

barium
56

calcium
20

zinc
30

arsenic
33

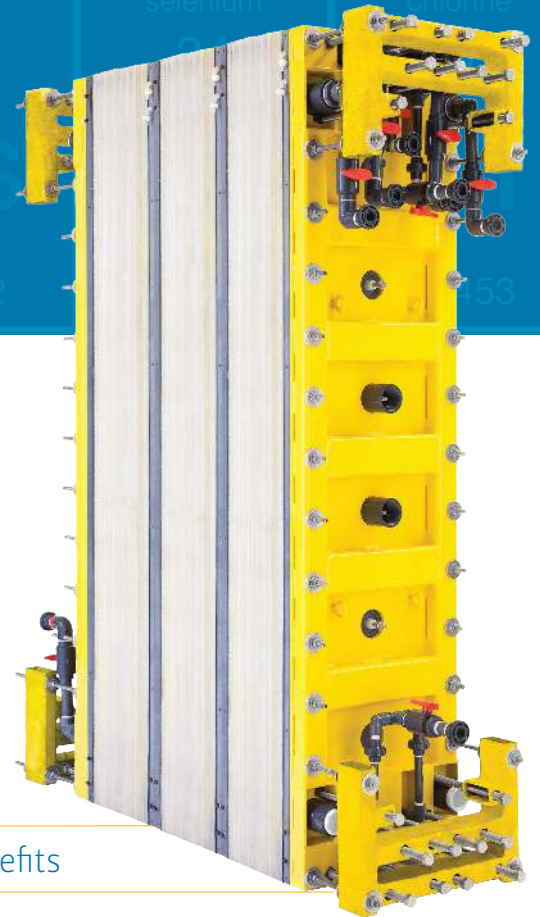
selenium
78

chlorine
35.5

Flex EDR

Next generation electro dialysis reversal (EDR) and IonFlux™ membranes

- Desalinate impaired waters, concentrate reject water, recover chemicals
- Reverse osmosis hybrids for extremely high recoveries and brine concentration
- Chemical-free softening, desalt produced and high TDS waters



> Patented improvements over traditional EDR

- robust design and resilient IonFlux™ ion exchange membranes
- developed for high concentration operation
- operate on highly scaling waters including produced waters containing hydrocarbons
- high recovery hybrids with reverse osmosis
- electrode protection from hardness fouling
- modular cartridges for ease of expansion and maintenance
- positive seal stack to ensure reliable leak free operation
- advanced configurations, chemical recovery, acid and base generation

> Benefits

- builds on fifty years of EDR technology with twenty-first century improvements
- developed for extremely high recovery operation, squeezing every last drop of water
- designed for robust operation with tens of thousands of hours in oil, gas, mining, landfill, and hard brackish RO reject applications
- built on standardized high quality skids delivering consistency and quality
- readily containerized for remote operation and modular build
- IonFlux™ membranes' strong transference of multivalent ions reduce scaling potential

Our process

1 Desktop

Chemistry, engineering and project assessment. Initial plant sizing, performance and economics.

2 Bench

Run your water on one of our fully automated test benches.



3 Pilot

Operate one of our automated pilot machines at your site or our fully permitted sea front facility.

4 Operate

Deliver a reliable, low cost plant to meet your needs. We can deliver the entire project or work with partners of your choice. Sale, lease, and operation options available.

barium 56	calcium 20	zinc 30	arsenic 33	selenium 34	chlorine 17
Flex EDR	Flex EDR	Flex EDR	Flex EDR	Flex EDR	Flex EDR
137.33	40.078	65.39	74.922	78.96	35.453

> Minimum Scope of Supply

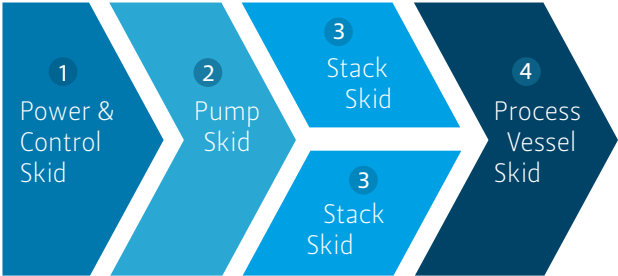
- **Stacks**
Flex EDR stack technology with Saltworks' IonFlux™ ion exchange membranes
- **Process**
Engineered for high reliability and ease of operations: automated reversal valves and power supply for ionic current reversal, clean in place system, and protective cartridge filters
- **Pumps**
Robust engineered plastic centrifugal pumps, TEFC motors with splash guards, Rockwell VFDs
- **Automation package**
Fully automated process with user friendly graphical interface, remote log-in, data logging, trending, automated start, stop, reversal and flush
- **Instrumentation package**
Digital flow, pressure, temperature, conductivity, pH, stack current and voltage via tier 1 vendors. Analogue indication of flow, pressure, temperature
- **Controls package**
Rockwell Allan Bradley PLC with control PC and HMI, touch screen or keyboard mouse
- **Engineering package**
P&ID, electrical drawings, equipment schedules, equipment operating and maintenance manuals
- **Electrical supply**
240, 460/480, 600 VAC/3 ph/50/60 Hz options
- **Safety**
Chlorine detection, over current and over pressure protection, removable valve handles for lock-out, sound ergonomic design, rated lifting lugs, protective shields

