

Illustrative photo: a UPS lineup and its battery cabinets.

NLC ACADEMY · EPISODE 39

UPS sizing, read the datasheet.

A 100 kVA UPS can supply 80 kW at a load power factor of 0.8, provided its rated kW output is at least 80 kW. The datasheet decides the rest: rated kW and kVA, output PF range, operating limits and derating.

TWO CEILINGS

Two ceilings, and the lower one binds.

UPS output PF 0.9, load PF 0.80

80 kW, kVA limit binds

UPS output PF 0.9, load PF 1.00

90 kW, kW limit binds

UPS output PF 1.0, load PF 0.99

99 kW, kVA limit binds

dashed line: 100 kW, what the kVA name suggests

the lower of the two ceilings binds

A 100 kVA UPS can supply 80 kW at a load PF of 0.8, provided its rated kW output is at least 80 kW. UPS output PF means rated kW ÷ rated kVA from the datasheet.

Actual capability also depends on the permitted output PF range (leading and lagging), the operating limits and derating, for example temperature. The nominal kVA alone does not prove the deliverable kW.

NINE COMBINATIONS

One rating, nine answers.

UPS output PF	load PF 0.80	load PF 0.90	load PF 1.00
0.8	80 kW both limits	80 kW kW limit	80 kW kW limit
0.9	80 kW kVA limit	90 kW both limits	90 kW kW limit
1.0	80 kW kVA limit	90 kW kVA limit	100 kW both limits

100 kVA does not automatically mean 100 kW

each cell: the lower of the kVA limit and the kW limit

UPS output PF = rated kW ÷ rated kVA, from the datasheet. Each cell is the lower of the kVA limit (100 × load PF) and the kW limit (100 × UPS output PF).

THE CODE

The performance classification is a code.

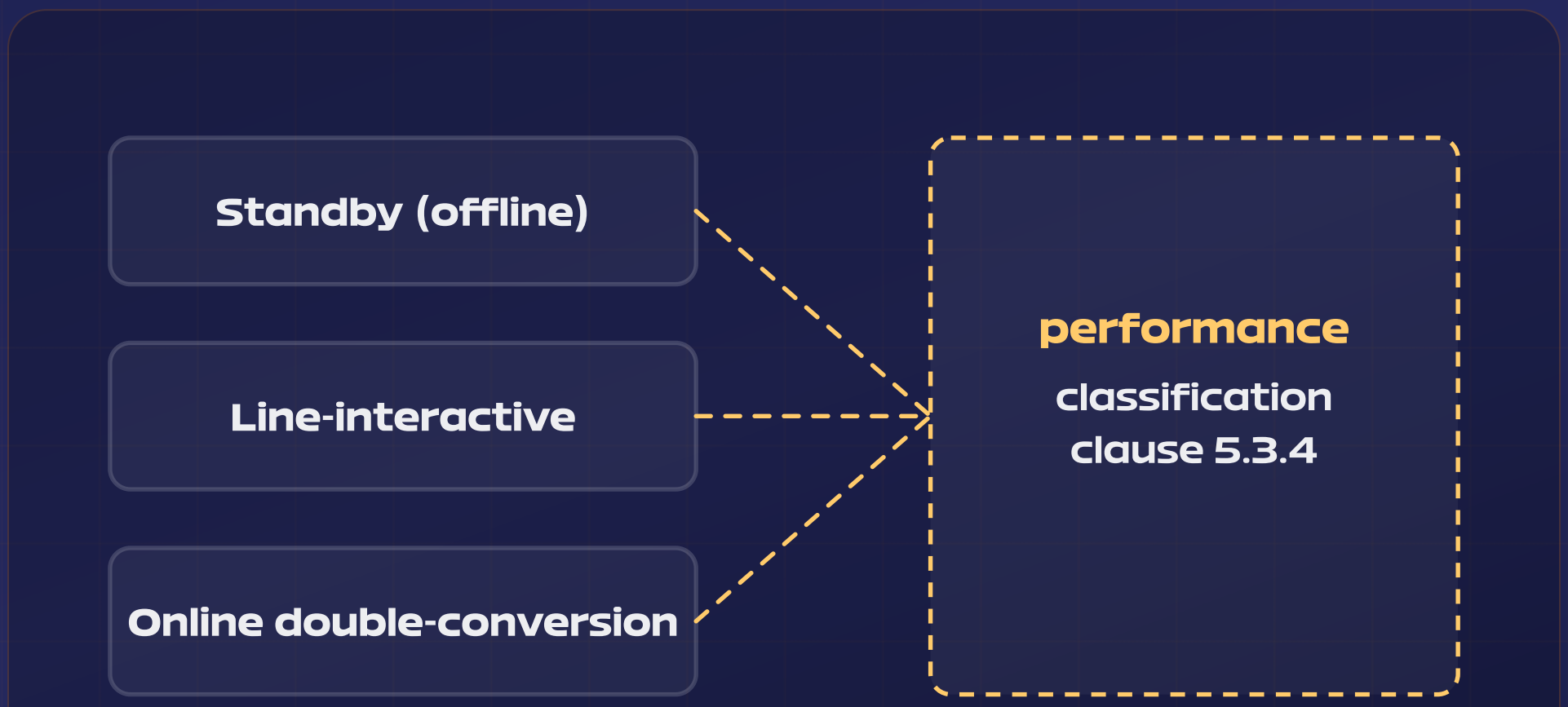
8 characters, Edition 2 → **7** characters, Edition 3.0

