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NACE INTERNATIONAL JUBAIL SAUDI ARABIA SECTION

AMPP

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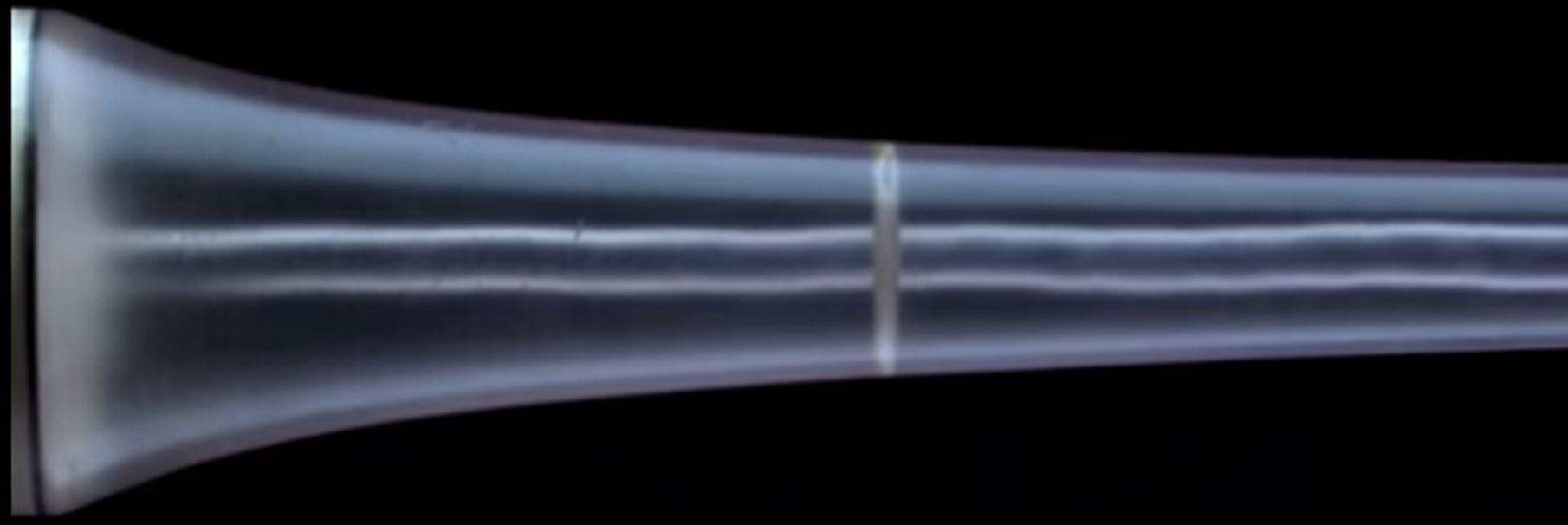
A.W.E.S

BIOMIMETIC WATER CONDITIONING SOLUTIONS FOR INDUSTRIAL APPLICATIONS

OBSERVE AND BE INSPIRED BY NATURE

BIOMIMICRY?

A method of innovation which consists, when encountering a technical problem, to look at the models observed in nature for inspiration. The living has almost all the answers to the challenges that man has to face today.



"Nature is an infinite source of inspiration for engineering and the solutions we develop"

H2oVortex offers Nature Based solutions
that meet both the environmental and financial challenges
industries face in the management of water consuming installations

Vortex Process Technology VPT Platform

Industrial Vortex Generator
IVG

Applications

- **IVG-CT – Cooling Towers & Evaporative Condensers**
- IVG-IR – Irrigation, indoor/outdoor agriculture
- IVG-AS – Anti scaling, residences

FlowMixer
FM

Applications

- Aeration of Rivers & Lakes
- Aeration in Fish Farming
- Aeration in Agriculture

REALice

Applications

- Making ice for Ice Rinks

Vortex Process Technology
VPT

Industrial Vortex Generator
IVG

Removes Air Bubbles
Decreases Viscosity (up to 20%)
Increases density (up to 5%)
Creates Cavitation
Crystalizes Calcium, Iron & Manganese

Reduces water consumption
Reduces energy
No need for chemicals

IVG-CT
Applications for Cooling Towers

Main issues in Cooling Towers & Evaporative Condensers

High Water usage
High energy usage
High chemical usage

Corrosion
Scaling
Bacteria (Legionella)

