

KERRion Technologies Office of Product Development

# KERRion CWS

## Community Well Station

July 23, 2017

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# Version History

Name	Change Description	Date	Version
Shervington Kerr	Initial Draft	May 22, 2016	v0.1
Shervington Kerr	Edits to Introduction	July 13, 2016	v0.2
Shervington Kerr	Edits to Applied Technology Solution	July 13, 2016	v0.3
Shervington Kerr	Added the CWS Cistern	August 19, 2016	v0.4
Shervington Kerr	Revised Executive Summary; Added research from the Molecular Hydrogen Foundation	December 04 2016	v0.5
Shervington Kerr	Updated solution concept	July 023 2017	v0.6

# Document Acceptance

Approval for the document is required by current members of the Project Delivery Committee.

Stakeholder	Name	Position	Date	Signature
Emco Tech	TBD	Research and Development	TBD	TBD
Fibracast Ltd.	TBD	Research and Development	TBD	TBD
SBT Aqua	TBD	Research and Development	TBD	TBD
Shenzhen Solartech Renewable Energy Co. Ltd.	TBD	Research and Development	TBD	TBD
TBD	TBD	Financial Management	TBD	TBD

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# 1. Introduction

## 1.1. Document Purpose

The purpose of this document is to provide an overview of how the KERRion Community Well Station (CWS) Technology produces highly filtered, clean alkaline well water for human consumption, sanitation and hygiene.

## 1.2. Executive Summary

KERRion Technologies is a privately-owned company. The “KERRion System” was registered (registration #1118256) as Intellectual Property with the Canadian Intellectual Property Office on January 7, 2015, pursuant to sections 49 and 53 of the Copyright Act. The lack of clean water and sanitation in many African regions leads to 1.5 million deaths a year from diarrhea and cholera. One in ten people globally (around 663 million people) lack first time access to improved drinking water sources.

How can the needs for improved drinking water sources for the community and water sources for agriculture be met as it intensifies to feed growing populations in Africa? Africa’s demand for clean bacteria free water is rising fast.

## 1.3. Water Importance

The importance of water is well known. Obviously, life would not exist without it. Indeed, water is virtually the most important nutrient for our health. You can go without food for about a month; however, going only three days without water can be fatal. It is used for maintaining body temperature, absorbing nutrients, eliminating wastes, and many cellular processes including enzyme catalysis. The average adult is 55% to 75% water by weight; the variation is due to gender, height, lean body and shape. Someone with a 55% total body water can be more hydrated than someone with a 65% total body water. This is because the total body water is relative to each individual based on their body type. Optimal body hydration is important for optimal cell hydration and cell function, (i.e. communication, signaling, cell metabolism, gene expression, etc.). About 2/3 of the water in the body is intracellular and about 1/3 is extracellular.

Water is necessary for the functions of life and for life to function. Water is the life-giving fluid that is always at the heart of creation. Its presence supports life, and its absence brings death. Water in liquid state is the principle criteria for planetary habitability.

### 1.3.1. Clean Water, Sanitation and Hygiene

KERRion Technologies will partner and work with government and non-government organizations to deliver workshops and seminars to communities that focus on Clean Water, Sanitation and Hygiene.

### 1.3.2. The KERRion Community Well Station (CWS) Concept of Engineering

The KERRion Community Well Station (CWS) is a CleanTech low-energy, high-volume Well Water technology solution. The CWS produces highly filtered, bacteria free alkaline well water and pumps it to a cistern for community self-service.

A deep well water solar powered pump delivers the well water to the CWS. The well water is filtered through hollow-fiber technology membrane filters capable of highly filtering the well water to remove sediment. Electrolysis is applied to change the state of the water to alkaline using “electro-plated platinum electrodes”. The electrodes are covered in a “super fine” mesh with very distinct high points and valleys and provide the highest level of conductivity and durability. The cutting-edge design and proven durability of the electrodes ensures the best oxidation reduction potential (ORP) alteration. Mildly alkaline water (pH 8-10) containing molecular hydrogen is produced by the negative electrodes. There are many names given to this water, Electrolyzed Reduced Water (ERW) is the most common term in the scientific literature.

## 1.4. Intended Audience

This document is intended for financiers, stakeholders, technology vendors and members of the project team.

