

Cooling Design Review — Report Extract

Reference facility: 12 MW IT colocation, two-storey, Western Europe · Chilled-water architecture, N+1 · Design stage: pre-tender (APD)

1. Executive summary

BuildGrid reviewed the mechanical design package (42 documents: schematics, equipment schedules, hydraulic calculations, sequence descriptions) against the stated design intent: 12 MW IT at N+1, ASHRAE A1 allowable envelope, PUE target ≤ 1.32 , and DLC-readiness for 30% of white space by Phase 2.

The design is fundamentally sound and buildable. However, the review identified **2 critical findings** that compromise the availability target during specific failure scenarios, **4 major findings** with significant capex or energy impact, and 7 minor observations. The two critical items are resolvable at the current design stage at near-zero cost; the same corrections made after tender award were estimated by the client's QS at a 6-figure variation order.

2. Risk register (extract — top 4 of 13 findings)

ID	Finding	Criticality	Impact	Recommendation
C-01	Chilled-water buffer volume sized for 42 s ride-through at full load; chiller restart sequence after mains failure requires 180 s. During a black-building event, supply temperature exceeds the A1 allowable envelope before mechanical cooling is restored.	Critical	Thermal excursion of white space during utility transfer; SLA breach exposure.	Increase buffer volume to ≥ 200 s equivalent or add UPS-backed primary pumps + free-wheeling non-return arrangement; validate with transient simulation.
C-02	Common header section between plant modules creates a single isolation point: one specific valve failure requires full plant shutdown for maintenance, defeating the concurrent-maintainability intent.	Critical	Concurrent maintainability not achieved; Tier objective compromised.	Add sectionalizing valve pair and revise isolation philosophy drawing; re-run failure-mode walk-through on updated schematic.
M-01	Free-cooling changeover set at fixed 12 °C ambient dry-bulb. Site's bin data supports partial free cooling from 16 °C with the selected coil surface, leaving $\approx 1,100$ equivalent full-load hours unexploited.	Major	Estimated 6–8% chiller energy penalty; PUE target at risk.	Implement modulating changeover on supply-water temperature demand rather than fixed ambient threshold; update sequence of operations.
M-02	CRAH fans selected at design duty with no diversity analysis; at typical Day-1 load ($\approx 35\%$), fixed minimum airflow drives fan power $\approx 3\times$ the optimized value.	Major	Operating-cost penalty in early years; oversized electrical feeds.	Introduce load-staged CRAH enablement and differential-pressure-based fan control; verify minimum airflow against containment leakage.

3. Detailed finding — C-01 (extract)

Observation. Hydraulic calculation note HC-104 rev C sizes the buffer vessel at 18 m³ based on a 42-second ride-through at 12 MW. The chiller schedule (EQ-201 rev D) specifies units whose controller requires a minimum 180-second restart window after power interruption, confirmed by the manufacturer's submittal data included in the package.

Analysis. Under a utility failure with successful generator start (design case, 15 s transfer), primary pumps restart on generator power but chillers remain locked out for the restart window. The stored cooling covers 42 seconds of full-load heat rejection; beyond it, loop temperature rises at approximately 0.9 K per 10 seconds at design load. Supply air crosses the A1 allowable limit roughly 75 seconds into the event — 90+ seconds before mechanical cooling returns. The design therefore passes the generator-start case on paper only because the calculations assume instantaneous chiller availability, an assumption contradicted by the selected equipment's own documentation.

Recommendation. Either (a) increase effective thermal storage to cover the full restart window plus margin (≥ 200 s equivalent), or (b) retain vessel size but add UPS-backed primary distribution with validated free-wheeling behaviour, and negotiate a fast-restart controller option with the chiller vendor (typically available; reduces lockout to 30–60 s). Option (b) was costed by the client at roughly one-tenth of option (a)'s footprint impact. A transient hydraulic simulation of the corrected scheme is included in BuildGrid's standard scope for this finding class.

Source traceability. HC-104 rev C §4.2; EQ-201 rev D items CH-01...CH-05; manufacturer submittal 7.3 (restart logic); ASHRAE TC 9.9 thermal guidelines, A1 allowable.

4. What the full report contains

- Complete findings register (all criticality levels) with source references for every figure used;
- Failure-mode walk-through of the cooling distribution at N, N+1 and maintenance states;
- Energy and PUE impact quantification for each major finding, using site climate bin data;
- DLC-readiness assessment of the proposed FWS/TCS provisions against Phase 2 intent;
- Prioritized remediation list with indicative cost class and optimal decision timing;
- A 45-minute review call with the responsible engineer, included in the fixed price.

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