Chemicals (expensive)
Wastewater (needs to be treated-cost)
Maintenance (cost)
CO2 footprint (future penalties-cost)
Image/Reputation

Feedback and benefits observed on installations equipped with IVG-CT

The solution is deployed in > 100 chemical-free installations in the Benelux, United States and United Arab Emirates

up to 50%
Water savings

- Operation of higher COC within cooling towers
- Water savings thanks to lower make-up water volume
- Up to 100% purge water can be reused for other purposes such as irrigation, and reduced discharge into sewers

6 to 8 %
Energy savings

- Optimization of heat exchanges
- Maintenance reduction and prevention of components of cooling towers
- Onboard energy: additional kWh / kW upstream / downstream the savings made by reducing pumping and water treatment

100%
Reduction in chemical usage

- Reduction of operational costs related to the purchase of chemicals and reduction of maintenance costs (cleaning)
- Reduction of toxic elements in purge water
- More sustainable: tends towards a circular economy

Substantial cost reductions

- No chemical costs
- As no chemicals - no discharge costs
- Reduced maintenance costs
- Increase of life expectancy of installation
- Compliance with ESG reporting
- Increase in sustainability
- Substantial reduction of CO2 footprint

PLUG & PLAY modular IVG-CT solution:

S

< 2 MWatt

M/L

> 2 Mwatt
< 15 Mwatt

L/XL

> 15 Mwatt
< 350 MWatt

Feedback and benefits observed on IVG-CT equipped installations according to a study by the **Dutch Ministry of Water** - extract

	Food processing	Data Center	Petro-chemical	Pharmaceutical
Type of Cooling Tower	Closed	Adiabatic	Open	Open
Existing Installation	Yes	Yes	Yes	Yes
Installation date of IVG solution	2015	2014	2019	2016
Size of Cooling Tower	24 MW	12 MW	30 MW	20 MW
Water consumption	68 m^3/h	17 m^3/h	59 m^3/h	62 m^3/h
Chemicals used	0 kg currently	0 kg currently	3400 kg currently	0 kg currently
	/ 28 000 kg before	/ 6 800 kg before	/ 66 000 kg before	/ 26 000 kg before
Pay Back period	2,2 years	2,1 years	2,2 years	3 years
Water savings	39%	75%	24%	15%
Energy savings	3%	not calculated	not calculated	7%
COC	10	4,5	8	7,8

Rijkswaterstaat
Ministerie van Verkeer en Waterstaat

Results measured by EPRI * (Electric Power Research Institute) as part of a study aimed at demonstrating the relevance of IVG-CT technology on cooling towers in relation to the reduction of water consumption, energy and elimination of chemical use

- Study carried out from July 2016 to April 2020 in California on two sites equipped with cooling towers: A large hotel and pharmaceutical factory where water treatment was representative of standard practices:

  https://www.etcc-ca.com/reports/cooling-tower-water-use-optimization-epicepri

- The IVG-CT system has been demonstrated and evaluated in terms of water, chemical and energy savings

- The measurement and verification plan followed the international performance measurement and verification protocol and consisted of equipment monitoring before and after the installation of IVG-CT technology.

- Main findings of the field assessment

  The solution offers an environmentally friendly water treatment option that requires a minimum of chemicals, water and energy,

  Provides significant water savings compared to traditional chemical water treatment by increasing cooling tower concentration cycles (COC)

	Hotel site	Pharmaceutical Manufacturing site
Water consumption reduction	30%	15%
COC	From 2,3 to 5,9	From 3,6 to 7,8
Chemicals reduction	30%	45%
Energy reduction	5,40%	6,40%
Maintenance feedback	Coils and piping are much cleaner after IVG CT installation The monitoring system provides an additional benefit by informing of maintenance requirements	

* The Electric Power Research Institute (EPRI) is an institute that conducts research for the power generation industry in the United States. It is an independent, non-profit organization, which was created by American industrialists in the energy sector. It accepts international participations. This institute is interested in all technical aspects relating to the production, transport and use of electricity.

