WATER & PROCESS SOLUTIONS

Reverse Osmosis System Operation

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- Operational steps
  - Loading
  - Start-up
  - Shut-down
  - Performance monitoring
    - Recordkeeping for RO Systems
    - Factors Influencing RO Performance
    - Data Normalization

Operation of membrane plants

- Successful long term performance depends on proper operation and maintenance of the system
- Proper operation is required to control fouling and scaling

Operation of membrane plants

1. Element Loading
2. Start-Up
3. Shut-Down
4. Performance Monitoring


Element Loading

Element loading
-Standard 8” membrane elements

1. Cleaning of pressure vessels (PVs) with water and lubrication with glycerin
2. Closing of PV’s brine end
3. Preparation of elements
4. Loading of elements
5. Shimming
6. Closing of PV’s feed end

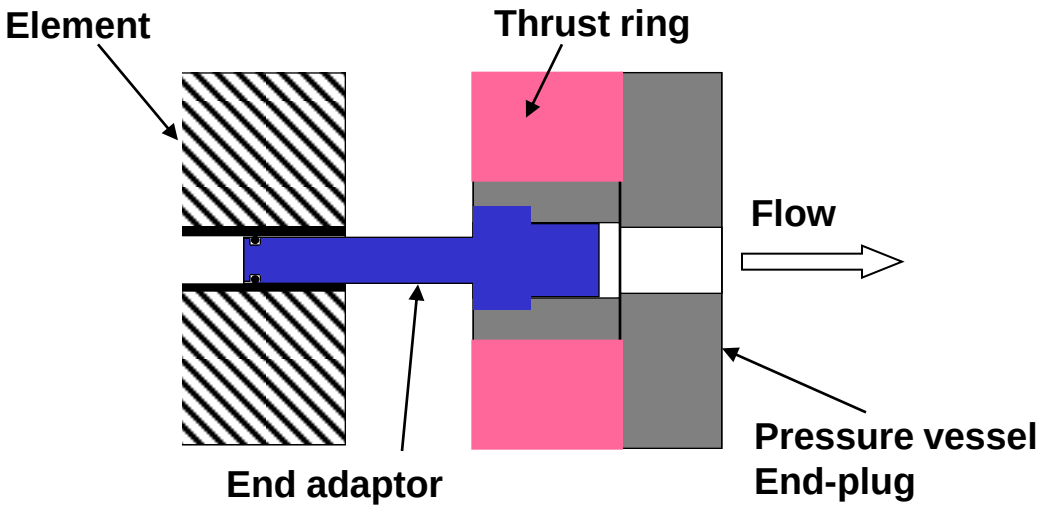
Cleaning and Lubrication of PVs

1. **Flushing** PVs with a pressurized water hose
2. **Cleaning** with sponge & water
3. **Lubrication** with sponge and glycerin/water (50/50)

Closing brine end

1. Insert thrust ring in empty PV
2. Close with lubricated end connector and end cap before loading

Concentrate side



Example for thrust ring

Alternative: Close brine end with thrust ring but without end connector temporarily for loading of each PV. This is to avoid damage to the end connector when moving the element into the fixed end connector.

Preparation of elements

- Unpack elements and place on clean surface (e.g. horizontally on a table, or vertically on clean floor –cardboard layer)
- Check appearance of elements, esp. the inside of the permeate water tube (PWT) and correct direction of the brine seal
- Note Serial numbers for loading plan
- Lubricate (1) interconnectors (O-rings) and the inside of the PWT's with very little amount of Silicon grease*; (2) brine seals to facilitate the posterior element removal

*** Dow Corning® 111; Molykote® 111**

Loading
-1st element and interconnector

- Place first element (last position, e.g. #7) into PV
- Place lubricated interconnectors into Feed end of PWT
  Turn and push interconnector at the same time!