## 1.5. Related Research

The following is a list of CWS Technologies and companies, Ground Water monitoring, and Aquifer research.

Related Research	Description
Emco Tech	<ol style="list-style-type: none"> <li>1. Electro-plated platinum mesh electrodes</li> <li>2. Emco Tech: The patented DARC (Double Automatic Reverse Cleaning) system. It completely eliminates the mineral scaling from collecting on the electrodes – The DARC system cleans as the water is ionized.</li> </ol>
Fibracast Ltd.	Hollow Fiber Technology Membrane Filters
SBT Aqua	Water Bacteria Detection sensors
Shenzhen Solartech Renewable Energy Co. Ltd.	Deep well water solar powered pump
Smartflower Solar Power Panels System	Smartflower Solar Energy Company – Infrastructure Energy
Well station office	<p>A steel frame Well Station Office is a structure to house the CWS</p> <ul style="list-style-type: none"> <li>• The well station office additionally serves as an office for the well station technician to manage, service and conduct reporting on the aquifer and CWS.</li> <li>• The well station office may serve as a community contact point</li> </ul>
Global Ground Water Monitoring Network (GGWMN)	<p>Related groundwater and aquifer research: Form an alliance / working relationship for Cloud based Aquifer monitoring and regulatory compliance reporting</p>
Groundwater Monitoring in the SADC Region (SADC - Southern African Development Community)	<p>Related groundwater and aquifer research: Form an alliance / working relationship to provide water / waste and water sanitation education – supporting aquifer workshops for the southern African states. Overview prepared for the Stockholm World Water Week 2013</p>
Groundwater availability and use in sub-Saharan Africa: A review of 15 countries	<p>Related groundwater and aquifer research: Groundwater availability and use in sub-Saharan Africa: A review of 15 countries. Published by: International Water Management Institute PO Box No. 2075, 127, Sunil Mawatha, Pelawatte, Battaramulla, Sri Lanka <a href="http://www.iwmi.cgiar.org">http://www.iwmi.cgiar.org</a></p>
The Molecular Hydrogen Foundation	<p>A non-profit scientific organization supported by the leading international researchers in the study of hydrogen.</p> <p>Research of various articles on;</p> <ul style="list-style-type: none"> <li>• Fundamental articles and hydrogen benefits</li> <li>• Chemistry of water and hydrogen gas</li> <li>• Ionized water history and relation to hydrogen gas</li> <li>• Ionized water basics</li> <li>• Oxidation-Reduction Potential (ORP) information</li> </ul>
The Kampala WASH Symposium (Water Sanitation Hygiene)	<p>Related water, aquifer research:</p> <ul style="list-style-type: none"> <li>• Kampala WASH Symposium Public Agenda</li> <li>• Kampala WASH Symposium background note</li> <li>• Kampala WASH Symposium Projects to Services</li> </ul>

## 1.6. Document Scope

The scope of this document is to convey the KERRion concept of engineering, vendor technology requirements for the design and build for the KERRion CWS and the infrastructure required to supporting the CWS.

In scope:

KERRion CWS Technology components:

- Shenzhen Solartech Renewable Energy Co. Ltd.
  - Deep well water solar pump (solar powered)
- Fibracast Ltd.
  - Hollow Fiber Technology Membrane Filter solution
- Emco Tech
  - Electro-plated platinum mesh electrodes
  - The patented DARC (Double Automatic Reverse Cleaning) system
    - Completely eliminates the mineral scaling from collecting on the electrodes – The DARC system cleans as the water is ionized.
- SBT Aqua: Water Bacteria Detection sensors
  - Bacteria Sensor detection in the well water intake chamber
  - Bacteria Sensor detection in the well water holding chamber.
- Smartflower Plus Solar Power Panels System
  - Provides solar energy required to support the CWS Infrastructure

Out of scope

- Construction requirements for the well station office.
- Resource requirements
- Staffing schedules
- The Community Cistern

## 1.7. Document Assumptions

The following assumptions have been identified.

ID	Assumption	Validation or Comment
A1	A vendor management business strategy will be developed to facilitate vendor onboarding.	
A2	A stakeholder management strategy will be developed to facilitate the onboarding of the Customer Segments.	

