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HIGHER STAKES.
BETTER SOLUTIONS.



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New England Healthcare Engineers' Society



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**PRACTICAL
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DESIGNING A CENTRAL UTILITY PLANT FOR RESILIENCY AND FUTURE GROWTH ON A TIGHT BUDGET



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AGENDA + LEARNING OBJECTIVES

TODAY'S SIX SECTIONS

- 1 The Reality: Budget-Constrained Hospital Infrastructure
- 2 What FGI Actually Requires — and Why It Matters
- 3 Standard of Care: The A/E's Role
- 4 CUP Design Strategies That Preserve the Future
- 5 Industry Examples & Lessons Learned
- 6 Takeaways for Facility Managers & Owners

LEARNING OBJECTIVES

- 1 **Interpret** the intent of **FGI Section 1.2.6.5** as it applies to emergency preparedness, infrastructure performance, and resilience in hospital Central Utility Plant planning.
- 2 **Evaluate** how facility management, phasing, and value-engineering decisions affect redundancy, maintainability, operational continuity, and future expansion capacity in CUP systems.
- 3 **Evaluate** how facility management, phasing, and value-engineering decisions affect redundancy, maintainability, operational continuity, and future expansion capacity in CUP systems.

01

SECTION 1

The Reality: Budget-Constrained Hospital Infrastructure

Capital constraints vs. operational expectations — and why CUP decisions are permanent.



Capital Constraints vs. Operational Expectations

The gap between these two pressures is where standard of care lives

First-Cost Pressures

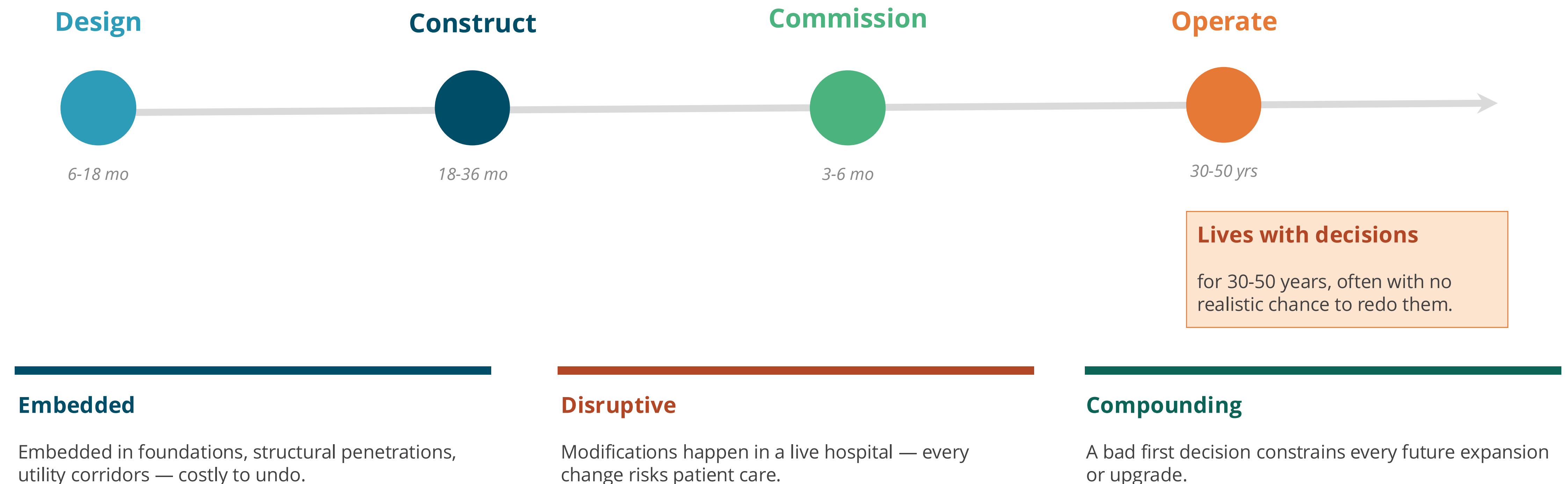
- Construction escalation outpacing reimbursement
- Shrinking margins in non-profit health systems
- CUP often seen as a cost — not as risk-mitigation
- VE pressure once budget exceeds early estimates
- Owners measured on cap-ex, not 30-yr operating risk

Operational Expectations

- 24/7/365 service — no acceptable shutdown
- Code-mandated redundancy (FGI/ASHE/JCAHO)
- Climate-driven utility & weather risk
- Expanding bed counts, services, and load growth
- Community-disaster role: shelter of last resort

Why CUP Decisions Are Difficult — and Permanent

Design decisions made in months become operational realities for decades.



