



R2 Cell Room Innovation

Experience, Expertise, and Knowledge



CloroSur
2022

COSTA DO SAUÍPE



Short Introduction

R2

R2

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R2 Cell Room Innovation

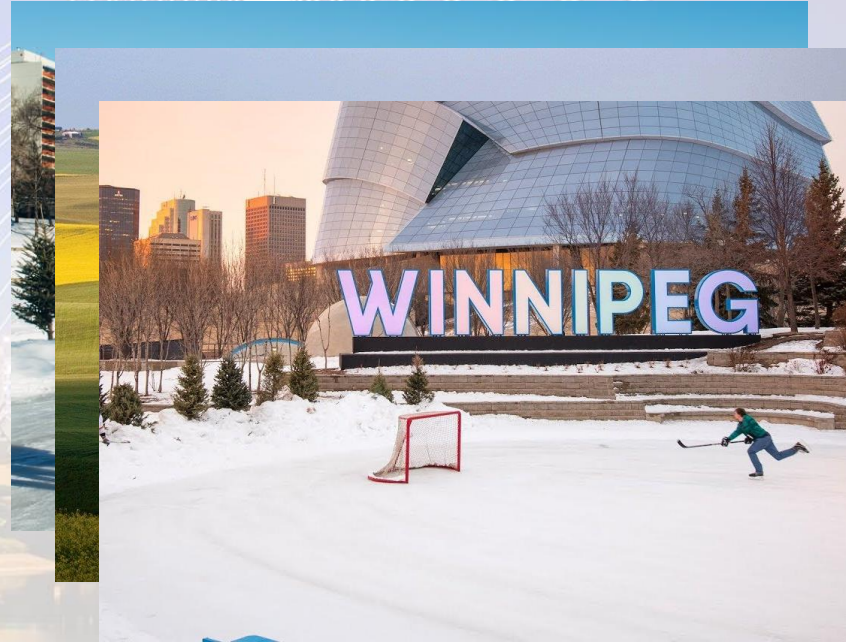


Chris Funk - EMOS Commercial Contact

Degrees from University of Winnipeg
and Concordia University.

20 Years in international sales and business
development

Joined R2 in Montreal in 2018 working with
EMOS clients in Europe, North America, South
America, Mid-East and Africa



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R2 Cell Room Innovation



Leandro Silva - EMOS Technical Expert

Joined R2 in Montreal in 2019...leaving Brazil

Welcome to R2 in Montreal!



R2 Cell Room Innovation



Leandro Silva - EMOS Technical Expert

Graduated in Chemical Engineering and received a Master's degree in electrochemical reactors from the State University of Campinas (Unicamp).

Over 15 years of experience in chemical and process engineering, with major chemical corporations such as Braskem and Solvay.

Chlor-alkali expert at R2 where he contributed to solutions such as EMOS® Advisory, an AI-powered tool for monitoring and guiding the chlor-alkali processes.

Agenda

R2

R2 at a glance

CPA

EMOS® Cell Performance Analyzer

SIL2

EMOS® SIL2 Safety System



EMOS® Asset Management Database

E

Soft Sensors



Support & Training

A

EMOS® Advisory

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R2

R2 at a glance



R2

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R2 at a glance

R2 was founded in 1989 by its current President, Gilles Tremblay, and Vice-President, Josée Nolet and has its Head Office in Montreal, Canada and a subsidiary in Germany.

Since 2020 group company of Asahi Kasei Group.

Patented SIL2 Safety System certified by German TÜV.



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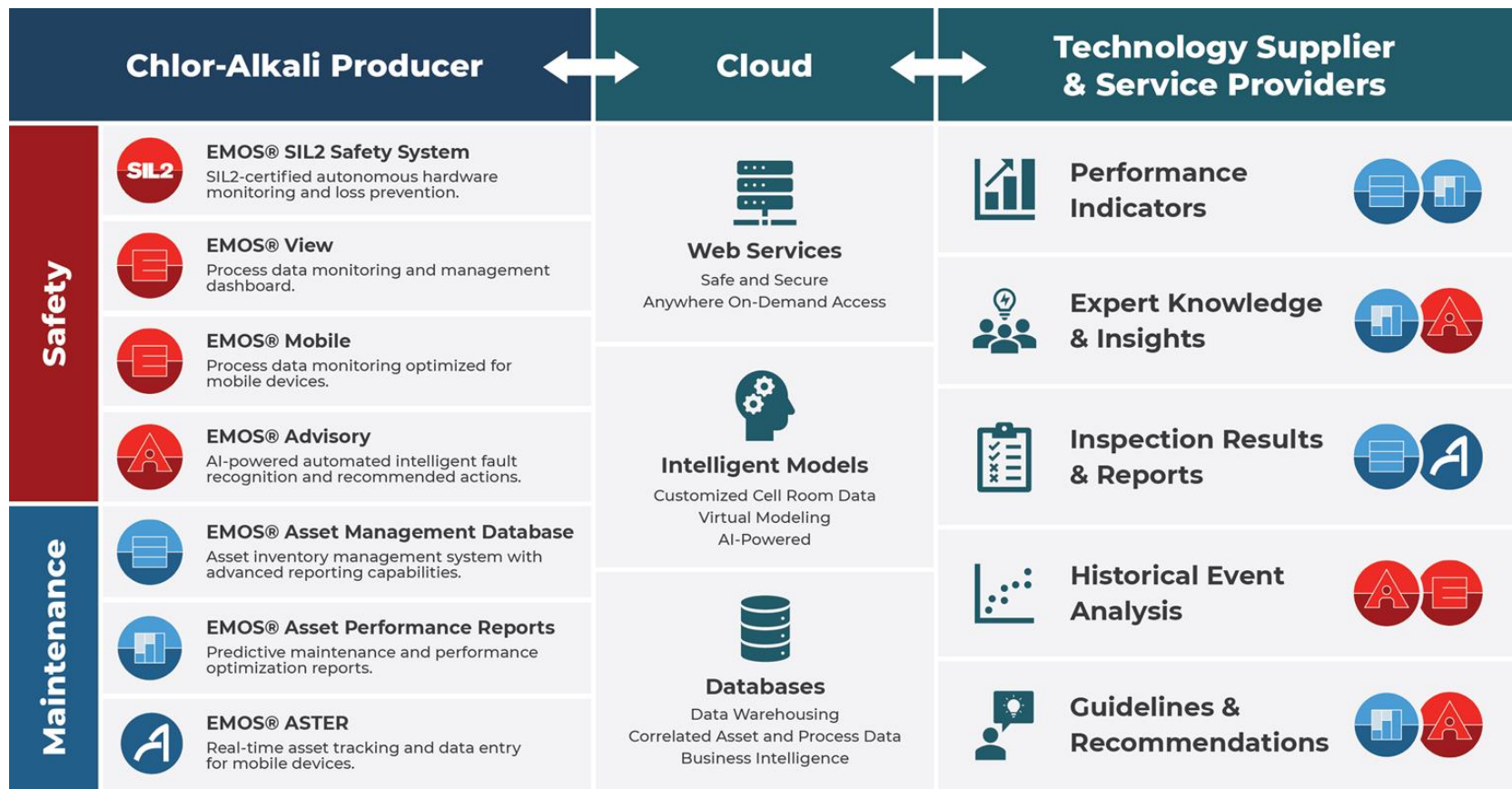


R2 at a glance

Over 20 global patents supporting R2's innovative hardware and software to improve cell room operation, plant performance and maintenance management (all customizable for a process/plant specific digital transformation).

Monitoring nearly **90,000 electrolysis cells** from all technology providers (over 90 installations in 25 countries on all continents).

Industry 4.0 ready.



SIL2

EMOS® SIL2 Safety System

CERTIFICATE

No. Z10 16 09 68122 016

Holder of Certificate: Recherche 2000 Inc.
390 St-Amand West, Suite 700
Montréal, QC H3T 1A7
CANADA

Factory(ies): 88122

Certification Mark:

Product: Safety components

Model(s): MODA sensor and SPOCOM logic, series
E919 (MODA) and E920 (SPOCOM)
Used with: E960-4 (TFP) and E960 (S)

Parameters: Safety parameter:
Safety Sampling Level (SL) 2
Proof Test Interval (PTI) 1 year

Tested according to: IEC 61508-1 and 2 (SIL 2)
IEC 61508-3 and 4 (SIL 2)
IEC 61508-5 and 6 (SIL 2)

The product was tested on a selective basis and complies with the essential requirements of the applicable standards. The certification mark shown above can be affixed on the product. It is not permitted to copy, reproduce, or use the certification mark in any way, or attach the certification holder's mark to the product, without the prior written permission of the certification holder. See also index coverage!

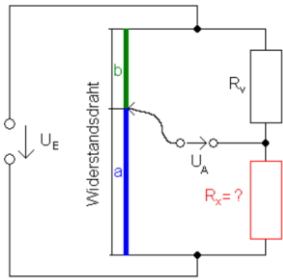
Test report no.: H98805027

Valid until: 2021-09-30

Date: 2019-09-30 (1 Year Validity)



Safety yesterday...



