

Columbia WTP Membrane Replacement Project

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- **Overview**
- **Replacement options/Decision/Factors considered**
- **Replacement process/installation/issues during replacement**
- **Integrity testing results**
- **Plant performance after installation**
- **Conclusions**



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Overview

- Columbia WTP, 6.0 million gallons per day (MGD), six microfiltration (MF) membrane racks X 112 L10V PVDF modules (1 MG per rack), outside-in design
- On-line March 15, 2005, 7 year prorated warranty on modules
- Production: 10.9 billion gallons from 2005-2013, met or exceeded all water quality performance targets
- Breakage and “potting failures” in 2011-12 led to increased maintenance and warranty module replacements
- Carollo Engineers led design workshops in late 2012. Worked with operators and plant managers to understand plant needs, what went well in first eight (8) years of operation and what needed improvement

Overview (Continued)



- Workshops to decide on whether to:
 1. Change to open platform design and then take bids from various suppliers of membrane modules
 2. Replace with membranes that fit existing racks and get sole-source price from replacement module manufacturer

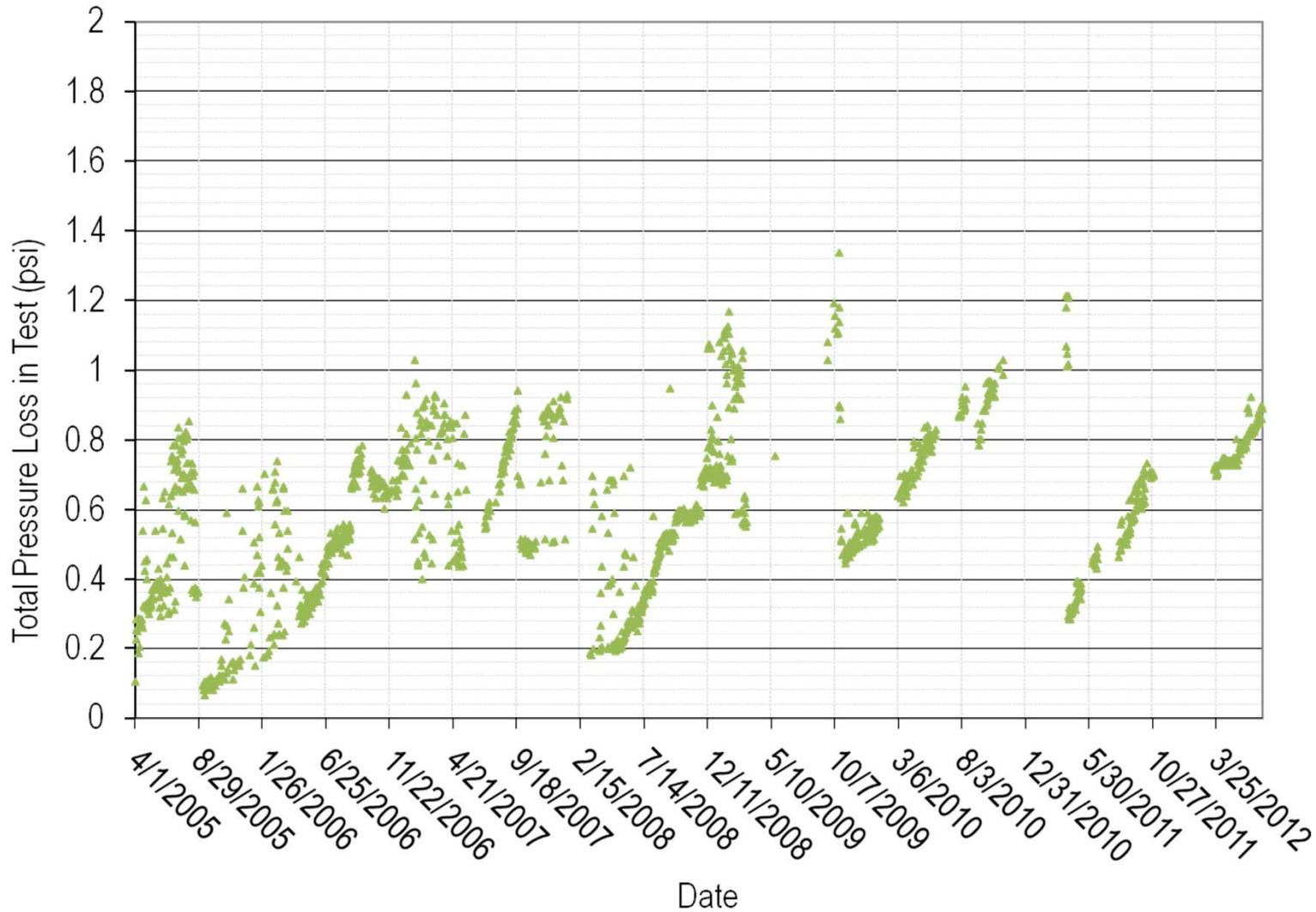
- Decided to replace with sole source purchasing and fit to existing racks, ordered new membrane modules in December 2012 and installation began in April 2013

