



"Significant Cost Savings Obtained Using Advanced Membrane Systems for Cooling Tower Water Treatment and in ZLD plants"

Webcast



**Bernhard Doll
Pall GmbH**

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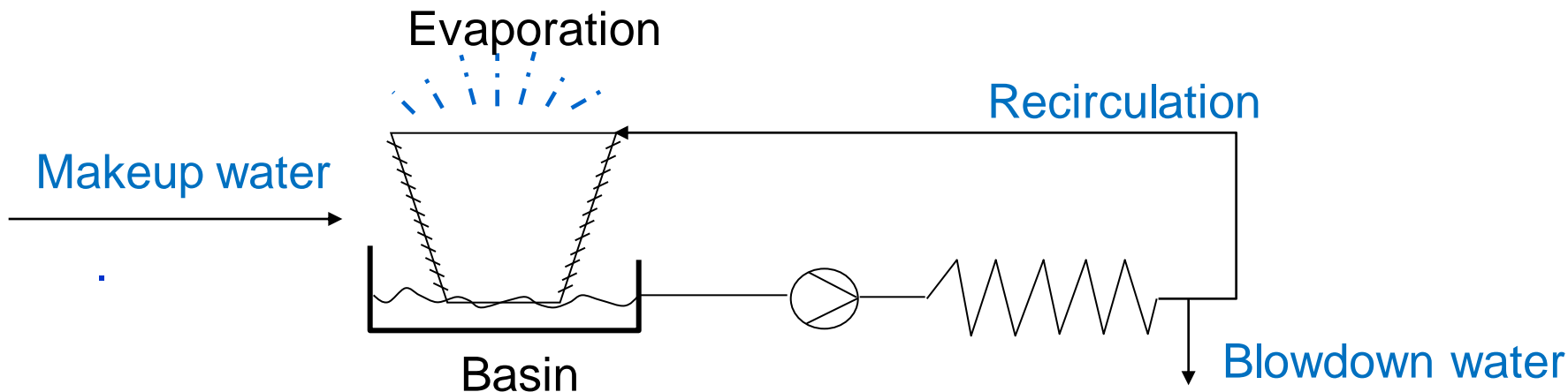
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Cooling Tower Water - Contents

- **Case studies in CT water applications, considering**
- Water quality improvement
- Water footprint improvement, waste minimisation
- Economic Improvement
- Sustainable, reliable operation
- **Conclusions**





Case: Cooling Tower (Indiantown, USA)

Typical Analysis of Different Makeup Waters used

Parameter	Units	Blend of Well Waters	Waste Water	Surface Water from Taylor Creek
Turbidity	NTU	3-10	N.R	3-30
Conductivity	uS/cm	6200	960	590
Iron	mg/l	0.13	0.05	0.56
Total Organic Carbon	mg/l			31
Ca Hardness	mg/l	440	260	98
Mg Hardness	mg/l	540	14	48
Sodium	mg/l	850	76	55
Aluminum	mg/l	<0.1		0.21
Silica	mg/l	15.0	21.0	9.7
Sulfates	mg/l	300	31	58
Chlorides	mg/l	2000	97	110



Original Flow Scheme for Zero Liquid Discharge

3 sources
Feed Water

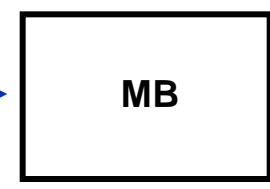
- Surface water (high in organics),
- Highly saline ground water from wells
- Treated municipal waste water



COOLING TOWER
(4-7 COC)

Blowdown

Distillate Stream



MIXED BED
DEMINERALIZER

To H.P.
Boiler
(180 bar)