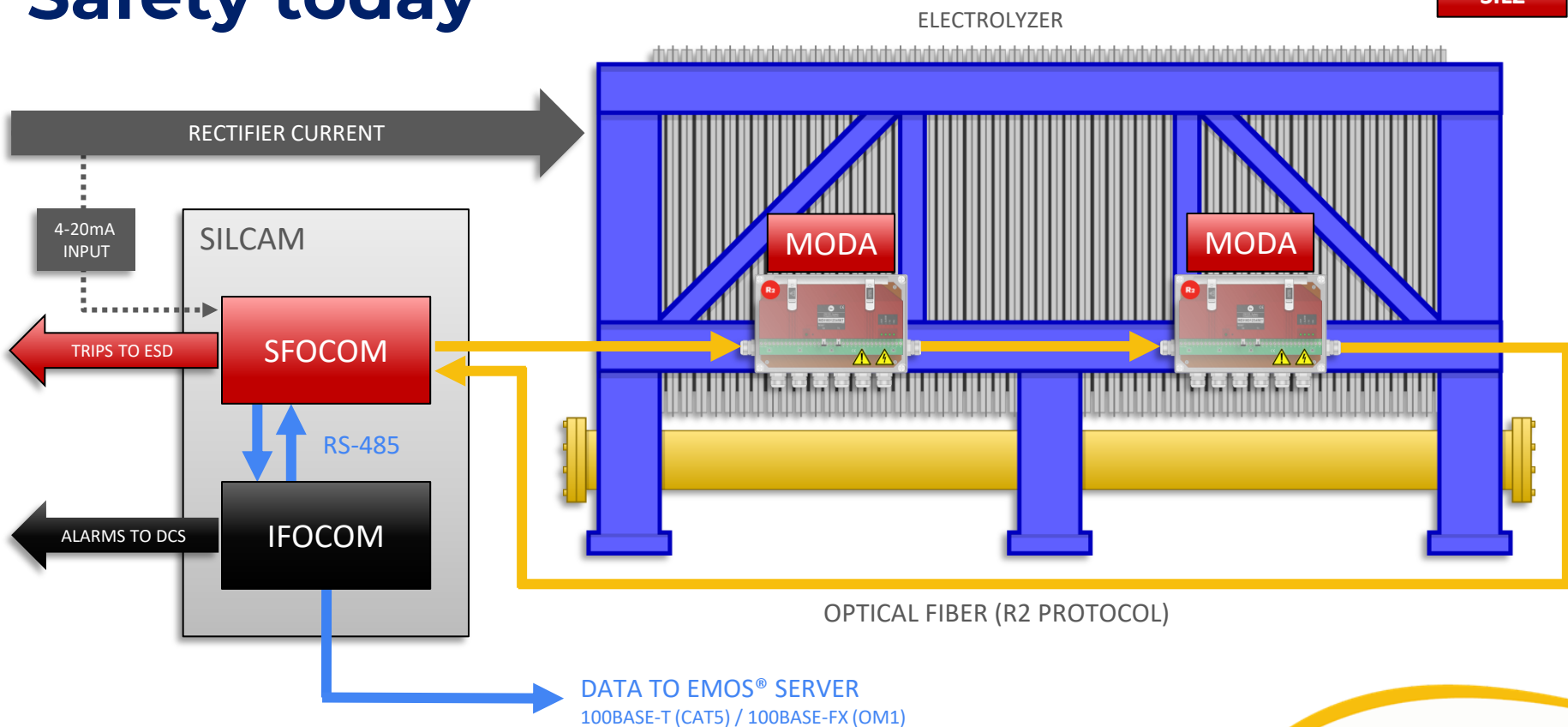
Wheatstone Bridge: Trips at 1 V
block voltage difference



Safety today

Legend

SIL2



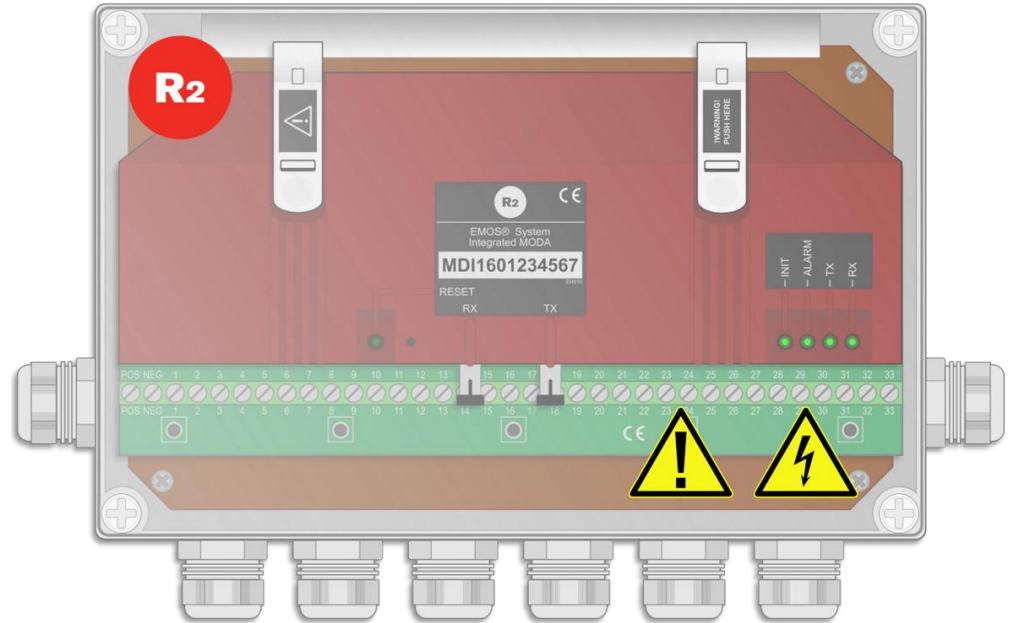
R2

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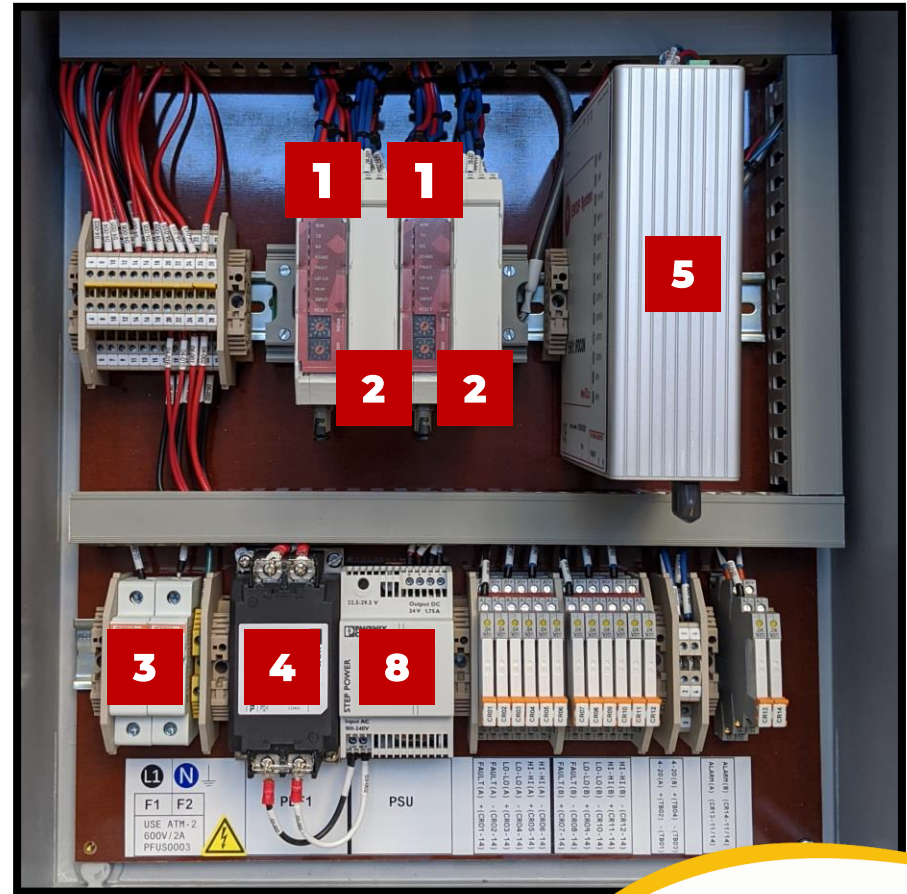
MODA

- **SIL2** Hardware and Firmware
- **32, ±5V DC** Readings (fused at 0.1A)
- Analog/Digital Converter
- Fiber Optic Communications
- **250ms** Scan Rate
- **±1.5mV** Accuracy (over temperature)
- **IPX7** Protection Against Chemicals
- **ATEX** Protection also available