MATChING

MATCHING or "Materials & Technologies for Performance Improvement of Cooling Systems performance in Power Plants" is a collaborative project, funded by the EU Horizon 2020 program, aims to reduce the cooling water demand in the energy sector.

CAN WE REDUCE THE COOLING WATER DEMAND IN THE ENERGY SECTOR?

Power generation is a sector requiring great amounts of water. Cooling water for energy production accounts, for 45% of total water abstraction in the European Union, second only to agriculture. Water is fundamental for electricity production and with water becoming increasingly scarce, the power industry cannot afford the risk of having to compete for water resources with other industries including agriculture and houshold uses.

This document shows the results of the part of the MATChING project focusing on the implementation of water treatment technologies for reduction of water use in wet cooling towers at fossil fueled power plants. A broad set of technologies are proposed acting on intake, blowdown, and evaporated water.

This project has received funding from the European Union's Horizon 2020 program under Grant Agreement no. 686031

Emerging Technologies

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Cooling Tower Water Treatment Using Industrial Vortex Generator Technology EPIC/EPRI – Energy and Water Savings

ET17SCE1020

Prepared by:

Electric Power Research Institute (EPRI)
Cypress, Ltd.
H2oVortex S.A.R.L. Luxembourg

July 2020

SOUTHERN CALIFORNIA EDISON®
Energy for What's Ahead™

Feedback and benefits observed on installations equipped with IVG-CT

Lamb Weston Meijer – IVG20-CT Pro skid

Type of industry: Food industry - Potato processing

2nd largest world producer of frozen potatoes (800,000 tons in Europe and 4 million tons worldwide per year)

Type of cooling and cooling towers: Evaporative condensers for ammonia cooling

IVG technology: 3 x IVG20-CT - Power consumption: 12 kw

	Before installation	After installation
Evaporation capacity in MW	24 MW	24 MW
Water evaporation	37,20 m3/h	37,20 m3/h
Water consumption	68,20 m3/h	42,51 m3/h
Cooling water thickening	Factor 2,2	Factor 10
Chemicals used	28 640 kg	0 kg
Reduction in chemicals		100%
Pay Back		2,2 years

Objective: to become circular by 2025

The target for 2025 is a 50% reduction in direct water consumption and a 30% reduction in direct energy consumption per ton of final product.

Lamb Weston Meijer has decided to no longer use process chemicals at the site.

In 2019, a third IVG 20 CT was deployed for the final cooling towers to allow all facilities to operate without the use of chemicals. We are currently in the process of installing our 4th application.

Given the fantastic results we were able to achieve, Lamb Weston has requested that by Q4 2021 their 50 sites should start to be equipped with our IVG-CT application.

Feedback and benefits observed on installations equipped with IVG-CT

SmartDC – IVG10-CT skid

Type of industry: DATA CENTER

Type of cooling and cooling towers: Adiabatic coolers for server rooms

IVG technology: IVG10-CT - Power consumption: 2.2 kw

Wastewater discharge: Discharge into the rainwater network

	Before installation	After installation
Evaporation capacity in MW	12 MW	MW
Water evaporation	18,6 m^3/h	18,6 m^3/h
Water consumption	16,91 m^3/h	5,31m^3/h
Cooling water thickening	Factor 2,1	Factor 4,5
Chemicals used	6 840 kg	0 kg
Reduction in chemicals		100%
Pay Back		2,1 years

Triple R Objective: Reduce, Reuse & Recycle

The integration of the solution made it possible to:

No longer use water treatment products,

Reduce water consumption by 75%,

Discharge water into the rainwater network,

Reduce energy consumption by degassing the cooling water.

Feedback and benefits observed on installations equipped with IVG-CT

Grolsch – IVG10-CT + Nano skid

Type of industry: Brewery

IVG technology: IVG10-C + NanoFiltration Water skid

Absorbed power: 6 KW

Wastewater discharge: Treatment of wastewater by sprinkling

	Before installation	After installation
Evaporation capacity in MW	8,9 MW	8,9 MW
Water evaporation	13,85 m^3/h	13,85 m^3/h
Water consumption	23,74 m^3/h	15,38 m^3/h
Cooling water thickening	2,4	5
Chemicals used	1 760 kg	0 kg
Reduction in chemicals		100%
Pay Back		Operational leasing, 37% cost reduction