The Facility Manager's Long View

“

The architects and engineers walk away after substantial completion. We live with the plant for 40 years. Every shortcut, every deleted valve, every 'we'll add that later' — eventually shows up on a night shift.

— Healthcare Facility Manager

What FMs Carry Forward

Reactive Maintenance

Living with workarounds the design never anticipated.

Limited Shutdown Windows

Every repair becomes a clinical-impact conversation.

Compounded Risk

Deferred redundancy accumulates as expansion arrives.

Institutional Memory

FM knows where the failures **will** happen — bring them in early.

02

SECTION 2

What FGI Actually Requires — and Why It Matters

*Decoding FGI §1.2.6.5: emergency
preparedness, infrastructure
performance, and resilience.*



FGI §1.2.6.5 Emergency Preparedness

FGI Says (paraphrased):

“The planning and design of a healthcare facility shall consider emergency preparedness — including assessment of utility loss scenarios, infrastructure performance under stress, system adaptability, and the facility's ability to recover and continue operations.”

Plain-English Translation:

Resiliency is not optional thinking — it's a required part of the design conversation.

Four Things FGI §1.2.6.5 Asks You to Assess

-  **Utility Loss**
What happens when normal power, water, steam, fuel, or chilled water is interrupted?
-  **Performance**
Does infrastructure perform under heat, cold, storm, flood, seismic, or grid events?
-  **Adaptability**
Can systems scale, isolate, and reconfigure for changing patient acuity & census?
-  **Recovery**
How quickly and safely can normal operations be restored after an event?

Emergency Preparedness ≠ Emergency Power

Most teams conflate the two. FGI §1.2.6.5 is a much broader requirement.

Emergency POWER (NFPA/EES)

What it is
A code-driven electrical system (generators, ATSS, branch wiring) that maintains life-safety and critical loads when normal power fails.

Triggered by
Loss of utility electrical service.

Scope
Electrical only. Does not address chilled water, steam, fuel, water, or system-wide recovery.

Emergency PREPAREDNESS (FGI)

What it is
A planning posture: think through how the entire facility responds to a range of disruptions and design accordingly.

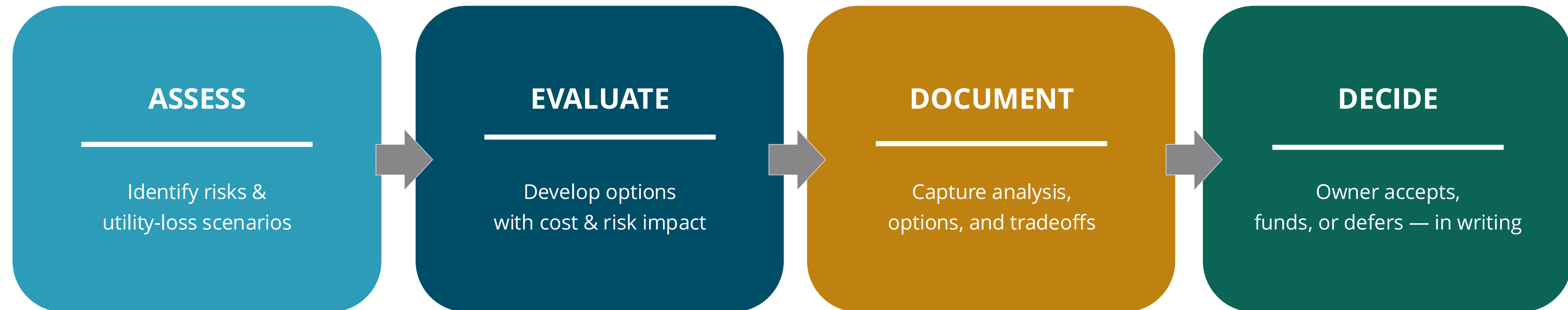
Triggered by
Any loss: utility, weather, seismic, fire, water main, fuel.

Scope
All systems — power, HVAC, plumbing, IT, structure — plus adaptability and recovery time.

Meeting NFPA does not mean you've met FGI §1.2.6.5.

