App Note: The Virtual Facility for a Consultant

RED

When **RED Engineering** designed a state-of-the-art rooftop plant for a Tier III 40,000 ft^2 data center, they used the **Virtual Facility** (VF) to predictively simulate the impact on the facility's operating conditions. As a result of doing so, they were able to safely instigate a significant redesign that safeguarded the cooling plant's performance in extreme weather conditions.

As the data center industry moves towards reducing PUE (power usage efficiency) and saving energy costs, attention has turned to the cooling plant. With up to 40% of the data center's energy consumed by the cooling infrastructure, there are significant savings to be realized with the latest technology advances in cooling systems and design techniques.

With a significant move towards more **free cooling** - either direct (fresh air directly into the data center) or indirect (fresh air used to cool the data center air without mixing) - the environment outside a data center is now more important than ever. The interaction between a building's intakes and exhausts with the weather outside can greatly impact the successful running of the facility. And, as dependency on nature for cooling grows, so too does the need to model the external environment. This is just one of the applications that the **Virtual Facility (VF)** has been designed for.

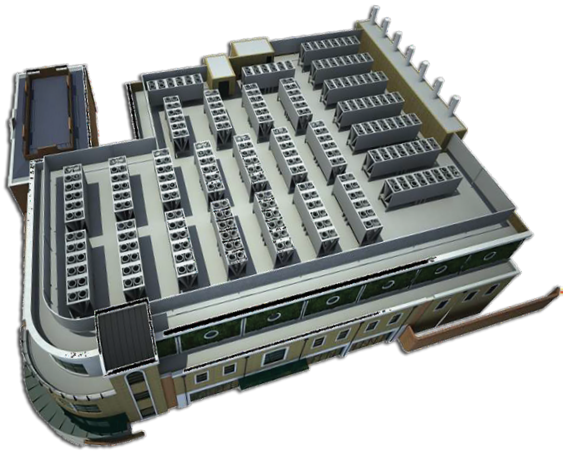
Without the VF, the consultant cannot easily ensure that the cooling system they have designed will deliver the required load in the operating environment, leaving unanswered questions about the resilience of the facility.

Case Study Design Requirements

- 4,000 m^2 technical white space at 2kW/m^2
- Uptime Tier III
- BREEAM Excellent for data centers
- 20% onsite renewable energy
- Building height and volume restrictions.

Proposed Design

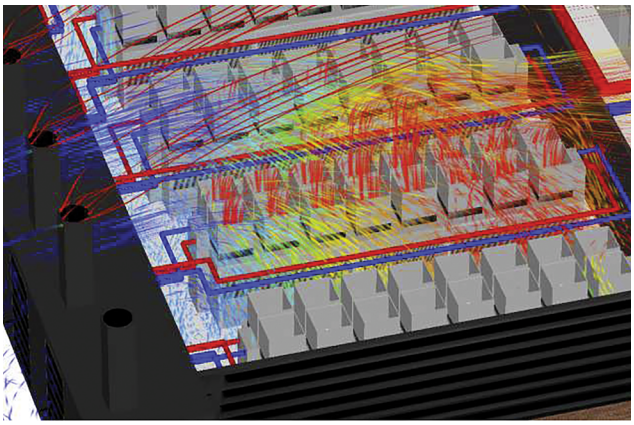
- Chilled water system with economizer
- Plant room generators with remote radiators
- Manufacturer's recommended separation between plant.



THE TIER III DATA CENTER (ABOVE)
THE DATA CENTER MODELED IN 3D (RIGHT)

"Traditional solutions didn't solve the problems. Simulation in the VF allowed novel approaches to be tested against numerous and varied weather conditions."

Design Problems Identified by the VF



(Above) The VF shows hot exhaust air from generators and dry coolers being pulled back into the roof well.

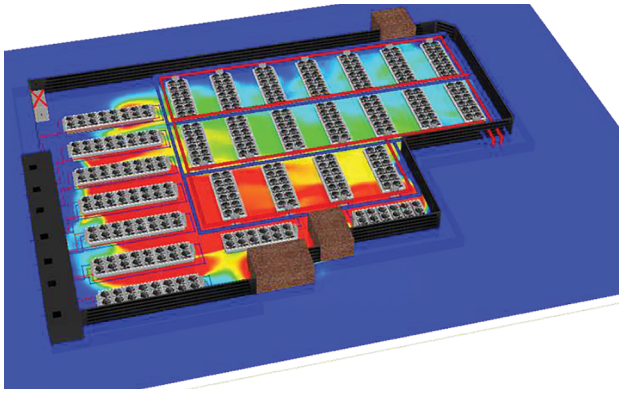
Designing the cooling plant compound is just as critical as designing the data hall itself. However, it is harder to achieve as you have no control on the weather!

Instead of being reliant on manufacturers' recommended space requirements (running the risk that the facility would not meet design goals), RED used the VF to understand the complex relationship between white space, external weather and cooling plant.

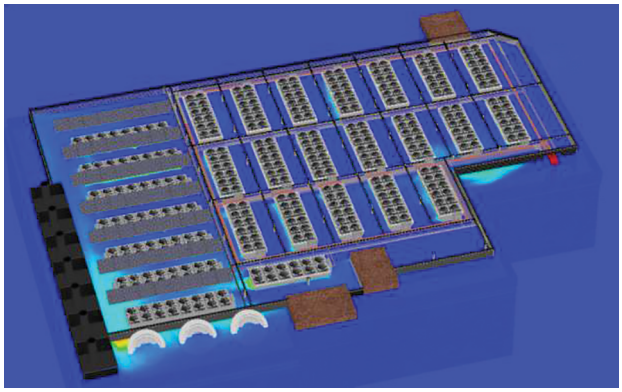
The site was part-loaded, but was reporting data hall supply air of 37°C. The VF showed that poor cooling plant layout, combined with specific weather conditions, were the cause.

Despite being only 34°C outside, strong winds were causing recirculation of exhaust air, raising temperatures in the roof well beyond 50°C. The chilled water temperatures rocketed to 28°C, which led to extreme temperatures within the hall.

With the problems identified, RED then used the VF to redesign the plant and to deliver safeguarded performance in all weather conditions.



(Above) The VF shows how roof temperatures in RED's design exceed 50°C (red areas).



(Above) The design is revised in the VF. The results now show a mass of blue, indicating roof temperatures all below 50°C.

Conclusion

It was clear that using the VF **at the design stage** to predictively simulate the rooftop would have highlighted the issues now faced by RED's customer. Had that been the case, it would have allowed for modifications to safeguard the plant against such extreme temperatures.

With all this in mind, it is clear from this case study that best practices and guidelines are not sufficient to ensure a fully operational plant. Instead by using the power of the computational fluid dynamics (CFD) built into the VF, you can safeguard your design against weather conditions and poor layout. Don't leave it chance: simulate.

The VF for a Consultant