> Optional Scope

- Saltworks 24/7 Remote Operations Control (ROC)
- Remote telemetry package
- Containerization package
- Tank package
- Chemical dosing and pH control package
- Saltworks' AntiScale
- Pre-treatment package
- Post-treatment package
- Reverse osmosis hybrid package

> Modularity:
How skids fit together

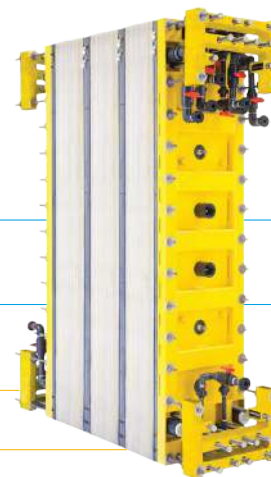
- Built up out of four modular repeatable units:
 - ① Power & Control Skid
 - ② Pump Skid
 - ③ Stack Skid
 - ④ Process Vessel Skid



One power and control skid can support up to 10 pump & vessel skids. One pump and process vessel skid can support two stack skids.

Flex EDR

STACK SPECIFICATIONS



Operating Requirements

Operating pressure	100–150 kPa [15 psi]
Max pressure	700 kPa [100 psi]
pH	0 < pH < 12
Max temperature	60 °C [140 °F]
Current density	5 – 250 A/m ² *
Current absolute	3 – 175 A
Inlet TDS	< 80,000 ppm* (hybrids)
Reject TDS	< 150,000 ppm*
Suspended solids	< 50 µm filter
SDI (5 min)	10
Hydrocarbons	Short chains < C10
Free chlorine	< 20 ppm
Organics	soluble non-charged

Specifications

Membrane area per compartment	1.084 m ²
Active area per compartment	0.645 m ² [6.9 ft ²]
Maximum flow per stack	14.5 m ³ /hr [64 GPM]
Compartment thickness	0.05 – 0.2 cm [20–80 thou]*
Minimum fluid velocity	>0.3 cm/sec*

Materials of Construction

Wetted parts	PVC, PP
Module plates	PVC
Compressor rods	non-wetted SS316
Compression frame	Powder-coated mild steel
Membrane separators	PET, PP
Reversible electrodes	Ti coated Pt-Ir

Modular Configuration

Saltworks' Flex EDR stack is built up out of repeated modules.

One stack can support ten membrane modules of 400 ion exchange membrane pairs each.

Each module is individually built using our resilient IonFlux™ membranes, compressed and quality assured at Saltworks.

Modules can be added to a stack until one of three limits are reached, at which point additional stacks are added.

Limits include:

- mechanical limit of 10 modules per stack;
- hydraulic limit of 14.5 m³/hr per stack;
- dissolved ion mass transfer maximum of 0.2 mols/sec per module (2 mols/sec per stack) assuming a current density of 200 A/m² and voltage < 600 V/stack.

Ion mass transfer and current densities are highly dependent on water chemistry.

Saltworks' professionals are ready to size an Flex EDR system for your application.

* Project specific & chemistry dependent.

Flex EDR

STACK SPECIFICATIONS

HYDRAULIC

Maximum 14.5 m³/hr [64 GPM]
per stack

ELECTRICAL

Maximum 250 A/m²
600V

CHEMICAL

Maximum brine reject
concentration up to saturation
or ~150,000 mg/L

MECHANICAL

Maximum 10 modules
per stack



Preliminary stack sizing can be achieved as follows:

Step 1 Calculate mass of dissolved ions to be removed:

$$\text{Salt removal load (kg/day)} = \text{flow rate (m}^3/\text{day)} * [\text{TDS}_{\text{inlet}} \text{ (mg/L)} - \text{TDS}_{\text{outlet}} \text{ (mg/L)}]$$

Step 2 One module can transport the salt loads below, simplified to only two salts:

Current Density A/m ²	NaCl kg/day	CaSO ₄ kg/day
60	305	708
150	760	1770

Flex EDR

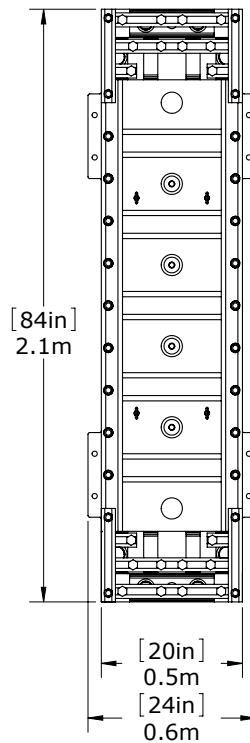
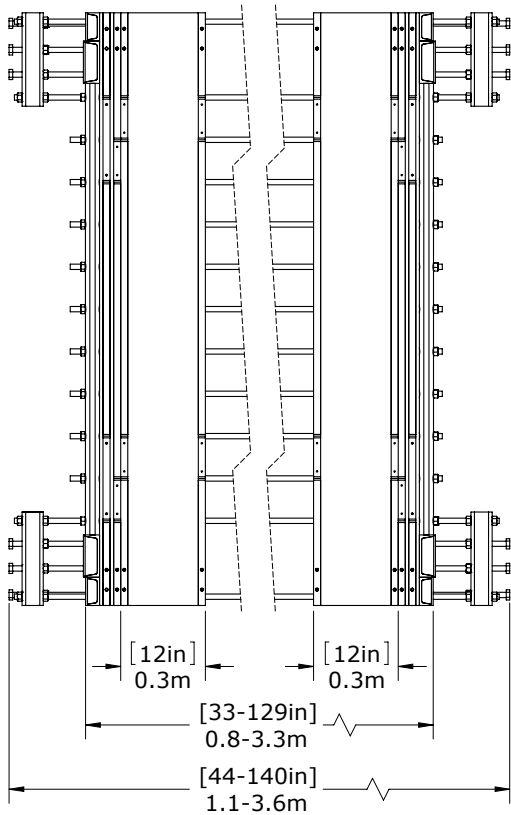
SYSTEM SPECIFICATIONS

Materials and Certification

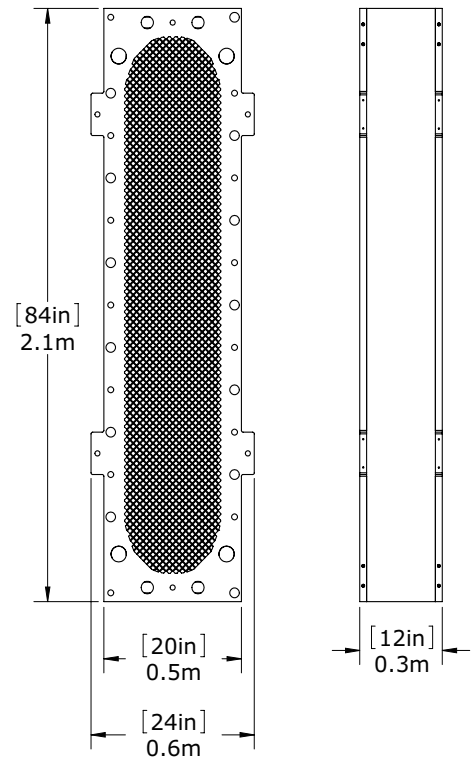
Electrical	CSA/UL (others available)
Electrical panels	NEMA 4 or 4X
Electrical protection	IP65 or higher
Process wetted parts	PVC, PP, Noryl (PPE)
Instrument wetted parts	PVC, Ti, Monel, PTFE, Pt, Epoxy
Process piping	ASME B31.1 / Sch. 80 UPVC
Skids	ASTM aluminum 6061, Powder Coated Steel

Skid Dimensions

Stacks



Modules

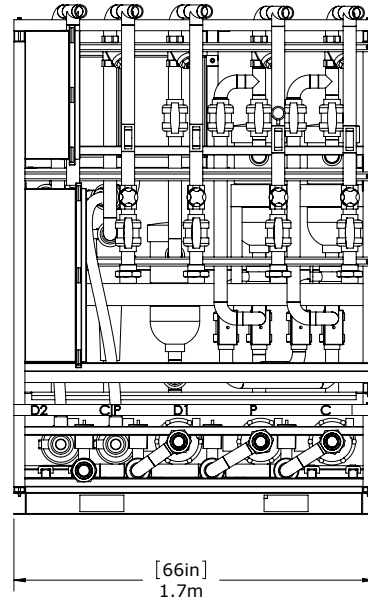
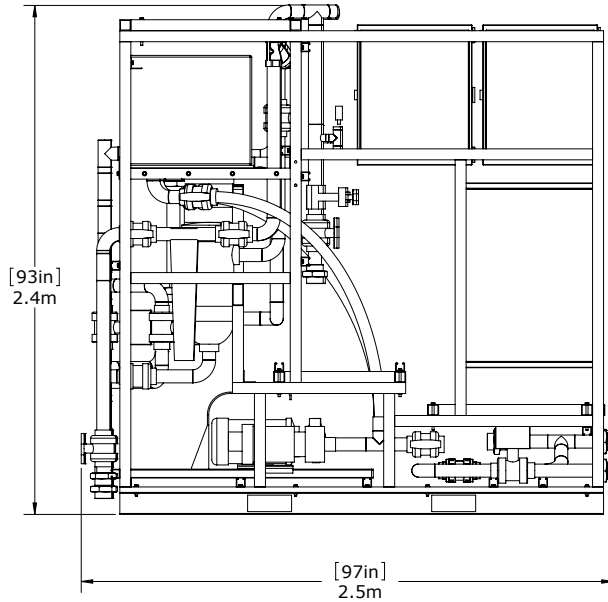


Flex EDR

SYSTEM SPECIFICATIONS

Skid Dimensions

Pump Skid



Process Vessel Skid