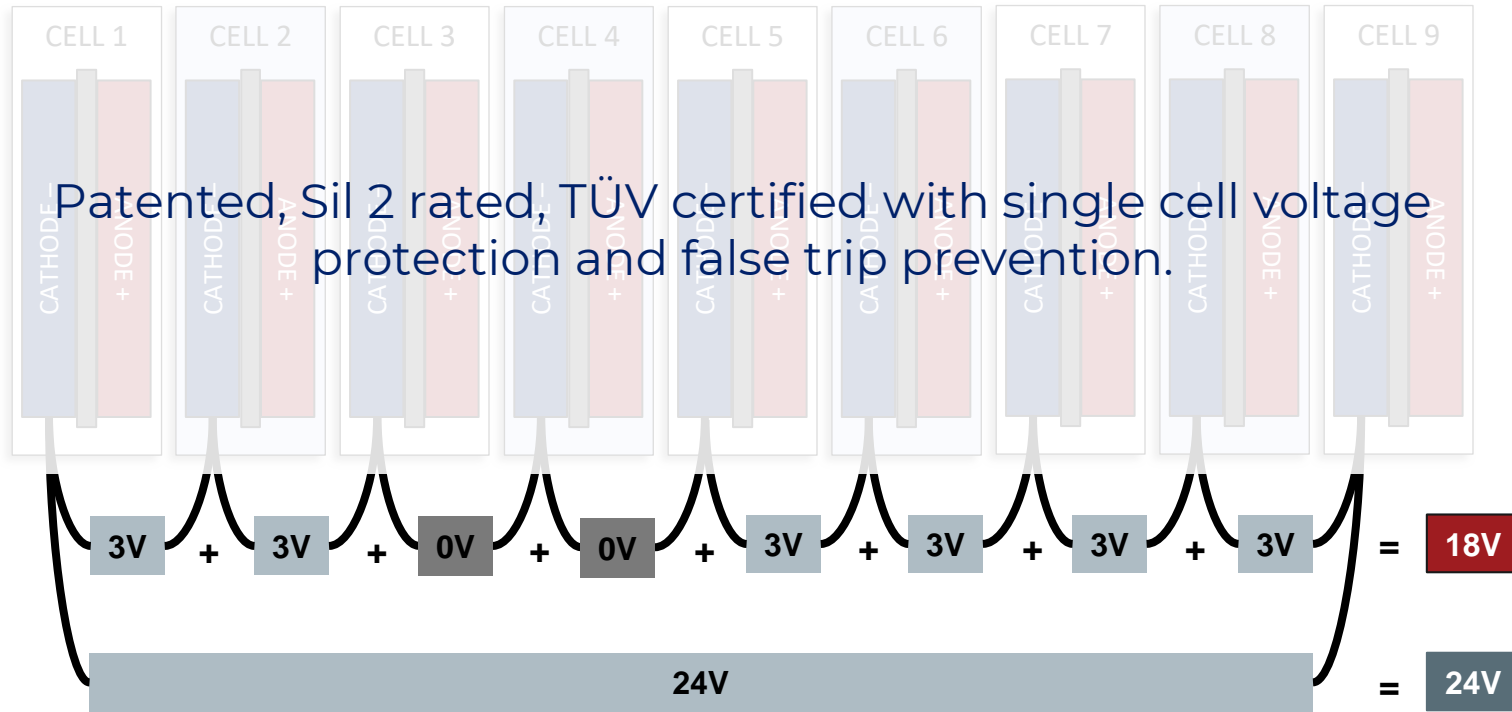


SILCAM

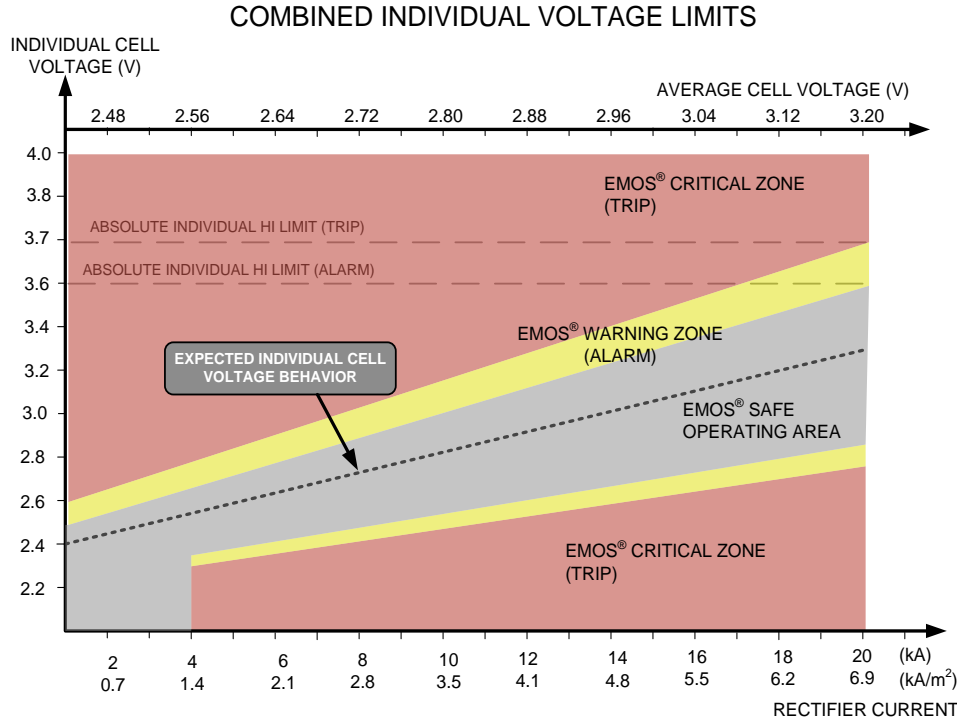
1. **SFOCOM** (1 to 4 units)
2. **Jumper Boxes**
3. **Power Supply** (120-240V AC, 50-60Hz)
4. **Signal Noise Filter**
5. **IFOCOM** Communicates with the EMOS® Server
6. Monitor up to **2 Electrolyzers**
7. **IPX7** Protection
8. **24V DC** Transformer



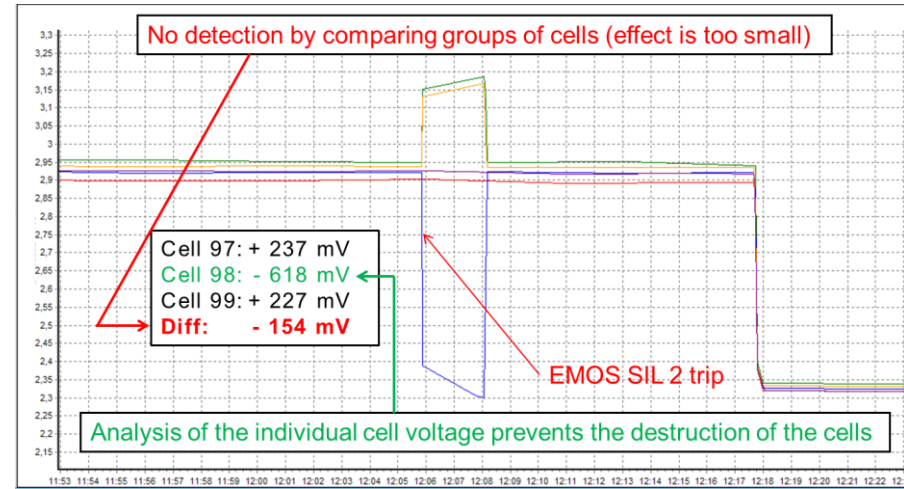
Total vs Single



Dynamic safety range calculated in real time



Exemplo de curto-circuito entre células

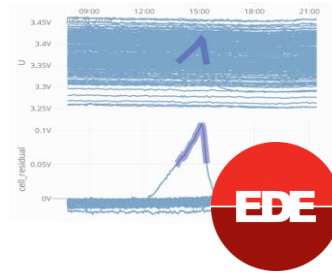
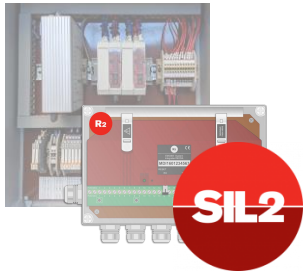


And more...

Multiple layers of protection.

Early protection with AI minimizes production loss.

Automatic detection of pre-damaged components.



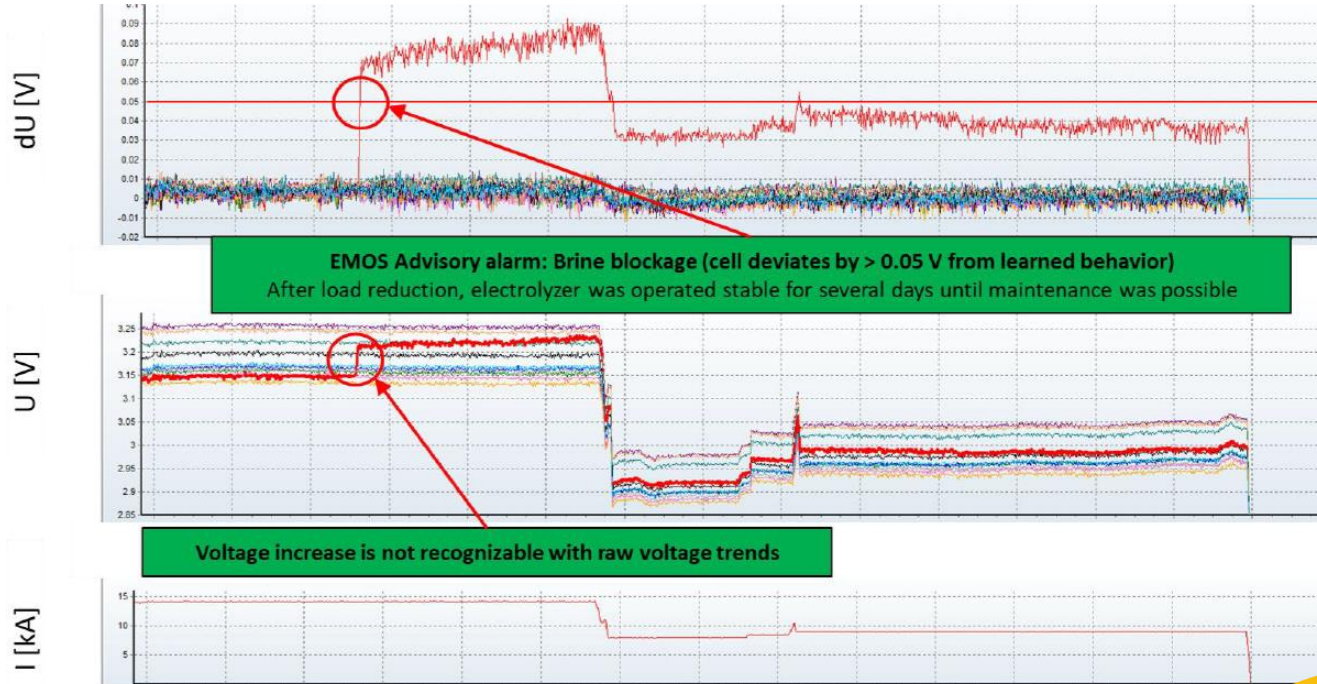
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Multiple layers of protection