What “Shall Be Considered” Means in Practice

Considered does NOT mean optional. It means evaluated, documented, and presented to the owner for an informed decision.



Three valid outcomes — all require documentation:

Fund Now

Owner approves the resiliency scope at full cost.

Defer with Hooks

Owner defers, but design accommodates a future add.

Accept the Risk

Owner declines — A/E documents the acknowledged risk.

Anatomy of an FGI Assessment Matrix

When an A/E satisfies §1.2.6.5, this is what the deliverable typically looks like.

What goes in the matrix

Building Area / Dept.	Day-1 Normal	Loss of 1 Gen	Loss of 2 Gen
ICU / Critical Care	Full	Partial	Vent Only
OR Suites	Full	Partial	Vent Only
Imaging (MRI/CT)	Full	Off (Shed)	Off
Med-Surg / Inpatient	Full	Min Vent	Min Vent
Sterile Processing	Full	Off	Off

(Illustrative — each row tied to a department and an FGI category.)

Four ingredients the matrix MUST contain

- 1 Scenario columns**
Day-1 normal, loss-of-1, loss-of-2, total utility loss — at minimum.
- 2 Department / area rows**
Every clinical, support, and CUP zone — so nothing is missed.
- 3 Performance call**
For each cell: Full, Partial, Vent-only, or Off (with consequence).
- 4 Owner's signature line**
Owner accepts each scenario in writing — closes the §1.2.6.5 loop.

Owner decisions belong to the Owner — the matrix gives them the information they need to choose.

03

SECTION 3

Standard of Care: The A/E's Role

*Why "not in the budget" never equals
"not our responsibility."*



The A/E's Obligation to Advise

"Not in the budget" is not the same as "Not our responsibility."

What the Standard of Care Actually Requires of the A/E



Advise on Resiliency

Identify utility-loss, redundancy, and adaptability needs — whether or not the owner has funded them.



Document Tradeoffs

Capture VE alternatives, what's preserved, what's foreclosed, and the long-term operational implications.



Disclose Risk

When the owner defers, the A/E states the deferred risk in writing — protecting both the owner and the team.

An undocumented deferral is the A/E's liability. A documented deferral is the owner's informed choice.

Documenting Risks During Value Engineering

A defensible VE log captures more than dollars — it captures consequences.

Building Area / Dept.	First-Cost Savings	Future Cost / Risk	Long-Term Implication
Delete N+1 Chiller	\$1.20 M	\$4-6 M to retrofit	Loss of cooling during a failure event.
Single utility feed	\$0.60 M	Plant outage risk	Single point of failure for entire facility.
No future-equipment pad	\$0.05 M	\$0.8 M to add later	Permanent loss of expansion footprint.
Single normal-pump skid	\$0.25 M	\$1.5 M + shutdown	Maintenance requires plant-wide outage.
Delete piping isolation	\$0.10 M	Drain-down disruption	Any future change becomes a full-system shutdown.

Best practice: include a “Future Cost / Operational Risk” column in every VE log — and require owner sign-off.

04

SECTION 4

CUP Design Strategies That Preserve the Future

*Designing for later without overbuilding
today*



Designing for Later — Without Overbuilding Today

Four allowance strategies that cost very little now and preserve major future options.



Space & Structural Allowances

Reserve footprint for the future chiller, boiler, or generator. Provide structural pad, slab capacity, and clearances.

Cost: Pennies.

Value: Full equipment slot saved.



Valves & Piping Strategy

Add isolation valves, taps, and capped stubs while pipes are open. Right-size headers for known expansion loads.

Cost: Thousands.

Value: Avoids plant-wide shutdowns later.



Equipment Redundancy vs. Expandability

If full N+1 is unfunded, design for a future N+1 — not a permanent N. Stub for the next unit, keep the slot.

Cost: Low.

Value: Redundancy can be added without rebuild.