## 2. Applied Technology Solution

### 2.1. Community Well Station (CWS)

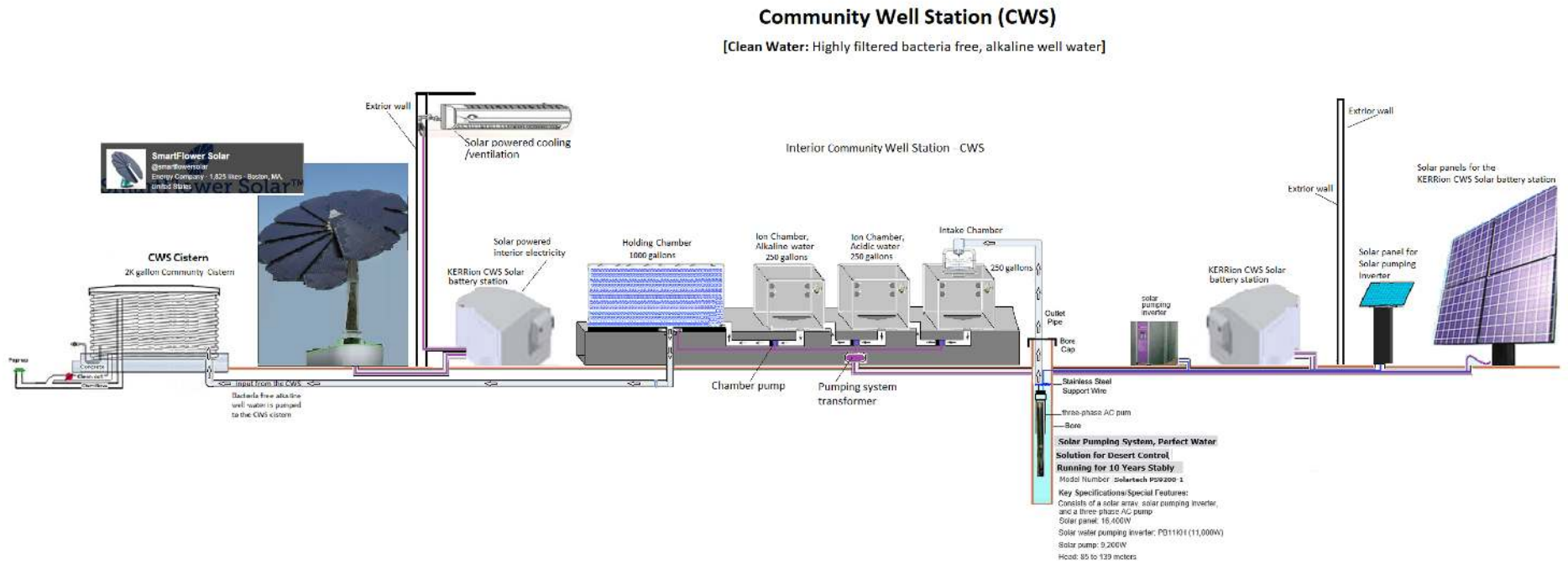
The Community Well Station is a low-energy, high-volume solar powered well water technology solution. The CWS is situated inside the well station office. The well station office is designed for protection of the CWS and serves as an office for the well station technician. The well station office may serve the community as an access point. The community will have access to the bacteria free alkaline well water via a community cistern.

### 2.2. Technology Solution Catalogue

The following table illustrates the vendor technologies

Actor	Description
Shenzhen Solartech Renewable Energy Co. Ltd.	Deep well water solar powered pump <ul style="list-style-type: none"> <li>- The solar pump delivers the groundwater from the aquifer to the Intake Chamber.</li> </ul>
SmartFlower Solar Energy Company	Smartflower Plus Solar Power Panels System <ul style="list-style-type: none"> <li>- Provides solar energy required to support the CWS Infrastructure</li> </ul>
SBT Aqua	Water Bacteria Detection sensors <ul style="list-style-type: none"> <li>- Detects bacteria as the groundwater flows into the Intake Chamber.</li> <li>- Detects bacteria as the groundwater flows into the Holding Chamber.</li> </ul>
Fibracast Ltd.	Hollow Fiber Technology Membrane Filter solution <ul style="list-style-type: none"> <li>- Filters groundwater as it flows into or out of each chamber.</li> </ul>
Emco Tech	<ol style="list-style-type: none"> <li>1. Electro-plated platinum mesh electrodes</li> <li>2. Emco Tech: The patented DARC (Double Automatic Reverse Cleaning) system. It completely eliminates the mineral scaling from collecting on the electrodes – The DARC system cleans as the water is ionized.</li> </ol>

## 2.3. Technology Solution design concept





## 2.4. Technology Vendor - Solartech



Shenzhen Solartech Renewable Energy Co. Ltd.

