Design-basis & single-line assumptions

The Definitive Guide to AI Data Centers — aidatacenterguide.com · v1.0 · defaults as of 2026-07 · Canonical chapters: Ch 0.5 (design-basis primer), Ch 4 (electrical), Ch 5 (cooling), Ch 12.1 (redundancy topologies)

READ-ONLY WORKED EXAMPLE - this PDF is not fillable. Copy its structure into your controlled project system before entering project-specific values.

Intended user: owner's engineer / design lead fixing the basis of design before schematic design — the document every discipline designs against and every change order is measured against. **How to use:** every row records a decision as *value + basis + consequence accepted*. A blank consequence cell means the decision hasn't actually been made. Amber cells show a worked example (reference case: ~100 MW-class GB200 NVL72 campus, direct-to-chip liquid, Tier III-class topology); blue cells are yours.

Document control

Project		**Revision / date**	
Prepared by (owner's engineer)		**Discipline reviews (E/M/S/T)**	
Approved by (owner)		**Jurisdiction / code edition**	

§1 — Site & environment

Parameter	Worked example (REF)	This project	Basis / source	Consequence accepted
Design ambient (N-yr dry-bulb / wet-bulb)	40.6 °C DB / 25.2 °C WB (ASHRAE n=20)			
Elevation / air density derate	310 m — no derate taken			
Seismic design category / importance factor	SDC C · Risk Category II (per NIST GCR 23-037 practice)			
Flood / wind / hail design events	Zone X · 185 km/h ult. · hail region 2			
Water source & curtailment priority	Municipal potable, industrial class; closed-loop design			

§2 — Capacity & IT basis

Parameter	Worked example (REF)	This project	Basis / source	Consequence accepted
IT design capacity / phasing	96 MW IT in 4 × 24 MW phases			
Reference platform & rack density	GB200 NVL72-class · 120 kW/rack design point			
Density band the shell must carry	80–200 kW/rack without structural rework (~3,000 lb racks)			
PUE target (annualized, design)	≤1.15 at phase-1 load			
Workload archetype the basis assumes	Training-dominant; synchronous power transients to 40% swing			

§3 — Electrical single-line assumptions

Parameter	Worked example (REF)	This project	Basis / source	Consequence accepted
Utility service (voltage, feeds, firmness)	2 × 138 kV, separate substations, firm tariff			

Topology per system (utility→UPS→PDU)	Distributed redundant (3-to-make-2) MV; 2N UPS paths to critical			
Concurrent maintainability boundary	Every element to the rack PDU — Tier III-class			
UPS technology & autonomy	Double conversion + Li-ion, 5 min at N load			
Backup generation & runtime basis	Diesel N+2 per block, 48 h on-site fuel, EPA T4F			
Training-transient mitigation	Rack-level capacitance + BESS smoothing at POI per interconnect study			
Fault level & grounding scheme	63 kA MV gear; HRG on 480 V critical			

§4 — Cooling & mechanical assumptions

Parameter	Worked example (REF)	This project	Basis / source	Consequence accepted
Heat-rejection architecture	DLC (cold plate) + RDHx residual air; dry coolers, adiabatic assist			
Liquid supply temperature class	W32 primary design; W45-capable headers for next-gen			
CDU architecture & approach	Row-level L2L CDUs, ~3–5 °C plate approach; N+1 per row			
Design ΔT / flow per rack	~10 °C secondary ΔT at 120 kW → ~180 L/min (PG25, cp ≈ 3.9 kJ/kg·K, ρ ≈ 1.03 kg/L)			
Ride-through on cooling loss	Thermal buffer tanks ≥60 s at N load until generators carry pumps			
Water use basis (WUE) & discharge	≤0.4 L/kWh annualized; zero process discharge			
Coolant chemistry & materials compatibility	PG25, OEM-approved wetted-materials list enforced in procurement			

§5 — Redundancy & fault-domain declarations (per system)

System	Topology (REF)	This project	Concurrently maintainable?	Fault tolerant?	Largest single fault domain
MV distribution	Distributed redundant				
UPS / critical power	2N to PDU				
Generation	N+2 per block				
Heat rejection / CDU	N+1 per row				
Network (fabric / WAN)	Dual fabric, rail-optimized; 2 diverse WAN paths				

Declare fault domains honestly: the guide's rule is that a topology certifies which *maintenance and fault events you ride through*, not an availability percentage. Anything not concurrently maintainable is a scheduled-outage commitment — write it down here, not in the O&M manual after the fact.