DIGITALIZATION OF A SEAWATER REVERSE OSMOSIS PLANT

BACKGROUND

The seawater reverse osmosis (SWRO) plant under consideration uses a shallow surface intake. A pre-treatment process involving rotating screen debris filters, coagulant dosing, multimedia filters, and cartridge filters is used. The pre-treated water is fed to a single stage RO system. The RO system has a recovery of 40-44%. The total plant influent throughput is ~16000 m^3/day (700 m^3/hr). The plant is located at a remote area close to Cape Town adjacent to False Bay. The plant performance is influenced by sea water influent quality variations, seasonal fouling potential changes of the influent, as well as frequent power failures.

AUTOMATION RETROFIT

The plant was retrofitted with IntelliFlux to optimize the performance of the coagulant dosing and multimedia filtration (MMF) operations in response to fluctuations in influent seawater quality. The retrofit integrated the operation of the coagulant dosing, six trains of MMF, 20 parallel cartridge filter units, and six trains of RO. Furthermore, by monitoring the process conditions of the cartridge filtration and RO system, a decision support dashboard was developed to provide real-time alarms and analytics support to the RO plant operator. IntelliFlux also recommended use of inline turbidity measurement at the feed inlet and the MMF outlet, which was implemented by the customer.

Baseline operation of the media filters involved backwashing when the pressure drop exceeded a threshold setpoint. The coagulant dosing rate was manually adjusted by the operator. The installation of IntelliFlux included digital twins of the coagulant dosing, MMF, cartridge filter, and RO systems. Time resolved data was analyzed, and the plant dynamic characteristics were learned using these models. IntelliFlux correlated the plant behavior using its ML and AI algorithms to enrich its operating knowledgebase. The autonomous control mode was deployed to the full system to synergistically optimize coagulant dosing, MMF, cartridge filter, and the RO system management. The overall goal of the optimization was to increase the replacement interval of cartridge filters, enhance the reliability of the RO operation, increase overall plant recovery, and provide early warning for influent quality excursions.

SUMMARY

APPLICATION AREA: **SWRO PLANT**

CUSTOMER: **DESIGN, BUILD, OPERATE COMPANY**

LOCATION: **SOUTH AFRICA**
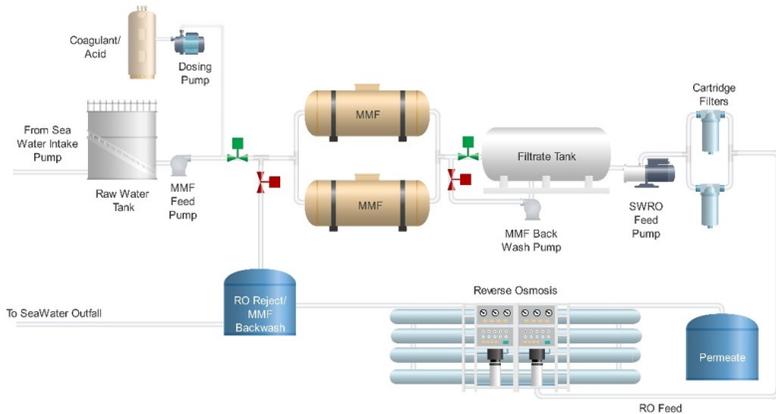
SYSTEM: **RO PLANT WITH PRETREATMENT**

CAPACITY: **7500 m^3/day**

OPERATING SINCE: **2019**

BENEFITS: **Water Savings, Increase Plant Recovery, Energy Savings, Dynamic Performance Enhancement**

IntelliFlux Controls

PLANT ASSESSMENT

## ✓ Overall Process Layout

Process Flow Diagram of the Plant.

✓ Plant Digitalization Profile Enhancement

IntelliFlux improved the digitalization profile of the plant by implementing a digital twin, ML, and AI based Decision Support and Automation layer, while improving the SCADA/IoT level system integration and performance. It was the least cost and quickest retrofit digitalization for the plant. IntelliFlux adhered to IEC-27002 security framework, and implemented an ISMS plan that is in compliance with customer requirements. IntelliFlux managed the cloud network for data analysis on behalf of the customer.

