DON'T PANIC

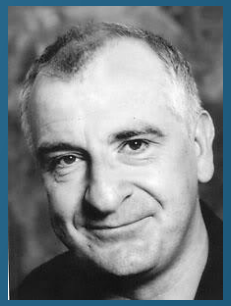
The SWATS Guide to a Membrane Filtration System Open Platform Retrofit

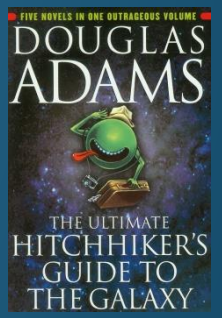
Joshua Berryhill, PE
Sr. Project Manager
Enprotec / Hibbs & Todd, Inc.

Texas Water 2016
Fort Worth, Texas

Acknowledgements

- Douglas Adams 11 March 1952 – 11 May 2001
  - The Hitchhikers Guide to the Galaxy





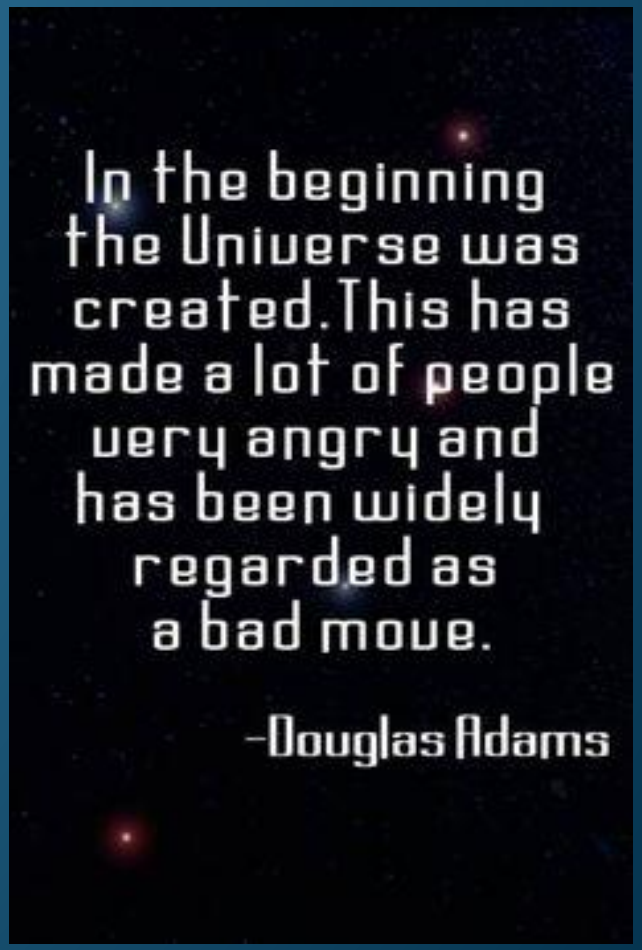
- Toray Membrane USA
- WesTech
- Brazos Regional Public Utility Agency (BRPUA)