Early protection with AI minimizes production loss



EMOS® View: The Interface

EMOS® View is an application designed to monitor and manage process data obtained from the **EMOS® SIL2 Safety System, Pinhole Detector, Single Cell Temperature, Early Detection Engine,** and **Advisory**, or any other OPC compliant system.



EMOS® View: The Interface

It is a streamlined user interface specifically tailored to the needs of the operators that displays key performance indicators such as raw and normalized voltages, cell temperatures, and feed. It offers reporting tools for alarms and cell voltages, the ability to trend process data like voltages or cell temperatures, and much more!





Soft Sensor



Soft Sensor

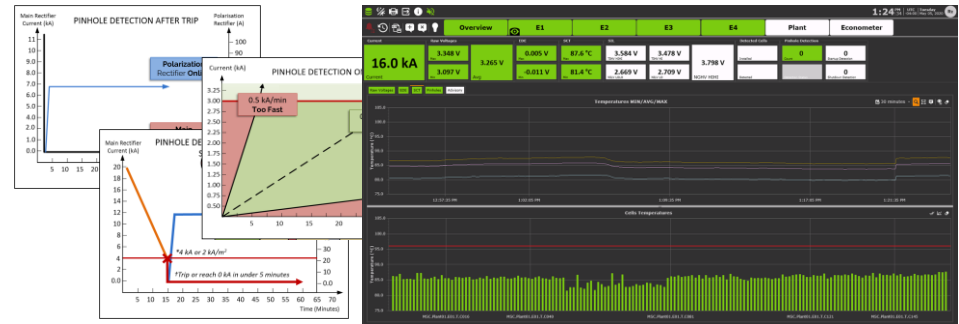
A **Soft Sensor** (“software sensor”) is a combination of process data (input) and a model that uses these input data to predict a target quantity (output). The input data used for the prediction are typically composed of signals from hardware sensors and actuators.



Pinhole Detector

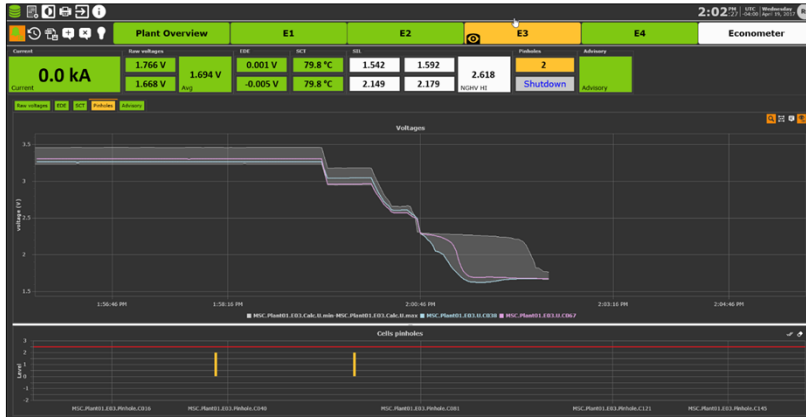


Single Cell Temperature

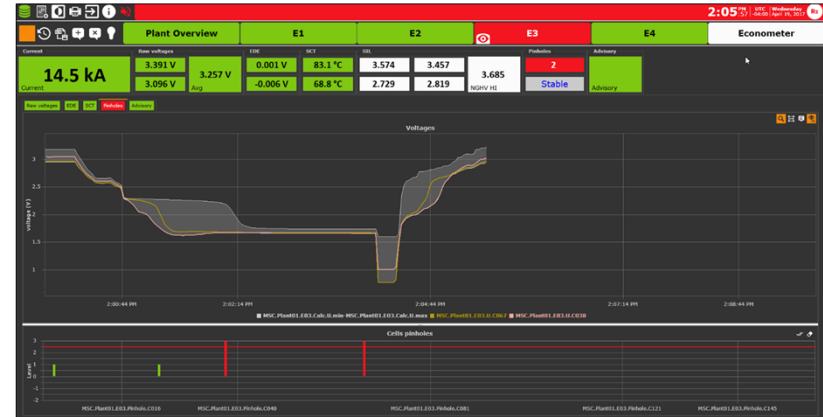


EMOS® Pinhole Detector

Pinhole Detected During Shutdown



Pinhole Detected During Startup



Calculates the current efficiency and applies a severity level during shutdown and startup.

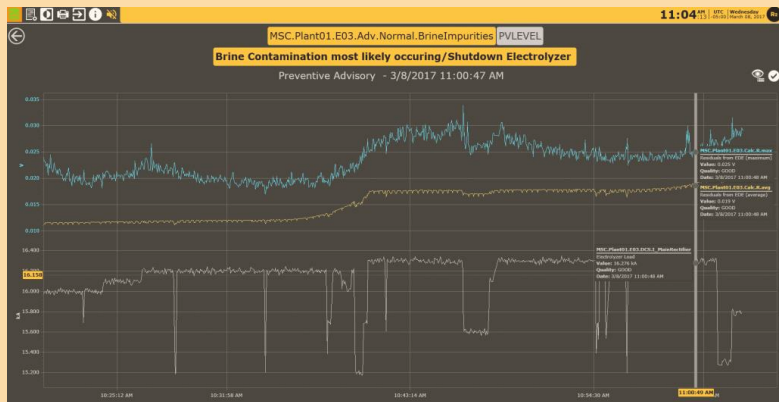
EMOS® Single Cell Temperature Evaluator

SCT evaluates the heat dissipation of each cell in the electrolyzer.



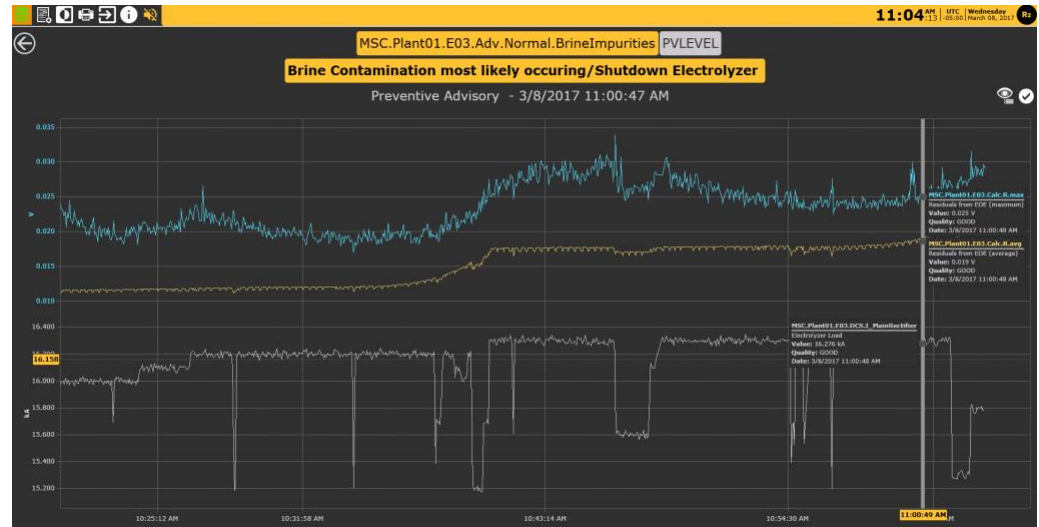


EMOS® Advisory



EMOS® Advisory

With **EMOS® Advisory System**, all **plant parameters** and **relationships** are **monitored**, covering all possible **phases of electrolyzer operation**: from start-up/ filling, to operating at full load, and back to shutdown / draining.