### 2.4.1. Technology Application

#### Shenzhen Solartech Renewable Energy Co. Ltd.

Solar Pumping System, Perfect Water Solution for Desert Control, Running for 10 Years Stably

Port	Shenzhen
Minimum Order Quantity	1 to 99Set
Payment Terms	Telegraphic Transfer (TT,T/T)
Brand Name	Solartech
MOQ	1 to 99 Set
Main Export Markets	Eastern EuropeMid East/AfricaCentral/South AmericaAsiaWestern Europe
Place of Origin	China (mainland)
Model Number	Solartech PS9200-1
Lead Time	15-20days
Category	Other Solar Energy Related Products

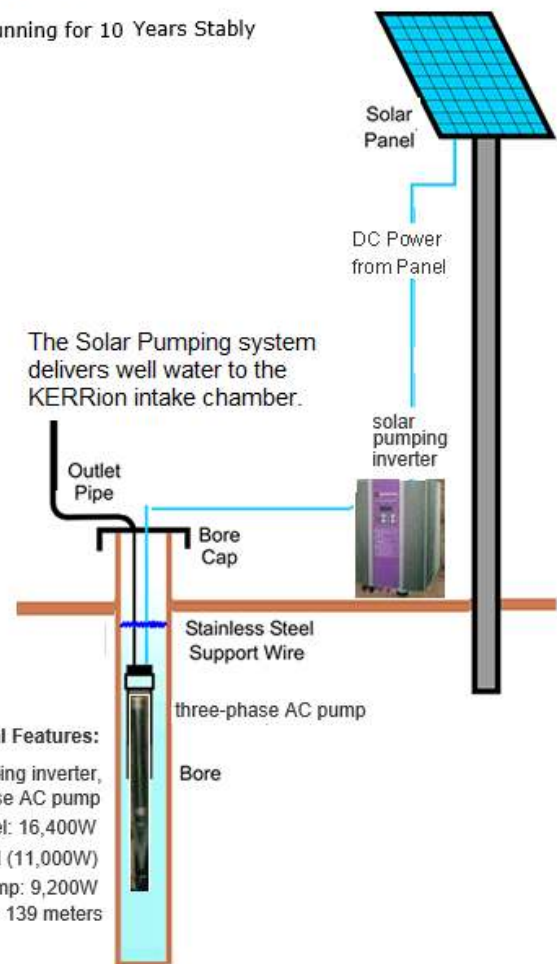
#### Solar Pumping System, Perfect Water Solution for Desert Control, Running for 10 Years Stably

Model Number Solartech PS9200-1



#### Key Specifications/Special Features:

Consists of a solar array, solar pumping inverter, and a three-phase AC pump  
 Solar panel: 16,400W  
 Solar water pumping inverter: PB11KH (11,000W)  
 Solar pump: 9,200W  
 Head: 85 to 139 meters