dynamic output performance classes 1, 2 and 3 (Figures 2 to 4)

The Foreword of Edition 3.0:2021 shortens the performance classification code from eight to seven characters.

TOPOLOGY

The classification is by performance.



Ask the bidder to state the performance code for the offered unit.

BATTERY AGEING

Divide by the ageing factor

the target

15.00 min

a 15 min NEW battery at end of life, if linear

12.00 min

simplified design target for a NEW battery

18.75 min

0.80 ageing factor, and it divides

not 20% more capacity. 25% more.

Simplified educational calculation: an ageing factor of 0.80 gives 15 ÷ 0.80 = 18.75 min for a new battery, a 25% margin. The battery itself is sized from the maker's constant-power or watts-per-cell data at the required autonomy, temperature, discharge rate and end-of-discharge voltage.

THREE NUMBERS

Three numbers worth quoting.

80	18.75	7
kW	min	characters
100 kVA, 0.8 PF load if rated ≥ 80 kW	15 min ÷ 0.80 simplified	in Edition 3.0 per Foreword

Each one is a line you can put in a specification.

80 kW holds only if the UPS is rated at least 80 kW, within its output PF range, operating limits and derating. The 18.75 min is a simplified educational calculation.

REFERENCE

What Edition 3.0 changed.

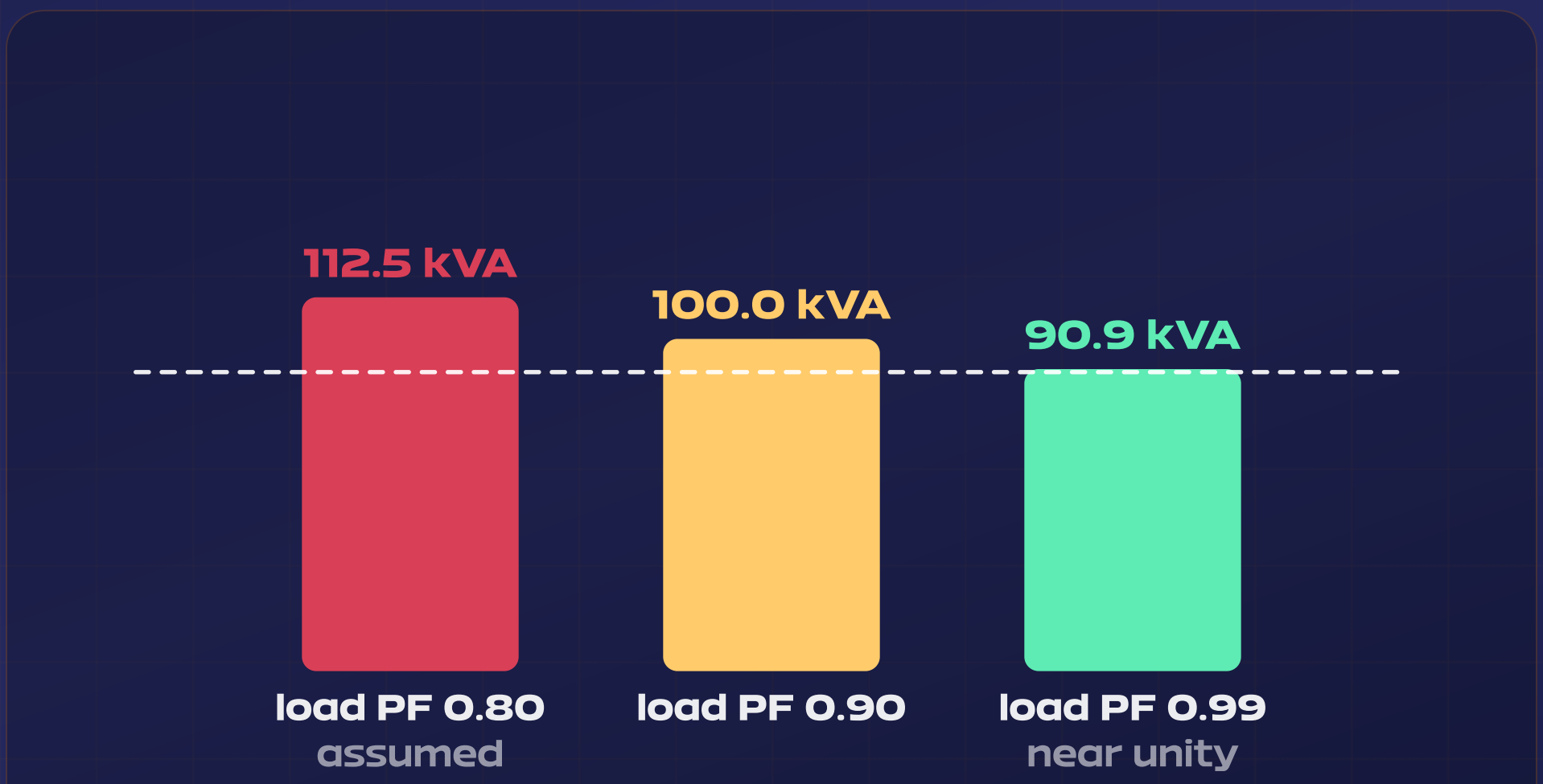
1. Classification code: 8 characters become 7
2. Non-linear step load: no longer a type test
3. Non-linear load requirements relaxed in Annex E
4. Annex I efficiency values become normative