Silicon lubricant: **Dow Corning® 111 or Molykote® 111**

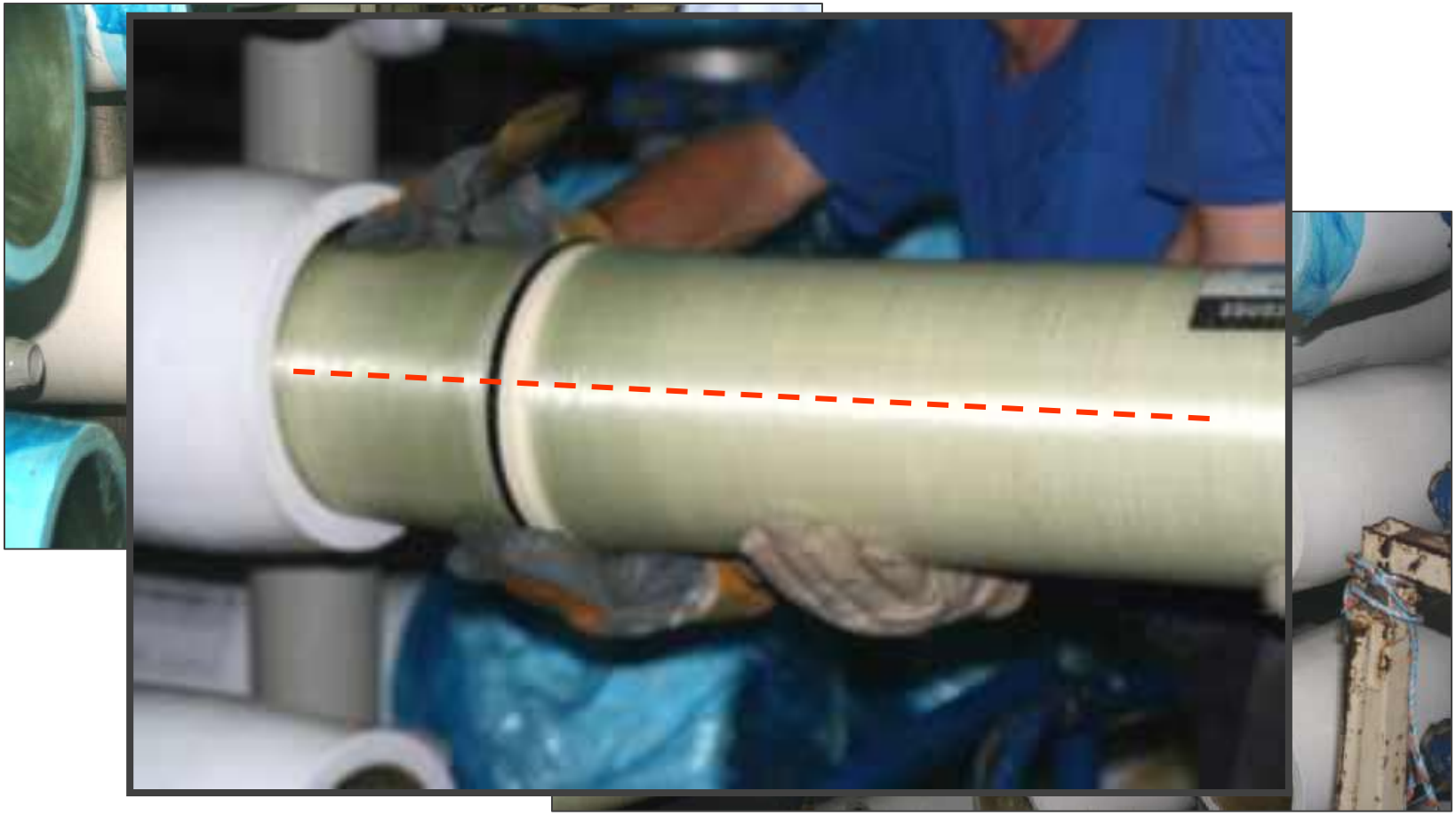
Other lubricants may cause performance issues!