- Plant remained on-line during project, at reduced capacity, with four of the six racks on-line at all times

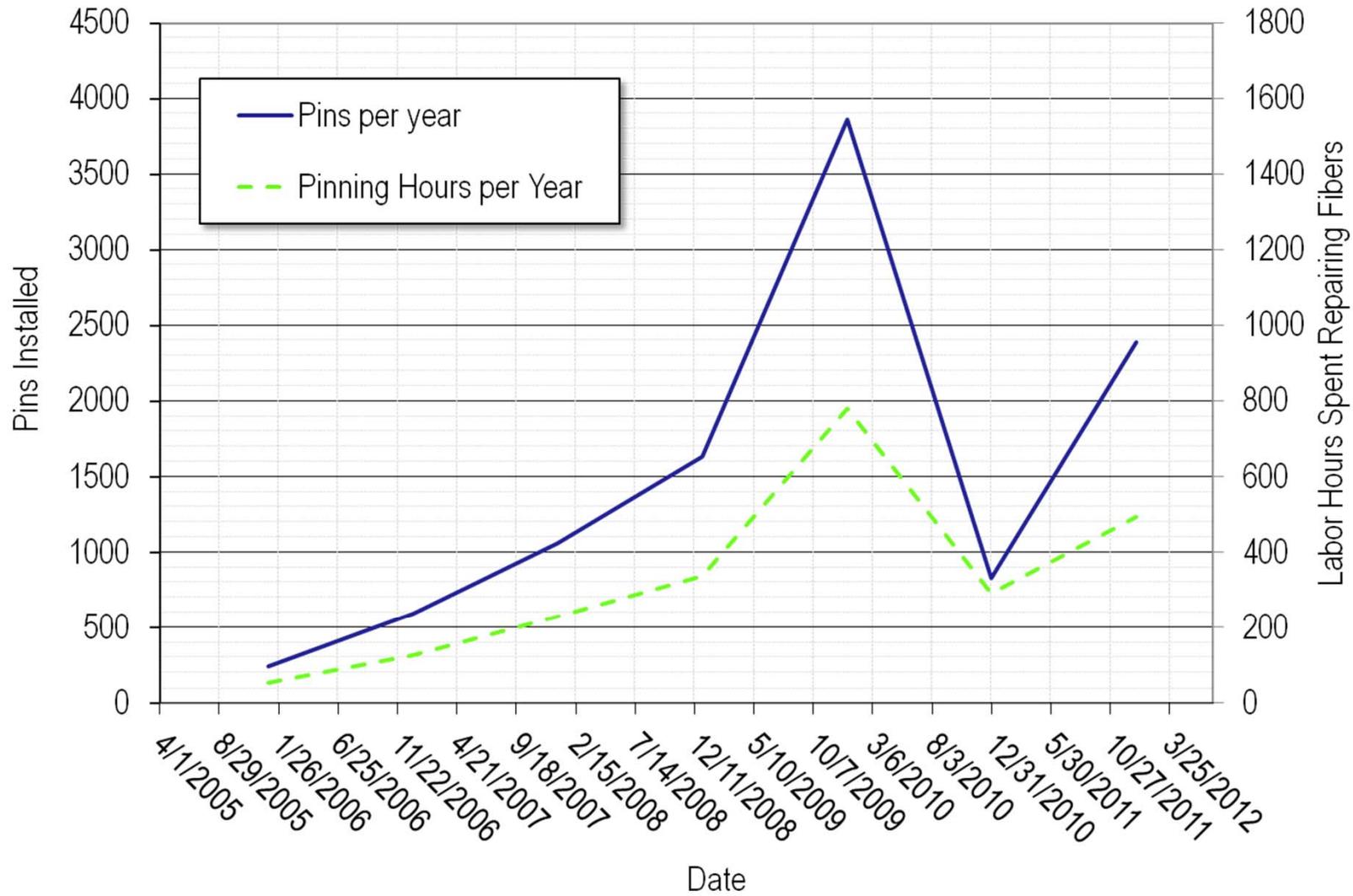
- Performance testing completed in August 2013

