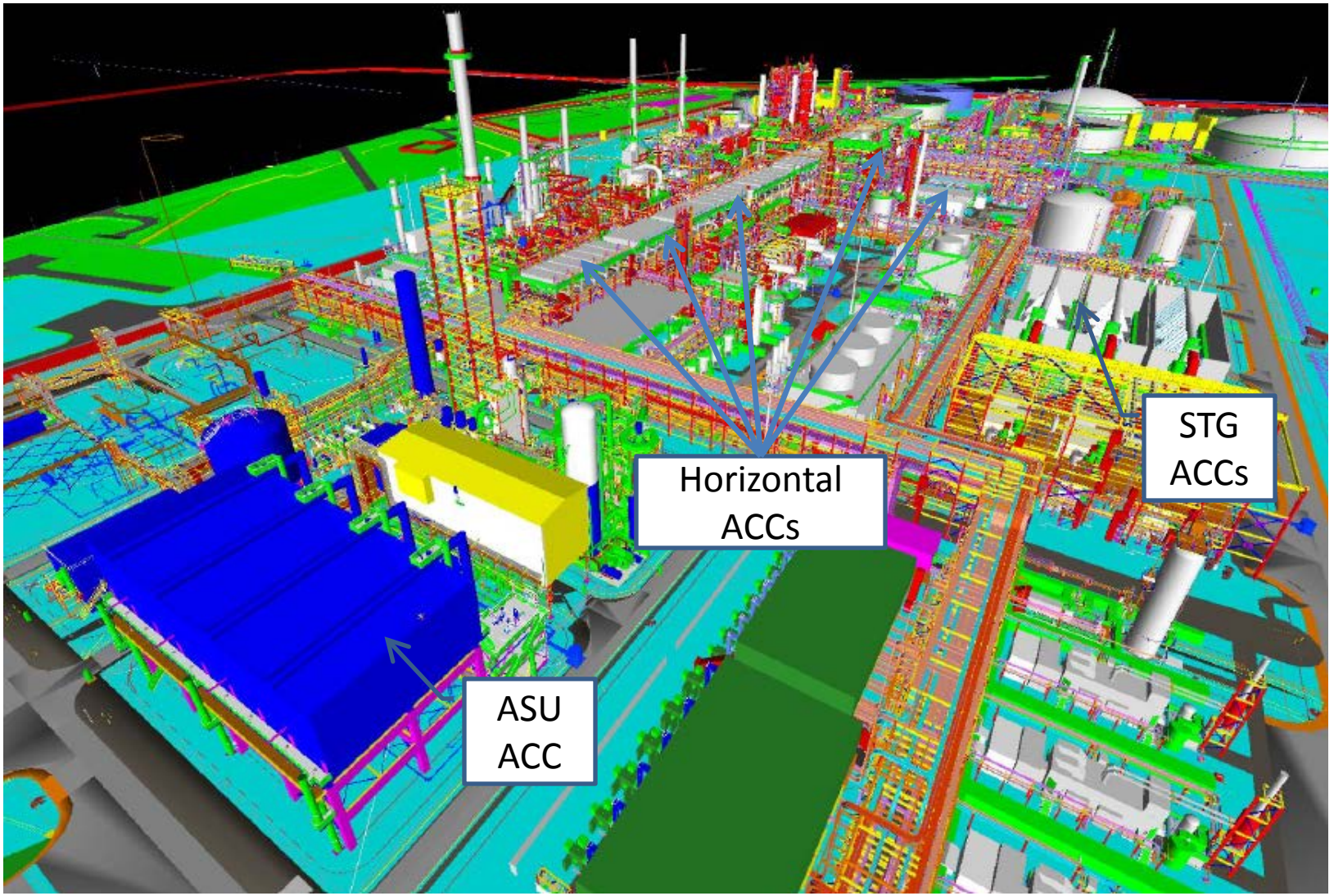
Abstract

A petrochemical consortium constructed a large Gas-to-Liquids processing facility in Delta State, Nigeria and needed a new way to commission the facilities steam systems. Demineralized water constraints were predicted to result in unacceptably long durations should atmospheric steam blows be implemented. The consortium elected to implement the SigmaBlow™ protocol to reduce the steam blow duration. SigmaBlow ™ enables condensate capture during the steam blow and provides for cleaning and passivating of all steam/condensate flow paths. During this SigmaBlow™ protocol, the steam system supporting five waste heat boilers, two process boilers, three package boilers, nine steam turbines, and process steam users was effectively and expeditiously cleaned and commissioned. Six Air Cooled Condensers of varying sizes and designs were also cleaned and used in commissioning the rest of the steam systems. The design details, advantages and savings in demineralized water, fuel and schedule are detailed in this presentation.