Brine seal check and lubrication

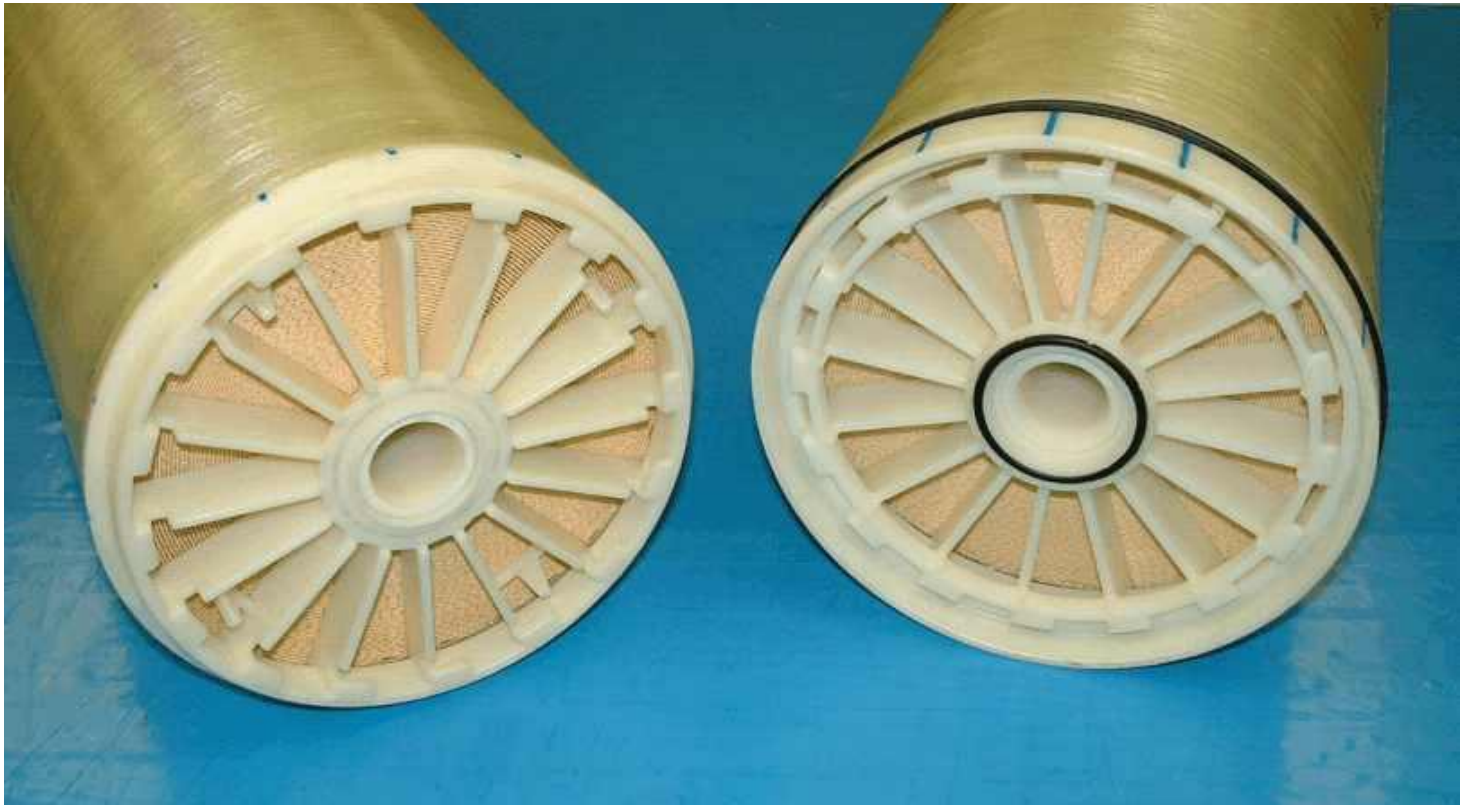
- glycerin/water (50/50) solution
- food grade glycerin
- Dow Corning® 111

Adding elements

Always support the element to keep it horizontal!



iLEC™ Elements

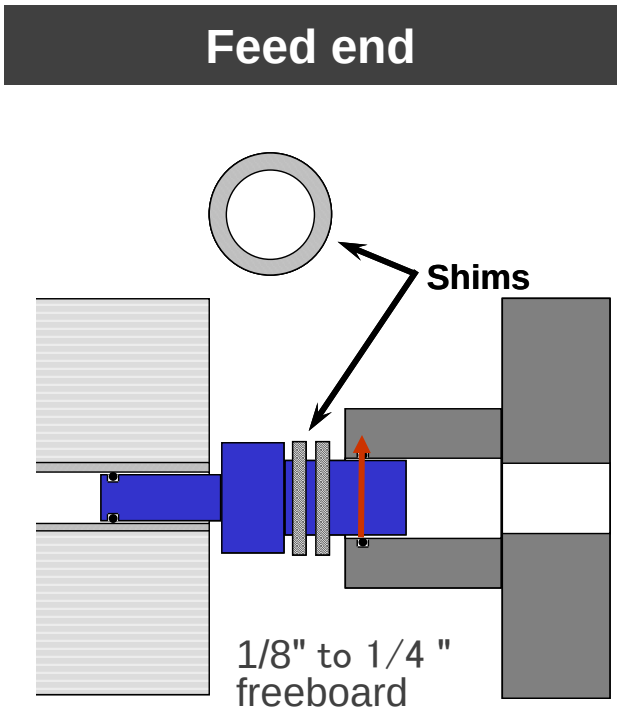


See Training video on

http://www.dowwaterandprocess.com/en/resources/

Keyword “iLEC”