Source: IEC 62040-3:2021 Edition 3.0, Foreword items c, f and g

Check which edition an offer cites, and whether it is the 2021 text.

THE MISTAKE

Sizing kVA on an assumed 0.8 PF.



At the same kW, a lower load power factor needs more kVA. Measure it, do not assume it.

COMPUTE IN KW

Compute in kW, then check both ceilings.



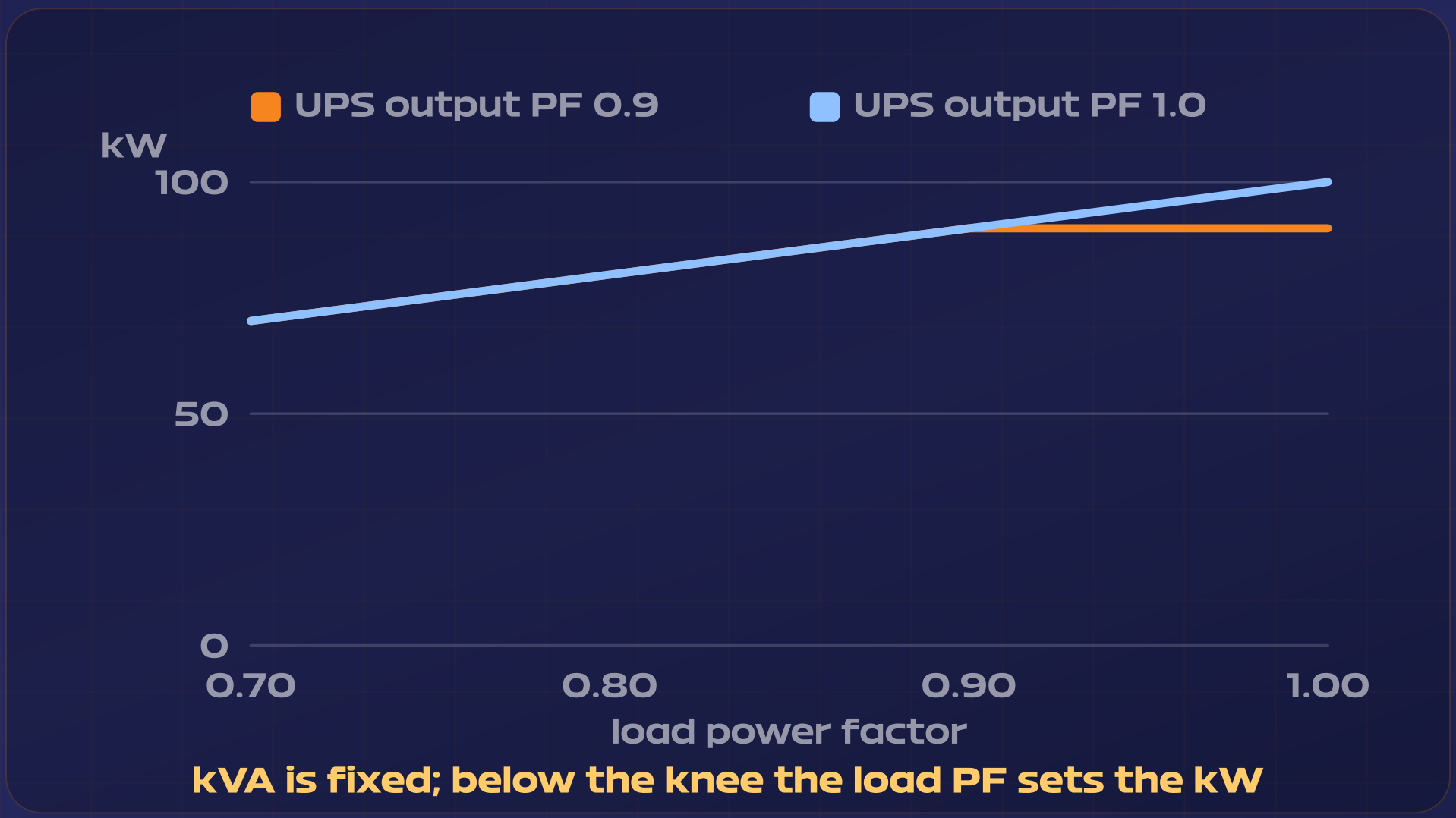
Illustrative photo: battery racks in a UPS plant room.