- Final report to Idaho Department of Environmental Quality (IDEQ), received final approval of installation in September 2013.

Membrane Integrity Was a Continuous Issue



Repairing Fibers Became a Significant Part of Our Maintenance Duties and Costs



Replacement Options... Replace Modules With New Membranes From Current Supplier



Existing: Proprietary design and specialized components, compact design.

Replacement Options... Switch to a New Open Platform Membrane System



Open platform examples (2): Headers/ports with space for modules in between.
Many parts available from local potable water supplier .

We decided to buy new membranes from existing supplier

Factors:



○ Cost

- Replacement (new membranes from existing supplier) \$1.1 million
- Install open platform (discarding old racks) get bids for new membranes from various suppliers >\$2.5 million

○ New, improved modules were available

- Thicker wall on fibers to reduce breakage
- Improved potting material compatibility with fibers
- Improved porosity to maintain plant capacity with fewer fibers per module (reduced from approximately 9,000 to 6,000 fibers per module)
- Modules had been challenge tested and had regulatory approval in other states
- Smaller pore size of L10N new membranes at 0.04 micron (0.10 micron for L10V)
- Capacity had never been a problem and we were confident that the materials of construction were compatible with our water and the CIP process.

○ Plant expansion to (10 or 20 MGD) planned in 5-10 years; will consider open platform at that time as part of the larger project

○ Existing racks & plant were serviceable with replacement of rack effluent valves

○ Refit of strainers (500 micron to 250 micron effective size) required by supplier to protect membranes from damage and as condition of warranty

Comparison Between "V" and "N" Series Membranes



	Original V-Series	New N-Series
Fibers per Module	9000	6000
Surface Area Per Module	252 ft ²	230 ft ²
Design Flux	41 gfd	44.5 gfd
Pore size	0.10 micron	0.04 micron

