



SCMA Workshop

“Low Pressure Membrane Operations & Troubleshooting”

Broken Arrow, OK – April 10, 2018

Membrane Troubleshooting and Replacement at Brazos Regional Public Utility Agency Surface Water and Treatment System

**Joshua Berryhill, P.E.
Enprotec / Hibbs & Todd, Inc.**



Agenda

- History of Membranes and Current Options
- Proprietary vs. Non-Proprietary
- Procurement Requirements
- Regulatory Requirements
- Design/Operations/Warranty Considerations
- History and Background of the SWATS Facility
- SWATS Upgrade/Expansion Options
- SWATS Retrofit Considerations
- Procurement, Selection and Testing
- Next Steps
- Summary

History of Membrane Supply

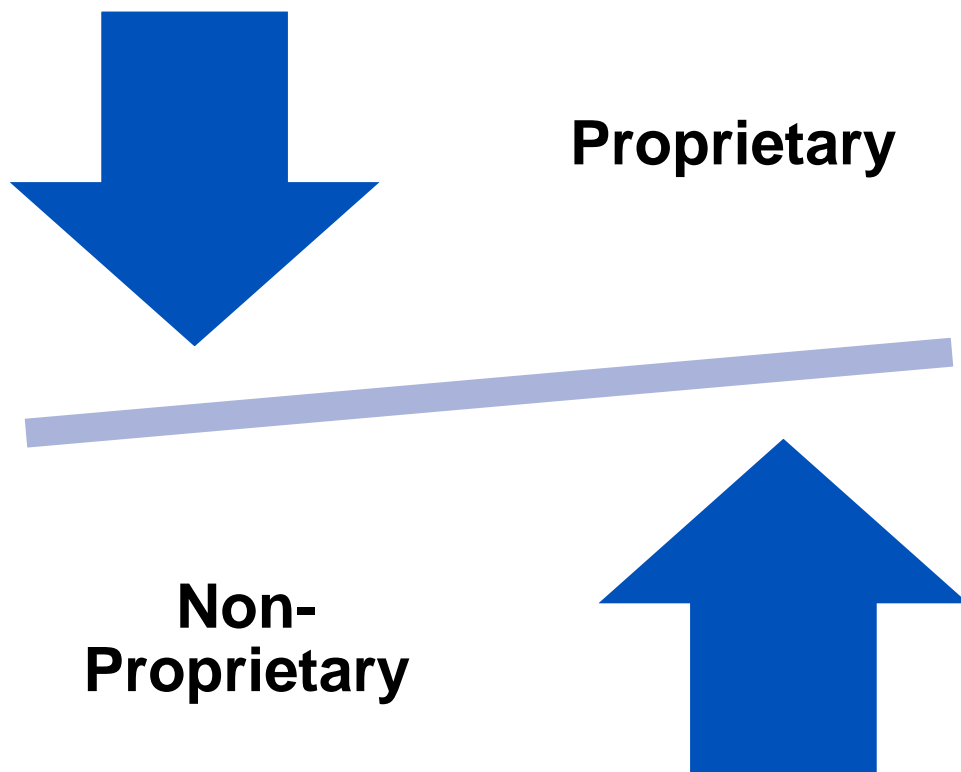
Proprietary System Approach

- Membranes, controls and support systems provided by a single supplier
- One point of responsibility
- Majority of the existing membrane systems in the US are proprietary



Current Membrane Supply Options

What Options are Most Common Right Now?



What Does Non-Proprietary Really Mean?