Sum the real power of the load, then size so the result clears both the kVA and the kW limit at the load's actual power factor.

Some IT power supplies use active power factor correction, one way to meet the harmonic limits of IEC 61000-3-2.

THE CORRECTION

Read the power factor curve too.



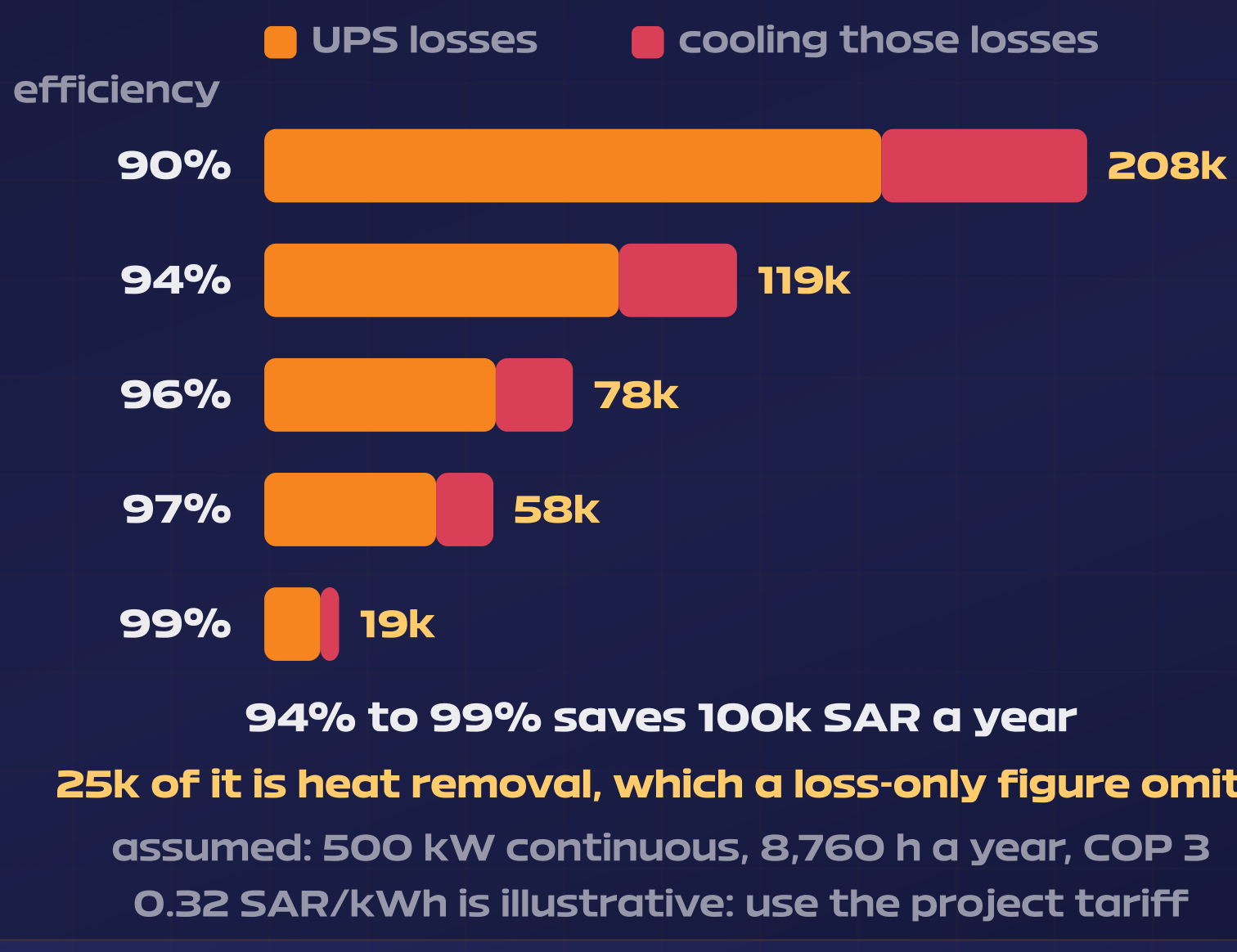
kVA is fixed; below the knee the load PF sets the kW