Gas to Liquids (GTL) Overview



Escravos GTL Site - 3D Model



Steam System Footprint- 860m x 350m x 60m

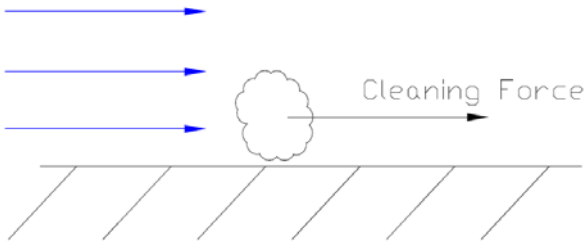
Escravos GTL Project / CCPP Comparison

	Escravos GTL	"F" 2x1 CCPP
Targeted Piping Volume	900m^3	170m^3
Steam Production	2000 tph	500 tph
Steam Generators	10	2
Air Cooled Condensers	10	1
Steam Turbines	9	1

Conventional Steam Blow vs. Admission Criteria

Transition Steam System from a Construction Environment to an Operating Environment

- Cleaning Force Ratios Greater than Unity (Typical OEM Specification is CFR >1.2)
- 'Dirty' Targets Indicate Harmful Material is Being Removed
- Clean Targets Prove System Cleanliness



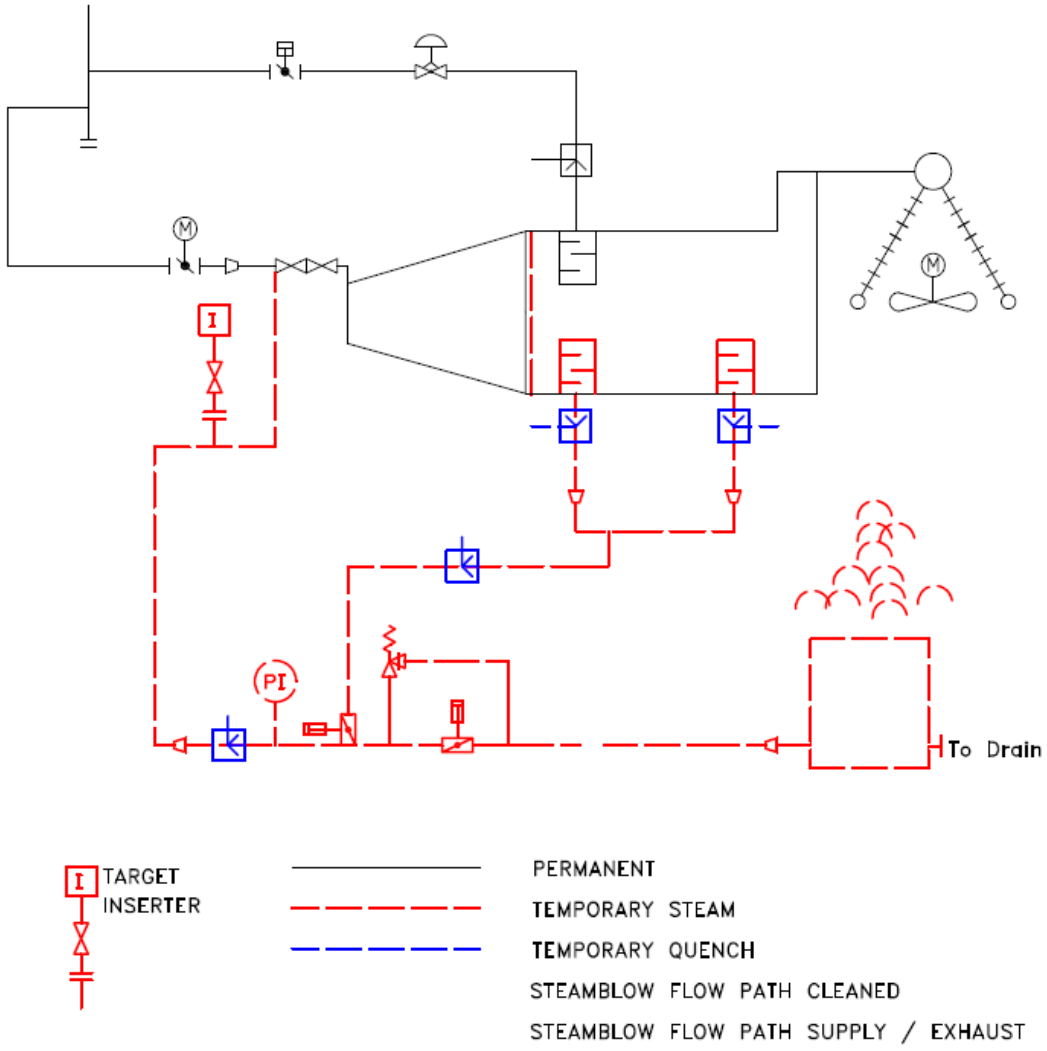
$$CFR = \frac{W_{sb}^2 \times \overline{V_{sb}}}{W_{op}^2 \times \overline{V_{op}}}$$

