PATCH MY WORN OUT JEANS, 'CAUSE I'M GOING TO COW TOWN

2020 TEXAS WATER SUMMIT – FORT WORTH, TX

CANYON REGIONAL WATER AUTHORITY ESTABLISHED 1989

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GENERAL

Canyon Regional Water Authority (CRWA) has operated the Lake Dunlap Water Treat Plant (LDWTP), a membrane filtration potable water treatment facility in New Braunfels, Texas, for nearly two decades. Over the years the membranes have required re-fibering to address and restore membrane filtration operation. Typical past replacements (five year intervals) have involved re-fibering with the original manufacturer and membrane product. This expedites regulatory approval, competitive bidding, and operational maintenance.

In the last 20 years, the membrane filtration market has gone through considerable evolution. New technology has replaced the original membrane composition. Economic factors, foreign manufacturers, and expiring patents have increased the competition and lowered pricing of replacement options.

This poster describes CRWA's evaluation of new technology and open markets in its most recent re-fibering effort.

EVALUATION OF AVAILABLE OPTIONS

The older polymeric fiber of the existing LDWTP membranes made operations more difficult and mandated membrane replacement. The existing membranes were "pin" repaired. This involved inserting plastic pins on either end of the fiber. The process was time consuming and over time reduced capacity. Chemical cleaning of the fibers showed lower restoration to original operating conditions. The raw water supply was rated a "Bin 2" for cryptosporidium testing classification. Direct Integrity Testing (DIT) became more frequent and required more of the operator's time for membrane repairs to pass DIT performance.

CRWA was faced with numerous options to replace the aging fibers. After evaluating numerous options, a path forward was selected.

- **Option 1.** The first option considered was replacing the Koch Targa II membrane filters. LDWTP has six (6) racks of 44 each, 10" modules, rated at 14.4 MGD capacity. Koch would be allowed to bid replacement of the current modules.
- **Option 2.** Pall MFS has successfully operated numerous water treatment plants in Central Texas and throughout the world. They were selected to perform an on-site pilot test to demonstrate their performance. Pall was one of five manufacturers who successfully pilot tested in 1999 and were allowed to bid on the original plant construction.
- **Option 3.** Manufactured in Germany, Nanostone, a ceramic filter, has performance characteristics of an ultrafiltration membrane (UF). Demonstrated to be successful in industrial and municipal operations, Nanstone's new technology offers benefits to conventional membrane filters.

REGULATORY APPROVAL

Because membrane fiber replacement is considered a new technology, it required Texas Commission on Environmental Quality (TCEQ) approval. This process involved demonstrating NSF certification, third party review of "log removal value" (LRV) for virus, Giardia and Cryptosporidium reduction and pilot testing protocol. TCEQ reviewed and approved Nanostone and Pall options. Since Koch was a reinstallation with similar fiber, prior approvals were allowed and no additional pilot testing was required.

Each of the vendors were allowed to demonstrate performance using single module pilot testing. Approved pilot protocol was followed for the 90-day performance testing. The test period involved field calibration, chemical cleaning, and DIT verification. Results, including a performance narrative and data reduction for each, were submitted to TCEQ. Performance was deemed successful by TCEQ and operational parameters approved.

COMPETITIVE BIDDING

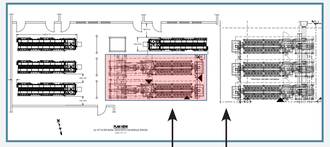
After the pilot test was completed and the performance results were submitted to TCEQ, Trihydro prepared an advertisement for competitive bidding with plans and specifications. Bid packages required membrane manufacturers to be responsible for contractor construction of the installation.

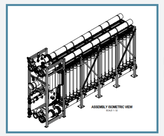
- **Bid Option 1 –** Included the complete replacement of the existing six (6) racks. It was anticipated that membrane feed pumps, pre-filters, chemical cleaning, and backwash pumps would be reused.
- **Bid Option 2 –** Included pricing to supply and install the six (6) racks with membrane modules and supporting components sufficient to supply the replacement 14.4 MGD capacity.
- **Bid Option 3 –** Included pricing on retrofit modifications with all new fiber only.

Capital, operating, warranty, and future module replacement costs were requested for each of the options. Financing of the selected option was also requested. The pricing for the multiple bid option was tabulated for evaluation. Not every option was required to be bid by each manufacturer. The overall objective was to secure the best pricing for CRWA for each option, regardless of the manufacturer.

VENDOR DETAILS - PALL

COMMERCIAL ITEMS	OPTION 1 – NEW RACK AND MEMBRANES	OPTION 2 – NEW MEMBRANES, RACK MODS
Total Cost	$3,500,000	$4,607,100
Down Payment Amount	$175,000	$230,355
Financing duration	Milestone payments : 5% at award; 20% at dwgs; 20% dwg approval; 20% release to fab; 25% ship; 10% production Financing : $2M payable via milestones with remaining $1.5 spread out as $125,000 payments x 12 (3 years, Qtr Payments)	Not offered
Warranty Terms	1-year workmanship - full repair/replace 10 Year Performance: 7-year absolute / 3-year prorated	
Replacement Costs	$0 - 7 years; yß -$1000; +$125 per year through warranty	
Proposed Schedule	May 7 - 34 weeks June 11 - 39 weeks	June 11 - 39 weeks July 10 - 43 weeks
TECHNICAL ITEMS		
TCEQ Approved Pilot Study / Pending Approval	Imminent	
Previous Project Experience	5 references provided ; large past project list	
Flux Rate	68 GFD (gallons/square foot/day)	
Recovery Rate	97%	
Total Chemical Usage, $/1000 gal		0.0176
Chlorine	0.0039	
Sodium Hydroxide	0.008	
Citric Acid	0.0019	
Sodium Bisulfite		
Accommodation of future membranes in installation plan	partial - demo of 3 existing future demo and 5 required	included with existing layout