The kVA rating is the constant; kW is what moves.

Leading and lagging limits are model-specific, so read them from the datasheet. This chart is the arithmetic ceiling only, and assumes nothing about the curve shape.

HOT COUNTRY

In a hot country, losses are billed twice.



94% to 99% saves 100k SAR a year

25k of it is heat removal, which a loss-only figure omits

assumed: 500 kW continuous, 8,760 h a year, COP 3

0.32 SAR/kWh is illustrative: use the project tariff

Every kilowatt a UPS wastes must also be removed by the cooling plant. Assumed: 500 kW continuous output, 8,760 h a year, cooling COP 3. Calculated at 0.32 SAR/kWh: 94% to 99% saves about 100,000 SAR a year, a quarter of it heat removal. At 100 kW, about 20,000 SAR. SERA commercial tariff above 6,000 kWh a month: 32 halalas per kWh (SERA, updated 18 March 2026); used here as an illustration, use the project tariff.

BATTERY SIZING

Read the runtime from the maker's constant-power data.

15 min target → ÷ 0.80 ageing factor → 18.75 min design target

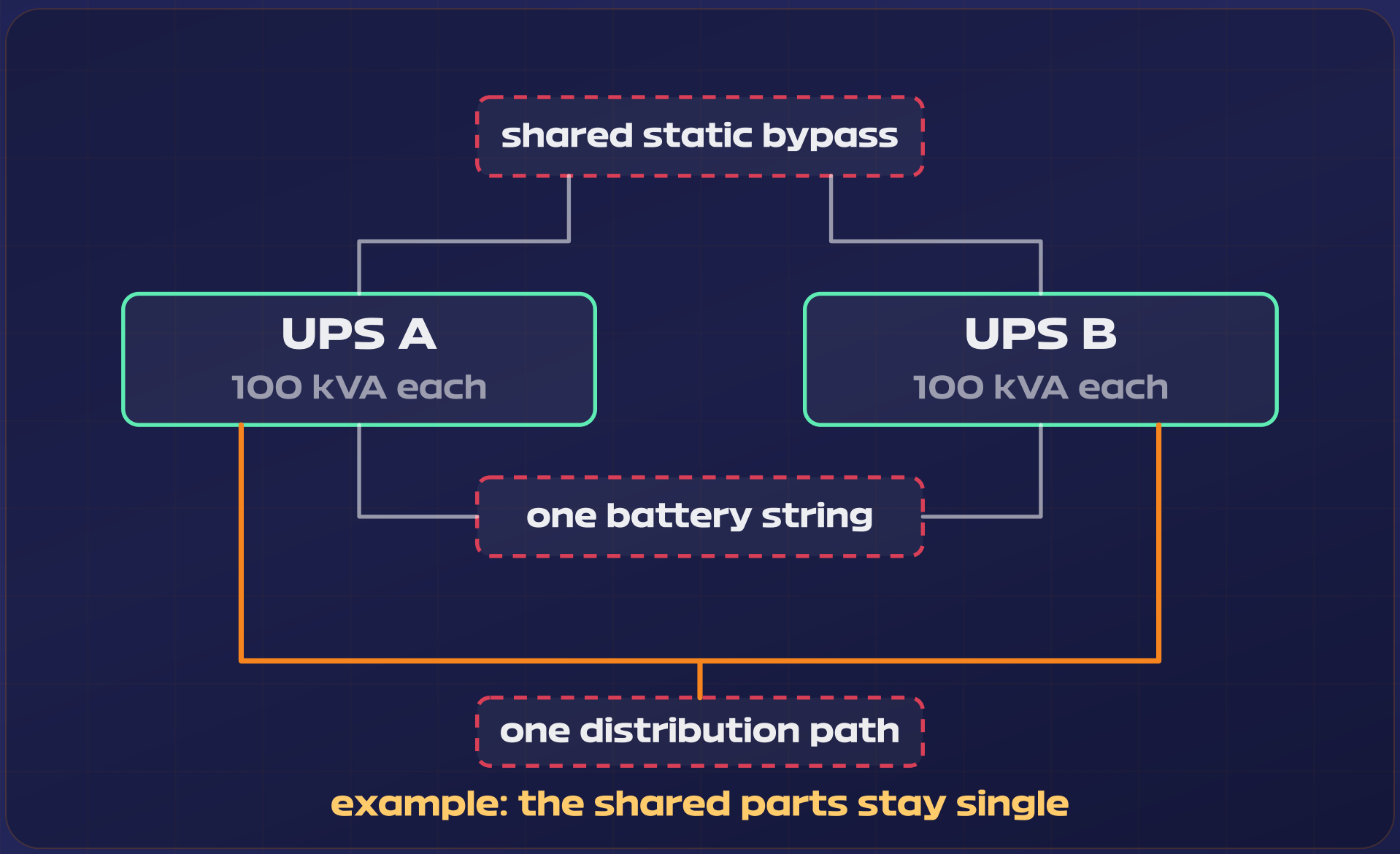
× 1.00 temperature factor, assumed (no derating)

discharge rate and end-of-discharge voltage also move the answer

Dividing by 0.80 is a simplified educational calculation of the margin, not a runtime equivalence. Size the battery from the maker's constant-power or watts-per-cell data at the required autonomy, temperature, discharge rate and end-of-discharge voltage.

PARALLELING

What survives N+1, and what does not.



Name which level the redundancy is at, and check what is still single downstream of it.

BEFORE YOU SIGN

Five checks before the offer is signed.