Conventional Steamblow Challenges

GTL Operating Condition	Conventional Steamblow
• Generating Condensate	• Consumes Condensate
• Steady State Operation	• Discontinuous Operation
• Clean Condensate Required	• High Contamination Levels in ACC Following Steamblow

SigmaBlow™ Addresses Conventional Steamblow Challenges Using ACCs

SigmaBlow™ Methodology - ACC



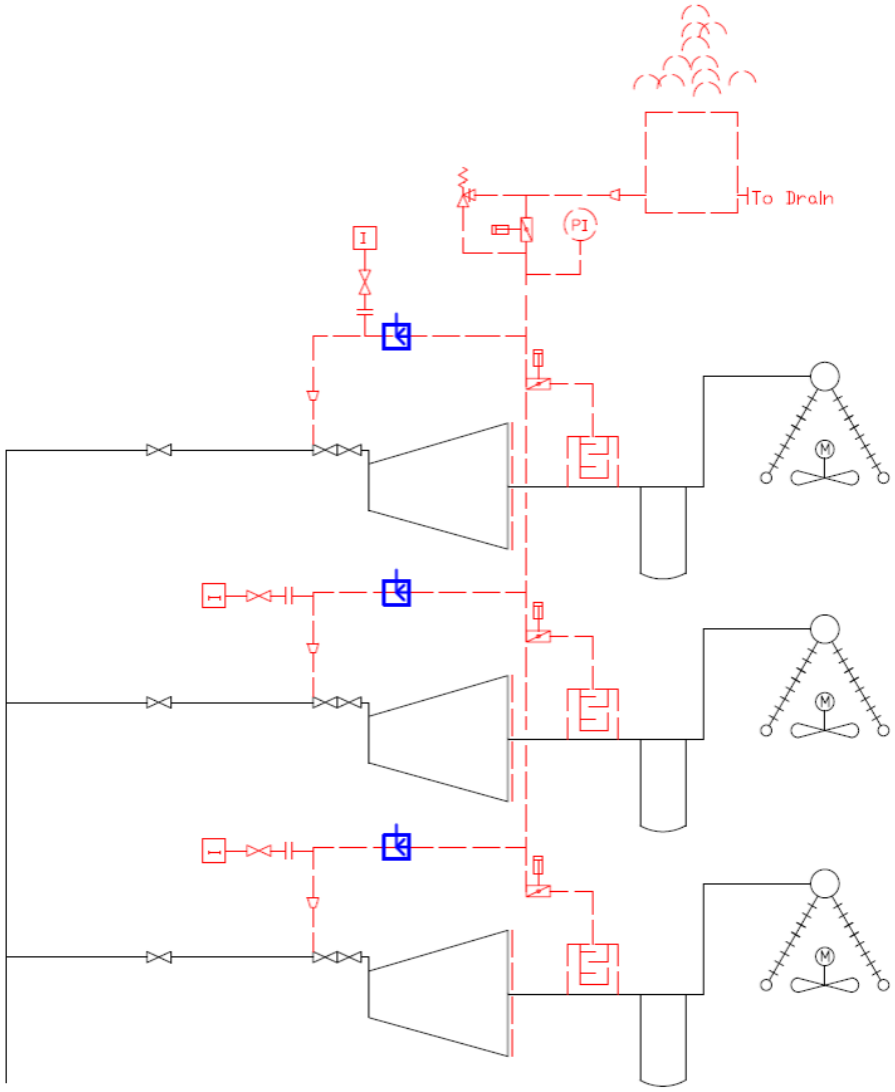
Gross Debris Removed Before ACC Steam Admission