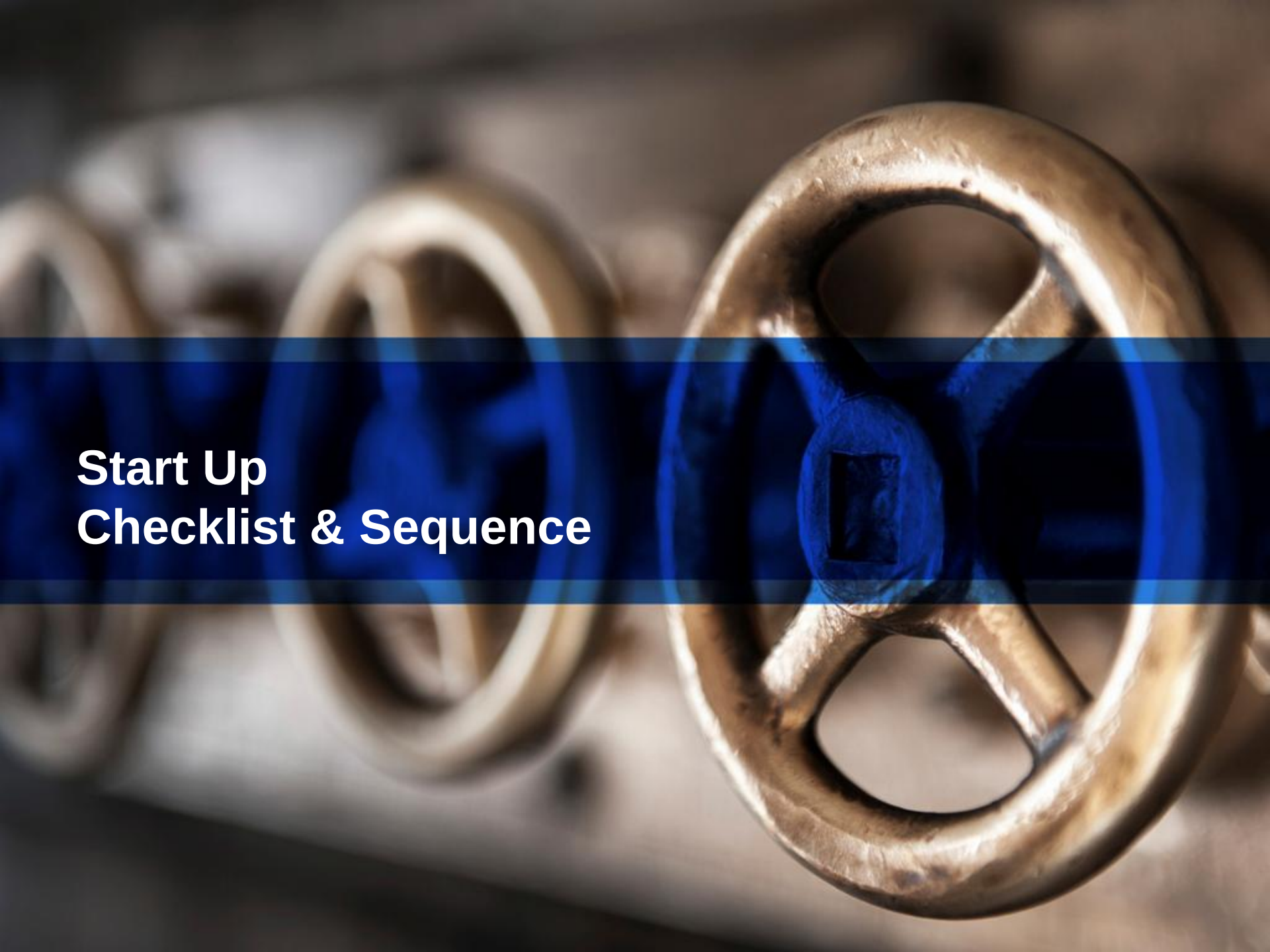
Shimming



1. Push elements with appropriate tool
2. Shim so that the endconnector cannot move when PV is closed

Closing of PV's Feed End

1. Place segmented ring
2. Close with spring



Start Up
Checklist & Sequence

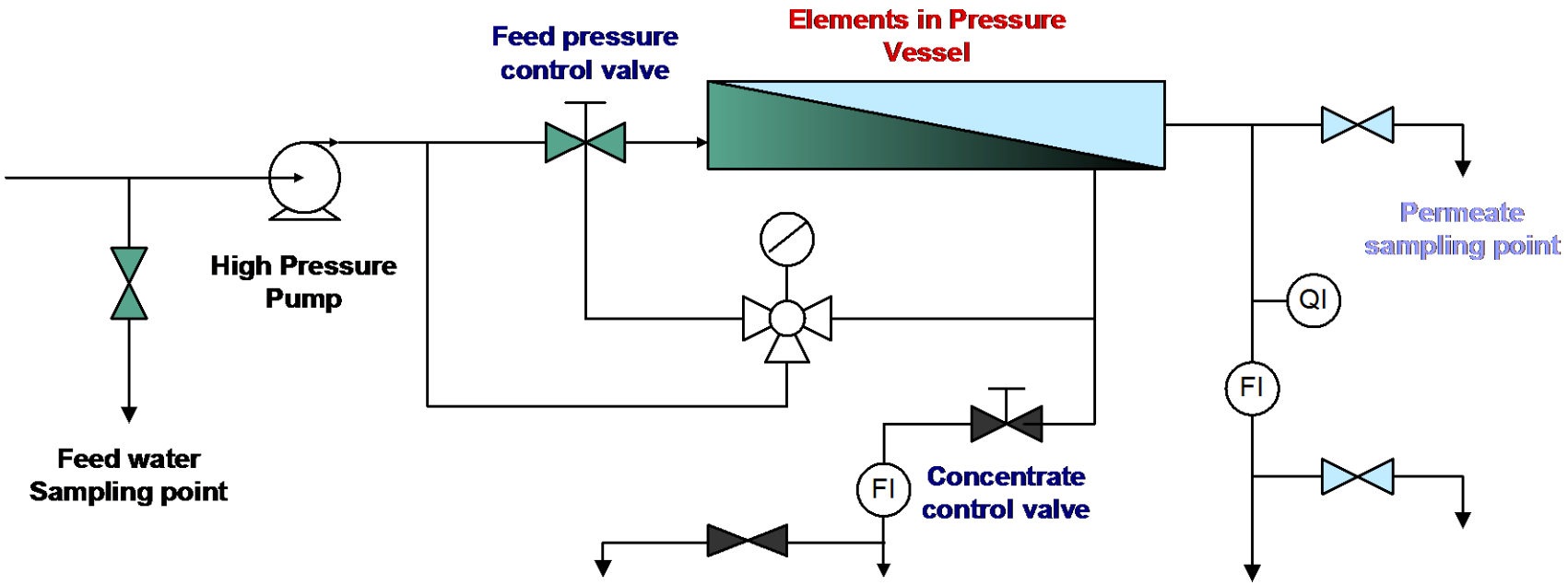
Checklist for start-up (1/2)

- ✓ Pretreatment
- ✓ Membrane units
- ✓ Turbidity and SDI
- ✓ Alarm shut downs (redox/pH, no sodium bisulfite, no acid, no antiscalant, temperature, pressure)
- ✓ Instrumentation is appropriate, properly installed and calibrated
- ✓ Provisions to prevent product back pressure (< 5 psi)

Checklist for start-up (2/2)

- ✓ Sampling valves installed
- ✓ Pressure vessels secured and piped for operation
- ✓ Pumps and valves ready for operation (permeate open to drain, reject flow control valve open, feed flow valve throttled and/or pump bypass valve partly open – feed flow < 50% of normal)
- ✓ Monitoring equipment
- ✓ Water analysis equipment

RO system start-up



Start-up sequence

1. Rinse upstream section to flush out contaminants
2. Check correct setting of all valves
3. Purge air out of system at low pressure
4. Check for leaks
5. Partially close feed pressure control valve
6. Start high pressure pump
7. Slowly open feed control valve
8. Slowly close brine control valve to adjust to design recovery
9. Adjust to design product flow with feed and brine valves
10. Check all chemical dosages rates and brine LSI
11. Let system stabilize one hour
12. Record all operating parameters
13. Check permeate conductivity from each vessel
14. Take water samples and analyze
15. Compare performance to prediction
16. Lock plant in automatic operation
17. Record operating data frequently over first 48 hours. This provides a baseline for all future readings