Controls & Operational Flexibility

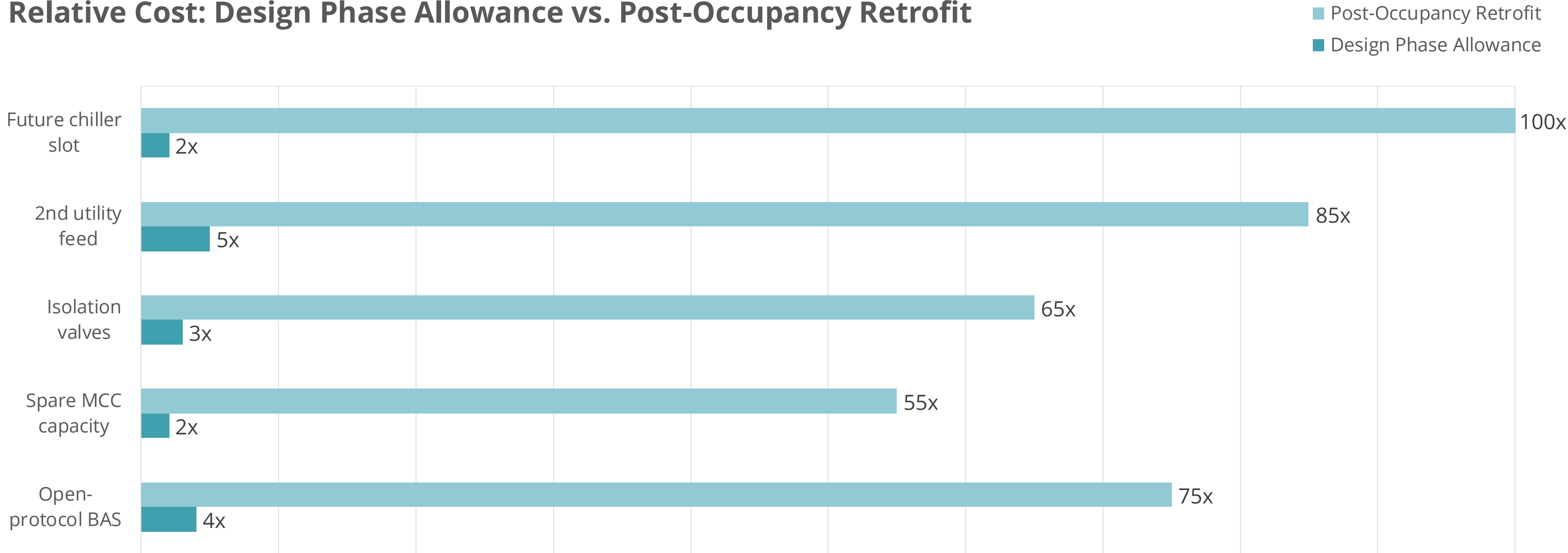
Specify open-protocol controls, spare I/O, and headroom in MCCs. Plan operating modes for partial-failure scenarios.

Cost: Minimal.

Value: Enables every future upgrade.

What Costs Pennies Now — and Millions Later

Relative Cost: Design Phase Allowance vs. Post-Occupancy Retrofit



Rule of thumb: every \$1 spent in design preserves \$20-\$100 of avoided retrofit cost & disruption.

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SECTION 5

Industry Examples & Lessons Learned

Two anonymized examples — generator sizing and water treatment — plus the patterns behind them.



Example 1: A Generator Sizing Tradeoff

GOOD A/E PRACTICE

Acute-care hospital — CUP design, late-stage VE on emergency power

Owner asked: “Can we save money by going from three generators to two?” The A/E built a scenario matrix.

	Option 1 Original Design	Option 2 Reduced Quantity	Option 3 Reduced Qty + Larger
Configuration	3 x 1.5 MW	2 x 1.5 MW	2 x 2.0 MW
First-cost savings	Baseline (\$0)	≈ \$0.84 M	≈ \$0.09 M
Service size	5,000 A	5,000 A	5,000 A
Day-1 chiller plant	100%	50%	100%
Loss -of-1: chiller	50%	0%	30%
Future expansion	+1 generator OK	+2 generators OK	Plant/gear rebuild required

The matrix doesn't pick the answer — it makes every tradeoff visible to the Owner.

What “Reduced Capacity” Actually Means

Translating a generator VE into the clinical and FGI consequences the Owner is accepting.

SCENARIO · Loss of 1 of 2 generators

Chilled-water plant

Will not start. Locked out by the emergency power system.

HVAC system

Enters ‘critical mode’ — only minimum code-required ventilation.

Relative humidity

Cannot be maintained per FGI in humid weather; rises in < 30 minutes.

Imaging equipment

Not allowed to operate on emergency power.

Owner's decision

Which areas accept loss of cooling? FGI does not let the A/E decide.

SCENARIO · Both generators running

Chilled-water plant

Automatically capped at 50% by the BAS (one chiller group only).