Objective: Solve recurring water treatment problems during hot periods

The integration of the solution made it possible to:

100% treatment of cooling water without chemicals,

Recycle water for irrigation,

Increase safety when cleaning cooling towers,

Stop corrosion and microbiological development.

https://youtu.be/XelDxzrb2II


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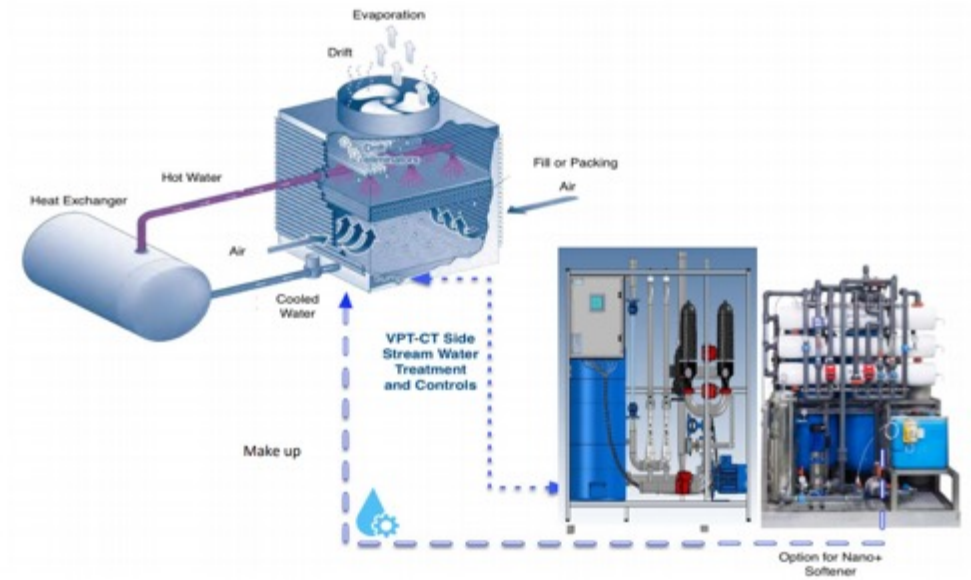
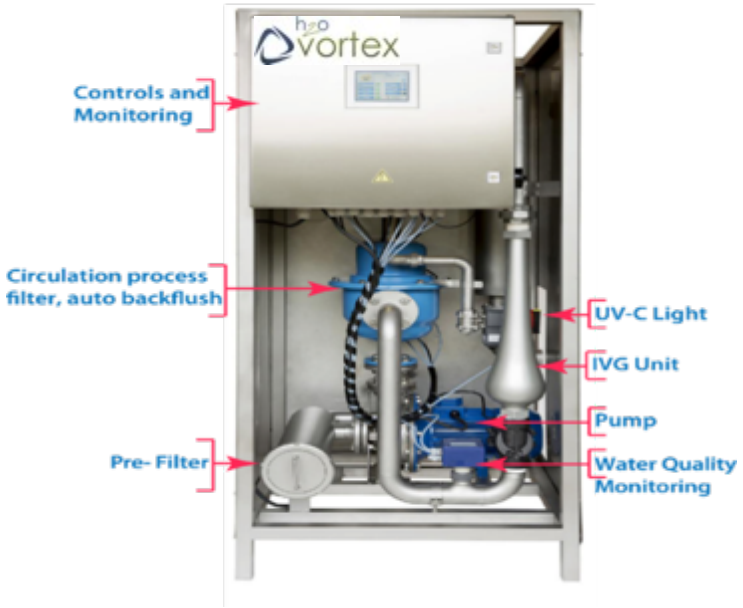
www.pathema.nl

IVG-CT - Technical description (1)