✓ Schematic Depiction of the IntelliFlux Retrofit Functionalities

The system delivered and its various functionalities are shown in the following schematic.
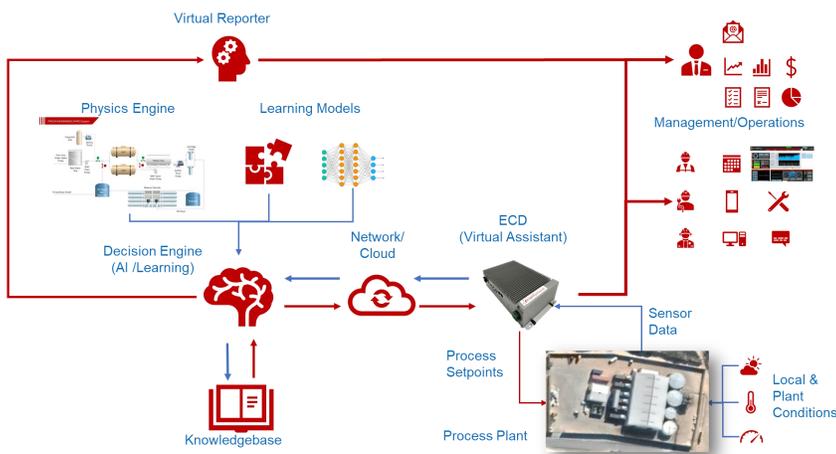
DIGITALIZATION UPGRADE
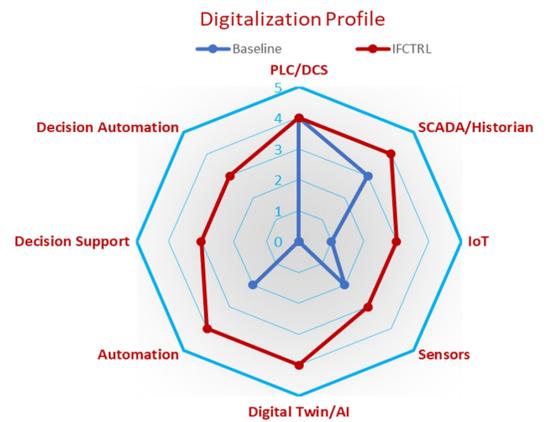
The plant already included a robust PLC/SCADA framework

IntelliFlux added the IoT, Decision Support and Decision Automation framework

IntelliFlux included ML, AI, and digital twin based model support

A cloud based reporting module was included for remote management

REIMAGINE YOUR PLANTS WITH INTELLIFLUX

IntelliFlux Controls

2081 Business Center Drive, Suite 285
Irvine, CA, 92612, USA

Phone: +1 949 630 0940
Email: info@ifctrl.com

INTELLIFLUX PROCESS REPORT

✓ IntelliFlux Dashboards and Report

IntelliFlux dashboards and reports are designed to provide the process engineer a thorough overview and detailed understanding of the plant. The process overview screen provides the operational details of the plant, whereas various drilldown menus provide detailed information about the individual process component behaviors. These reports and dashboards are designed to provide an expert all key operational parameters, without requiring the time consuming post processing and analysis of raw historical data stored in most SCADA historians. Typical report generation requires selection of date ranges, desired process components to display, and the required report is ready for email or printing at the press of a button.

Using the reporting toolkit, an engineer or a remote process management team can directly communicate with the plant operator or onsite personnel, guiding them through operational logistics and troubleshooting plant components in real-time.

The reporting tool also allows the plant engineers to track plant behavior in response to fluctuations of influent quality or operating conditions.

The reporting tool is customized for every plant, and is developed in consultation with the plant designer, operator, and process engineering team.

The reporting tool also provides a dynamic view of how IntelliFlux optimizes the plant, and provides estimates of savings, reduction in waste and energy, as well as increase in production with resolution at individual process train level.

With IntelliFlux Control as a Service (CaaS), you Redefine your Process Automation

IntelliFlux Controls

2081 Business Center Drive, Suite 285
Irvine, CA, 92612, USA

Phone: +1 949 630 0940
Email: info@ifctrl.com

3

PERFORMANCE

✓ Coagulant Dosing

The coagulant dosing rate adjustment implemented by IntelliFlux improved the fluctuations of turbidity in the MMF effluent. It prevented overtreatment of the feed water, and led to chemical savings of 35%.

✓ Multimedia Filter Performance

IntelliFlux optimized the performance of the MMF to ensure that the effluent turbidity is maintained below 0.7 NTU, while reducing cleaning water and energy consumption in the MMF. The MMF cleaning was triggered based on measurement of inline bed permeability, which led to better control of the effluent turbidity and stagger the media backwash during feed water turbidity excursions.

✓ Performance of Cartridge Filters

With improvement in the MMF effluent water quality, the cartridge filter performance improved, leading to an increase in the changeout interval time of the cartridges, effectively increasing the cartridge lifetime by 21%. The cartridges also operated with about 44% lower specific energy consumption (SEC).

✓ Performance of RO

The RO decision support system based on the fouling index of the Cartridge Filter and the MMF units provided early warnings and process guidance to the operators, helping them to proactively manage feedwater quality excursion events without having to shut down or frequently clean the RO units. Although the management of concentrate does not pose a challenge to this plant, the process improvement reduced the concentrate volume by 4%, effectively improving the plant recovery by 1.6%.

Chemical Savings
35%

Avg. Energy
28%

Avg. Water
22%

Filter Life
21%

Avg. SEC
44%

THE INTELLIFLUX TECHNOLOGY

A Patent Pending Tunable Combination of Digital Twin and Deep Learning

Deployed in a Client-Server Configuration

Deliverable on any Existing Plant Automation (DCS/SCADA) Platform

With IntelliFlux managing the optimal performance of an SWRO plant, recurring OpEx savings of $0.05 / m³ is achievable by properly managing the RO influent water quality through a simple digitalization retrofit.

With IntelliFlux, You are in Control from Anywhere—Anytime.

IntelliFlux Controls

2081 Business Center Drive, Suite 285
Irvine, CA, 92612, USA

Phone: +1 949 630 0940
Email: info@ifctrl.com