- [x] Ask for the IEC 62040-3 performance code.
- [x] Size on both ceilings: kW and kVA.
- [x] Read leading and lagging derating on the datasheet.
- [x] Ask how the bidder applies the ageing factor.
- [x] Name the redundancy level and what stays single.

Each line names a code, a rating, a curve or a battery figure the bidder must put in writing.

SOURCES

Where each figure comes from.

1. **IEC 62040-3:2021, Edition 3.0**
   clause 5.3.4 title: performance classification
2. **IEC 62040-3:2021, Foreword, items c, f and g**
   performance code shortened from 8 to 7 characters
3. **IEC 61000-3-2:2018**
   title: limits for harmonic current emissions
4. **SERA commercial tariff, updated 18 March 2026**
   above 6,000 kWh/month: 32 halalas per kWh, illustrative
5. **NLC calculation, assumptions on each slide**
   kW and kVA, losses and cooling, ageing

Locator, edition and issuing body, for each figure.

THE NLC DEFAULT

Specify the code, the output PF and the ageing factor.

62040-3
Code
the offer states the full code

0.9
Output PF
sets the kW at the rated kVA

÷ 0.80
Ageing factor
says how much battery you buy

These three settings set the usable rating and the battery you buy.

NLC default, not an external rating: the code is the IEC 62040-3 performance classification code the offer must state. The output power factor sets how many kW the UPS delivers at its rated kVA. The ageing factor sets how much battery you buy.

Electrical engineering, in practice

Save this. Send it to a colleague.

Read the full episode article

https://nlc.com.sa/academy/ups-sizing.html

Next episode
Automatic transfer switches