Temperature & RH

BAS raises setpoints to keep load <50 % — may fall outside FGI ranges.

Imaging equipment

Operates initially — ATS is lower priority than the chiller plant.

Priority cascade

If gensets approach overload, imaging is shed BEFORE cooling.

Operational reality

“50% capacity” reads simple on paper, complex on a humid afternoon.

“Reduced capacity” is a budget term. Translate it into FGI terms before the Owner decides.

Example 2: Water Treatment & Sterile Processing

DOCUMENTED DEFFERAL

Domestic water filtration / RO system was VE'd out of a hospital project

What the site water testing showed

Parameter	Site Reading	Vs. Spec
Hardness (CaCO ₃)	1-40 ppm	LOW
Alkalinity	15-20 ppm	LOW
pH	6.5-8.5	HIGH
Copper (Cu)	0.19 ppm	HIGH
Iron (Fe)	< 0.3 ppm	HIGH
Chlorides	Out of range	OUT
Total silicate	Out of range	OUT

Spec source: SPD equipment manufacturer's utility-water criteria.

Risks documented to the Owner

Hardness

Deposits in washer/disinfector; reduces detergent effectiveness; damages instruments.

Conductivity / metals

Heavy-metal ions stain and corrode devices; pitting on stainless surfaces.

pH out of range

Disinfectant ineffectiveness; device pitting, corrosion, discoloration.

Chlorides

Pitting and corrosion of devices and sterilizer; increases breakage and replacement cost.

A/E's job: document the gap. Owner's job: decide what to do about it.

Anatomy of a Deferral Acknowledgment Letter

When the Owner accepts the risk, the A/E's next deliverable is a closeout letter.

Closeout Letter (Excerpt)

Re: Water Treatment / Filtration — VE Decision

We wanted to document the decision to remove the water filtration system so we can close out this discussion for the design team.

It is our understanding that the Owner has clear knowledge of the previously discussed risks associated with the removal of the water treatment system, and that the Owner accepted these risks after reviewing the water quality testing reports and the manufacturer's utility-water criteria.

Based on the above, we have been directed to update the Construction Documents to reflect removal of the domestic water filtration system serving the facility.

Please confirm that the statements above align with your direction.

Why these four moves matter

- 1 State what is being removed**
Specific scope — no ambiguity about what was VE'd out.
- 2 State that the Owner knows the risks**
Confirms the §1.2.6.5 conversation actually occurred.
- 3 Reproduce the risks in writing**
If something goes wrong later, the record is unambiguous.
- 4 Ask the Owner to confirm**
Converts a meeting into a paper trail. Standard of care: complete.

A signed acknowledgment letter is the cheapest insurance an A/E can write.

When VE Becomes Permanent

A composite of patterns seen across multiple healthcare CUP projects.

RECOVERABLE	ACCOMMODATED	PERMANENT
<i>VE that removes capacity but preserves the path back</i> - Deleted equipment — pad, structure, and MCC slot retained. - Deleted utility tap — conduit / pipe stub run to the property line. - Single-pump skid — header and isolation valves still installed.	<i>VE that defers, with documentation and design hooks</i> - Water treatment deferred — risks documented; Owner acknowledges in writing. - Open-protocol BAS retained even if features are deferred. - Generator quantity reduced — load-shed plan published per FGI matrix.	<i>VE that removes the path back — no graceful recovery</i> - Equipment yard footprint reallocated to parking or other use. - Common chilled-water header deleted; direct-to-loads piping. - Proprietary BAS locks future upgrades to a single vendor.

The category is decided in design – not at occupancy. Get it right while the drawings are open.

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SECTION 6

Takeaways for Facility Managers & Owners

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Five Questions FMs Should Ask During Design

01

What did we cut from this design — and what does that prevent us from doing later?

Force the VE log onto the table. Make the foreclosed options visible.

02

Where are the single points of failure that won't be obvious at commissioning?

Identify them now, before they become a 2 AM phone call.

03

If we wanted to add redundancy in 10 years, what would we have to demolish?

If the answer is 'a lot,' we have a design problem — not a budget problem.

04

Has FGI §1.2.6.5 actually been considered — and where is that documented?

Ask to see the assessment, the options, and the owner's recorded decision.

05

Who advised the owner about the long-term risk of each VE decision?

Standard of care requires this advice — confirm it happened and was acknowledged.

Questions

