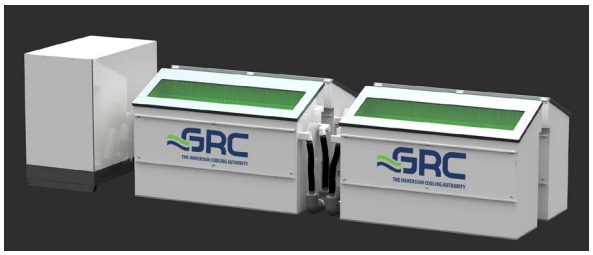
Green Revolution Cooling

Media Kit

GREEN REVOLUTION COOLING

The Immersion Cooling Authority

Company Background



Green Revolution Cooling (GRC) is an Austin, Texas-based company founded in 2009 with the belief that solving the problem of ever-increasing heat loads and complexity in designing and deploying data centers requires an innovative approach.

The premise behind the technology is simple: Instead of cooling servers with high velocity air, they could be cooled by submerging all heat-generating server components in a dielectric fluid, which has a higher heat retention capacity by volume than air. In 2009, GRC pioneered an immersion cooling technology, which won a Disruptive Technology of the Year award at Supercomputing '09 and GRC received a National Science Foundation (NSF) grant to fund research and development.

In 2010, GRC brought to market the CARNOTJET™ system, a low cost, high efficiency data center cooling solution that uses a single-phase, synthetic dielectric fluid coolant to remove heat from the servers. The company sold the first unit to *TEXAS ADVANCED COMPUTING CENTER* (TACC), then the ninth-fastest supercomputer on the Top-500 supercomputing list. By the end of 2010, GRC had again won a Disruptive Technology of the Year award at Supercomputing '10 and was beginning to lease evaluation units and sell full-size systems.

In 2011, GRC rapidly grew its customer base, including *CGGVERITAS*, the largest pure-play geophysical firm in the world, several major server OEMs, a major bank, and academic supercomputing sites including *KTH ROYAL INSTITUTE OF TECHNOLOGY* in Stockholm and *THE TOKYO INSTITUTE OF TECHNOLOGY*.

In 2012, GRC received additional grants from National Science Foundation and the Department of Defense. In 2017, GRC was named one of the top 25 data center companies by CIO Applications magazine. And in 2018 GRC rebranded its signature products as **HashTank**™, **HashRraQ**™, **ICEraQ**™ and **ICEtank**™ to meet the expanding needs of the market and blockchain technology.

The company serves many industries including defense, oil and gas, financial services and blockchain processing. It currently has installations in academic, corporate, and government data centers in five continents and over a dozen cities worldwide, with a total installed compute capacity of more than fifteen megawatts.

AWARDS

- Corporate LiveWire 2018/2019 Innovation in Liquid Cooling Award
- Top 25 Data Center Tech Companies 2017 – CIO Applications magazine
- Department of Defense Grant Awardee – 2012
- NSF Small Business Innovation Research (SBIR) Grant Awardee – Phase I 2009, Phase II 2012
- Top-50 Cloud Innovators, 2011 – GigaOm
- CRiP Awards 2014 - Trophy for IT Innovation (Category: Data Center & Green IT)
- The Green500 List - #1 Most Efficient Supercomputer 2013 &2014
- Green Enterprise IT Awards
- Most Disruptive Technologies of the Year at SC10

TESTIMONIALS

"GRC Cooling is the most efficient cooling technology we have tested. We save about 20% in energy versus our existing free cooling system and can now add capacity in some previously unusable space." **Infrastructure manager at Orange**

"Our equipment runs at a more consistent and lower temperature in the GRC solution, while consuming less power at the server level. We've grown to love the GRC solution and have a majority of our on-site infrastructure in GRC tanks." **Dan Charbonneau, CEO of CBT Nuggets, LLC**