Current	Raw voltages	EDE	SCT	SIL	Pinholes	Advisory
2.1 kA	2.856 V 2.663 V Avg 2.702 V	0.048 V	90.5 °C 84.9 °C	2.953 2.278	2.903 2.328	2.955 NGHV HI
					0 Stable	Advisory

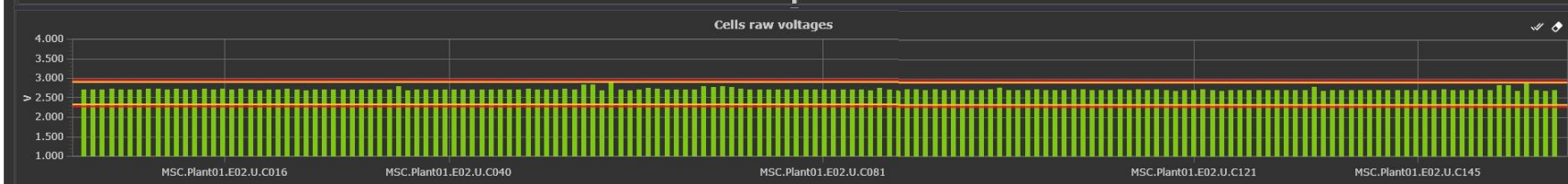
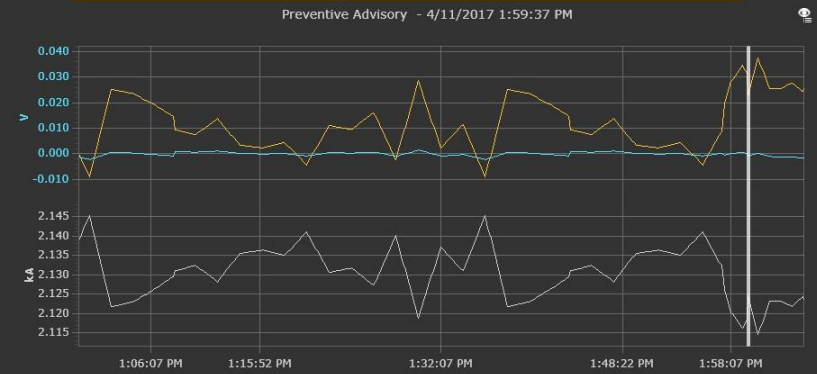
Raw voltages EDE SCT Pinholes Advisory

Brine Blockage

Brine Blockage most likely occurring on Cell011 E02 /Reduce Load

BRINE BLOCKAGE EXAMPLE

Brine Blockage most likely occurring on Cell011 E02 /Reduce Load

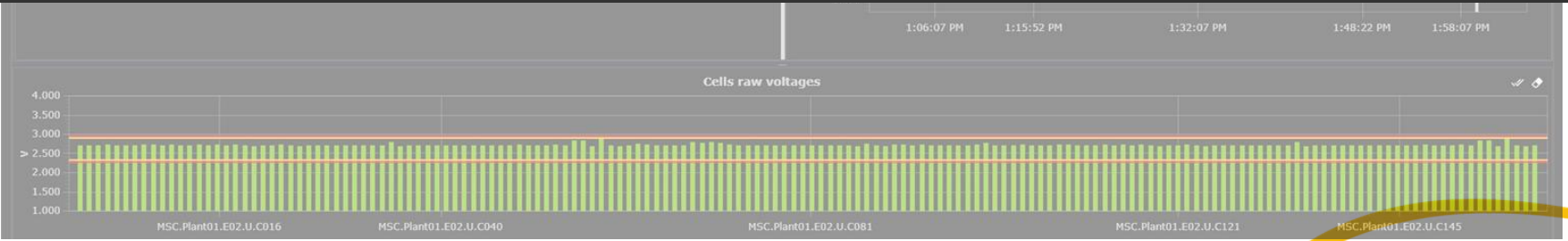
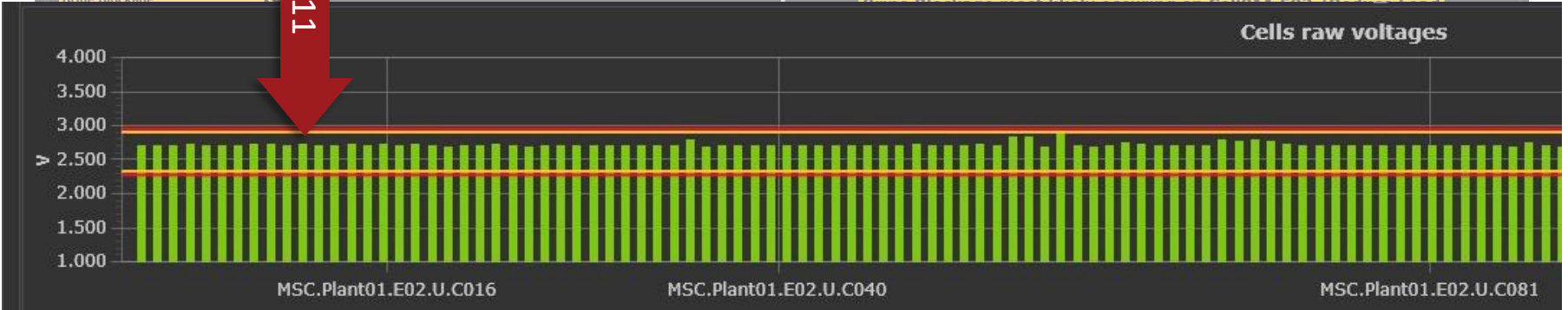


Plant Overview

Current	Raw	EDE	SCT	SIL	Pinholes	Advisory
2.1 kA	2.702 V	0.048 V	90.5 °C	2.953	0	
Current	Avg	-0.005 V	84.9 °C	2.278	2.955	Stable

Raw voltages EDE SCT Pinholes Advisory

CELL 011



Current: 2.1 kA

Raw voltages: 2.863 V, 2.709 V (Avg), 2.670 V

EDE: 0.115 V, 0.000 V

SCT: 90.4 °C, 84.8 °C

SIL: 2.964, 2.913, 2.956 (NGHV HI), 2.278, 2.328

Pinholes: 0, Stable

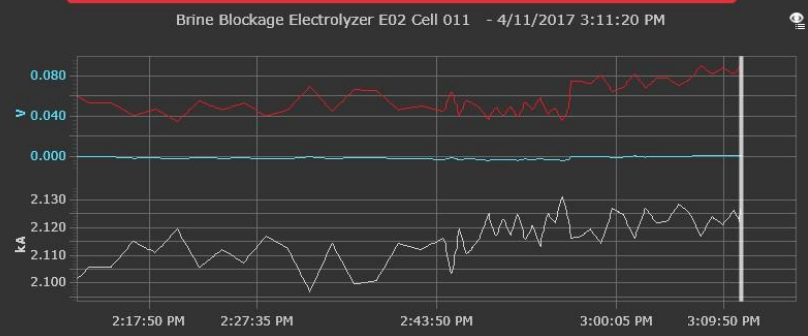
Advisory: Advisory

Raw voltages EDE SCT Pinholes Advisory

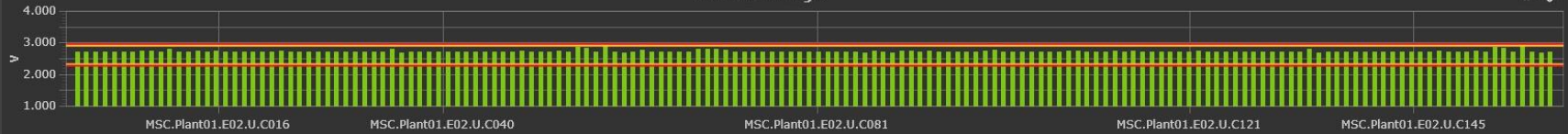
Brine Blockage
 Immediately Reduce Load or/and Shutdown Electrolyzer

BRINE BLOCKAGE EXAMPLE

Immediately Reduce Load or/and Shutdown Electrolyzer



Cells raw voltages



CELLS VOLTAGES

Plant Overview E1 E2 E3 E4 Econometer

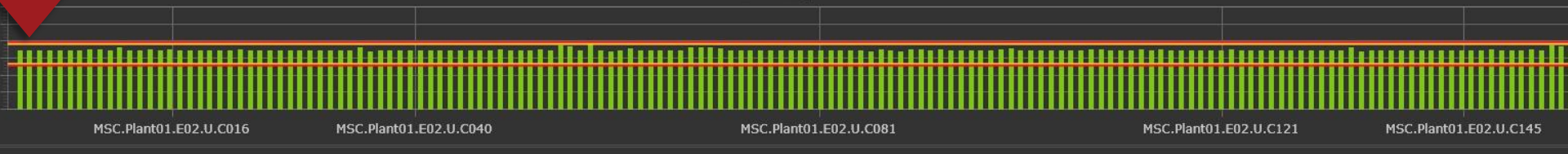
Current: 2.1 kA

Raw voltages	EDE	SCT	SIL	Pinholes	Advisory
2.863 V	0.115 V	90.4 °C	2.964	0	Advisory
2.670 V	0.000 V	84.8 °C	2.278	Stable	Advisory
Avg: 2.709 V			2.913		
			2.956		

