THE LIKE-FOR-LIKE TRAP

GETTING OFFSHORE EC REPLACEMENT SIZING RIGHT

Audience:
Offshore facilities engineers, OIMs, chief engineers, and maintenance teams facing an electrochlorination replacement decision

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Running at 10%

Why Like-for-Like Electrochlorination Replacement Can Be a Costly Mistake

EXECUTIVE SUMMARY

When an offshore electrochlorination system reaches end of life, the easiest path is to replace it with the same rated capacity. Easy is not the same as right.

Most legacy EC systems were sized around worst-case dosing assumptions that have never been used in practice, or around operating cases that no longer reflect how the platform runs. In H2O's experience across replacement assessments, most existing systems are found operating well below 50% of nameplate capacity. Many run near minimum turndown and have done so for years.

That is not just a capital cost problem. Every unnecessary cell is a future replacement cost. Every oversized pump, tank, dosing header, and valve adds maintenance burden, spare parts inventory, and operating complexity across the life of the system.

H2O's PEPCON division has supplied electrochlorination packages since the 1950s, with installations in the Gulf of America, North Sea, Southeast Asia, Brazil, West Africa, and every major producing region worldwide. Over the last decade we have carried out more than 20 offshore EC refurbishment and replacement projects. The pattern is consistent: the replacement system rarely needs to be as large as the one it replaces.

THE RIGHT QUESTION

***The right question is not**: 'What size is the existing EC system?'*

***The right question is:** 'What hypochlorite demand does this platform actually need today?'"*

KEY TAKEAWAY

Do not carry the old nameplate forward until you have rebuilt the current demand basis and defined the actual dosing scenarios

Before specifying a replacement, rebuild the current demand basis. Identify every dosing user, assess the existing dosing lines, define the dosing scenarios, verify dosing targets, and confirm the field conditions that affect the replacement package.

The goal is not the biggest system that can be justified. The goal is the smallest compliant system that meets the platform's actual biofouling control requirements.

Why like-for-like Replacement Goes Wrong

The Old Capacity May Be an Old Assumption

A like-for-like replacement assumes the original EC capacity is still correct. The original system may have been sized for a different operating profile, different seawater users, different pump duty cycles, or a biofouling control philosophy that has since changed. It may also have been sized around conservative shock dosing scenarios that were never used in practice.

Electrochlorination demand is driven by three inputs: the seawater flow being treated, the target hypochlorite dose, and the duration and frequency of each dosing event. If any of those inputs are wrong, the replacement capacity will be wrong.

The most common problem is stacking worst cases: every continuous user online simultaneously while every shock user is dosed at the highest assumed dose with no interruption. That logic can make a replacement system far larger than the platform needs.

Most EC systems operate between roughly 10% and 100% of rated capacity. A 10 kg/hr system turns down to approximately 1 kg/hr at minimum. Below that, transformer-rectifier and cell operation becomes unstable. If a platform normally needs 0.5 kg/hr, a 10 kg/hr system is not just oversized on paper. It creates real operating problems every day.

TURNDOWN MATTERS

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The Long-Term Cost of Oversizing

Oversizing a replacement EC system is a decision that follows the platform for the entire system life: more cells, more future cell replacements, larger power supplies and electrical infrastructure, larger degassing and dosing equipment, more spare parts, more valves and instruments, and greater risk of low-flow problems in dosing lines. If the existing system has lived near minimum output for years, buying the same capacity again is not conservative. It is wasteful, and that wastefulness compounds through every maintenance cycle.

OVERSIZING FOLLOWS THE SYSTEM

Every unnecessary cell is a future replacement cost that compounds through every maintenance cycle for the life of the platform

Rebuild the Current Demands Basis

START WITH THE USERS, NOT THE NAMEPLATE

The first step in any EC replacement is rebuilding the current user list. A user is any point that requires hypochlorite: lift pumps, seawater supply pumps, jockey pumps, firewater systems, sea chests, cooling water headers, CIP systems for ultrafiltration membranes, etc.