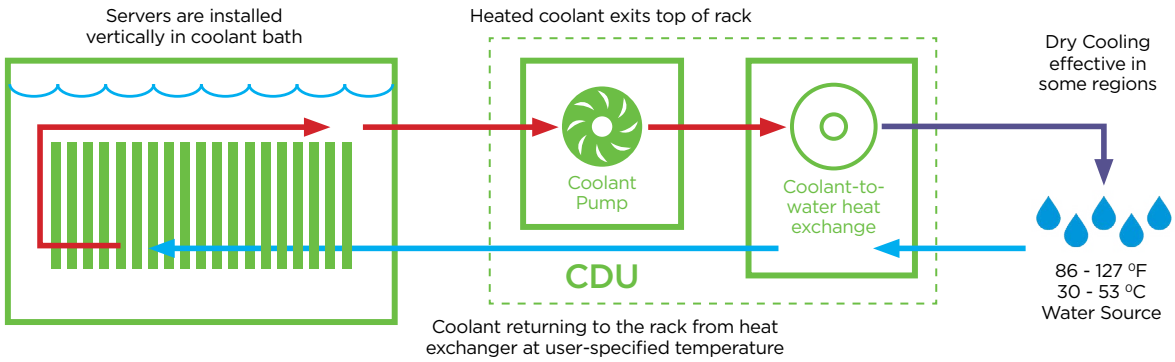
"We are seeing significant savings in terms of electricity. It's not impossible to go up to a factor of two, essentially gaining 50% of the electricity. And there is almost no noise, no air draft, and the temperature is very reasonable. There are none of the things you would normally associate with a very high density computer. That makes for a much nicer environment overall."
Laurent Clerc, VP of Information Technology at CGG

"Oil immersion can substantially reduce cooling costs. And has the potential to cut in half the construction costs of future data centers because immersion cooled systems do not require chillers, CRAC units, raised flooring, and temperature and humidity controls." **David Prucnal, PE at NSA**

Immersion Cooling Facts

Today's high-performance computer server operations demand more robust cooling than ever before, primarily due to the proliferation of high-output CPU and GPU processors. As more processing power is packed inside a smaller server chassis, a full rack of servers often demands more cooling than air can feasibly provide.

The GRC products – HashTank™, HashRraQ™, ICEraQ™ and ICEtank™ – are highly efficient and powerful open bath immersion cooling systems for rack-based servers. Servers hang vertically, submerged in a circulating bath of ElectroSafe® dielectric fluid coolant, an eco-friendly single-phase synthetic blend with 1,200x the heat capacity by volume than air. The coolant captures nearly 100% of heat generated by server components and removes it for rejection to the facility's water line which may then be cooled according to on-site infrastructure needs.



Energy Savings

- 90-95% less cooling power
- 40-50% less overall data center power consumption
- 10-20% less server power (removal of internal server fans)

Cost Savings

- Immediate savings for Greenfield installations
- No CRACs or Chillers and smaller generators/UPS
- 1-3 year payback for most retrofits based on energy savings alone

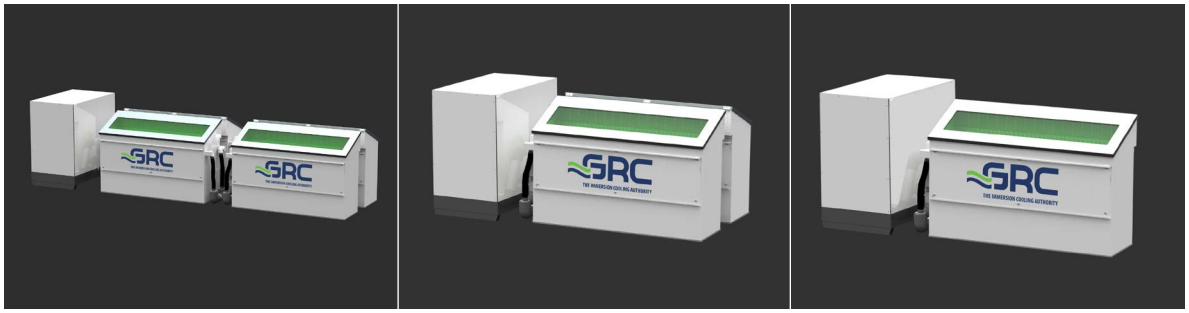
Performance

- Supports up to 100 kW per 52U Rack
- Supports any OEM server with a 19-inch form factor
- Supports blades, trays, and GPU or MIC-accelerated servers

ICE Facts

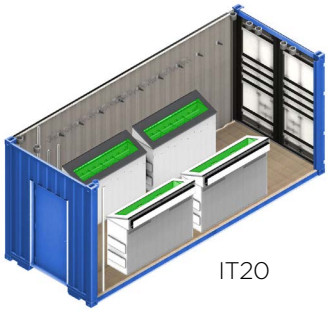
ICEraQ™ is a low-cost, high-efficiency immersion cooling for data centers.