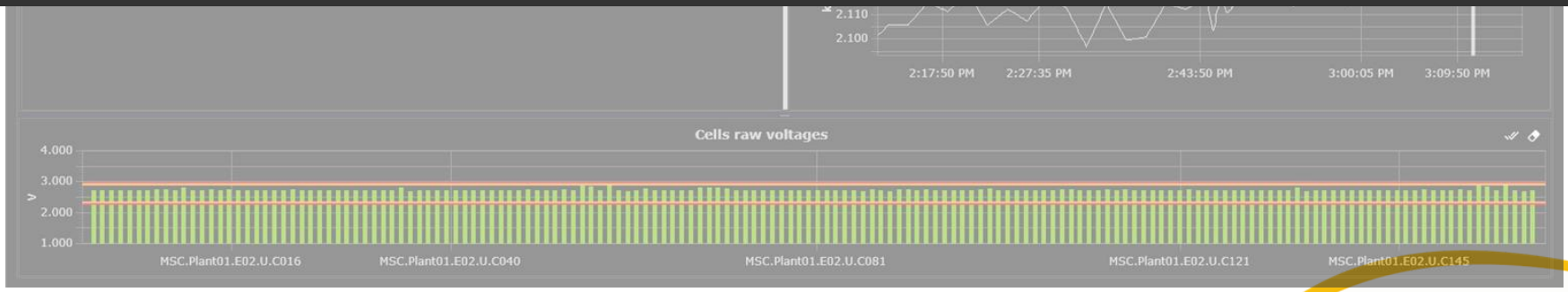
Brine Blockage

Immediately Reduce Load or/and Shutdown Electrolyzer

Cells raw voltages



Cells raw voltages

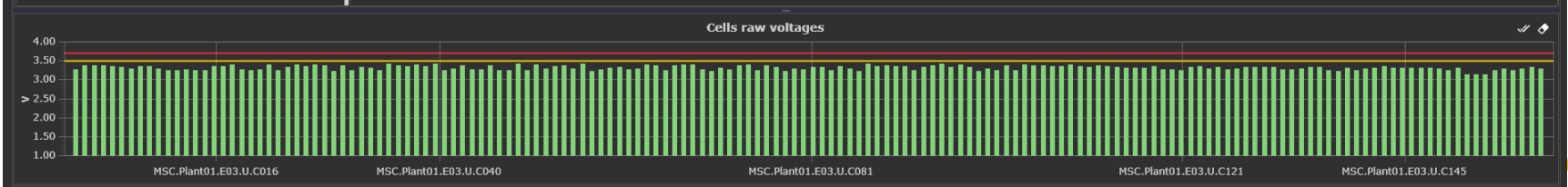
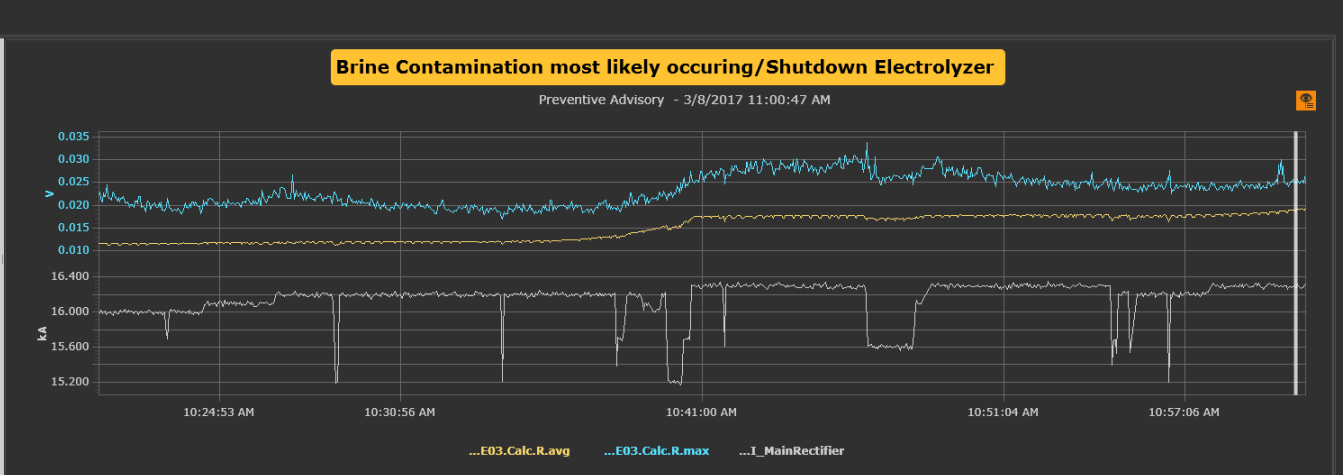


Current 15.8 kA	Raw voltages 3.42 V 3.11 V Avg 3.30 V	Residuals 0.03 V 0.01 V	Temperatures 91.98 °C 84.52 °C	Pinholes 0 Stable	Advisory Advisory
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BRINE IMPURITIES EXAMPLE

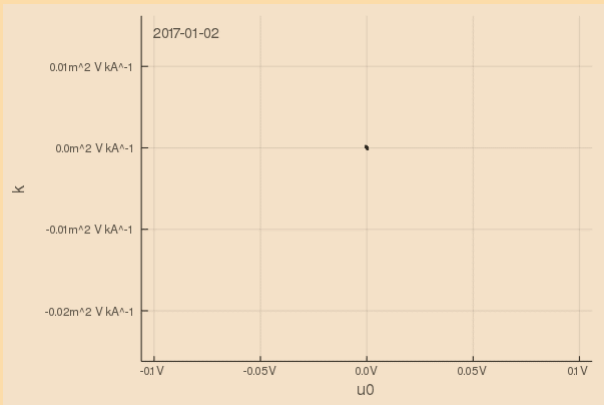
Brine Impurities

Brine Contamination most likely occurring/Shutdown Electrolyzer



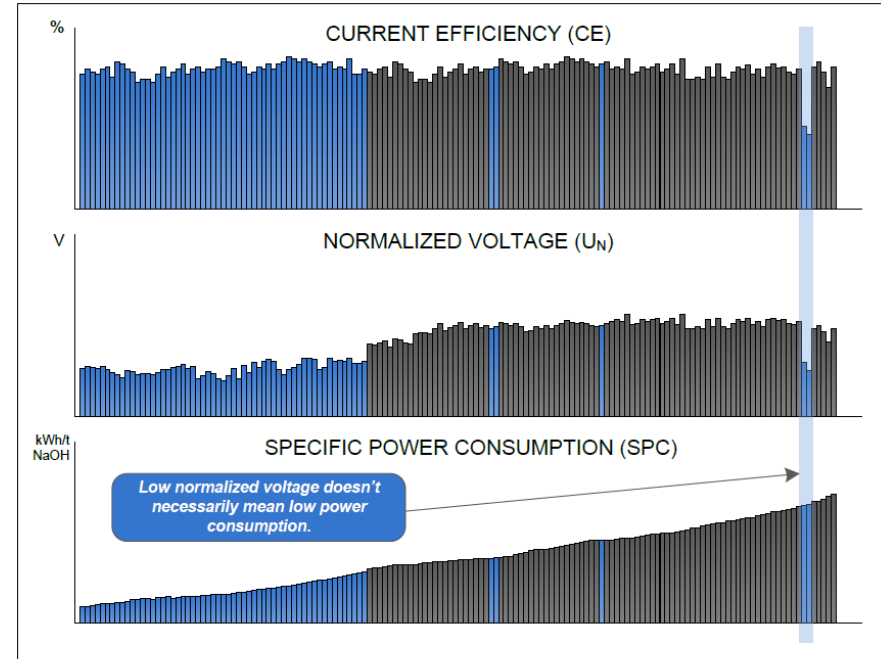


EMOS® Cell Performance Analyzer



EMOS® Cell Performance Analyzer (CPA)

The **EMOS® Cell Performance Analyzer (CPA)** is a service which determines the precise performance and economics related to the operation of electrodes (**U0, k-values**) and membranes (**k-value, C.E.**) of single electrolysis cells.

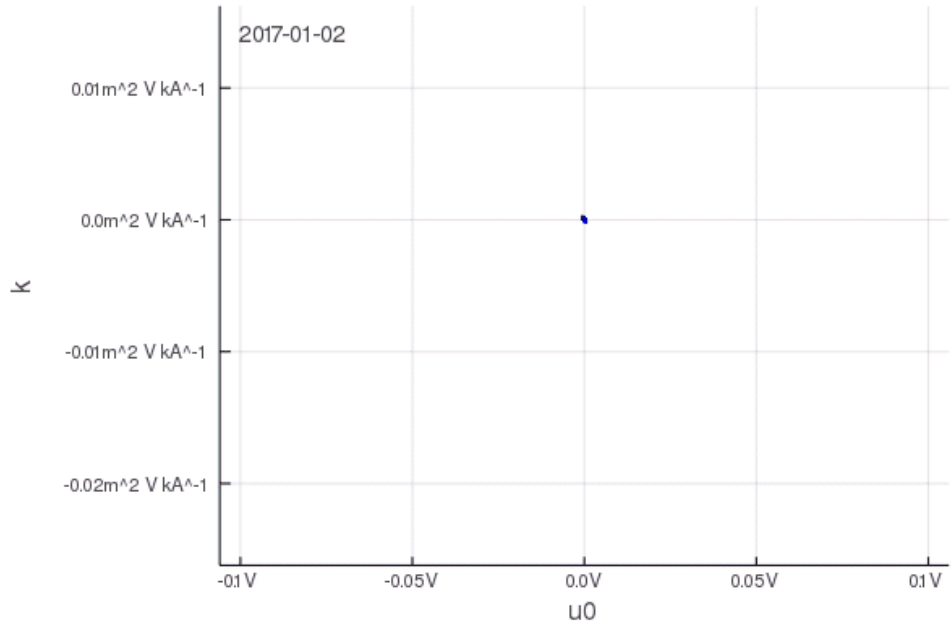


EMOS® Asset Performance Report

CPA: Cell Specific KPI calculation

One year of data calculated by R2's Cell Performance Analyser (CPA)