Sizing

- Collection of installation input data:

check list TAR

- Sizing and simulation carried out by our design office

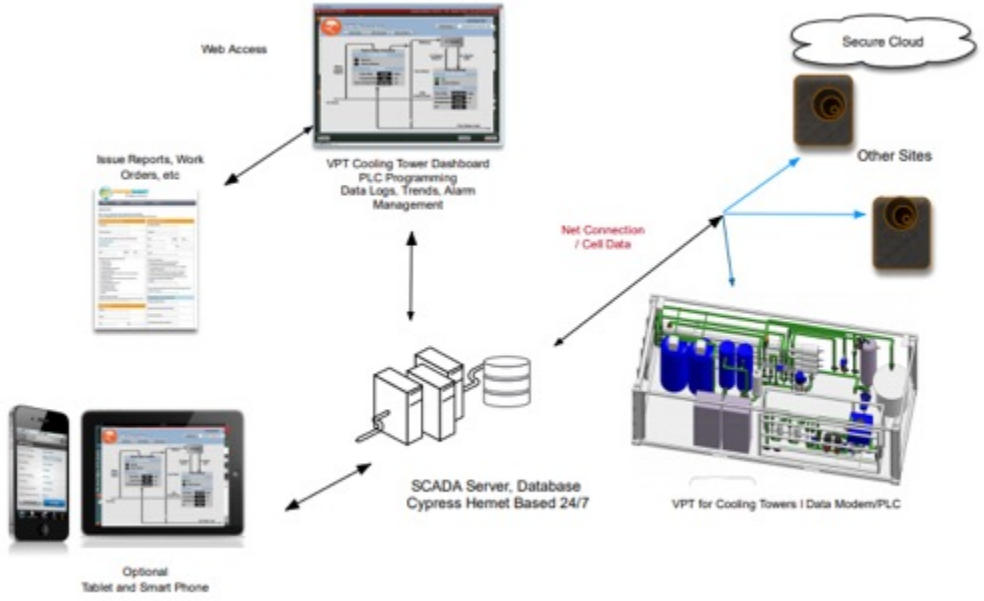
Typical configuration

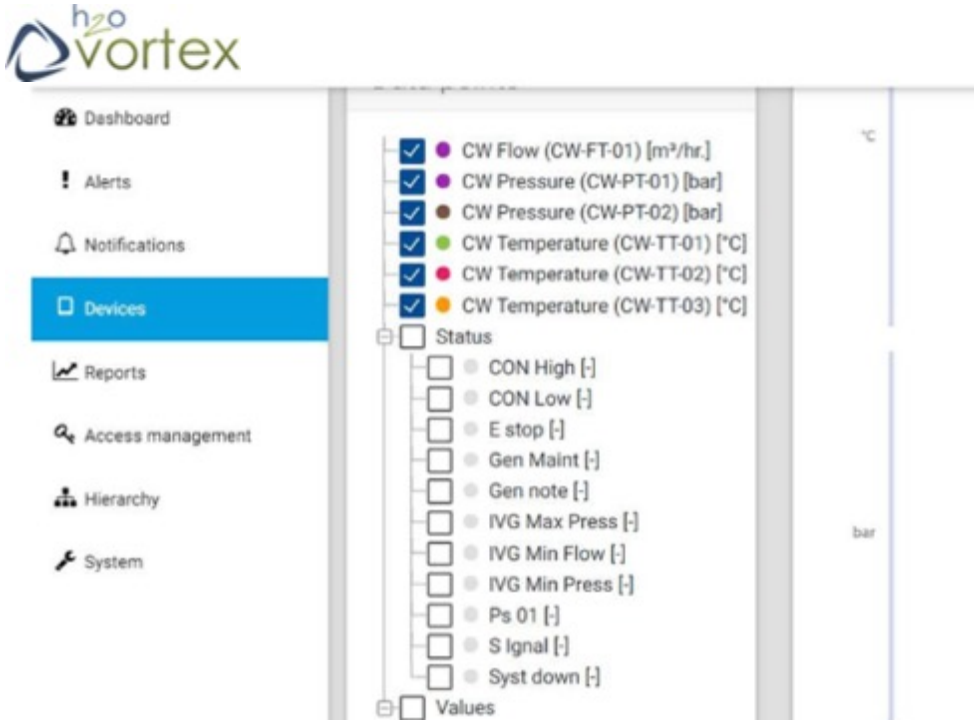
- The IVG-CT is connected as a side stream to the Cooling Tower or Evaporative Condenser
- It is equipped with filter, pump, suitable IVG, UV treatments, monitoring equipment.