Spring Return Fail-Safe Valves Provide ACC Protection

Quickly Isolates ACC from Steam Flow in the Event of Process Excursion or Black Plant

Prevents Permanent Rupture Disks from Bursting

SigmaBlow™ – Integrated ACC Cleaning



3 Air Cooled Condensers with Common Steam Blow Piping Cleaned in Single Blow Process

Saves Significant Set-up Time

Temporary Equipment Costs Reduced

Common Piping for 3 ACC's

ACC Cleaning Integrated with Steam Blow

5 A-Frame ACC's were Operated in Parallel

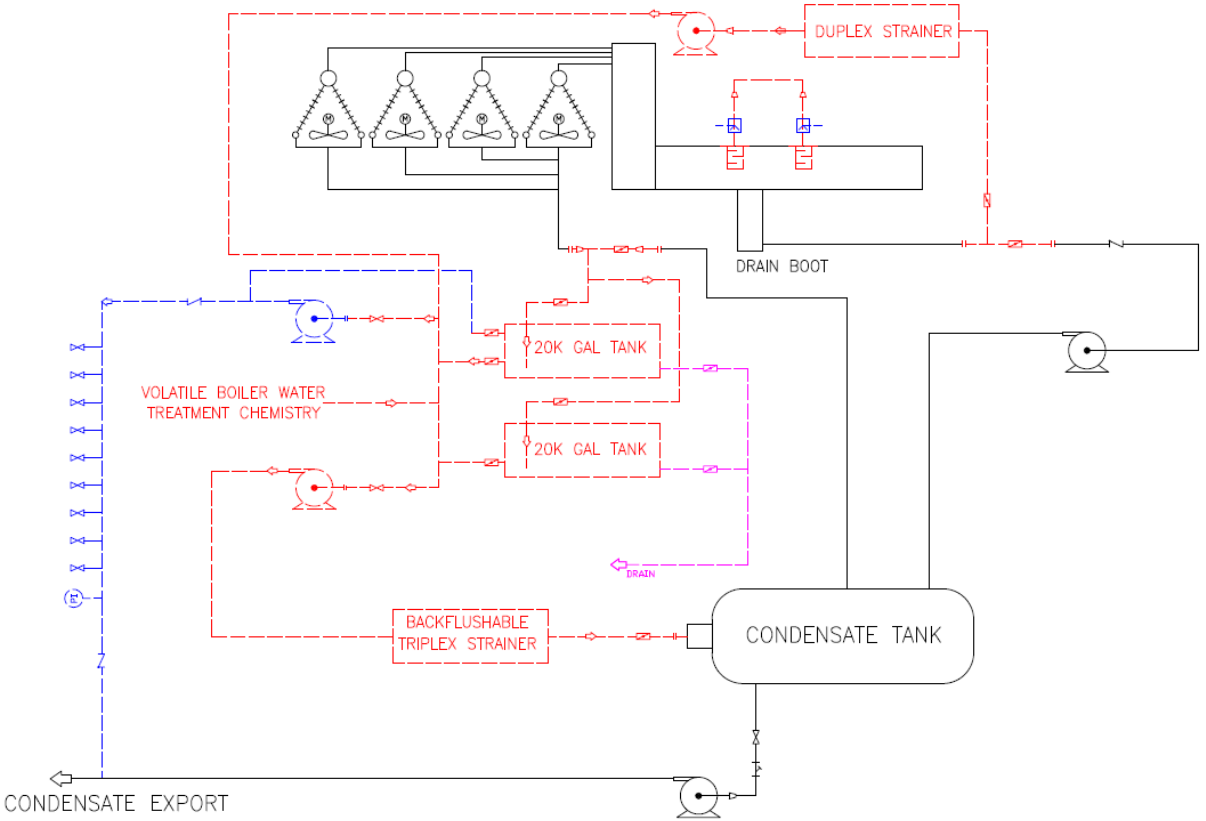
Selective Fan Operation Focused Steam Flow on Individual ACCs