- ICEraQ: Quad, Duo, & One Product Information

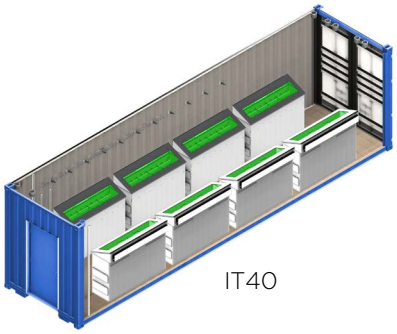


ICEtank™ is a containerized, immersion-cooled data center for rapid deployment in any environment. It's available in two container sizes, to support up to 8 X 42U immersion cooled racks:

- ICEtank: IT20 & IT40 Product Information



IT20

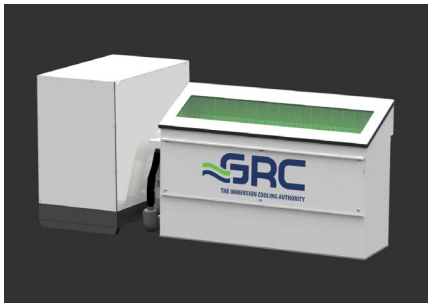


IT40

Hash Facts

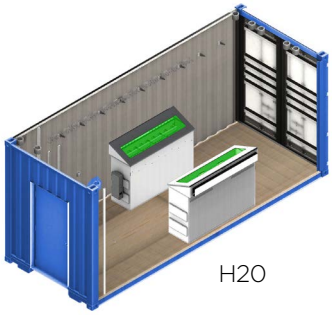
HashRaQ™ is a complete blockchain computing system.

- HashRaQ: HR & HRc Product Information



HashTank™ is a complete immersion-cooled data center for blockchain computing, in a box. It's available in two container sizes, to support up to 6 x 52U immersion cooled racks:

- HashTank: H20 & H40 Product Information



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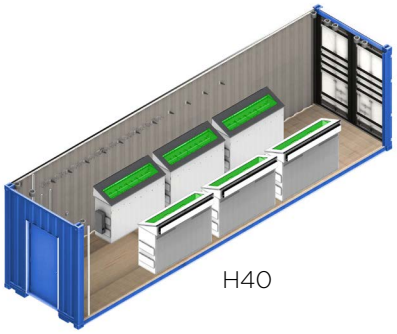

H40

Frequenty Asked Questions

What is immersion cooling?

Liquid immersion cooling is a technique where entire servers are immersed in a dielectric coolant such as GRC's ElectroSafe®. Dielectric coolants are excellent conductors of heat yet bad conductors of electricity, making them ideal for cooling IT and electronic equipment. The higher density and heat capacity of liquids compared to air, allow for significantly higher performance and efficiency.

Applications of immersion cooling for servers and PCs date back to as early as the 1980s, but adoption was limited given the minimal cooling requirements and cost and safety concerns about coolants used at the time. In 2009, GRC pioneered an immersion cooling system for data centers (now called the ICEraQ™) that uses a non-toxic, non-conductive, non-evaporative and high-performance liquid called ElectroSafe®.

Q: What are the benefits of GRC's immersion cooling technology versus traditional air cooling?

When compared to traditional data centers, GRC's single phase immersion cooling technology radically simplifies data center infrastructure, and removes constraints of power, cooling, capital, and location. This cooling technology eliminates the need for expensive and energy intense devices such as chillers, air-handlers, humidity controls, and even raised floors. This simplification of the data center results in:

- Up to 60% reduction in the upfront capital cost of data center construction.
- Up to 50% lower data center energy use resulting from a 95% reduction in cooling energy and 10-20% reduction in server energy (due to fan removal).

Because of the higher heat capacity of liquid coolants such as ElectroSafe®, GRC's immersion cooling technology efficiently and reliably cools over 100kw/rack, over 6x more than the 15kW/ rack limit of traditional air conditioning. This higher cooling capacity enables future-proofing of the data center and easy adoption of new, high performance computing trends such as AI/ ML, VR/AR, blockchain, etc.

Finally, immersing servers in ElectroSafe™ protects clients' technology from dust, moisture, oxygen, vibrations, and hotspots. This helps improve hardware performance and reliability, while allowing for deployments in traditionally unfavorable climates. This environmental resilience along with the minimal site requirements of GRC's products give data center operators complete location flexibility allowing them to build an ultra-efficient, high performance data center anywhere from a high-rise building to the middle of the desert.

Q: How does GRC's immersion cooling system work? What are its key components?