Commissioning and monitoring

- Installation and settings on site
- Built in SCADA system for monitoring
- Energy efficient installation
- Low maintenance

IVG-CT - Technical description (2)





Continuous monitoring

- Instrumentation of equipment, configuration and training of technicians,
- Secure data,
- Compatible with most building management solutions,
- We use Siemens PLC for information control of SCADA system or can via e.g. Mudbus be connected to customers SCADA system
- The points that are mainly controlled are the conductivity, pH, scaling, corrosion, flow rate, pressure and UV-C

Pathema
Most Sustainable Water Cooling Treatments Provider 2019 Western Europe

IVG-CT – Costs

The cost will depend on:

- Total size of the Cooling Tower
- Quality of incoming water

Cost start at around: €500.000
Return on investment: +-3 years

Ideally we work on Cooling Towers/Evaporative Condensers > 2000tons /7MW

Certifications, recognitions

- European Commission Horizon 2020 Matching Program
- Swedac Certified
- EPRI - Electric Power Research Institute study report: : https://www.etcc-ca.com/reports/cooling-tower-water-use-optimization-epicepri conducts research for the United States' power generation industry. It is an independent, non-profit organization, which was created by American industrialists in the energy sector.
- Report "The Use of Additives in Open Recirculating Cooling Systems" from the Dutch Ministry of Water
- DAkkS - Deutsche Akkreditierungstelle - accreditation on drinking water tests
- Certificate of conformity for food use - Food and Drug Administration
- IVG Cooling Tower Approved for Utility Incentives in USA
- Certificate: BioCompatibility test Following EC / ISO 10993-1

Certifications, recognitions

- 2020: Approved by DVGW W270 certification for its compliance with the PA2200 test
- 2020: Accepted in the European Horizon 2020 program for innovations in air-cooling towers

- 2019: Pathema: Receives the “Energy Innovator Award 2019” - the most virtuous supplier in the field of air-cooling towers in Western Europe

- 2015: REALice is referenced as part of the Utility Incentives in the USA and Canada - Recognized among the Top 20 Innovations by Esource

- 2011: Nominated for the “WWF Climate Solver”

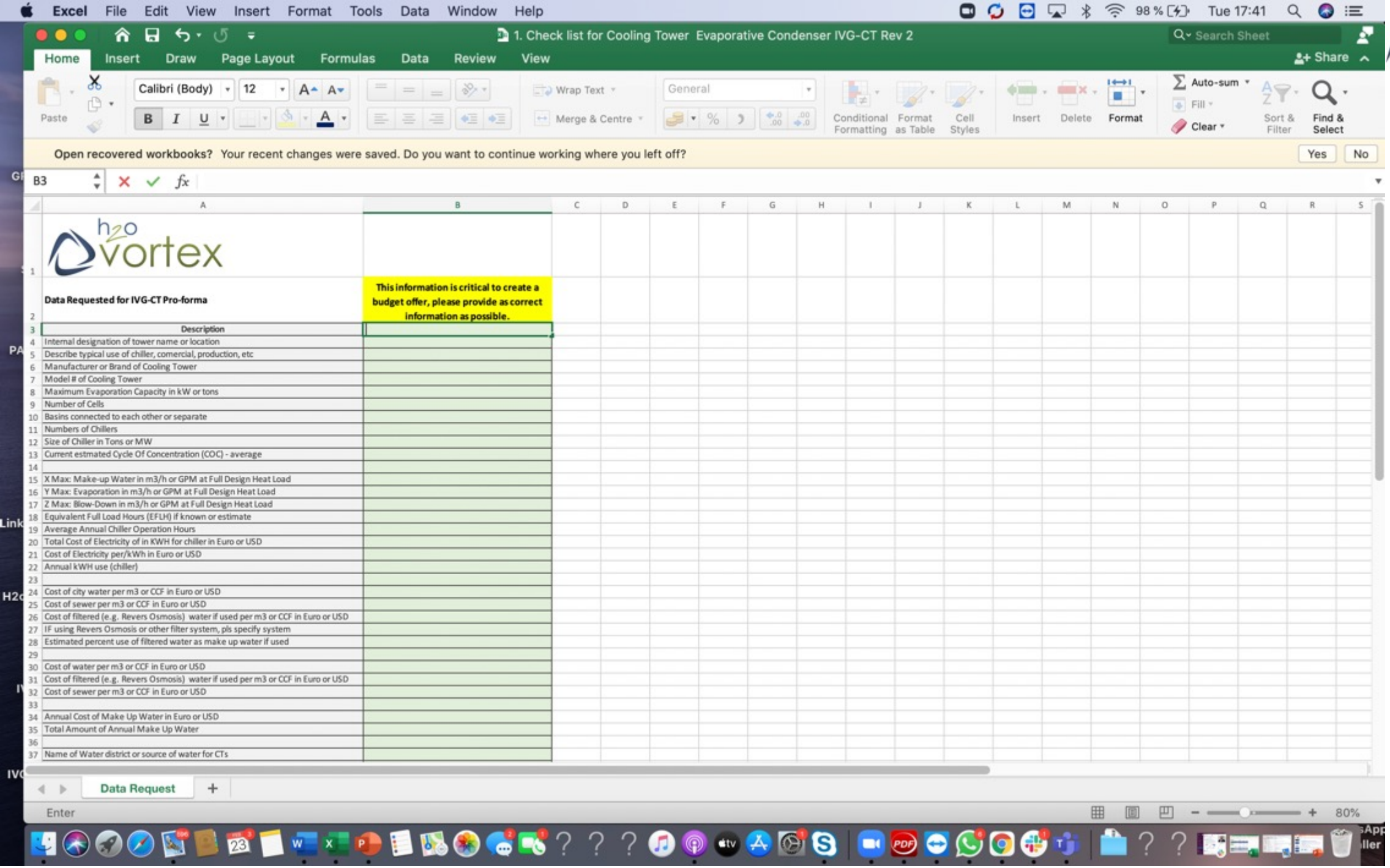
- 2009: Nominated at the “Clean Tech Awards” in Sweden