Installation Phase



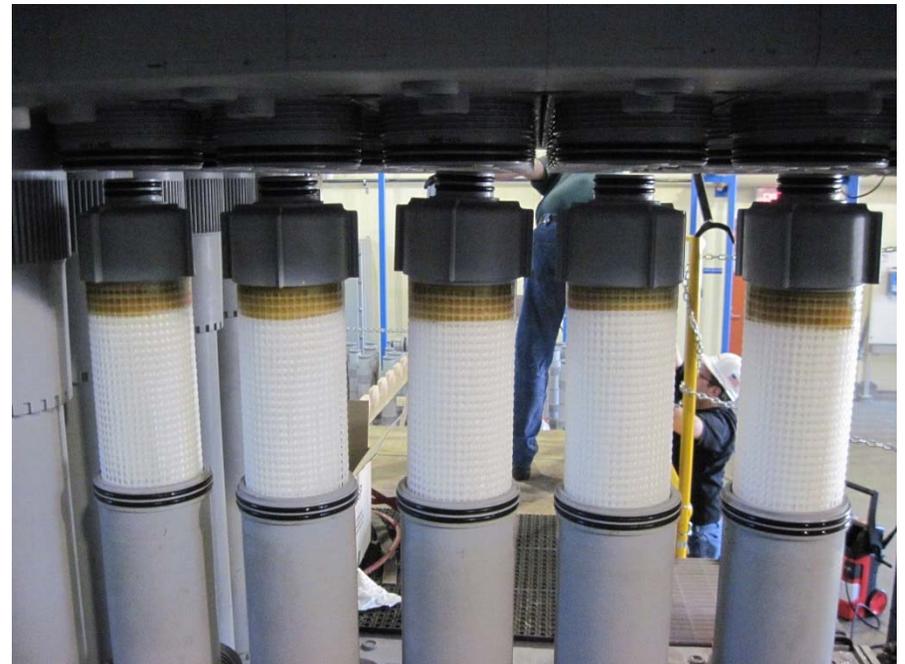
- Contracted with membrane manufacturer to provide a three person team; Team installed membranes in two weeks. One person stayed an additional week for programming and start-up. One United Water (UW) person assisted with installation and provided coordination with UW operations staff

Removed 1/2 of the rack at a time



Installation Phase

Methodical installation, in stages, needed to maintain hydration of membranes



Installation Phase



To protect the new membrane modules, and comply with warranty requirements the existing 500 micron strainers were replaced with 250 micron strainers

Existing duplex strainer assembly

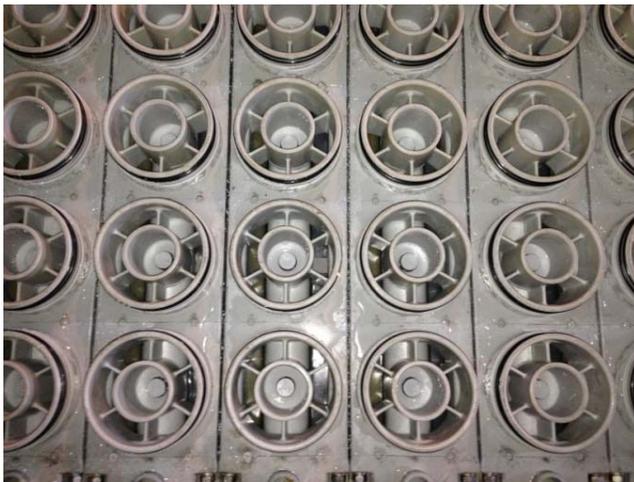


Retired 500 micron strainers



Issues to Look Out For During Membrane Replacement...