## 2.5. Technology Vendor – SBT AQUA

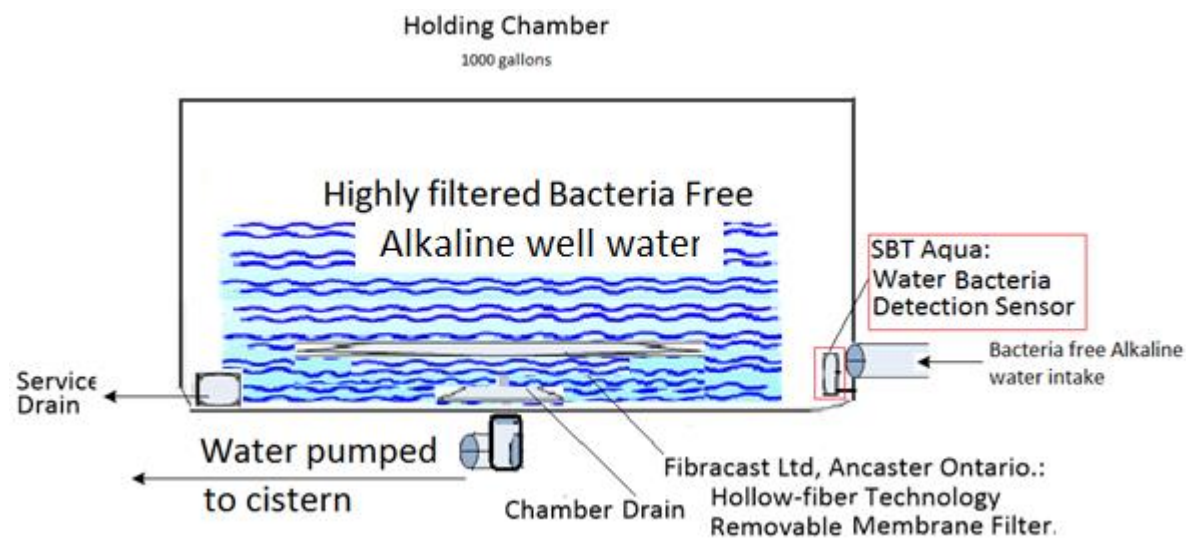
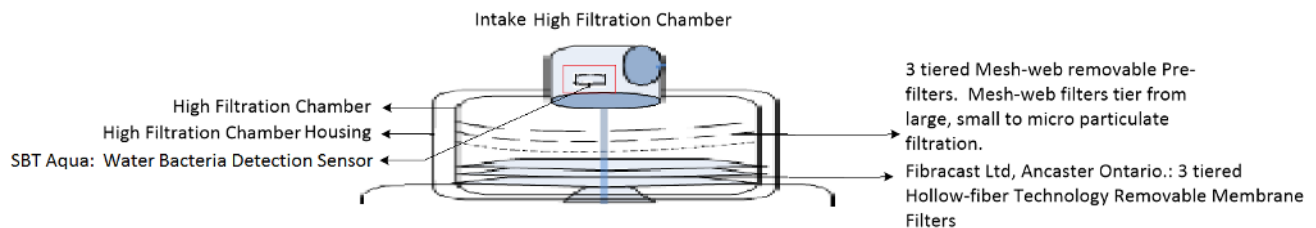
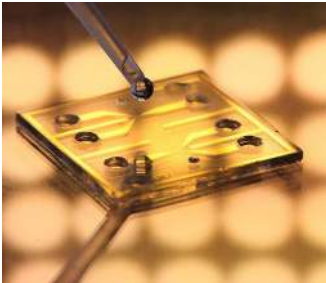


### 2.5.1. Technology Application

SBT Aqua is developing a biosensor based on impedance flow cytometry that is able to monitor the bacteria and particle level of drinking and process water online and in real-time. The sensor provides accurate and instantaneous results regarding the bacteria concentration with low maintenance requirements.

The working principle behind impedance flow cytometry is simple. A liquid sample is continuously injected into a microfluidic channel with integrated electrodes over which a multi-frequency voltage signal is applied. Bacteria and particles transition across the electrodes which results in a change in impedance.