Non-Proprietary is frequently used interchangeably with open platform, flexible, universal platform, an open system

- **Not quite accurate though...**

- Open System – Allows for 1:1 replacement with **NO** modification of a rack to accept a different module
- Flexible / Open Platform – Allows for modification of a rack as needed to accept a different module...theoretically allows for any membrane to “plug in”, though this is affected by multiple parameters (dimensions, inside-out or outside-in flow regime, etc.)
- Universal Platform – A rack that is designed to accept ANY module without modification
 - **Great idea...that doesn't exist yet...**

Procurement Terminology

Key Terms (Especially Acronyms!) to Remember:

- Membrane Supplier (MS)
- Membrane System Supplier (MSS)
- Fabricator
- Integrator
- Original Equipment Manufacturer (OEM)



memegenerator.net

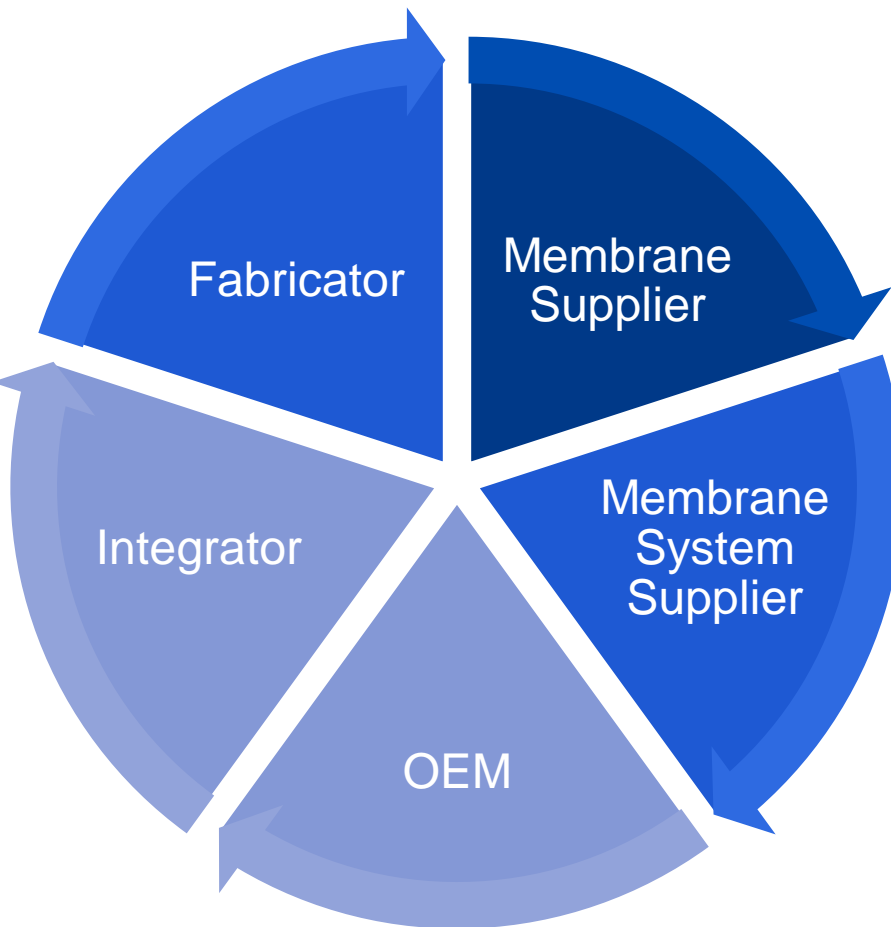
Procurement Roles

▶ Fabricator

- Fabricates major rack framing and pipe components

▶ Integrator

- Integrates membranes, controls and support equipment into a single functioning system