Evolution of **U₀** and **k** values shows real-time membrane and electrode aging

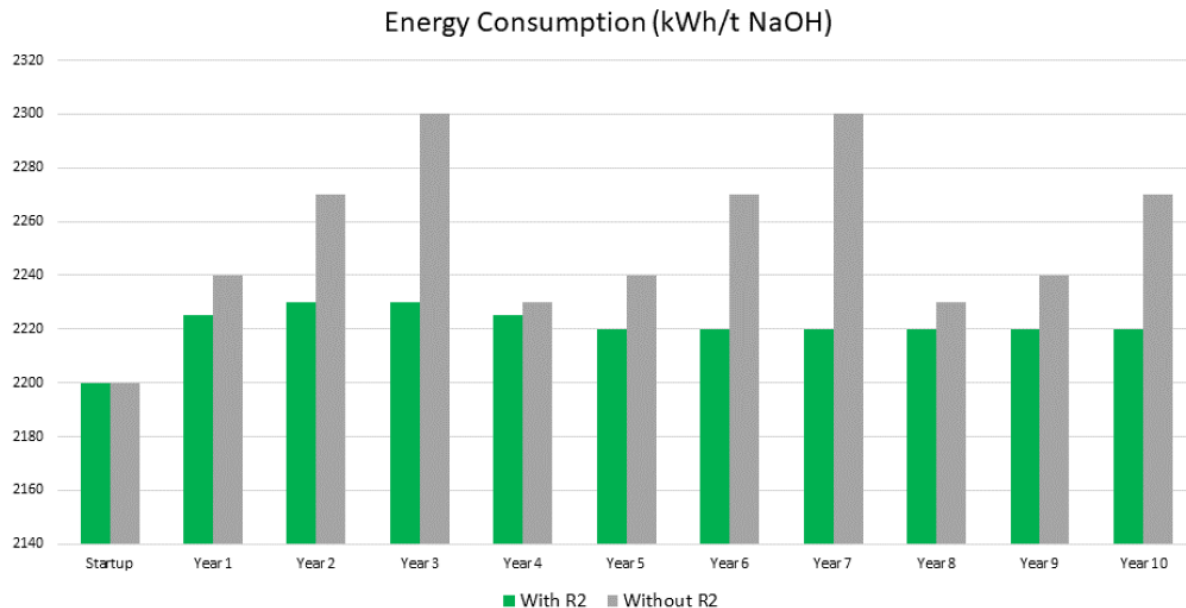


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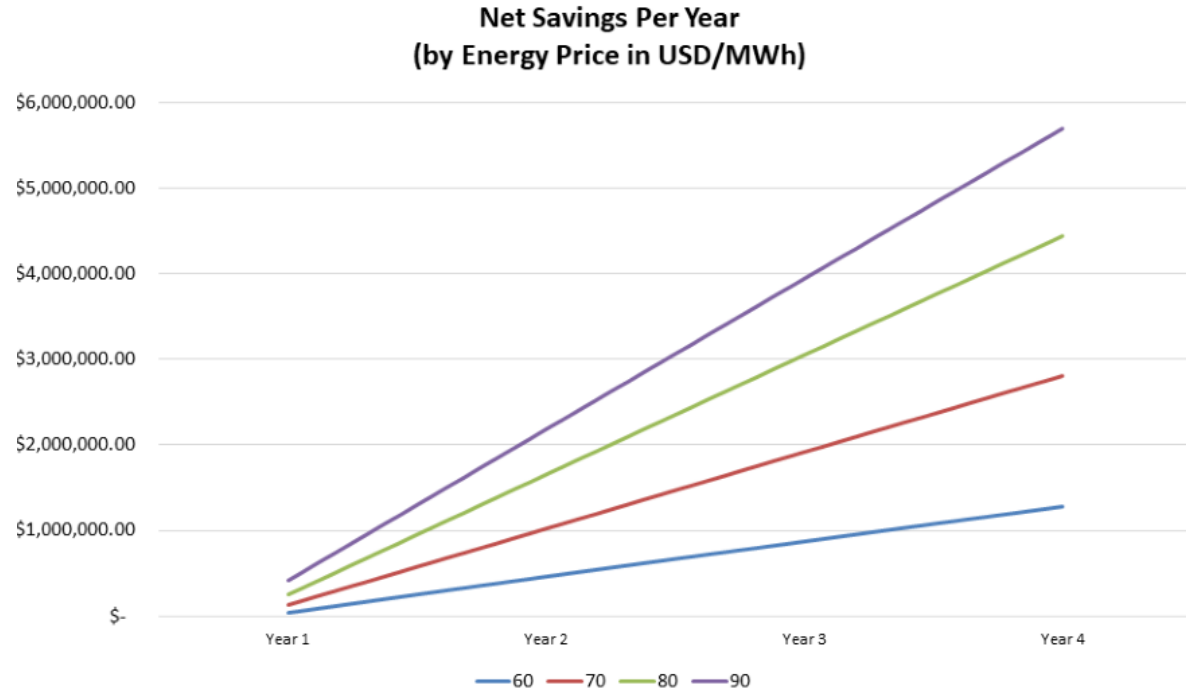
Case Study

The following case study used a **new plant** with **8 electrolyzers** over a **10-year** period. Each electrolyzer has **175 cells**, for a plant total of **1400 cells**. It shows the **savings** in **Specific Power Consumption (SPC)**, with and without R2's EMOS® Cell Performance Analyzer.



Case Study

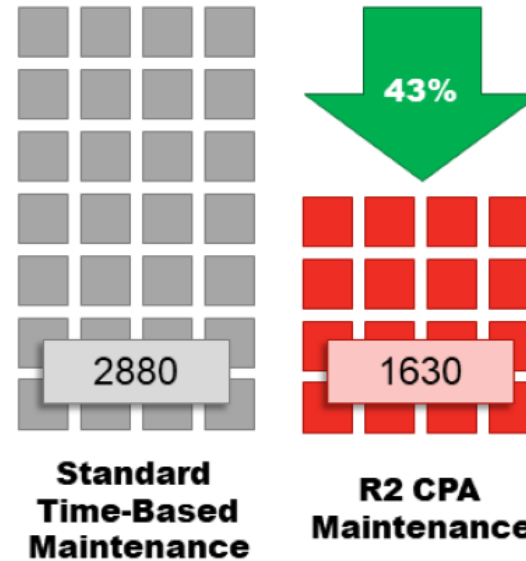
This second graph displays the annual financial savings for different energy prices, over a 4-year period.



Case Study

The last diagram shows the **reduction** in replaced components from a total of 2880 components replaced after 8 years without R2, down to 1630 components replaced after 8 years with **EMOS® Cell Performance Analyzer**.