#### SBT AQUA BIOSENSOR



## 2.6. Technology Vendor – Fibracast

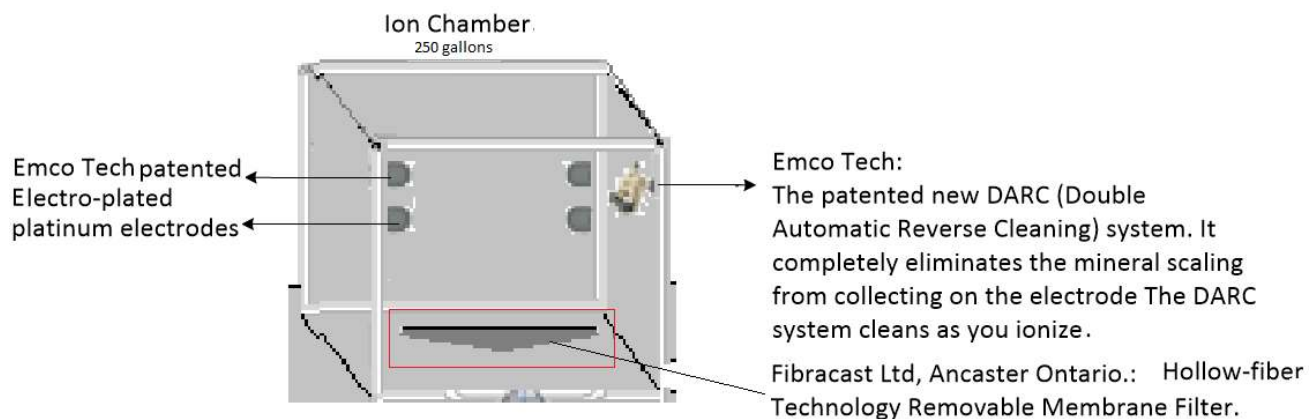
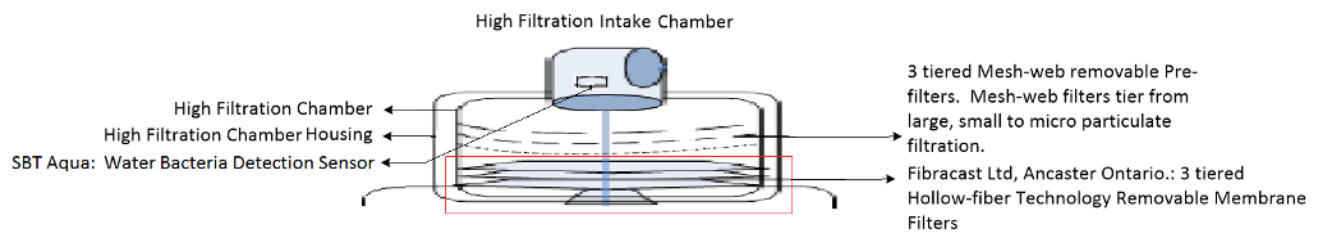


### 2.6.1. Technology Application

Fibracast is a global leader in the research, development and manufacturing of advanced membrane technologies for water and wastewater treatment. Founded in Ancaster, Ontario, in 2010, by an expert team of water-technology veterans, Fibracast created the next generation of membrane filtration technology that improves on the robustness, performance and operational flexibility of existing membrane designs. We are currently looking for machine operators to join the company.

With support from federal, provincial and municipal governments and agencies in Canada, Fibracast's extensive development effort resulted in a breakthrough filtration-membrane product — FibrePlate™ — designed to revolutionize membrane filtration for municipal and industrial water and wastewater applications.

#### FibrePlate™



## 2.7. Technology Vendor – Emco Tech



### 2.7.1. Technology Application

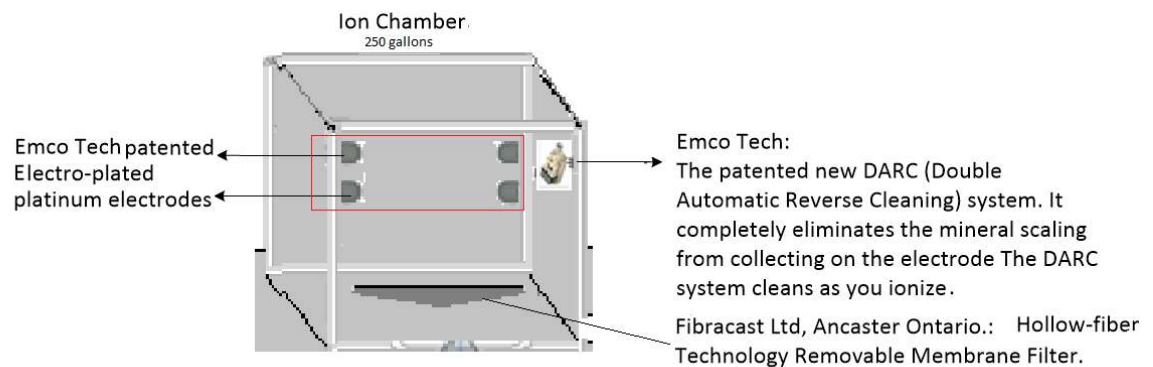
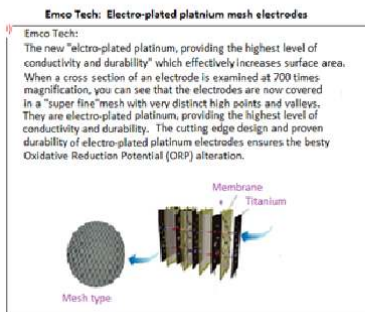
The Electro-Plated Platinum Mesh Electrodes:

In Ion Chamber #1, a small electrical charge is applied to the electro-plated platinum mesh electrodes. The resulting electrolysis changes the state of the water to Acidic, eliminating all bacteria.