▶ OEM

- Provides support equipment for membrane system

▶ Membrane Supplier

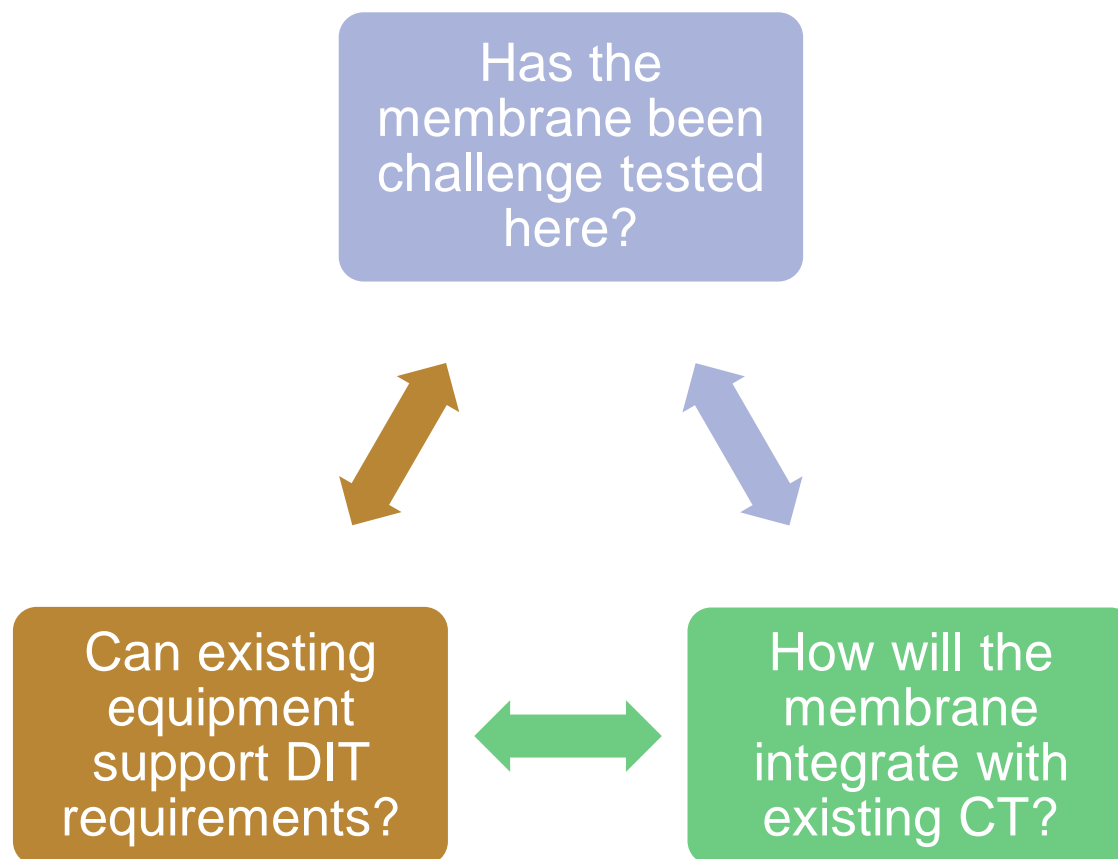
- Membrane MFR
- Can supply membranes to multiple MSS

▶ Membrane System Supplier

- Develops internal rack design and provides guidelines for fabrication & integration

Regulatory Compliance

- 3 Critical Questions:



Design Considerations

“Green Field” Design

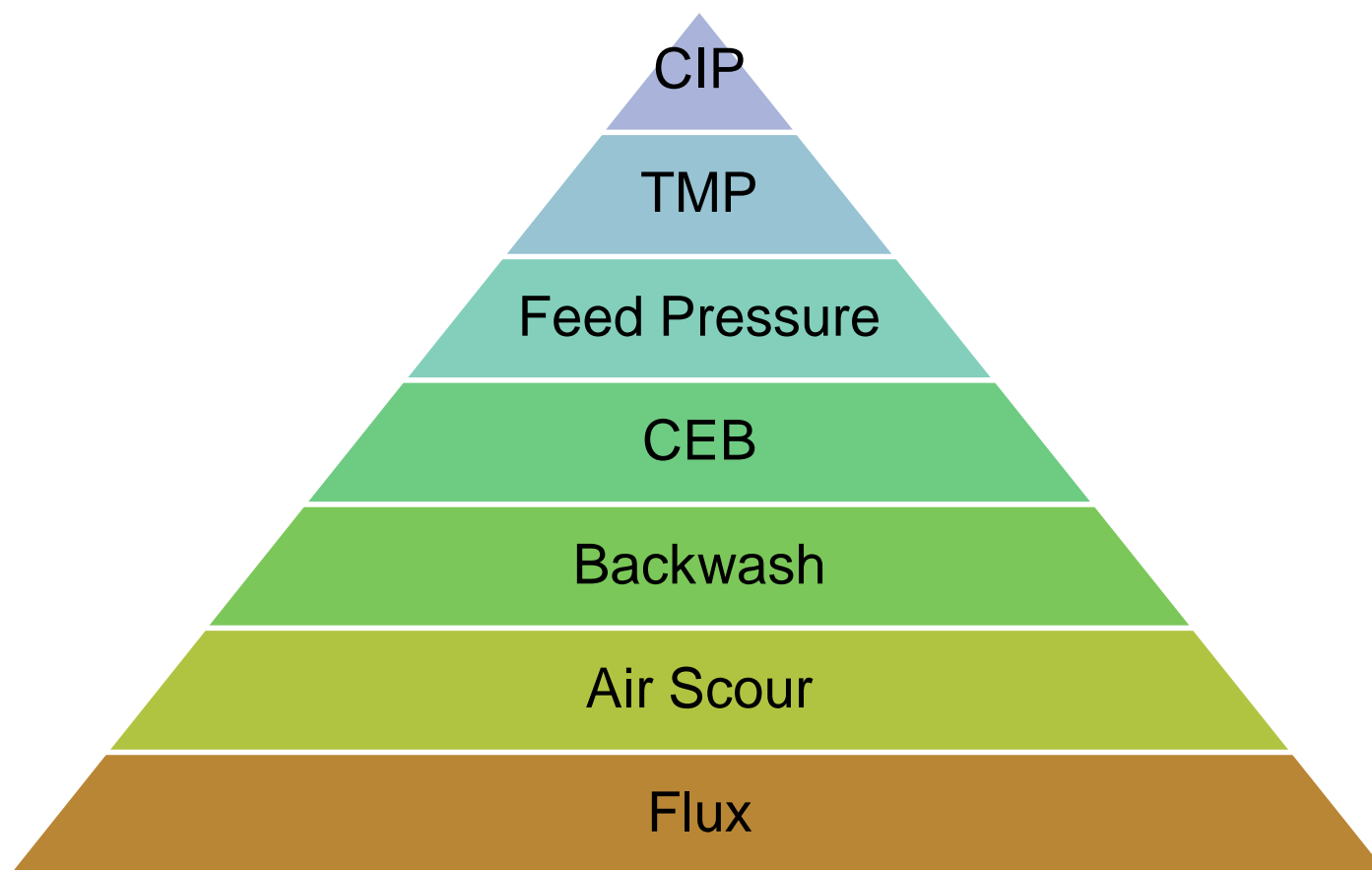
- Proprietary or open platform?
- How much flexibility in membrane supplier alternatives are you willing to pay for?

Membrane Replacement

- 1:1 replacement or allow for modifications to support more membranes?
- Maintain existing capacity or expand capacity?

Operational Differences

- Differences in Operations Prove No Such Thing as “Universal”:



Warranty Considerations

How Does Membrane Replacement Compare to New Systems?

- Membrane system supplier is typically the sole source of warranty for the membranes and support equipment (membrane warranty is incorporated into the MSS warranty)
- New membrane warranty is normally 1-2 years full warranty, 5-8 years prorated warranty
- New support equipment warranty is typically a 12 month warranty



Case Study

Surface Water and Treatment System (SWATS)

History of the SWATS Facility

- The Surface Water and Treatment System (SWATS) was constructed in 1988 by the Brazos River Authority (BRA)
 - The SWATS facility was purchased from the BRA by the two primary wholesale customers in 2012, who formed the Brazos Regional Public Utility Agency (BRPUA)
- The 1988 SWATS facility consisted of clarification, dual media filtration, and electro dialysis reversal (EDR)
- Desalination technology was implemented to address widely varying chloride levels in Lake Granbury (**50 to 1,400 mg/L**)
- The SWATS facility was expanded/upgraded in 2001 and 2008
- The SWATS facility currently consists of lime-softened clarification, dual media filtration, ultrafiltration (UF) membrane filtration, and reverse osmosis (RO) membrane treatment

SWATS Membrane System Background

UF Membrane Filtration System

- Consists of 5 pressure UF trains
- HydraCap UF membranes originally installed in 2001, replaced with X-Flow UF membranes in 2008
- Previous effective filtrate capacity – 8.0 MGD



RO Membrane Treatment System

- Consists of 5 two-stage (85% recovery) RO trains
- Current RO elements used include Dow and Toray
- Current **theoretical** permeate capacity – 7.5 MGD



SWATS – Upgrade/Expansion Options

What Was the “Right” Fit for this Project?