2 EVAPORATORS / BRINE
CONCENTRATORS (2x0.7 MW)

Waste
Stream



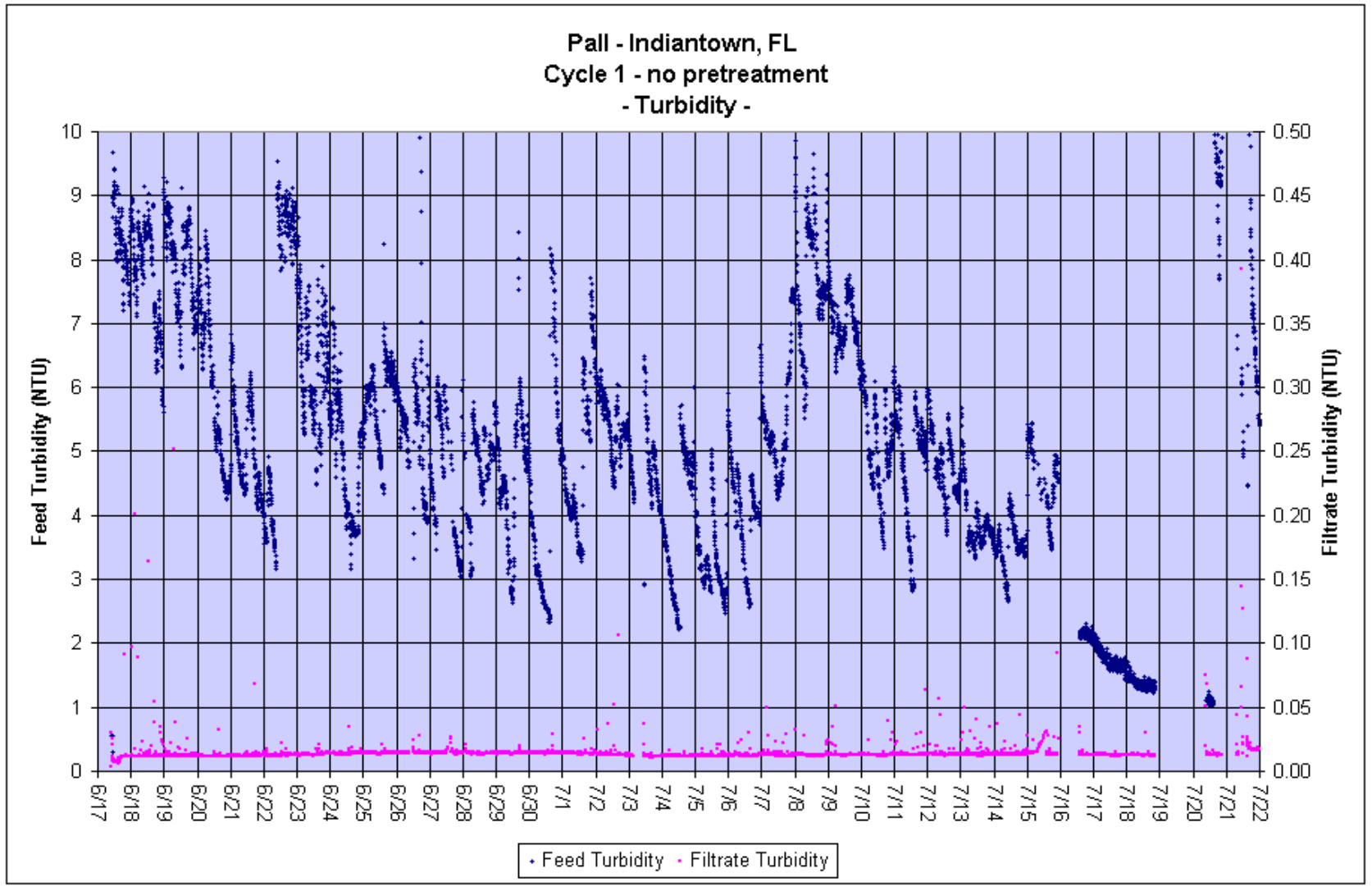
SPRAY DRIER
ABSORBER

Indiantown, Florida
contact: Marvin Drake
NAES Corporation





Pall Pilot System: Confirmed Performance Under Varying Conditions in CTBD





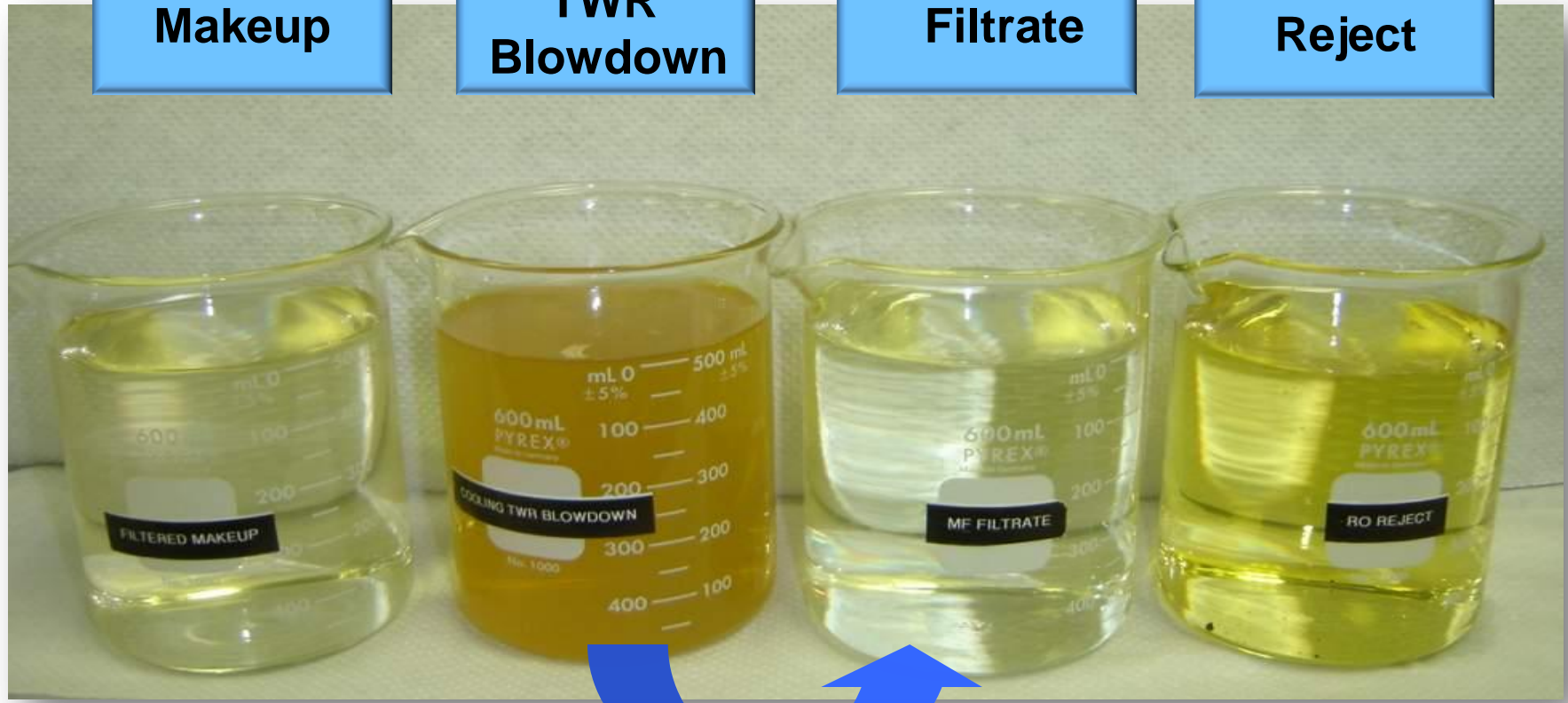
Indiantown Cooling Tower Water Samples

**Filtered
Makeup**

**Cooling
TWR
Blowdown**

**MF
Filtrate**

**RO
Reject**



MF-Filtrate: SDI 0.3 – 1.9 achieved



Return on Investment Calculations