In Ion Chamber #2, a small electrical charge is applied to the electro-plated platinum mesh electrodes. The resulting electrolysis changes the state of the water to Alkaline.

#### 2.7.1.1. Electro-plated platinum mesh electrodes

The following diagrams illustrate the cutting-edge design of the Electro-plated Platinum Mesh Electrodes.



### 2.7.1.2. The patented DARC (Double Automatic Reverse Cleaning) system

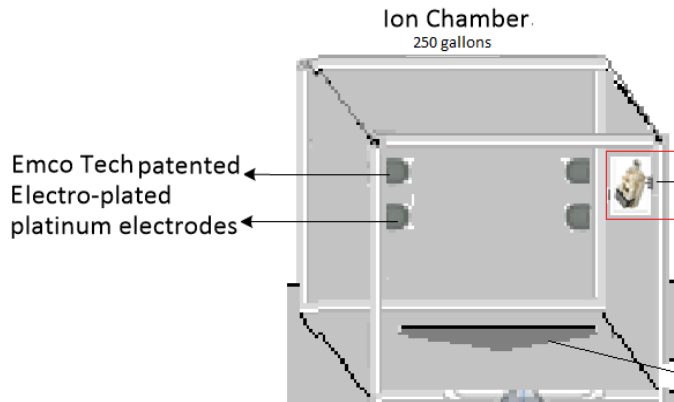
The patented DARC (Double Automatic Reverse Cleaning) system completely eliminates the mineral scaling from collecting on the electrodes – The DARC system cleans as the water is ionized.

The electrodes are the crucial operating component. The patented new DARC (Double Automatic Reverse Cleaning) system completely eliminates the mineral scaling from collecting on the electrodes.



#### The DARC System.

#### “Double Automatic Reverse Cleaning”



Emco Tech:  
The patented new DARC (Double Automatic Reverse Cleaning) system. It completely eliminates the mineral scaling from collecting on the electrode The DARC system cleans as you ionize.

Fibracast Ltd, Ancaster Ontario.: Hollow-fiber Technology Removable Membrane Filter.

### 2.7.1.3. The Smartflower Plus Solar Panels System



The most efficient solar system under the sun. The modular panels move automatically across two axes to always align itself at the optimal angle to the sun. The result: up to 40% more output compared to a conventional rooftop system, which receives optimum sunlight for only a few hours during the day.



#### Smart Tracking

smartflower's modular panels autonomously follow the sun so they're always at the optimal angle to the sun, generating 40% more energy output than traditional solar.



#### Smart System

The integrated control panel automatically sends you data on your energy use via the smartflower mobile app, helping you decide how better to use your electricity (select models only).

## Smartflower at a glance:

Energy output		Physical Specs	
Nominal output	2,50kWp*	Installation	4 fastening points Earth Screws or concrete foundation
Annual output	4.000-6.200kWh/a**	Clearspace	~16ft <sup>2</sup>
Self consumption	~<100 kWh/year	Weight	~1.500lbs
Safety		Warranty	
Temperature range	-4° F — 122° F	Module performance warranty	25 years
Wind speed before automatically entering safety position 1 or 2	1: >32 miles per hour 2: >39 miles per hour	System warranty	5 years

\*according to STC standards

\*\*depending on the region

## 2.8. CWS System Functional Use Case

### 2.8.1. Pre-conditions

The following pre-conditions exist for this use case:

All of the following conditions must exist and/or be available to support operational use of the CWS.