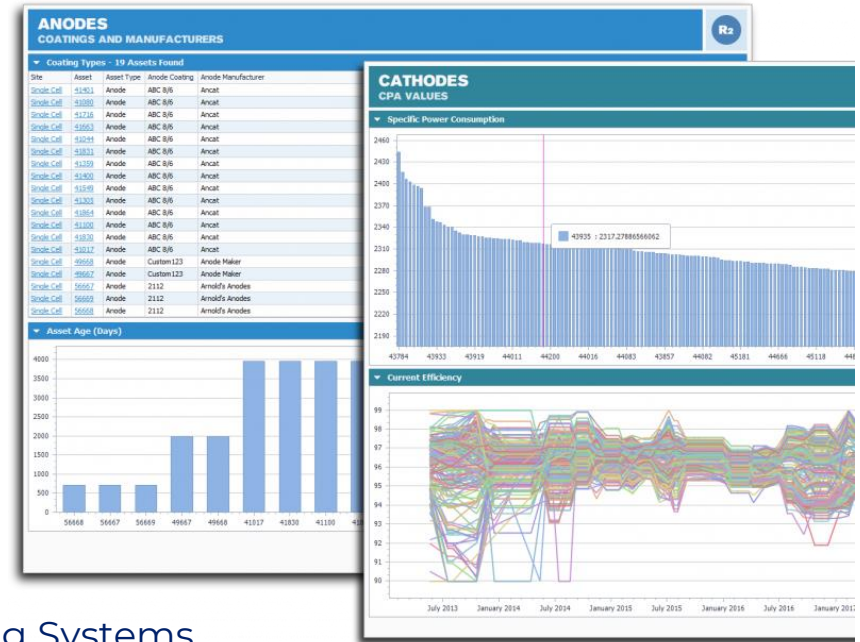
Total Components Replaced After 8 Years



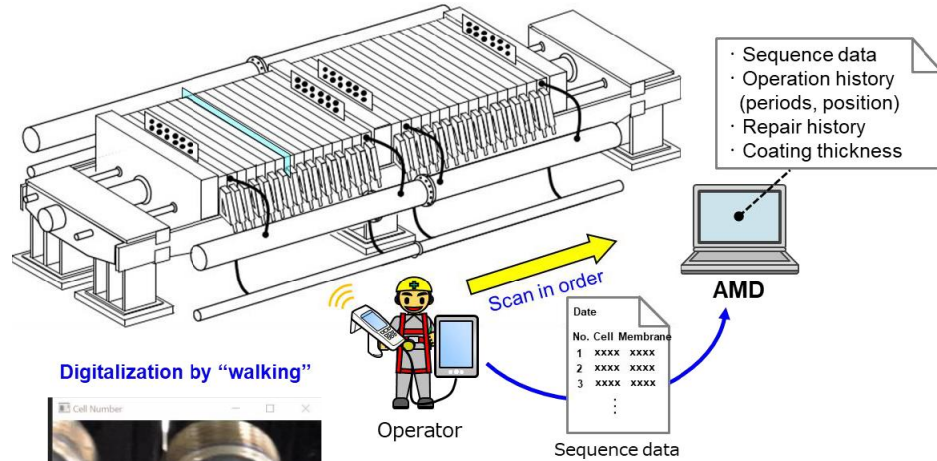
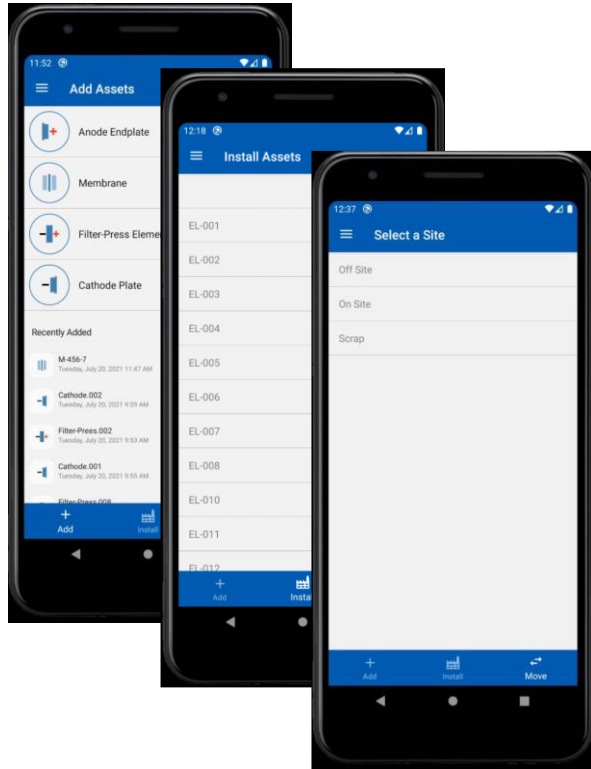
EMOS® Asset Management Database (AMD)

BENEFITS

- Save Time and Increase your Productivity
- Improve the Quality of your Data
- Designed for the Chlor-Alkali Industry
- Lower your Training Costs
- Adapt the Software to Fit your Workflow
- Export/Import Data To and From your Existing Systems



EMOS® Aster: AMD in hand

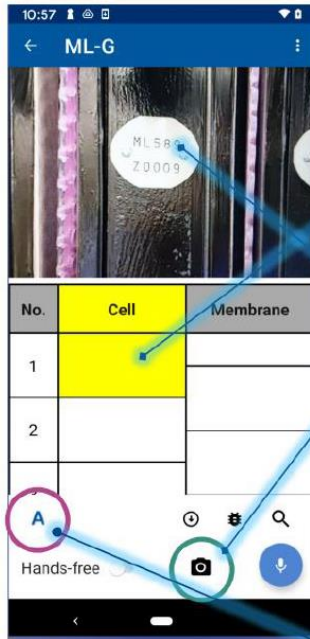


Digitalization by "walking"



Efficient digitization of information with **mobile devices** by **Optical Character & Speech Recognition**

EMOS® Aster: AMD in hand



Import Electrolyzer Data using video OCR

Select the column you want to enter.

Press Camera button.



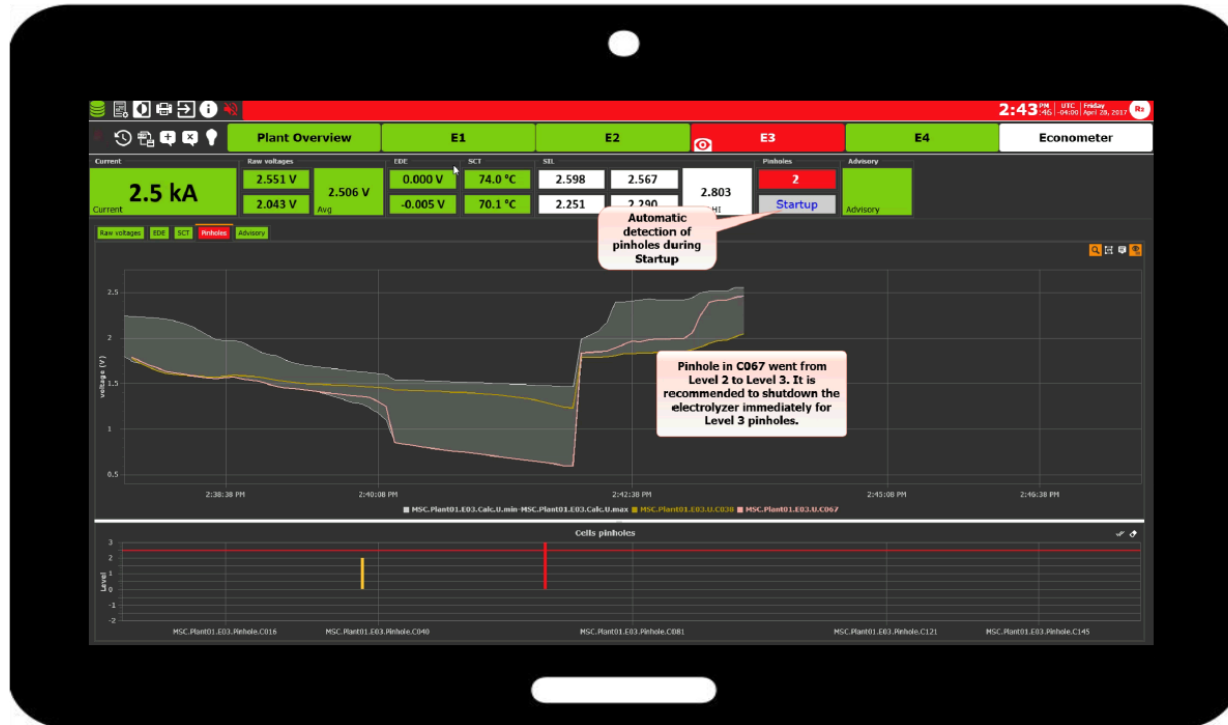
* Keep pressing button while ASTER recognizes.

Make sure that ASTER has recognized the number and entered the number in the column.

* If there are multiple nameplates on the screen, adjust the camera so that it is one nameplate by moving it closer.

* Make sure the direction is the same as the direction of the letters on the nameplate.

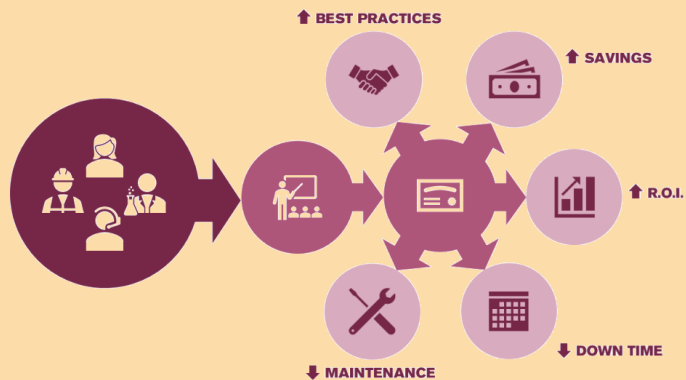
Enter in the age of Industry 4.0



The screenshot shows a mobile application login screen. At the top, the status bar displays 12:57. The app title is "EMOS® Mobile". The main text reads: "All information available everywhere with mobile." Below this is a house icon with a padlock, indicating a login screen. The text "Please sign in to access your plant data." is displayed. A blue button labeled "Sign in with Microsoft" is visible at the bottom.



Support & Training



Expert Services



Our **Support & Maintenance** plan for current users of our EMOS® Safety System includes unlimited support from our team as well as significantly discounted rates for software upgrades and updates.



Performance Analysis delivering early detection of abnormal performance loss, predictive and proactive maintenance planning (recoating and re-membraning based on economics), root cause analysis, improved utilization rates, and neutral investigation in warranty claims

Expert Services



Performance Optimization by optimizing of operating conditions, detecting and preventing of improper operation, increasing utilization rate, and improving plant safety.

Standard trainings are given by an R2-certified operations specialist or engineer and cover required topics and standard products.



Expert trainings are given by an R2-certified chlor-alkali expert and cover advanced topics and products.

Online and **On site** trainings.



Thank you!

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+1.514.987.1303 | F. +1.514.987.1305 | R2.ca*