GRC's ICEraQ™ system consists of three major components:

- Rack(s): enclosed horizontal racks that hold the servers and coolant. The racks open at the top to allow ergonomically improved access to each server.
- Coolant Distribution Unit (CDU): contains coolant pumps, filters, and coolant-to-water heat exchangers.
- Control Computer: monitors and manages the temperature and flow of the coolant. The control computer also integrates with DCIM systems including GRC's Foresight, monitoring tool that provides both real-time and historical data reporting, early fault detection and configurable email alerts.

Rack-based servers from virtually any OEM are vertically mounted in the racks that are filled with the ElectroSafe® coolant. The CDU circulates the coolant between the racks and heat exchangers, removing heat from the servers and transferring it to a warm water loop. The system's ability to accept warm water allows for the use of evaporative cooling towers, or dry-coolers as the final form of heat rejection, resulting in chiller-free cooling virtually anywhere on the planet.

Q: What is ElectroSafe™?

ElectroSafe™ is an odorless, non-toxic, single phase coolant that is both electrically and chemically inert. The proprietary blend of high-performance fluids is the result of years of development, testing, and deployments across the globe. ElectroSafe™ is compatible with virtually every electronic and IT component and system out there, and ensures maximum performance and material compatibility, enabling your servers to run efficiently and reliably. GRC has been commercially deploying ElectroSafe® immersion cooling systems since 2010 and hardware reliability data shows a significant increase in the mean time between failures (MTBF).

Q: What are the different types of immersion cooling technologies?

There are two types of immersion cooling systems:

- Single-phase immersion cooling (SPIC) uses a coolant that remains in the liquid form and does not evaporate or boil off. This is what GRC's patented ICEraQ system is based on.
- Two-phase immersion cooling (TPIC) uses special coolants that evaporate at lower temperatures. While TPIC offers a marginal increase in efficiency (cPUE of 1.01 vs. 1.02), the upfront cost and operational challenges of the technology outweigh the marginal efficiency increase.

Q: What are the benefits of single phase immersion cooling over two-phase?

Two-phase coolants change from liquid to gaseous, i.e. evaporate at low temperatures. Single-phase coolants like ElectroSafe® do not evaporate. They stay in the liquid form under normal operating conditions, which provides two significant benefits over two-phase coolants:

- It enables GRC's patented open rack design that gives you easy access to your servers, making hardware maintenance a breeze.
- The lack of evaporation also eliminates the risk of inhalation related health risks that two-phase coolants pose. ElectroSafe® is non-toxic and does not pose major health risks due to inhalation or ingestion.
- Newer two-phase coolants have shown some potentially catastrophic issues with material compatibility. A recent study by Lawrence Berkley National Lab (LBNL) showed dramatically high failure rates and vapor leaks that cost 368% of the total cost of IT equipment energy consumption.

Q: What types of servers can we use with the system?

GRC immersion cooling technology solutions are compatible with virtually any OEM servers including ; Supermicro, Dell, Nvidia, HP and IBM.

Q: What are GRC's maintenance needs?

Occasional cleaning of the filter and strainer system that cleans the coolant is required, which can be completed without turning off the system. The coolant does not need to be replaced over the life of the data center.

Executive Biographies

Peter Poulin, CEO

Peter has more than 30 years of experience in the technology industry. He spent the first half of his career at Compaq Computer Corporation in a variety of sales, marketing, operations, and general management roles, serving the client and data center needs of large commercial and public sector customers. His data center experience also includes roles as VP of North American Sales and Marketing for APC (now a Schneider Electric company), VP of Business Development for NetBotz, a DCMI software company acquired by APC, and VP of Sales for Virtual Bridges, a Linux-based VDI platform. Prior to joining GRC, Peter was the CEO of Motion Computing, a rugged tablet manufacturer. Peter holds a BS in electrical engineering from Cornell University.

Jim Weynand, Chief Revenue Officer

Jim has over 30 years of IT industry experience, and brings to the team an impeccable record of leading the growth of complex B2B commercial services and solutions for some of the world's leading data center technology providers and private equity consulting firms. Having spent the first half of his career in various sales and marketing roles at IBM and Compaq, he has also served as the VP and GM of Americas Public Sector at HP, Senior Vice President of North America for Unisys and EVP of CEVA Logistics global technology sector. Jim holds a BBA from the University of North Texas.

Alex McManis, Director of Applicatin Engineering

Alex is one of the leading experts in the field of immersion cooling with multiple innovations (patents pending) since starting with GRC in 2013. He's led design, development, and installation projects ranging from spartan hyperscale deployments to environmentally resilient, modular data centers for the Department of Defense. Alex holds a BS in engineering physics from the University of Colorado and is an avid traveler for both work and pleasure.