1. **WASH (W**ater, **S**anitation, and **H**ygien**e)** Community workshops have been held with the community residents
2. The community aquifer(s) must be operational/functional
3. The community aquifer(s) must feed the existing well(s)
4. The Well Station Office has been constructed to house the CWS
5. A CWS is installed, inside the well station, and is operational in servicing the existing well(s)
6. The CWS has been tested and approved for the delivery of highly filtered, bacteria free, alkaline well water.
7. The Well Station Technician has been introduced to the community
8. The Well Station Technician has been fully trained to provide customer service to the community
9. The Well Station Technician has been fully trained to service and support the CWS
10. The Well Station Technician has been trained or certified in potable water regulatory compliance

### 2.8.2. Trigger event

The CWS access point has been activated to deliver highly filtered, bacteria free, alkaline well water.

### 2.8.3. Basic flow

The functional technology operations of the CWS is noted below.

1. The deep well solar pump delivers the well water to the KERRion high filtration chamber
2. High Filtration Chamber:
  - a. The incoming well water the flows over the SBT AQUA BIOSENSOR. The level of bacteria is detected.
  - b. The water passes through the 3-tiered FibrePlate™ filtration-membrane product.
  - c. The water flows into the Water Intake Chamber.
3. Water Intake Chamber:
  - a. The water enters the Intake Chamber and flows through a FibrePlate™ filtration-membrane product into Ion Chamber #1.
4. Ion Chamber #1:
  - a. The water enters Ion Chamber #1
  - b. Electrolysis is applied via electro-plated platinum mesh electrodes to change the state of the water to Acidic, eliminating all bacteria.
  - c. The patented DARC (Double Automatic Reverse Cleaning) system completely eliminates the mineral scaling from collecting on the electrodes – The DARC system cleans as the water is ionized.
  - d. The water is pumped through a FibrePlate™ filtration-membrane product into Ion Chamber #2.

5. Ion Chamber #2:
  - a. The water enters Ion Chamber #2
  - b. Electrolysis is applied via electro-plated platinum mesh electrodes to change the state of the water to Alkaline.
  - c. The patented DARC (Double Automatic Reverse Cleaning) system completely eliminates the mineral scaling from collecting on the electrodes – The DARC system cleans as the water is ionized.
  - d. The water is pumped through a FibrePlate™ filtration-membrane product into the Holding Chamber.
  
6. Holding Chamber:
  - a. The incoming water the flows over the SBT AQUA BIOSENSOR. The level of bacteria is detected.
  - b. The highly filtered, bacteria free, alkaline well water is pumped from the holding chamber to the community cistern and stored for community use.
  
7. CWS Cistern:
  - a. The highly filtered, bacteria free, alkaline well water is stored in the CWS Cistern for community use.
  
8. End use case.

#### 2.8.4. Post conditions

The post condition is as follows:

The highly filtered, bacteria free, alkaline well water is pumped from the Holding Chamber to the Community Cistern and stored for community use.

#### 2.8.5. Business Rules

The following business rules exist for this use case.

ID	Business Rules
BR.2.8.5.1	The Well Water Technician provides assistance to the community patrons.
BR.2.8.5.2	The Well Water Technician manages the service and support of the KERRion CWS.
BR.2.8.5.3	The Well Water Technician assists in community WASH workshops delivered by KERRion Technologies.



### 3. Non-Functional Requirements

The following non-functional requirements are required to support the use case.

Requirement ID	Area	Requirement Description	Priority
NFR.001	Reliability	Overall Targeted Availability	99% Targeted operational availability of the CWS
		Maintenance Period	Scheduled as required to maintain vendor technologies (to be determined)
NFR.002	Reporting	Regulatory Compliance	<p>Documenting the SBT AQUA BIOSENSOR bacteria detection readings for regulatory compliance reporting.</p> <ol style="list-style-type: none"> <li>1. Document the bacteria reading in the untreated well water as it flows into the Water Intake Chamber.</li> <li>2. Document the bacteria reading of the highly filtered, bacteria free, alkaline well water as it flows into the Holding Chamber.</li> </ol>
NFR.003	Well Station Management	The management and systems maintenance of the KERRion Well Station.	Working in consultation with The CWS technology vendors, the KERRion Well Station Technician will manage and perform systems maintenance.
NFR.004	Aquifer Monitoring	Monitoring the levels of the aquifer groundwater.	KERRion Technologies will partner with the GGMN to collect data on aquifer groundwater levels.