SAVINGS to the Power Plant

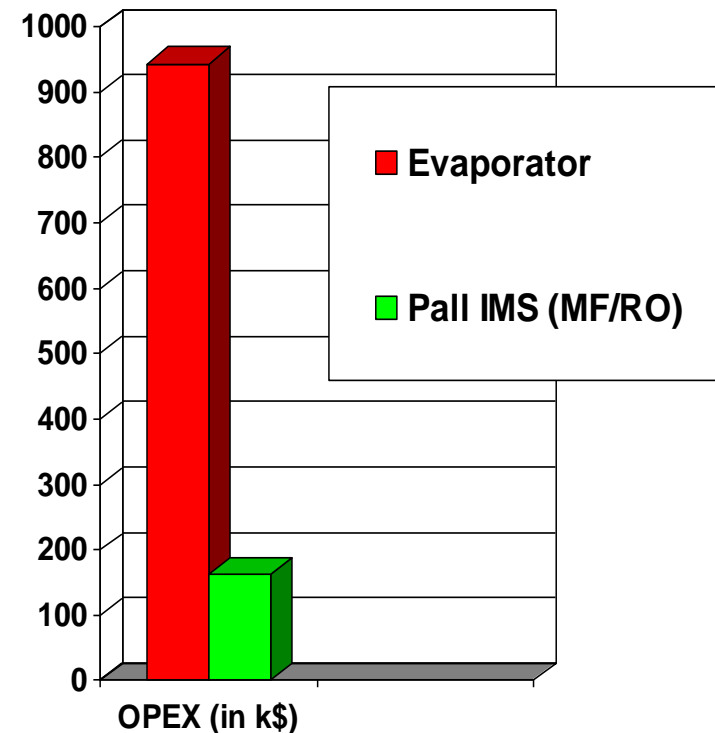
- Power (evaporation) = €317,600/year
- Elimination of maintenance/refurbishing/re-tubing & chemical cost on evaporators = €625,600/year

Investment costs

- Cost of MF/RO System: €1,240,000
- Cost of Installation: €564,000 (estimated).
- Annual Power, Chemicals and Consumables, cost to operate the MF/RO Plant : €162,400

ROI

- Return on Investment = **2.4 years**





Evaporator Replaced by Membrane System (MF-RO)



3 Feed Water sources

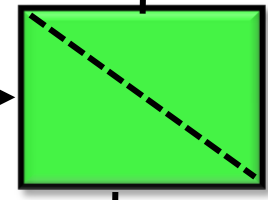
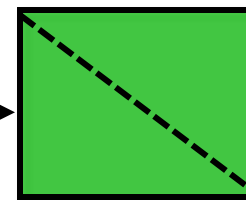
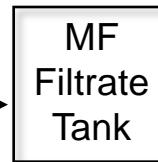
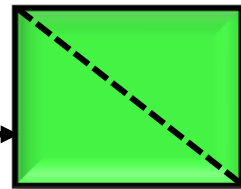
To H.P Boiler (BFW)

MIXED BED DEMINERALIZER

High quality Permeate

COOLING TOWER

Blowdown (140 m³/h)



Pall Aria™ IMS

RO Pass 1

RO Pass 2

MF Reject

RO Reject to SDA

Reject to Lime Slaking

SPRAY DRIER ABSORBER





MF and RO Systems Installed at Indiantown ZLD Plant Replacement of Brine Concentrators