Power Washing



Damaged Blocks

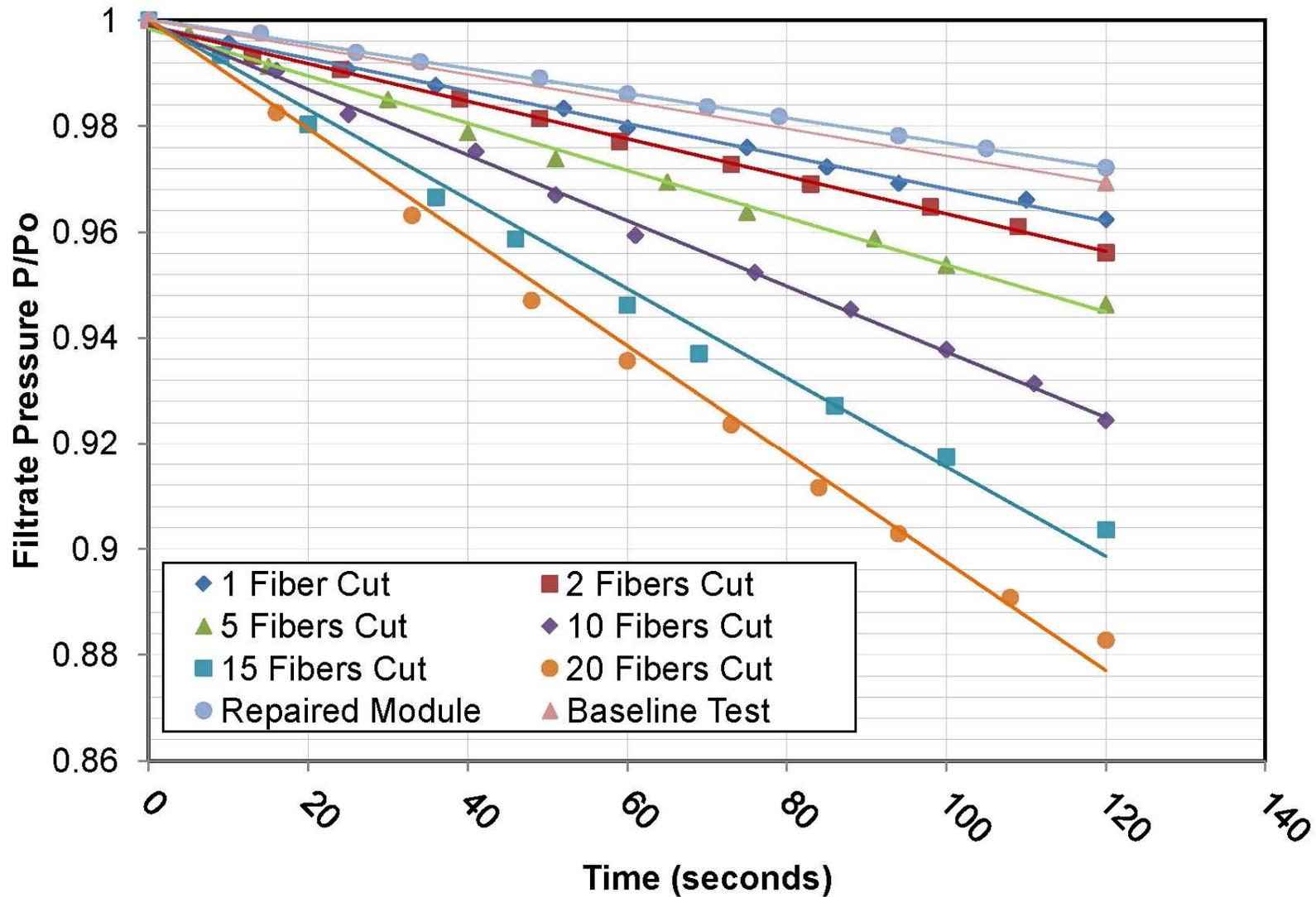


Testing and Approval

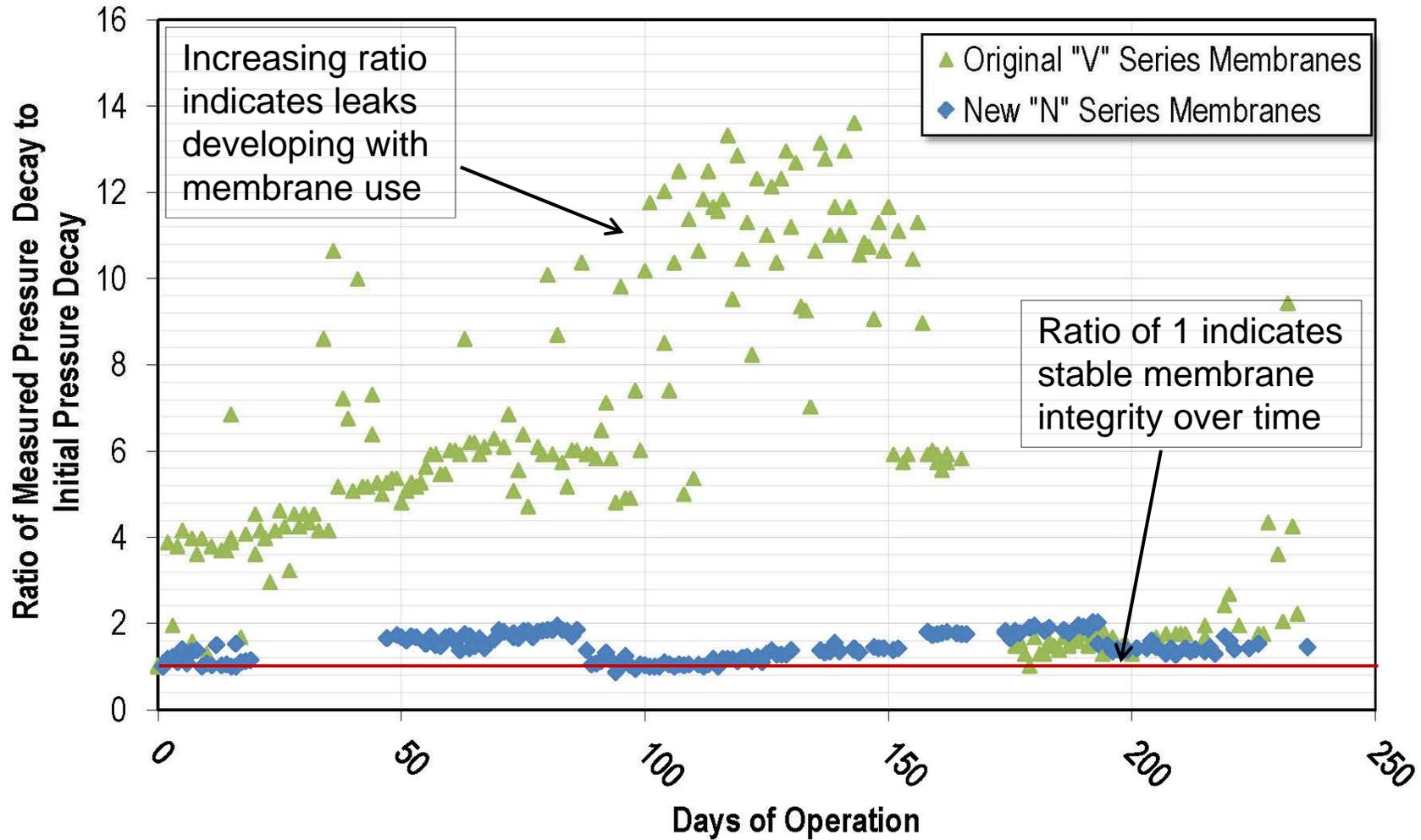


- The plant operated from May to August with new membranes
- Gathered routine operational data and reported to IDEQ
- Integrity testing completed in August, 2013
- Obtained final approval in September 2013