This is where most replacement projects uncover unnecessary capacity. A user that was in the original design may no longer be active. A pump may run on a different duty cycle or run at a different flowrate. A shock dosing assumption may be more conservative than the current biofouling risk warrants. The following information is needed for each user before the replacement can be sized:

USER IDENTIFICATION	FLOW BASIS	DOSING BASIS	SCENARIO LOGIC
• Name and tag • Equipment duty • Active or inactive	• Normal flow rate • Max flow rate • Pumps on same chest • Volume-based cases	• Continuous target mg/L • Shock target mg/L • Shock frequency • Shock duration	• Continuous scenario • Shock scenario A • Shock scenario B • Additional scenario

DOSING CATEGORIES

Grouping users correctly is what allows the replacement to be sized accurately

Continuous dosing users

These users receive low-dose hypochlorite during normal operation to prevent marine growth from being established. A typical continuous dose is in the range of 1 to 2 mg/L, though values up to approximately 3 mg/L may be required depending on platform requirements and local conditions. The real measure of adequate continuous dosing is the free chlorine residual at the outfall, typically targeted at approximately 0.5 mg/L. A residual at that level confirms adequate dosing. A much higher residual indicates overdosing and wasted hypochlorite injection.

Sea chests require careful consideration. Where multiple pumps draw from the same sea chest simultaneously, the dosing flow basis must account for the combined flow of all operating pumps, not just one.

Shock dosing users

These users receive a higher dose for a limited period. Shock dosing is commonly around two times the continuous dose rate. For every shock user, the assessment must document frequency and duration, for example once per week for 15 minutes. These inputs are essential for both sizing and controls design.

Volume-based users

Some users require a defined volume of hypochlorite on a set schedule rather than a continuous flow-proportional dose. CIP systems for ultrafiltration membranes are a common example: a fixed volume of hypochlorite solution at a known concentration delivered on a scheduled basis. Firewater pump caisson screen protection is another, covered in the oversizing traps section.

Assess the Existing Dosing Lines

Replacement is the right time to gather complete data on every dosing line running from the EC system to each user. This information is essential for two reasons: verifying that line velocities are adequate, and confirming the correct control strategy for each dosing point.

Line Velocity

The electrochlorination process produces hydroxides as a byproduct. In dosing lines running at low velocity, these hydroxides can settle and accumulate, eventually causing fouling and plugging. Line velocities below approximately 1.5 m/s are generally at risk.

Evaluating velocity requires current P&IDs for every dosing run, including pipe size, length, and elevation changes. Mitigation options exist that do not require replacing the lines, but they cannot be identified without knowing the current line configuration. If this data does not exist or is out of date, gathering it is a prerequisite for a well-specified replacement.

On/Off vs. Proportional Dosing Control

On/off valves are the preferred default for dosing points. They are less expensive, simpler to control, and appropriate for any user where the required dosing scenario can be executed by changing the current output from the transformer rectifier alone. Changing current changes the concentration of hypochlorite produced without changing the volumetric flow rate. Going from a 1 mg/L continuous dose to a 2 mg/L shock dose, for example, is accomplished by increasing current from approximately 50% to 100% at constant flow. No valve adjustment is needed.

Proportional valves are only needed when a dosing scenario requires an actual change in flow rate to a specific user, not just a change in concentration. This is the exception, not the rule, and should be identified during the line assessment for each user.

Mass Balance and the Trim Valve

Regardless of how many proportional valves exist for scenario control, the system always needs a way to trim total dosing flow to match production flow through the EC cells. If total dosing flow drifts above or below production flow, the degassing tank level will rise or fall until a high or low level shutdown occurs.

The preferred approach is to designate the largest continuous user as the trim point and fit that dosing line with a proportional valve. By slightly increasing or decreasing flow to that user, the system maintains tank level stability while continuing to dose productively. A dedicated bleed-off or dump valve back to sea is a viable fallback, but it wastes produced hypochlorite and should be avoided where possible.

Talk to the Field

Before finalizing the dosing line assessment, speak with the operators and maintenance technicians who work with the existing system. They typically know exactly which lines have plugged, where dosing has been unreliable, which users have had recurring problems, and what workarounds have been put in place over the years. This institutional knowledge is often not captured in any document, and replacement is the right time to surface it and address it in the new design.

If the P&IDs for the dosing lines do not exist or are out of date, do not skip this step.
Line velocity issues, plugging history, and control strategy decisions all depend on having accurate line data. Gathering it before the replacement is specified avoids retrofitting the design after installation.