NTU/bacteria:
Up to 100%
removal

Pall Aria™ MF System

Inlet Flow : 140 m³/hr
Number of Modules: 56



TDS: 97%
removal

Pall Aria Spiral RO System

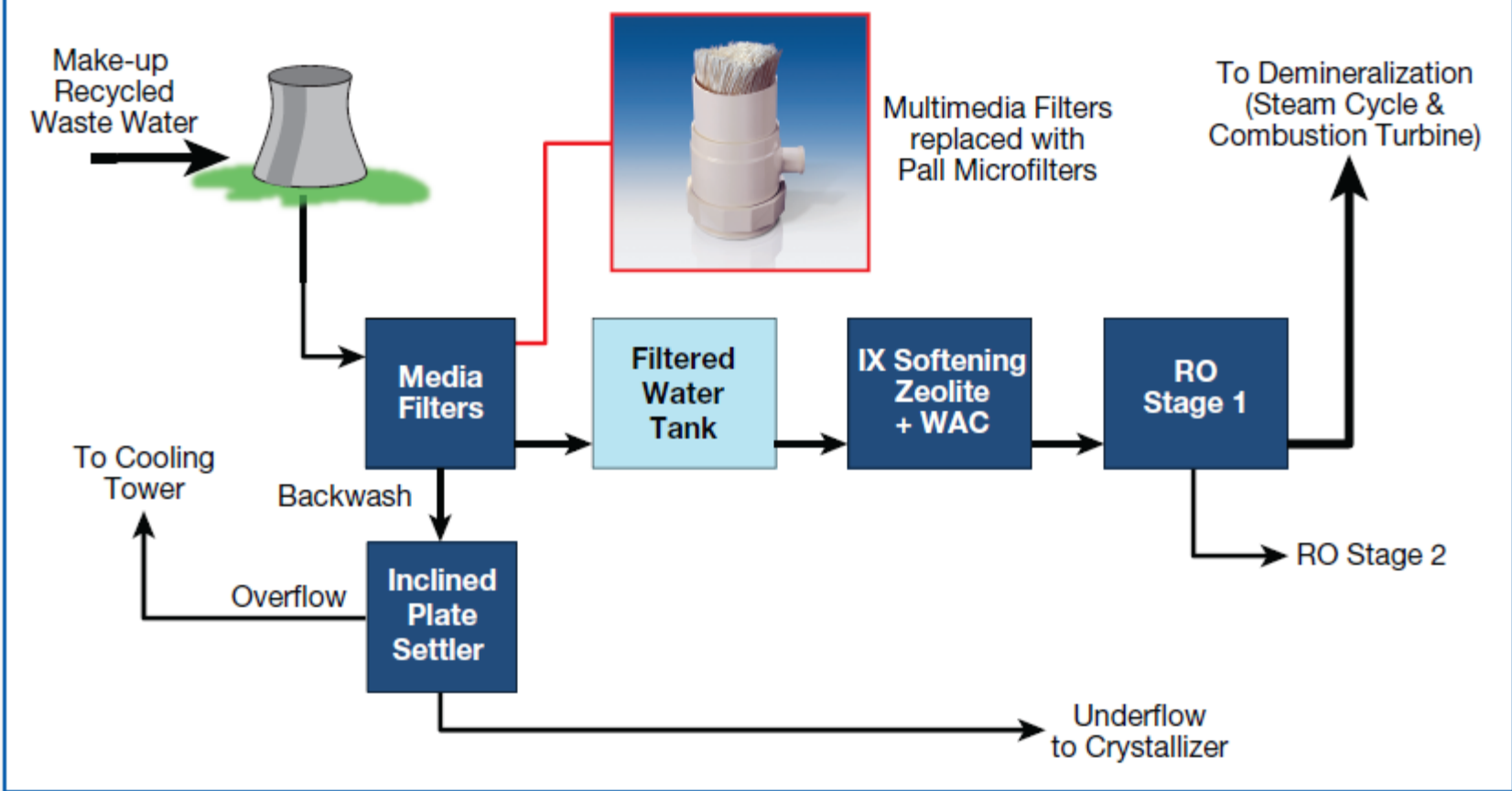
2 Trains RO





Case Study: Cooling Tower Blowdown Treatment Replacing Media Filters

Figure 1: Simplified cooling tower blowdown and ZLD flow diagram





Case Study: Cooling Tower Blowdown Treatment Replacing Media Filters



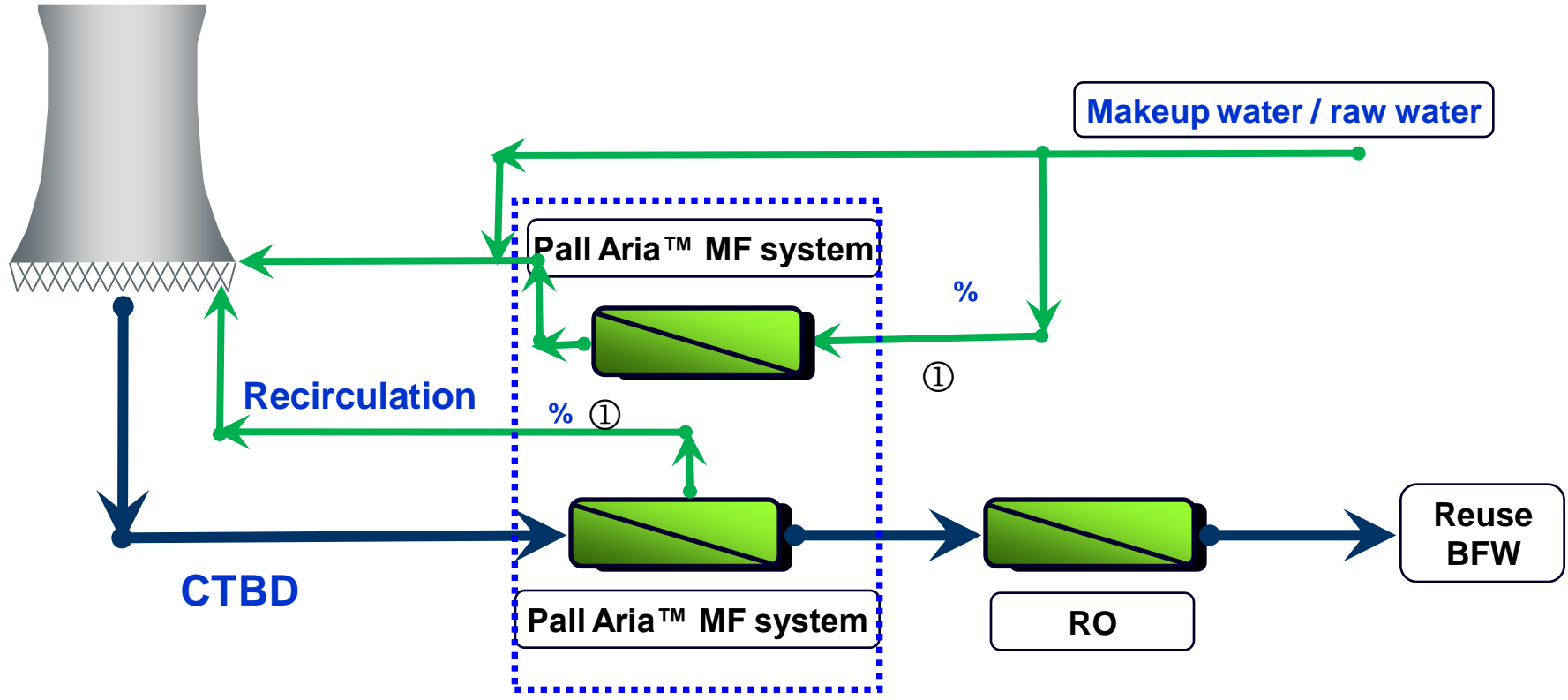
Pall Aria MF-System (136 m³/h; 600 gpm)

Results/Achievements:

- Unit running smoothly for more than a year with MF
- Turbidity < 0.1 NTU
- SDI improved from SDI₅ of 20 to SDI₁₅ ~ 3
- RO run-length increased from 2 to 21 days
- Water footprint improved
- Coagulants eliminated
- Plant reliability and availability up



Case Study: CTBD / Recycle/ makeup water treatment Replacing MMF at EnCana Cavalier



① Used for a portion of raw water treatment and recycled water
 Result: Reduction of TSS on the CT, and increased efficiency of CW-chemistry



Case Study: Water Treatment in Cooling Tower Area, Recirculation Water in Steel Mill, Asia