- 1:1 Replacement?
 - **Insufficient capacity to meet current (much less future) facility production demands**
- Full Replacement?
 - **Existing support systems still have remaining useful life (full replacement would be overkill)**
- Open Platform Retrofit?
 - **Restore/expand train capacity within the same footprint**



SWATS – Retrofit Considerations

Ready to Start?

Not Quite...

- What is the realistic effective filtrate capacity that we can obtain?
- Do any of the support systems limit effective capacity?
- What are the capital/O&M cost implications?
- What needs to be done to obtain regulatory approval?

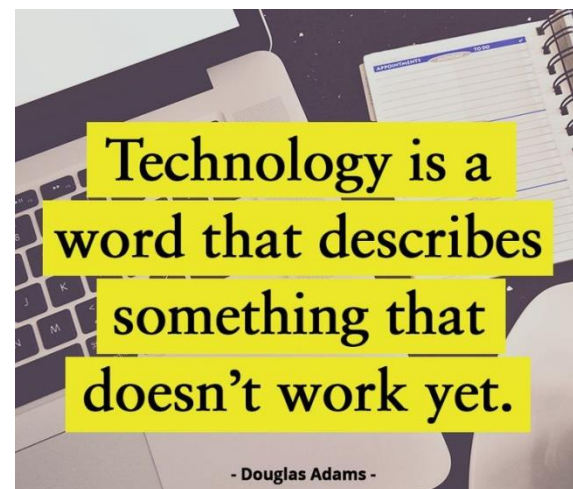
SWATS – Retrofit Considerations

Now We're Ready!

Still Not Quite...

- How is this going to operate?
- Are there any existing issues we have to overcome on Day 1?
- What have operators done at other plants to “make it work”?

Bottom line...coordination with the plant operators is key!



THAT MOMENT WHEN YOU MISS ONE STEP ON THE STAIRS, AND YOU THINK YOU'RE ABOUT TO DIE.