Larry Stone, VP of Engineering

Larry has over 30 years of product development experience, as Mechanical Engineer (SUNY Binghamton) and Product Development Manager. He has gravitated to developing leading-edge products and has received many industry accolades and awards. He's managed many cross functional teams and has an extensive patent portfolio. He brings large company rigor (IBM, Compaq, Dell) and small company know-how (Valence Technology, Motion Computing) to help lead the GRC Development Team.

Jerry Mayfield, VP of Customer Experience

Larry has over 30 years of product development experience, as Mechanical Engineer (SUNY Binghamton) and Product Development Manager. He has gravitated to developing leading-edge products and has received many industry accolades and awards. He's managed many cross functional teams and has an extensive patent portfolio. He brings large company rigor (IBM, Compaq, Dell) and small company know-how (Valence Technology, Motion Computing) to help lead the GRC Development Team.

Debra Dresser, VP of Operations

Debra is responsible for the supply chain, manufacturing, and logistics to deliver high quality products to customers while scaling to meet demand. Prior to GRC, Debra provided operations leadership at Xplore Technologies, Motion Computing, Augmentix, and Dell. She started her career in manufacturing at the Amdahl Corporation working on their first liquid cooled mainframe system, and also held positions at Johns Hopkins University Applied Physics Lab and Litton Amercom Space Systems Operations. She currently serves on the Board of Directors for the Austin Regional Manufacturers Association. Debra holds an MS in Industrial Engineering from Stanford University and a BS in industrial engineering from Arizona State University.

Press

January 16, 2019 - GRC Celebrates Ten Years at the Epicenter of Liquid Immersion Cooled Data Centers
https://www.grcooling.com/wp-content/uploads/2019/01/grc-celebrates-tenth-anniversary-20190116.pdf

October 18, 2018 - GRC Receives Innovation in Liquid Cooling Award:
https://www.grcooling.com/wp-content/uploads/2018/10/grc-receives-innovation-in-liquid-cooling-award-20181018.pdf

September 25, 2018 - GRC Launches Global Partner Program To Support Accelerating Adoption Of Data Center Liquid Immersion Cooling:
https://www.grcooling.com/press_releases/grc-launches-global-partner-program-to-support-accelerating-adoption-of-data-center-liquid-immersion-cooling/

September 4, 2018 - Immersion GPU System Provides AI Horsepower For Frontera:
https://datacenterfrontier.com/immersion-gpu-system-provides-ai-horsepower-for-frontera/

August 3, 2018 - Blockchain Power Commissions Hashtank H40:
https://www.nasdaq.com/press-release/blockchain-power-commissions-hashtank-h40-20180803-00430

July 2, 2018 - Green Revolution Cooling Now Doing Business as GRC:
https://www.grcooling.com/wp-content/uploads/2018/07/Green-Revolution-Cooling-Now-Doing-Business-as-GRC-20180701.pdf

July 2, 2018 - Bitcoin Drove a Surge in Immersion Cooling Sales, But GRC is Eyeing More Stable Markets:
http://www.datacenterknowledge.com/power-and-cooling/bitcoin-drove-surge-immersion-cooling-sales-grc-eyeing-more-stable-markets

November 29, 2017 - GRC Awarded Spot On 'Top 25 Data Center Tech Companies' List By CIO Applications Magazine: https://www.grcooling.com/wp-content/uploads/2018/06/CIO-Applications-Press-Release.pdf

November 13, 2017 - TACC Doubles Down on Liquid Immersion Cooling, GRC Delivers Another Immersed HPC Cluster Solution:
http://www.prweb.com/releases/2017/11/prweb14909904.htm

October 24, 2017 - John Paul Catholic University Adopts GRC's Liquid Immersion Cooling For HPC Cluster:
https://www.grcooling.com/wp-content/uploads/2018/06/JPC-Press-Release.pdf

April 24, 2017 - GRC Immersion Cooling Helps Research The Origin Of Stars:
https://www.datacenterdynamics.com/news/grc-immersion-cooling-helps-research-the-origin-of-stars/

April 19, 2017 - GRC's Oil Immersion Cooling System At PIC Supports Data Processing For The Large Hadron Collider At CERN:
https://www.grcooling.com/wp-content/uploads/2018/06/PIC-Press-Release.pdf

March 17, 2017 - Green Revolution Cooling Appoints IT Industry Veteran, Jim Weynand As Chief Revenue Officer:
https://www.grcooling.com/wp-content/uploads/2018/06/Jim-Weynand-Joins-GRC-Press-Release.pdf