Membrane Pretreatment Pressure Filter System Rehabilitation and Expansion

Boca Raton, Florida

Client
City of Boca Raton

Scope of Services
Professional engineering services for design, permitting, bidding, construction administration, and resident project representative (RPR) services.

Contact
Justin Barrington, P.E.
Deputy Director
City of Boca Raton
1401 Glades Road
Boca Raton, Florida 33487
561.338.7382
jbarrington@myboca.us

Start Date
Rehabilitation: April 2016
Expansion: March 2019

Completion Date
Rehabilitation: October 2019
Expansion: March 2025

Construction Cost
Rehabilitation: $2.78 million
Expansion: $3.4 million

Key MBC Staff
Frank A. Brinson, P.E.
Andrew Barba, P.E.
Mathew Marsh, CGC

Key Features
Pressure filter system provides pretreatment of membrane feed water for 40-mgd NF process.

Benefit to the City
Pressure filter system removes particulate and colloidal foulants from the feedwater, extending the service lives of the cartridge filters and NF membrane elements and improving overall process efficiency and reliability.

Background

The City of Boca Raton owns and operates a 40-million gallon per day (mgd) nanofiltration (NF) or membrane softening water treatment facility, which includes a granular media pressure filtration system upstream of the membrane process. The filters provide cost-effective physical pretreatment of the raw water upstream of the 5-micron cartridge filter system by substantially reducing the loading of suspended particulate contaminants that enter the membrane system, thereby extending the service lives of the pretreatment cartridge filter elements.

Design-phase pilot testing for the original membrane softening process addition project in 2001 identified the need for additional physical pretreatment upstream of the NF process 5-micron cartridge filter system. During early pilot testing without pressure filters, excessive particulate loading on the pilot-scale cartridge filters showed filter element service lives on the order of several weeks, which is not viable for a full-scale large NF plant. Subsequent pilot testing of pilot-scale pressure filters upstream of the cartridge filter yielded cartridge filter element service lives in excess of four to six months. This is consistent with cost-effective operation for the full-scale plant. Therefore, pressure filters were incorporated into the 2002 membrane softening process design.

The pretreatment pressure filter system was originally constructed in 2004 with the NF process improvements, and has been in service since that date. The original pressure filter system included four 10-ft diameter by 40-ft long horizontal cylindrical steel pressure vessels, each vessel housing two independent cells of granular media filter beds, an underdrain system, a backwash system including air laterals and washwater launders, and filter vessel face piping with automatic control valves and electric actuators that automatically control the flow of water through the various operating sequences for each filter (e.g., normal filter mode, filter backwash, air backwash, filter-to-waste, etc.).

The Projects

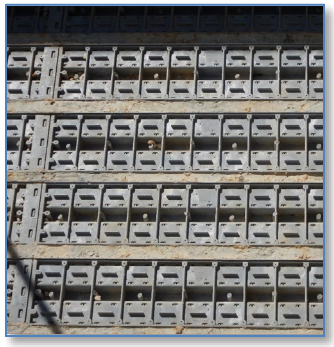
MBC's scope of services for each project included design, permitting, bidding, and construction contract administration including all civil, process mechanical, electrical, instrumentation and controls engineering improvements. Specifically, MBC's scopes of services included:

- Design development and preparation of construction contract documents (drawings and technical specifications), and opinions of probable construction cost at the 30%, 70%, 100%, and bid set stages of design development
- Procurement of a Permit to Construct Public Water System (PWS) Components from the Florida Department of Health in Palm Beach County Permit (FDHPBC)
- Bidding services
- Construction contract administration
- Review of shop drawings, pay applications, and other submittals
- Responding to Contractor's requests for information (RFIs)
- Periodic project meetings and site visits
- Resident project representative (RPR) services (on-site construction observation)
- Contract milestone inspections
- Start-up, testing, and operator training
- Record drawings and contract close-out.

Rehabilitation Project: In 2016 the City undertook a project to rehabilitate the original pressure filter system to address media loss that had been observed, as well as normal age-related degradation of the system. The scope of the project included:

- Replacement of the filter media.
- Inspection and rehabilitation/replacement of the underdrains, air laterals, and other components as needed. The underdrain systems in some of the filter cells were completely replaced with a more robust underdrain design.
- Repairs to corroded portions of the steel pressure vessels.
- Blasting and re-coating of the filter vessels inside and outside.
- Replacement of all existing electric valve actuators on the face piping control valves.

The design was completed in 2017. The construction contract was awarded to Florida Design Contractors. During the construction phase, the City added to the scope of the project by means of a change order the rehabilitation and media replacement for three of the City's six multimedia gravity filters, which are an integral component of the City's conventional lime softening process at the water treatment plant. The rehabilitation project was completed in October 2019.



Expansion Project: In 2019, the City elected to expand the capacity of the pressure filter system by 50% through the addition of two new steel pressure filter vessels similar in design to the existing pressure filters. The two new filters included all required internals, face piping, fittings, valves, electric valve operators, electrical systems, instrumentation, and controls, as necessary to be integrated into the existing filter system. The design of the new pressure filter system included numerous upgrades from the existing system, including a more robust underdrain system design and media-retaining launders, while the operation of the new filters was seamlessly integrated into the existing filter system.

Prior to implementation of this project, the pressure filters were the capacity-limiting component of the NF treatment process. The original designed hydraulic loading rate on the pressure filters had proven to be difficult to maintain for extended periods of time, requiring frequent filter backwashing with the associated filter cell down-time. The expansion allows the City to operate the NF process at the full 40-mgd rated capacity, without excessive pressure filter backwashing, while reducing the particulate loading on the downstream membrane pretreatment 5-micron cartridge filters. The contract for construction of the project was awarded to RJ Sullivan Corporation with a Notice to Proceed issued September 9, 2021. The project was completed in March 2025.