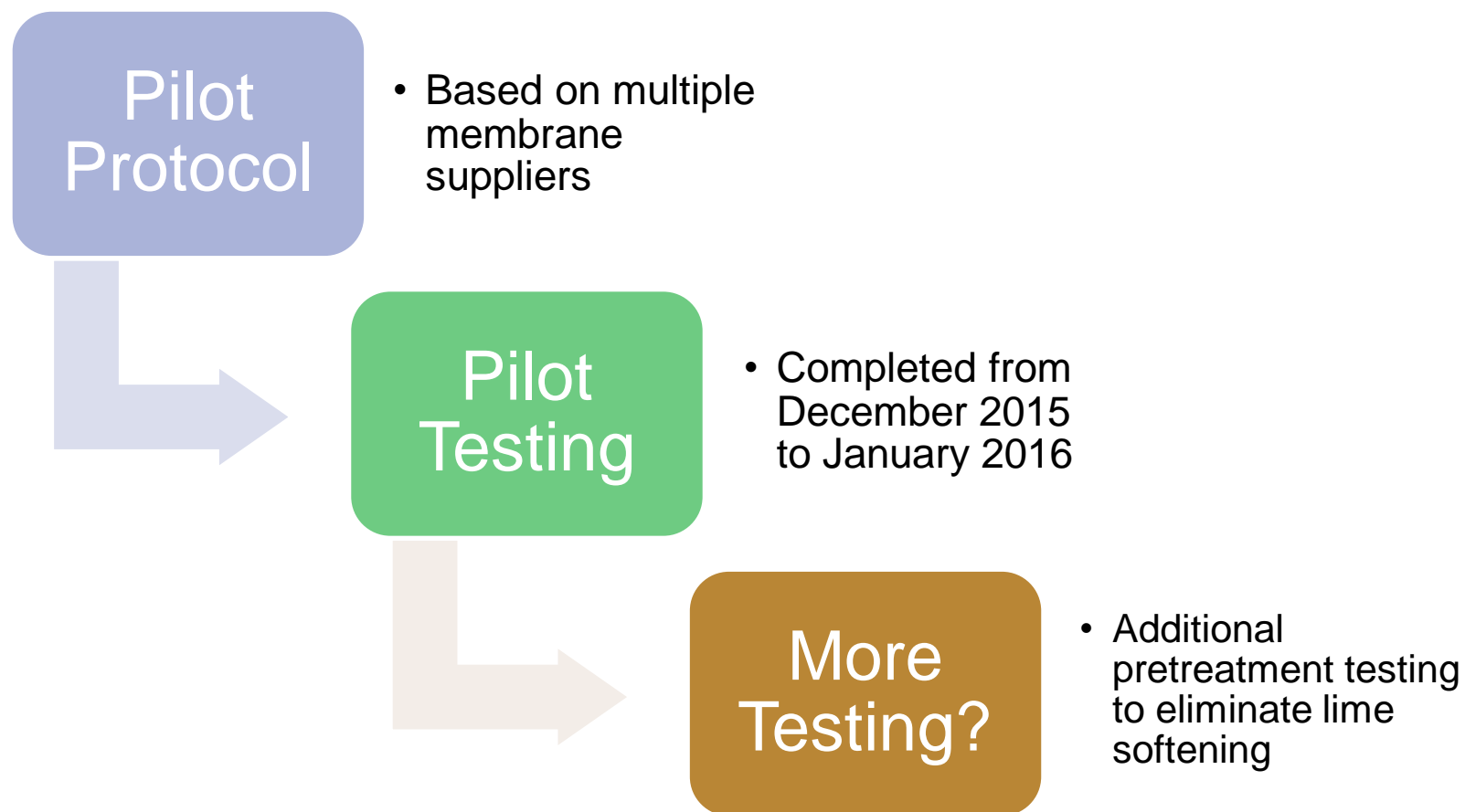
SWATS – Selected Procurement Approach

A Better Question...Where to Start?

- A Request for Proposals (RFP) procurement approach was selected by BRPUA
- Multiple MS/MSS firms were contacted to begin the prequalification process
 - Potential suppliers were required to closely examine the existing UF system to maximizing repurposing of the existing support systems as feasible in order to be prequalified for the project
- The RFP was structured to provide a minimum capacity equivalent to the original UF rated capacity
 - Additive alternates were also prepared to support an expansion of the existing UF train capacity from 2.0 MGD (each) up to a maximum of 3.0 MGD (each) within the existing train footprint

SWATS – Membrane Selection and Performance Testing

- Okay, We've Bid...Now What?



SWATS – Next Steps

Now We Know this Will Work...Now What?

- ✓ Continue coordination with TCEQ for approval the pilot-scale testing report and subsequent plans and specifications for the new UF retrofit
- ✓ Implement UF system retrofit
- ✓ Coordinate with TCEQ to update DIT protocol for new membranes, amend CT protocol documentation and prepare for a new SWMOR
- ✓ Complete full-scale performance validation and optimization
- ✓ **Watch the new membranes do their job...enjoy!**



Summary

What is the Right Answer?

- **There isn't one yet.**
- Picking Proprietary vs. Non-Proprietary isn't as simple as it sounds
- Trying to select a system that can provide a wide array of options (now or in the future) isn't as complex as it sounds either!
- Either option ends up with a new membrane system that should perform well for many years
- Take a deep breath and don't hesitate to question your approach to make sure you feel comfortable!

Questions?

Thank you for your time!

If you have more questions, please feel free to contact me at:

joshua.berryhill@e-ht.com

Joshua Berryhill, P.E.

Enprotec / Hibbs & Todd, Inc.