- Alain Richard, Co-Author

- Colden Rich, Co-Author

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



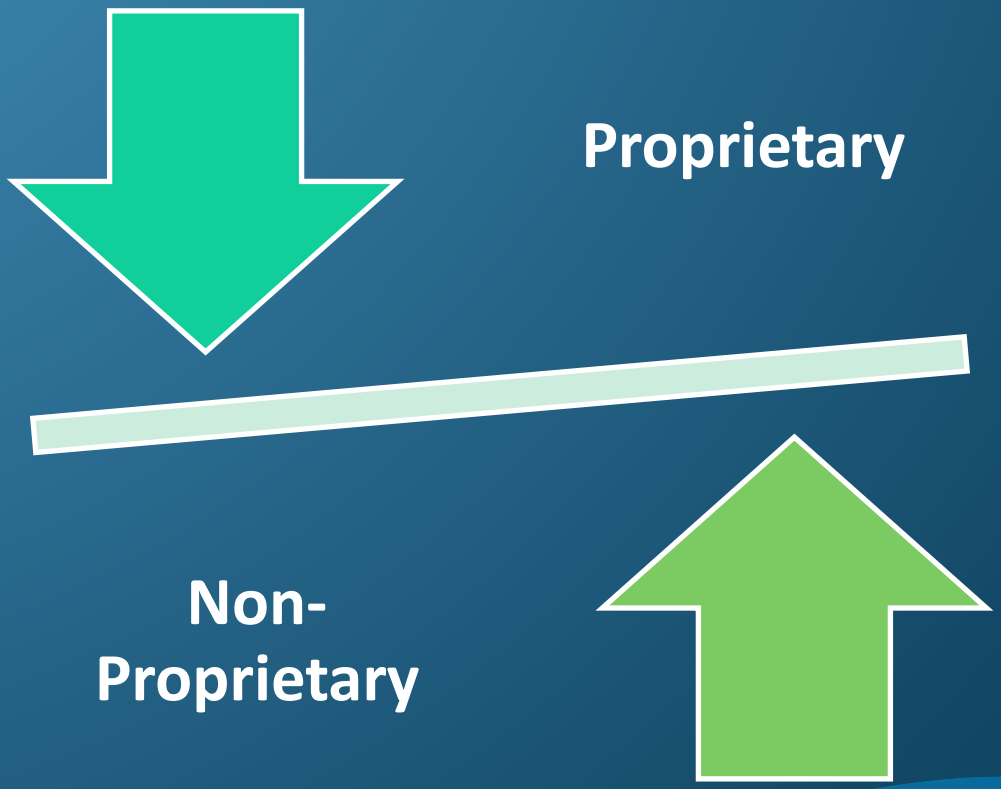
History of Membrane Supply

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…**

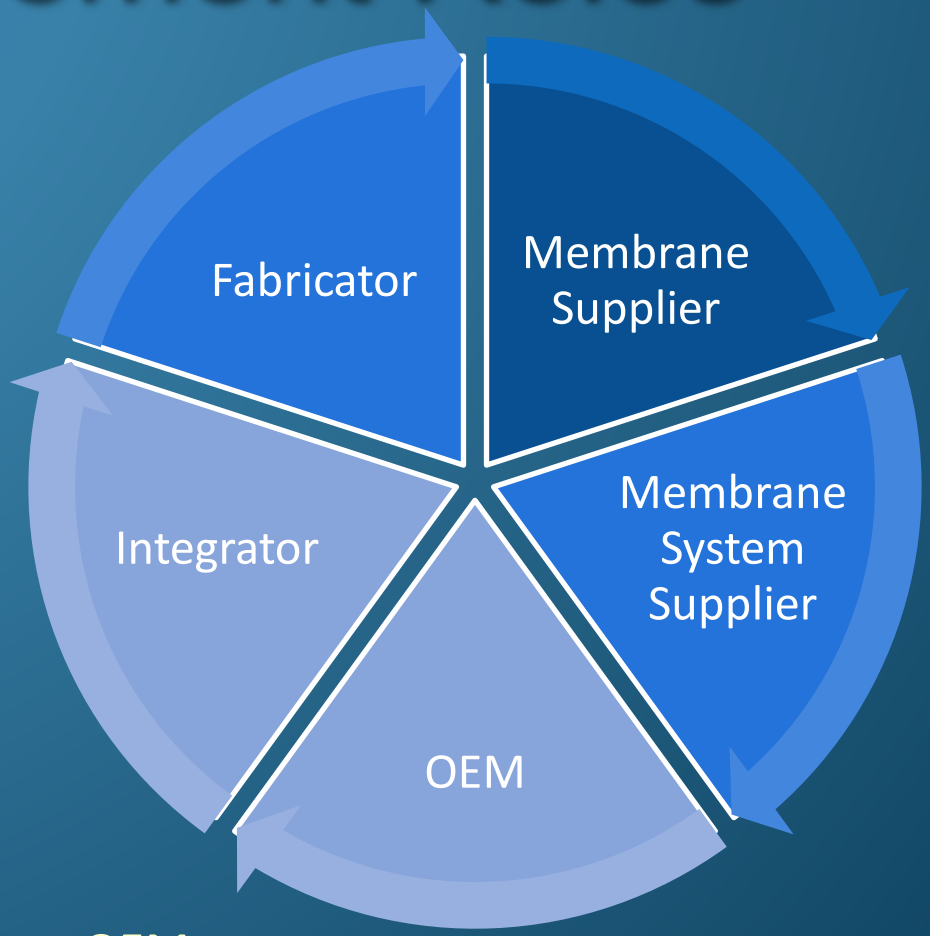
Procurement Terminology

Key Terms (Especially Acronyms!) to Remember:

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

Procurement Roles

- Fabricator
  - Fabricates major rack framing and pipe components
- Integrator
  - Integrates membranes, controls and support equipment into a single functioning system

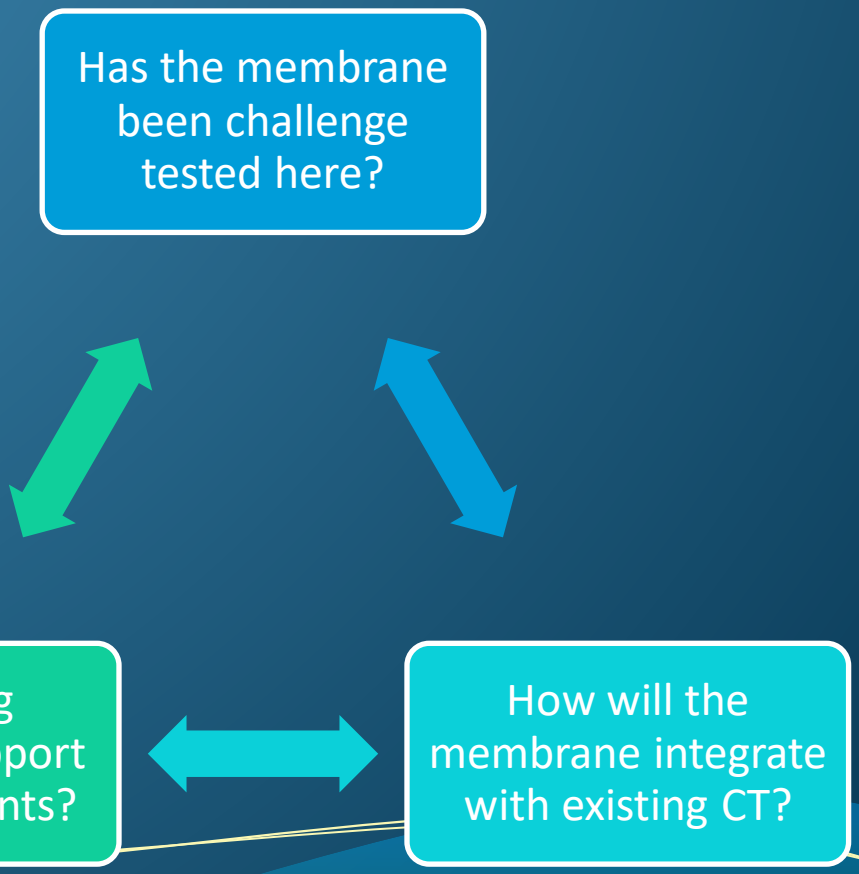


- OEM
  - Provides support equipment for membrane system

- 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:



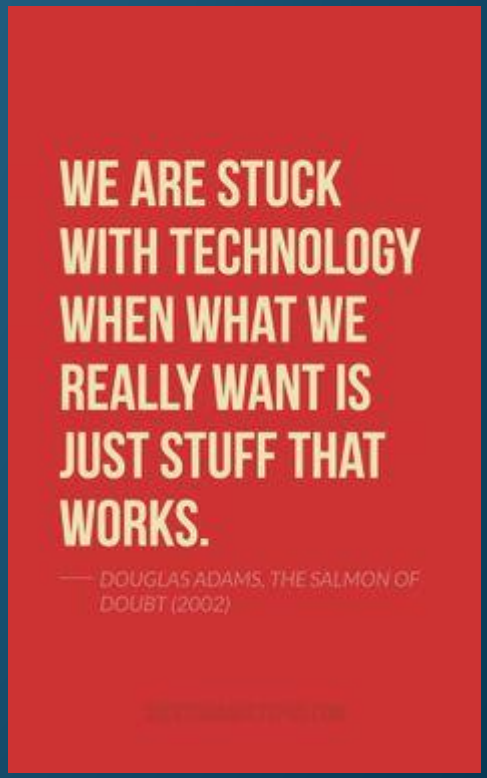
Design Considerations

“Green Field” Design

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

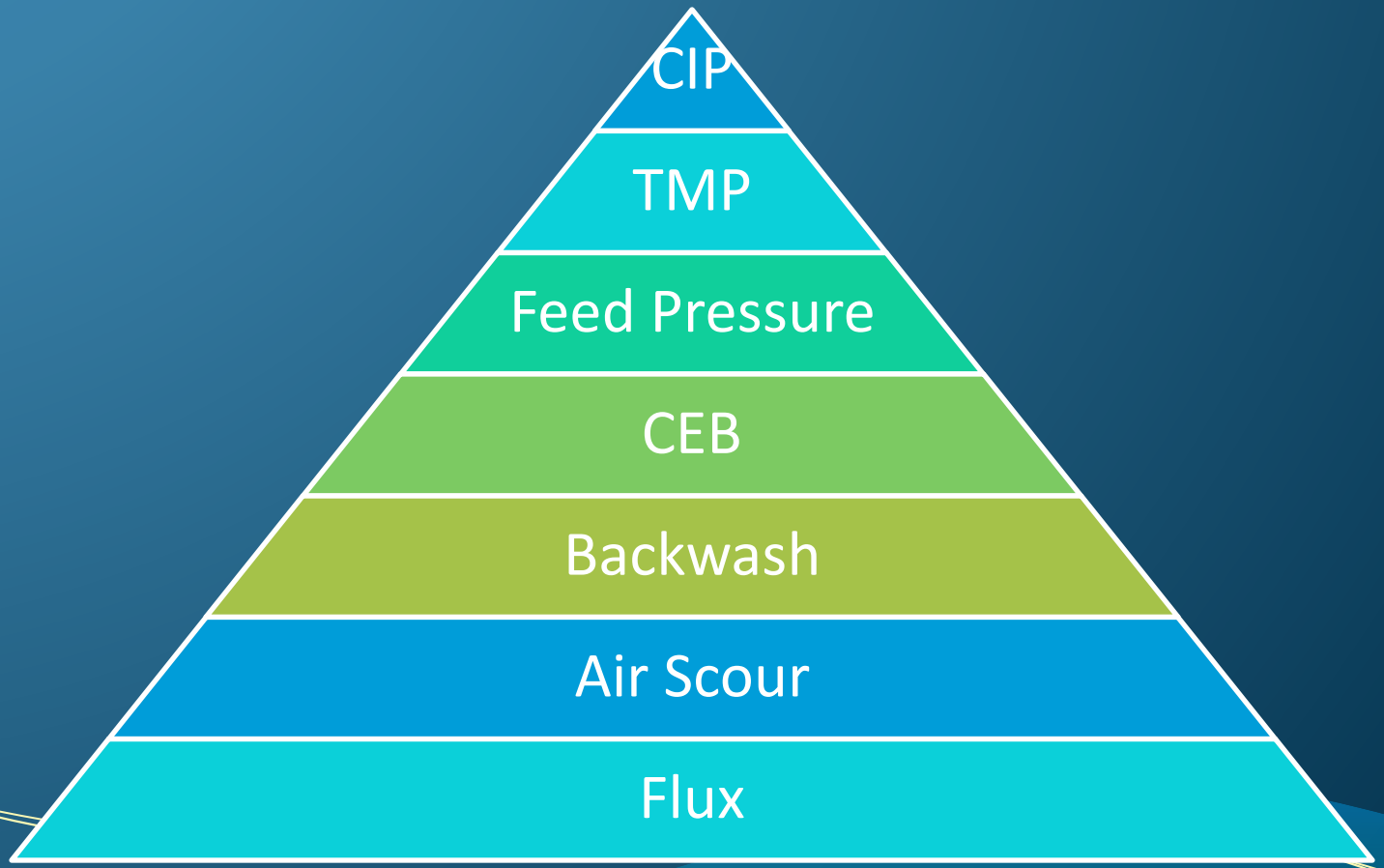
Membrane Replacement

- 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

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 electrodialysis 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
- Current 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?

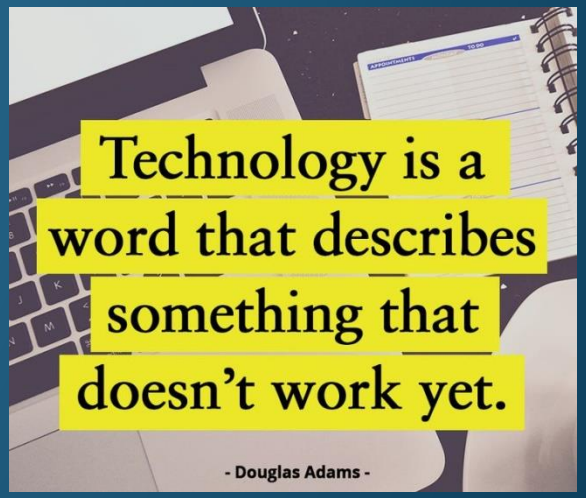
SWATS – Retrofit Considerations

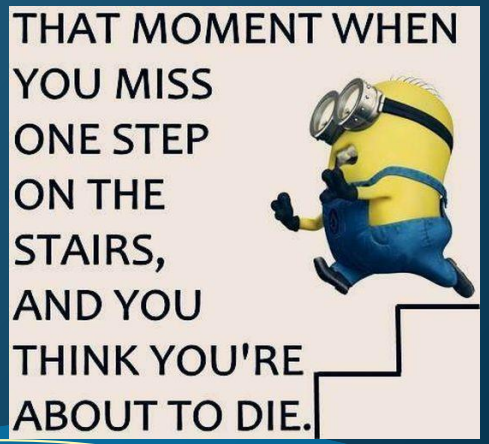
Now We're Ready!

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 your operators is key!





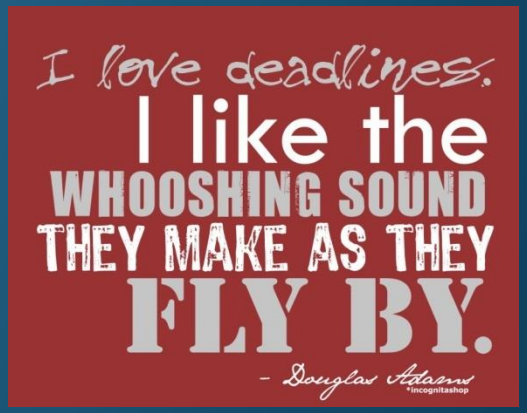
SWATS – Selected Procurement Approach

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?



Pilot Protocol

- Based on multiple membrane suppliers

Pilot Testing

- Completed from December 2015 to January 2016

More Testing?

- Additional pretreatment testing to eliminate lime softening

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, keep questioning your approach to make sure you feel comfortable, and above all…


Questions?
Thank you!