Define the Dosing Scenarios

Once the user list and dosing line data are complete, the next step is to define the dosing scenarios. A dosing scenario is a defined operating case that specifies which users are active, what type of dosing they are receiving, at what concentration, for how long, and how often.

Defining dosing scenarios is not just a sizing exercise. The scenarios become the foundation for the controls design. The EC system needs to know which scenario it is in at any given time, what concentration and flow targets apply, and how to transition cleanly between scenarios. If the scenarios are not defined before the replacement is specified, the controls design will be built on assumptions that may not match actual platform operation.

🔵Continuous Dosing Scenario

Every platform has at minimum one continuous dosing scenario: all continuously dosed users online at normal dose. This is the baseline operating case and typically represents the continuous kg/hr demand.

It defines the steady-state operating point of the system.

⚡Shock Dosing Scenarios

There will typically be multiple shock dosing scenarios, each representing a different combination of users being shock dosed. Each scenario must define which users are being shock dosed, whether continuous dosing to other users is maintained or suspended during the event, the shock concentration required, the duration of the event, and the frequency at which it recurs.

It is not necessary for every shock user to appear in the same scenario. One scenario might cover the lift pumps, another the cooling water header, another the firewater jockey pump. Each is assessed for its instantaneous kg/hr demand, and the highest-demand scenario becomes the design case.

This is where scenario-based thinking directly reduces system size. Lumping all shock users into one simultaneous scenario almost always produces a design case kg/hr that is substantially higher than any individual scenario requires. Splitting users across sequential scenarios reduces required capacity without compromising biofouling control.

If you cannot define the dosing scenarios, you cannot size the replacement correctly.

Scenarios are not just a sizing input. They are the specification for how the system needs to operate.
Building them before specifying the replacement saves rework in both sizing and controls.

Challenge the Dosing Scenarios

The Hard Part Is Not the Math. It Is the Scenario Logic.

Once the dosing scenarios are defined, the next step is to challenge them. This is where most replacement systems become oversized, and where the largest capacity reductions are consistently found.

1 Oversizing Trap 1: The Firewater Pump as the Design Driver

The most common oversizing trap is sizing the EC system to treat the full discharge flow of the main firewater pump. A firewater ring main is kept pressurized at all times by a jockey pump, which circulates a small flow through a pressure control valve back to sea. Dosing the jockey pump continuously keeps hypochlorite circulating through the ring main and prevents biofouling without ever treating the main firewater pump flow.

The main firewater pump only activates when ring main pressure drops due to a genuine fire demand. It does not run during normal platform operation, and it does not need to be treated as a continuous or shock dosing user. The pump intake screen requires protection, but this is a volume-based case: a fixed volume of hypochlorite injected into the pump caisson on a defined schedule.

In one Gulf of Mexico replacement project, the original system had been sized to shock dose the full firewater pump flow. Applying the correct basis, continuous jockey pump dosing for ring main protection and a scheduled volume-based injection for caisson screen protection, reduced the required EC capacity from 18 kg/hr to 9 kg/hr. If a full-flow firewater pump case is driving the replacement size, that assumption should be the first thing challenged.

2 Oversizing Trap 2: Continuous Dosing That Can Never Stop

If the shock dosing scenarios can be designed to allow a temporary suspension of continuous dosing during the shock event, the EC system may not need to simultaneously serve both the shock demand and the full continuous demand. Marine biofouling does not become a platform problem because continuous dosing was suspended for 30 to 60 minutes during a controlled scenario. If that trade-off reduces the design case significantly, it deserves serious evaluation.

3 Oversizing Trap 3: All Shock Users in One Scenario

If all shock users are specified in a single simultaneous scenario, the instantaneous kg/hr required will almost always be much higher than any individual scenario demands. Defining discrete shock scenarios and sequencing users across them means the highest-demand individual scenario, not the sum of all shock users at once, becomes the design case. The same biofouling control outcome is achieved on a defined schedule rather than all at once.

4 Oversizing Trap 4: Legacy Dose Assumptions Never Revisited

The measure of adequate dosing is the free chlorine residual at the outfall, targeted at approximately 0.5 mg/L. If a 1 mg/L continuous dose achieves that residual, there is no technical basis for specifying 2 mg/L and dumping 1.5mg/l back to the sea. If the original design assumed higher values, the replacement project should verify whether they are still required or simply a conservative legacy assumption carried forward without review.