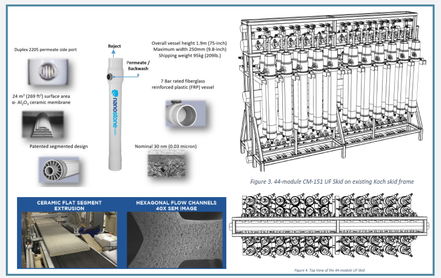


EXISTING KOCH MODULES TO REMAIN

EXISTING KOCH MODULES TO BE DEMOLISHED

VENDOR DETAILS - NANOSTONE

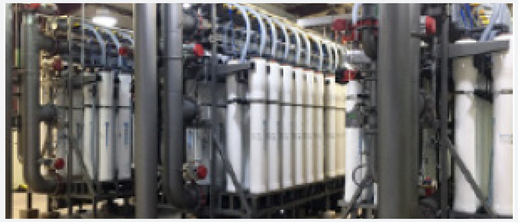
COMMERCIAL ITEMS	OPTION 1 – NEW RACK AND MEMBRANES	OPTION 2 - NEW MEMBRANES – MIN MODS
Total Cost	$2,842,000	$1,425,000
Down Payment Amount	$710,500	$285,000
Financing duration	$710,500 with drawings ; $852,600 ready to ship; $968,400 at perf test pass	$32,571.43/month for 35 months or $95,000 per quarter x 12 quarters
Warranty Terms	workmanship - repair/replace on perf test failure 20-year lifetime warranty 3 year complete replace; prorated MMRP x (months left / 24)	
Replacement Costs	+$175 x year in service through 2029	
Proposed Schedule	April 17 - 31 weeks May 15 - 35 weeks	December 18 - 14 weeks Jan 15 - 18 weeks
TECHNICAL ITEMS		
TCEQ Approved Pilot Study / Pending Approval	Approved	
Previous Project Experience	None	only two references available- both retrofit
Flux Rate	208 GFD (gallons/square foot/day)	
Recovery Rate	93.90%	
Total Chemical Usage, $/1000 gal	0.0011	
Chlorine	0.0011	
Sodium Hydroxide	0.0015	
Citric Acid	0.0045	
Accomodation of future membranes in installation plan	Skids fit within existing foot print	No major mechanical modifications required. Open bay remains open for 3 future skids.



TRIHYDRO RECOMMENDATION - NANOSTONE

Ultimately, CRWA decided to utilize Nanostone for the membrane replacement. It offered:

- Lowest cost option
- Shortest completion schedule
- Best warranty
- Minimal mechanical modifications
- Greatest flexibility for future expansion



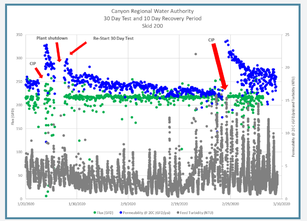
VENDOR COMPARISON

COMMERCIAL ITEMS	PALL OPT 1	NANOSTONE OPT 2
Total Cost	$3,500,000	$1,425,000
Down Payment Amount	$175,000	$285,000
Financing duration	Milestone payments : 5% at award; 20% at dwgs; 20% dwg approval; 20% release to fab; 25% ship; 10% production Financing : $2M payable via milestones with remaining $1.5 spread out as $125,000 payments x 12 (3 years, Qtr Payments)	$32,571.43/month for 35 months or $95,000 per quarter x 12 quarters
Warranty Terms	1-year workmanship - full repair/replace 10 Year Performance: 7-year / 3-year	1 yr- workmanship - repair/replace 20-year lifetime warranty : 5 year / 15 year
Replacement Costs	$0 - 7 years; $1000; +$125 per year through 2029	$0 – 5 years; +$175 x year in service through 2039
Proposed Schedule	May 7 - 34 weeks June 11 - 39 weeks	December 18 - 14 weeks Jan 15 - 18 weeks
TECHNICAL ITEMS		
TCEQ Approved Pilot Study	Approved	Approved
Previous Project Experience	5 references provided ; large past project list	Only 2 references available
Flux Rate	68 GFD	208
Recovery Rate	97%	93.9%
Total Chemical Usage, $/1000 gal	0.0314	0.0071
Accommodation of future membranes in installation plan	partial - demo of 3 existing future demo and 5 required	No major mechanical modifications required. Open bay remains open.

CONSTRUCTION AND FULL-SCALE PILOT DEMONSTRATION

The construction involved the direct retrofit of the existing racks with new Nanostone ceramic ultrafiltration (CUF) module to replace the original polymeric units. The first shipment of the Nanostone included modifying plumbing and constructing structural module supports within the existing rack modifications.

Initial rack preparation began in February 2019. The first shipment of the Nanostone CUF modules arrived in March 2019. In June 2019, the first of six polymeric membrane racks were retrofitted and put online with 44 Nanostone CUF modules and controls each. Process start-up and rack calibration were underway immediately. The remaining polymeric racks continued operation as the next rack modifications began. The final rack retrofit was completed in December 2019. Full scale pilot testing began in January 2020 on a single rack. The remaining retrofitted racks continued in production mode.



The system operated in dead end filtration mode, with a system recovery of 97.7%. System flux was 217 GFD at 20 degrees C.

CONCLUSIONS

- System water chemistry and physical characteristics are key parameters in overall membrane operation and retrofit selection.
- The system retrofit benefited from reuse of the existing racks and control system.
- CIP procedures demonstrated module recovery to original flux conditions and 95% performance below 0.025 NTU filtrate quality.
- Direct integrity testing showed that log removal values (LRV) averaged 5.36, above the required 4.