Our solutions are recognized by energy producers in North America and approved for manufacturers to qualify for subsidies

CLEANTECH HUBS
INNOVATIONS BY SWEDEN
Sweden
Sverige

CV ENERGY INNOVATOR AWARDS 2019
Pathema
Most Sustainable Water Cooling Treatments Provider 2019 Western Europe

nationalgrid
NYSEG
TACOMA POWER
Xcel Energy
TORONTO HYDRO
BC Hydro Power smart
SoCalGas
A Sempra Energy utility
Efficiency Vermont
CenterPoint Energy
PSE PUGET SOUND ENERGY
EVERSOURCE



Excel File Edit View Insert Format Tools Data Window Help — Tue 17:41

1. Check list for Cooling Tower Evaporative Condenser IVG-CT Rev 2

Home Insert Draw Page Layout Formulas Data Review View

Open recovered workbooks? Your recent changes were saved. Do you want to continue working where you left off? Yes No

B3

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Data Requested for IVG-CT Pro-forma

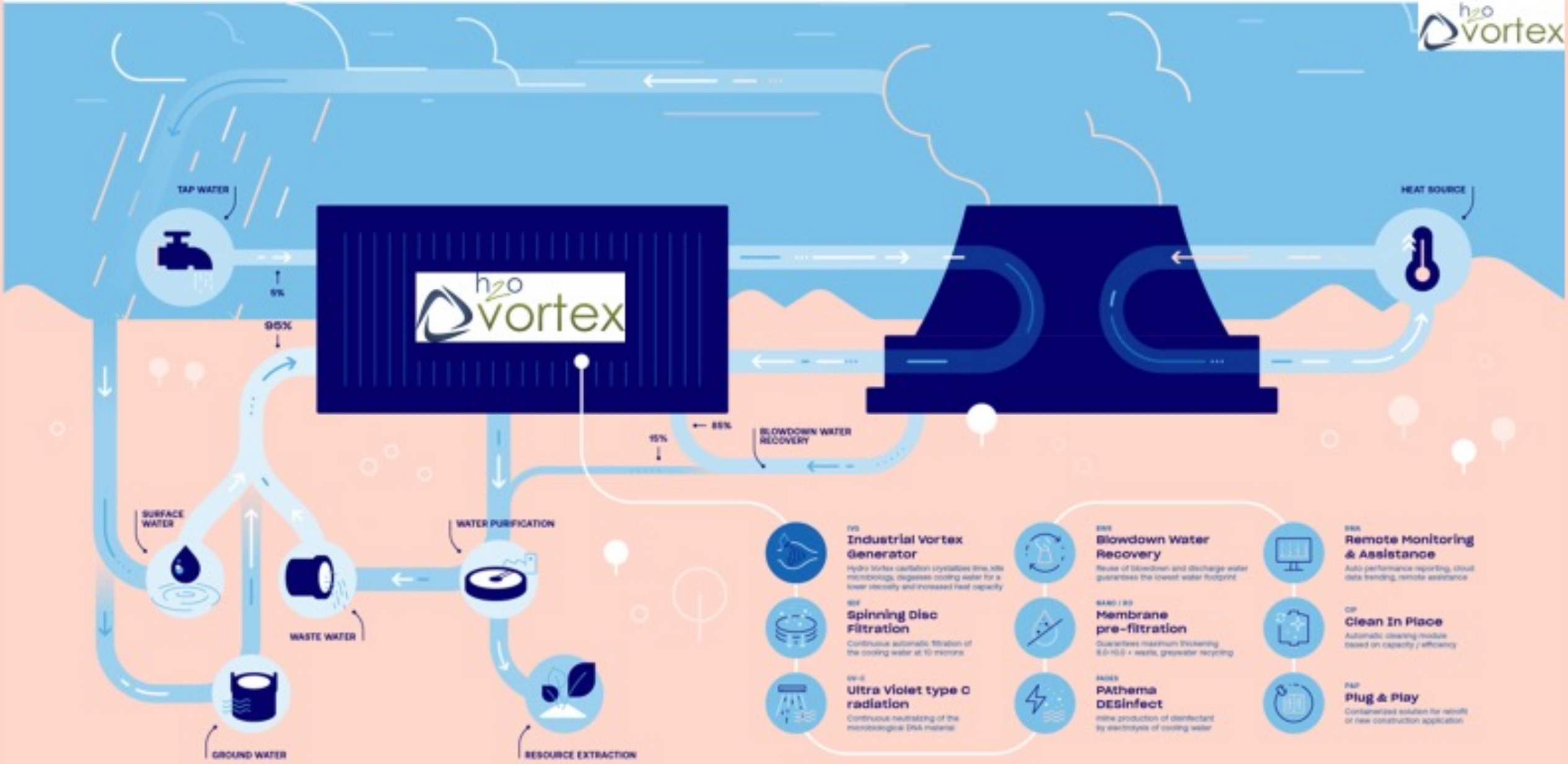
This information is critical to create a budget offer, please provide as correct information as possible.

Description	
Internal designation of tower name or location	
Describe typical use of chiller, comercial, production, etc	
Manufacturer or Brand of Cooling Tower	
Model # of Cooling Tower	
Maximum Evaporation Capacity in kW or tons	
Number of Cells	
Basins connected to each other or separate	