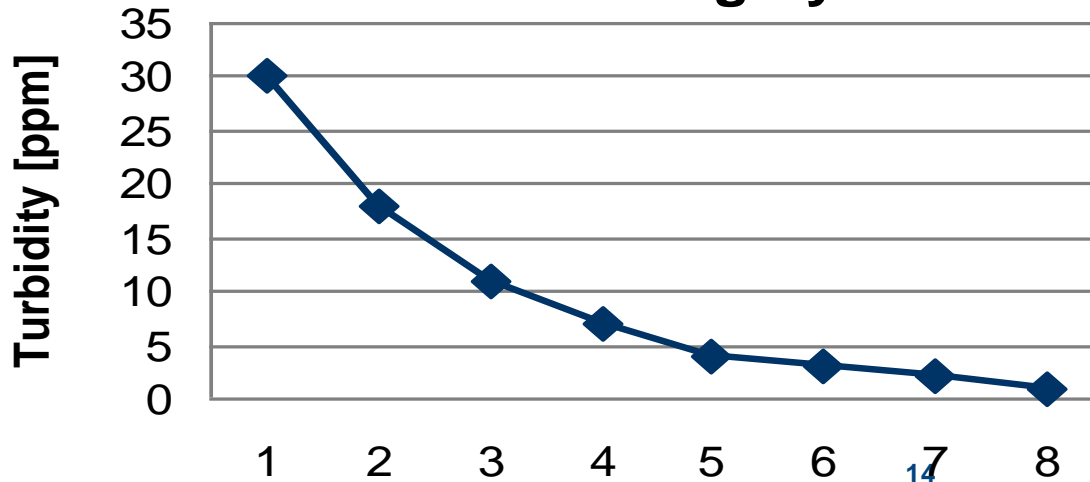
Pall Aria MF system installed in **kidney loop of recirculating water**:

- **NTU reduced** heavily in the loop; TSS from 30 to <1 mg/l (colloids, precipitates, corrosion products)
- **Bacteria reduced** (from 10 cfu to 1-2)
- **Reduced maintenance**, waste, chemicals, down-time, labour, water balance improved



deposits

Turbidity Reduction in Recirculating System

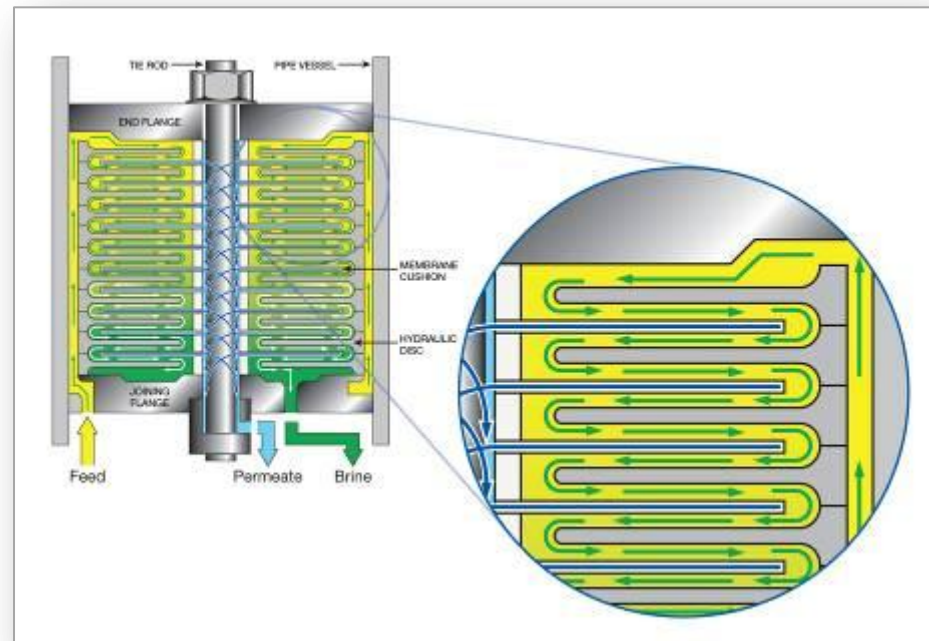


**Pall system in slipstream
of recirculation (5%; 80 m³/h)**



Minimization of Brine Streams from SWRO Plants

Open Channel Design Zero Spacers on Feed Side



- Pall Disc Tube™ RO membrane alternative configuration
- Operating up to 160 bar (140,000 TDS)
- Technology for waste minimization upstream ZLD plants



Pall Aria Mobile Units for Rental or Examining Performance Improvement around Cooling Towers