Shut-down

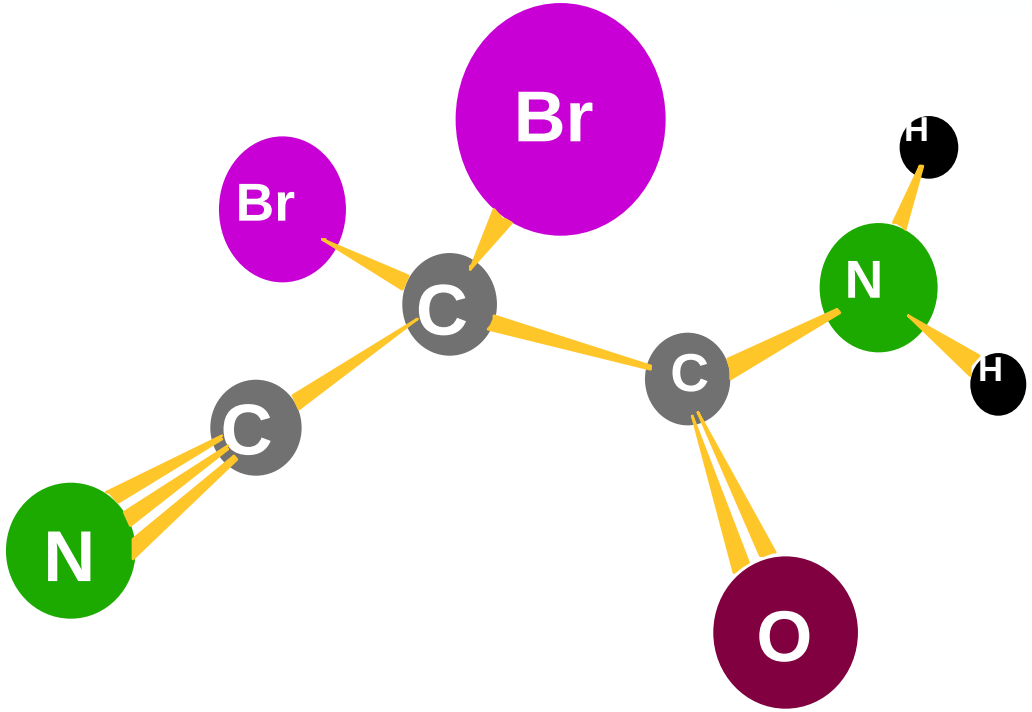
Reasons for Shut-down

- Storage tank full; operation not required
- Start-up not successful
- Power outage
- Scheduled maintenance
- Cleaning
- Number of shut-downs should be kept at a minimum

Shut-Down Considerations

- Automatic flush at low pressure (~ 45-60 psi) for about 3 minutes (C_f=C_b)
- Flush water quality
  - Permeate water preferred
  - No pretreatment chemicals (except sodium bisulfite)
  - No free chlorine
  - DBNPA may be added

2,2 Di Bromo-3-Nitrilo Propion Amide



Features:

- Quick kill
- Rapid degradation
- Low use concentrations
- Non-oxidizing

Precautions during Shut-Down Period

- After flushing keep system full of water with no air (this becomes extremely critical when H_2S is present)
- Keep system cool but frost-free
- Avoid temperatures > 35° C
- Protect membranes from microbiological growth
  - Flush at least once every day with permeate or good quality feed water
  - Operate the system for a short time once every day
  - Preserve the system


Preservation

Preservation

Required for periods > 48 hours without flushing or operation

- Preservation solution: 1 - 1.5% sodium bisulfite
- Renew solution if pH drops below 3 or latest after one month
- Keep system cool but frost-free
- Avoid temperatures > 35° C


Performance monitoring

Performance monitoring

1. Recordkeeping for RO Systems
2. Factors Influencing RO Performance
3. Data Normalization

Performance Monitoring
-Why?

- To track performance of system trends
- To decide when to clean
- To decide when to replace membranes
- Useful information in troubleshooting
- Required in event of warranty claim

Performance monitoring
-How?

- Record operating data on log sheet
- Normalize data to account for feedwater pressure, temperature, concentration and recovery
- Graph salt passage, product flow and DP vs. time

Recordkeeping for RO Systems

- Recommendations for RO operating records are in ASTM D 4472
- Data which should be recorded is:
  - Permeate and concentrate flows
  - Feed, concentrate and permeate pressures
  - Feed temperature
  - Feed pH
  - Feed, concentrate and permeate concentrations

Data normalization
-Why normalize?

Fluctuations in operating conditions cause permeate flow and salt passage to change. Performance changes due to membrane properties might go undetected.

Normalization eliminates the effects of fluctuating operating conditions and allows monitoring of the membrane properties.

Thank You!

For more information please visit our web site or contact your local Dow representative.
http://www.dowwaterandprocess.com/