TCEQ Design Criteria and Approval Process for Reverse Osmosis (Nanofiltration)

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Brackish Groundwater in Texas

- Defined as groundwater with a TDS (Total Dissolved Solids) content between 1,000 and 10,000 ppm

- The state has more than 2.5 billion acre-feet of brackish groundwater in 26 of the 31 major and minor aquifers.

- Based on TWDB online publications dated 11/2022

TCEQ Review and Approval Process

- Step 1 –Construction review and approval
  - Engineering Report
  - Plans and Specifications

- Step 2 – Use review and approval
  - Engineering Report Addendum & Baseline Data
  - Chemical Analysis for Raw Water and Permeate

Step 1 – Construction
Engineering Report

- Identification of Raw Water Source
  - Constructed well
  - Proposed Well
- Pretreatment:
  - Bags, Filters, Antiscalant, Dechlorination, Aeration, Softening
- Computer Model Runs
  - New and End-of-life (5-7 years)

Step 1 – Construction
Engineering Report

- Computer Model - Design Parameters
  - System flow rate, system recovery, feed pressure
  - Configuration -Array
  - Flux
  - Fouling factors for new and end-of-life membranes
  - Ion concentrations in feed water
  - Projected ion concentration in permeate and concentrate
- In lieu of the computer modeling for flow rate <300 gpm, the design specifications can be based on the allowable operating parameters of the membrane manufacturer. Pilot Studies are still acceptable.

Step 1 – Construction
Engineering Report

- NSF Documentation must be provided
  - All treatment components that have direct contact with water must conform to NSF 61
  - All chemicals used must conform to NSF 60

Step 1 – Construction
Engineering Report

- Provide post-treatment and/or re-mineralization
- Supply degasifier details
- Provide projected water quality
- When blending is proposed, provide the blending ratio, source of the water to be blended, and the calculations showing the concentrations of regulated constituents in the finished water

Step 1 – Construction
Engineering Report

- Provide a description of the disinfection byproduct (DBP) formation potential based on total organic carbon and other precursor sample results.

- Provide the process control details to ensure the integrity of the membrane system. The engineering report shall identify specific parameters and setpoints that indicate when membrane cleaning, replacement, and/or inspection is necessary.

Step 1 – Construction
Plans and Specifications

- Design must be in accordance with the findings of the engineering report
- Signed and Sealed Plans and Specs for construction must be submitted.
- Must base the flow rate on:
  - Computer models for new and end-of-life membranes;
  - Site-specific pilot study;
  - Comparable design data from alternative site; or
  - Manufacturer's allowable operating parameters (less than 300 gpm).

Step 1 – Construction
Plans and Specifications

- Pretreatment process shall be designed:
  - Feed water quality meets manufacturer's membrane requirements
  - Sized correctly for the flow of the plant
- Acceptable pretreatment techniques:
  - Bags, cartridge filters, or screens for particulate removal
  - Chemical addition not adversely affect membranes
  - Filters for iron and manganese removal (5 gpm/sq. ft)
  - Aeration or degasification
  - Ion exchange softening
- Other pretreatment processes may be considered as innovative/alternate technology and exception(s) may be required.

Step 1 – Construction
Plans and Specifications

- Post-treatment process
  - Corrosivity control, re-mineralization and removal of dissolved gases
  - Sized correctly for the flow of the plant
  - Conform to ANSI/NSF 60 and 61 requirements
- Measuring and recording Devices
  - Equipment to monitor conductivity or TDS in feed and permeate waters
  - Flow meters for feed, permeate and concentrate waters
  - Pressure measuring and recording devices between membrane stages
  - Equipment to monitor temperature

Step 1 – Construction
Plans and Specifications

- Cross-connection protection for common piping used for cleaning and normal production modes:
  - Double block and bleed valving arrangement
  - Removable spool system
  - Other alternative methods approved by executive director

- Chemical feed and storage facilities for pre- and post-treatments and membrane cleaning shall comply with §290.42(f)
- Pipes and pipe galleries shall comply with 290.42(d)(12) & (13).

Step 2 Use
Engineering Report Addendum & Baseline Data

- After construction of the approved RO treatment system, the engineer must submit an addendum to the engineering report. The addendum shall include verification data of the full-scale treatment process

- Well completion material can be submitted with RO Step 2 submittal

Step 2 Use
Engineering Report Addendum & Baseline Data

- Provide the initial baseline performance of the plant. The baseline net driving pressure, normalized permeate flow, and salt rejection (or salt passage) must be documented when the RO or nanofiltration membrane systems are placed online.

- Provide the frequency of cleaning or membrane replacement. The frequency must be based on a set time interval or at a set point relative to baseline performance of the unit(s).

Step 2 Use
Engineering Report Addendum & Baseline Data

- If modeling is used, provide verification of the model's accuracy
  - Inaccurate model - Overall salt passage or feed pressure 10% greater than modeled projection.
  - Determine if incorrect water quality assumptions or other incorrect data used in the modeling is the cause of inaccurate modeling projection
  - Provide corrected model.
- Provide verification of plant capacity.

Step 2 Use

Chemical Analysis for Raw Water and Permeate

- Provide a complete physical and chemical analysis of the water in accordance with §290.41(c)(3)(G) for:
  - Raw water before any treatments;
  - Permeate produced from the membrane systems; and
  - Finished water after any post-treatment or potable water at entry point.
- Samples must be submitted to a TCEQ-accredited laboratory for chemical analyses.

Step 2 Use
Engineering Report Addendum & Baseline Data

- Public water systems shall ensure that their operators are trained regarding the use of all chemicals used. Submit the applicable training records of operators pertinent to this requirement.
- Effective September 1, 2016, RO or NF membrane systems must have operators that have successfully completed at least one executive director-approved training course or event specific to the operations and maintenance of reverse osmosis or nanofiltration membrane treatment. Submit the applicable training records of operators pertinent to this requirement.

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Questions?

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