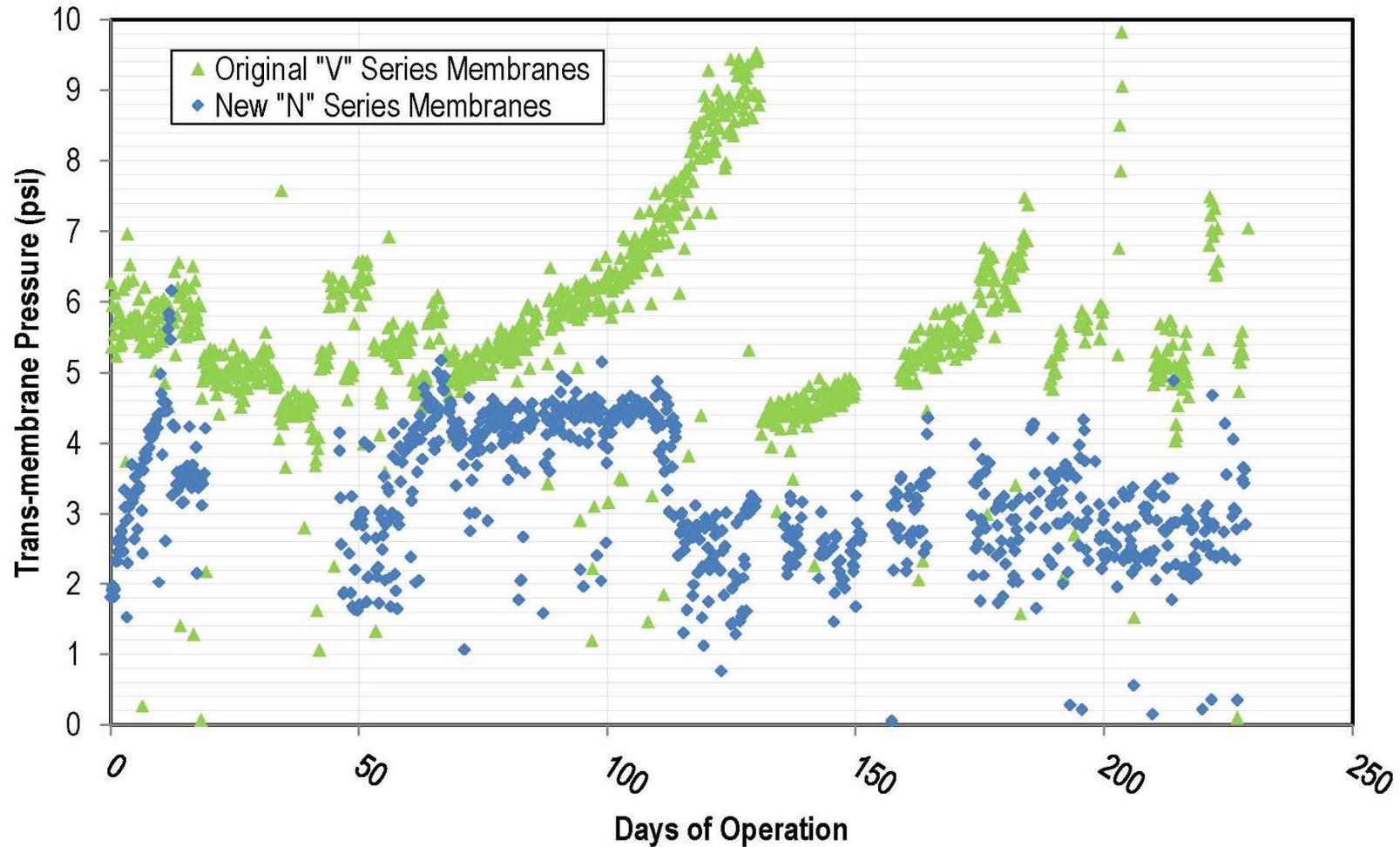
Integrity Test Validation



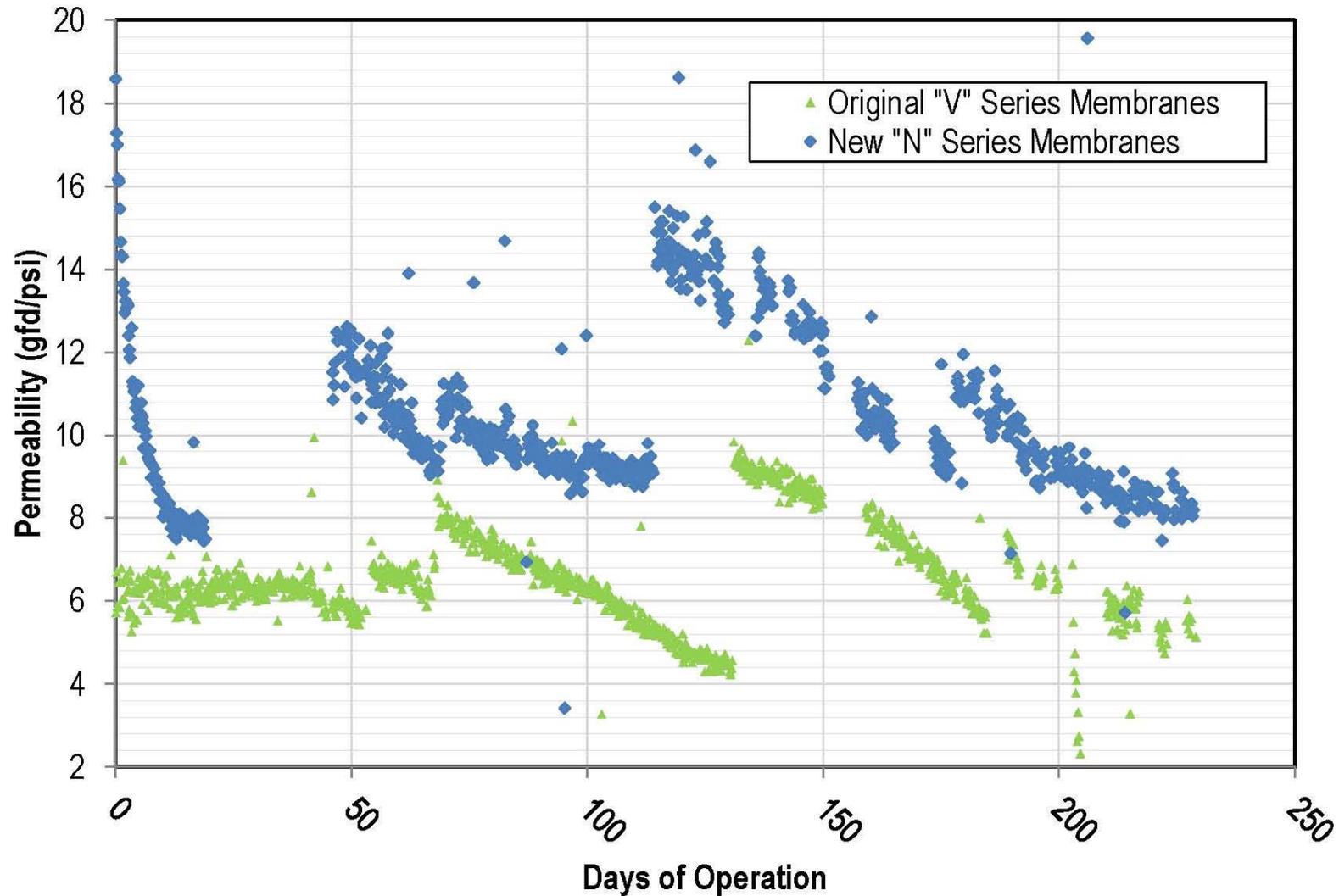
Integrity Problems Have Been Significantly Reduced



Decrease in TMPs With New "N" Series Membranes



Significant Increase in Permeability Compared to the Original "V" Series Membranes





Conclusion

- **Membrane performance has improved**
 - Reduced integrity problems
 - Improved pressure decay test results
 - Improved porosity
 - No significant breakage or other problems with new modules to date
- **Project was completed on time and on budget**
- **Carollo Engineers: Dan Hugaboom, Project Manager**
 - **Dustin Whyman, Project Engineer**
 - Scope: Preliminary engineering report to IDEQ;
 - Workshops on how to replace the membranes;
 - Procurement of membranes;
 - Installation oversight;
 - Integrity testing, submittal of test results, and IDEQ final approval
- **Plant staff:** Maintained plant production and process integrity throughout the project with no water quality or supply problems. Strong work by all!
 - Chief Operator-Treatment Scott Cairl Idaho DWT-4
 - Operator 1 (installation lead) Bob Adams Idaho DWT-4
 - Operator (operations lead) Jeff Lough Idaho DWT-2
 - Operator (operations) Brandon Miller Idaho DWT-2