Sizing lever	Old basis	Better basis
Firewater logic	Full firewater pump flow as shock dosing basis	Jockey pump continuous dose for ring main; pump caisson as volume-based on schedule
Shock timing	All shock users dosed simultaneously in one scenario	Discrete shock scenarios sequenced to stay within available kg/hr
Continuous dosing	Continuous dosing can never be interrupted	Evaluate controlled suspension during defined shock scenarios
Dose assumptions	Legacy shock dose values never verified	Verify against outfall residual target of ~0.5 mg/L; excess is waste

Mass Balance

The volumetric flow rate into the EC cells must match the volumetric flow rate being dosed to users at all times. This constraint is managed primarily by changing current output, not flow. Increasing current from 50% to 100% doubles the hypochlorite concentration produced in the same volumetric flow, delivering twice the mg/L to users at the same flow rate. If the volumetric balance drifts, the degassing tank level rises or falls until a high or low level shutdown occurs.

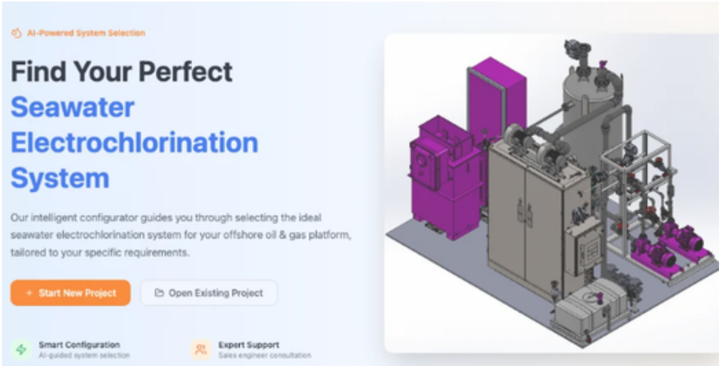
Dosing scenarios must be designed with mass balance in mind, and the trim valve strategy confirmed as part of the dosing line assessment. Every scenario transition needs to be managed so that total dosing flow remains matched to production flow throughout.

Use the Flexifit Configurator Before you write the Specification

You Do Not Need to Build This From a Blank Spreadsheet

The analysis described in this paper, user lists, dosing line data, scenario definitions, kg/hr calculations, and field condition inputs, requires a structured framework to do correctly. That framework already exists.

H2O's FlexiFit Electrochlorination System Configurator walks through each step of the demand basis assessment and gives the platform team the option to request a review with an H2O engineer experienced in offshore EC replacement projects. It is available at https://ffc.h2oinc.com Sign up takes a few minutes using SSO or an email address.



1	**Build the user list**	Tag, duty, flow rate, dosing type, dose level, shock frequency and duration, volume-based requirements. Flag inactive users.
2	**Define dosing scenarios**	Continuous scenario and each shock scenario: which users, concentration, duration, frequency, and whether continuous dosing is maintained or suspended.
3	**Calculate demand**	kg/hr required per scenario. Highest-demand scenario becomes the design case.
4	**Assess dosing lines**	P&ID line sizes, lengths, elevation changes. Flag velocity risks below 1.5 m/s. Note proportional vs. on/off valve requirements per user.
5	**Enter field conditions**	Space, seawater supply, electrical supply, hazardous area classification, materials of construction, redundancy, and installation constraints.
6	**Request engineering support**	Submit assessment to an H2O EC engineer for replacement package recommendation.

When the assessment is complete, the platform team has a documented user list, assessed dosing lines, defined dosing scenarios, calculated kg/hr demand per scenario, identified field conditions, and enough structured information to support a well-founded replacement specification. The goal is a replacement system that meets the platform's requirements, fits the available space and utilities, and can be installed without the surprises that come from an under-analyzed specification.

FlexiFit Electrochlorination System Configurator

Before you issue a like-for-like replacement specification, run the capacity assessment. Build the user list. Assess the dosing lines. Define the scenarios. Calculate the demand. Configure the right replacement.

https://ffc.h2oinc.com
Sign up free with SSO or email. Request engineering support directly from within the tool.

About H2O, Inc.
H2O designs and manufactures industrial water treatment systems for offshore oil and gas and commercial marine applications. The PEPCON division has supplied electrochlorination packages since the 1950s. FlexiFit systems available from 2.5 to 75 kg/hr per train.