Numbers of Chillers	
Size of Chiller in Tons or MW	
Current estmated Cycle Of Concentration (COC) - average	
X Max: Make-up Water in m3/h or GPM at Full Design Heat Load	
Y Max: Evaporation in m3/h or GPM at Full Design Heat Load	
Z Max: Blow-Down in m3/h or GPM at Full Design Heat Load	
Equivalent Full Load Hours (EFLH) if known or estimate	
Average Annual Chiller Operation Hours	
Total Cost of Electricity of in KWH for chiller in Euro or USD	
Cost of Electricity per/kWh in Euro or USD	
Annual kWH use (chiller)	
Cost of city water per m3 or CCF in Euro or USD	
Cost of sewer per m3 or CCF in Euro or USD	
Cost of filtered (e.g. Revers Osmosis) water if used per m3 or CCF in Euro or USD	
IF using Revers Osmosis or other filter system, pls specify system	
Estimated percent use of filtered water as make up water if used	
Cost of water per m3 or CCF in Euro or USD	
Cost of filtered (e.g. Revers Osmosis) water if used per m3 or CCF in Euro or USD	
Cost of sewer per m3 or CCF in Euro or USD	
Annual Cost of Make Up Water in Euro or USD	
Total Amount of Annual Make Up Water	
Name of Water district or source of water for CTs	

Data Request

Enter — 80%

Flow Chart IVG-CT (all modules installed)



Thank you for your attention

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