Steam Flow to Individual ACCs Exceed MCR Flow

Heavy Solids Rapidly Flushed from Cells

- Initial Condensate Routed to Waste
- Temporary Filtration Removes Suspended Solids
- Dissolved Solids Removed by Boiler Blowdown

Condensate Handling - Single ACC



Condensate from ACC

Condensate After Filter

Condensate Handling Hardware

SigmaBlow Condenser Passivation

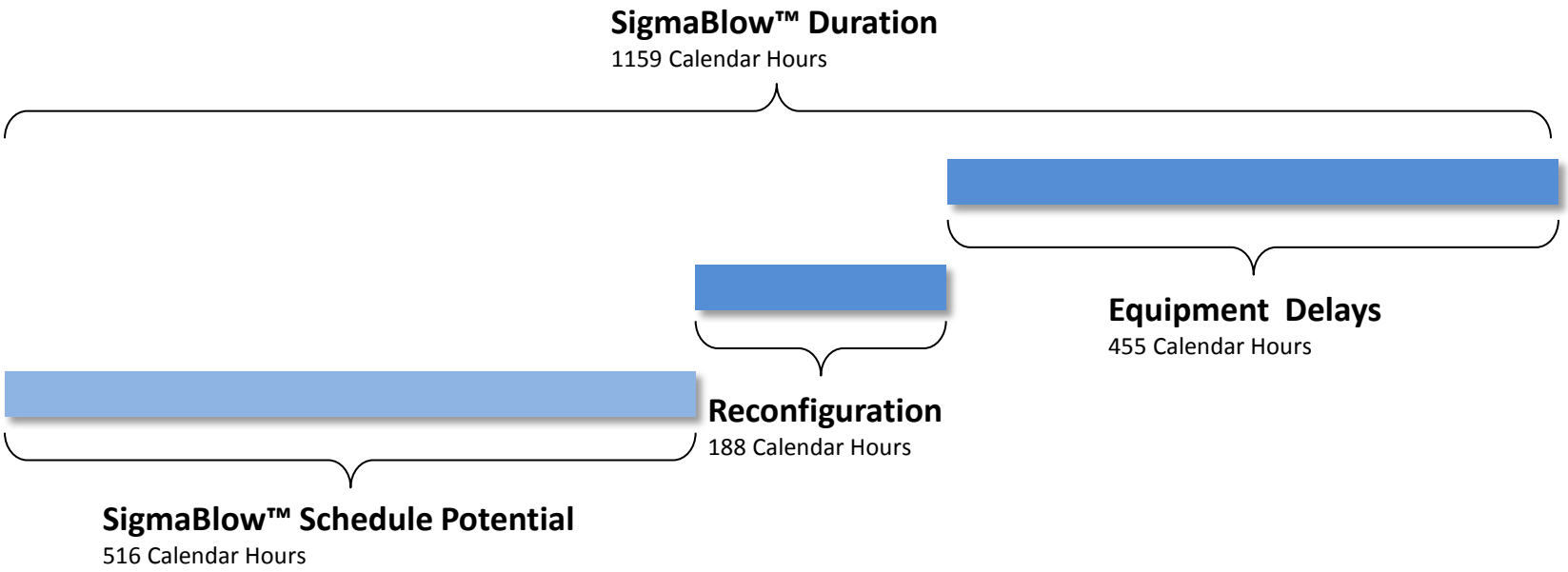
ACC Duct Showing Passivation after SigmaBlow™

Inside of ACC Duct Showing Passivation on Metal Surface

SigmaBlow™ Process Controls Steam Temperatures and Chemistry to Accelerate Formation of a Stable Passive Oxide Film on Steam Path Surfaces

Passive Oxide Film Prevents Harmful Oxidation

Demonstrated SigmaBlow™ Schedule Compression



Original Plan was for a <u>4200</u> Calendar Hour Conventional Steam Blow

Demineralized Water Savings in Excess of <u>116,000 Tons</u>

100's of Billions of BTU's Fuel Savings

Lessons Learned – Design-for-Commissioning™

Multiple Temporary Connections Added to Condenser in the Field >> ***Incorporate During Design Phase to Reduce Field Work***

ACC Blanking Plates Required Modification to Perform SigmaBlow™ >> ***Specify Blanking Plates for Full Vacuum During Design Phase when Required***

ACC Steam Jet Air Ejectors Required During Commissioning >> ***Must Design for this Condition***

Thank You