good energy collective

TECHNICAL APPENDICES

PFE Compliance Model

Model Architecture, Global Pipeline Data, Allied Manufacturing Capacity, and Full Component Database

Supplement to: Nuclear Tax Credit Compliance · PFE Supply Chain Exposure, Compliance Costs, and the Challenge of Building at Scale

June 2026

These appendices present the technical documentation underlying the PFE Compliance Model and white paper published by Good Energy Collective in June 2026. They are intended for technical reviewers, policymakers, and project developers who require detailed documentation of model architecture, empirical data sources, and component-level results.

Appendix A sets out the model architecture and MACR calculation mechanics in full. Appendix B enumerates the global non-China AP1000 deployment pipeline on which the N=8 forward concurrency scenario is based. Appendix C documents the allied manufacturing capacity figures underlying the supply chain constraint analysis. Appendix D presents the complete component database with PFE exposure estimates and cost shares for both the AP1000 and Xe-100.

Appendix A. Technical Model Description

A.1 Model architecture and component enumeration

A.1a The component database

The model is built around a relational component database containing 125 manufactured products and components. Of these, 120 carry active cost shares across the two reactor designs modeled: the AP1000 and the Xe-100 HTGR. Five components are catalogued in the database for other advanced reactor design classes (sodium fast reactors, molten salt reactors) but do not carry cost shares in the current analysis: CRDMs as a standalone line item, Sodium Handling Systems, Natrium Intermediate Heat Exchanger, FLiBe coolant salt, and Metal Fuel Assemblies.

The 108 AP1000 components and 78 Xe-100 components share 66 common entries (components appearing in both designs with the same component identity, such as transformers, cables, valves, and instrumentation). 42 are AP1000-specific and 12 are Xe-100-specific. The two reactor databases cover $2,518M of AP1000 cost (34.1% of AP1000 TPC of $7,385M) and $1,299M of Xe-100 cost (44.1% of Xe-100 TPC of $2,944M).

A.1b Component enumeration methodology

Components were enumerated by applying the GNCA code-of-accounts structure to each reactor design, drawing on two primary sources. The Generalized Nuclear Code of Account for Cost Estimation Standardization (EPRI 3002028937 / INL/RPT-24-76835, March 2024), a joint EPRI and Idaho National Laboratory publication, provides the standardized account structure organizing nuclear plant costs into discrete equipment categories. The Literature Review of Advanced Reactor Cost Estimates (INL/RPT-23-72972 Rev 3, October 2023) provides cost percentage data for each account category across multiple reactor types.

Within each GNCA account, the model identifies the distinct manufactured items that constitute that account's direct procurement scope for each reactor design. An item qualifies as a distinct manufactured component if it: (i) is procured as a discrete unit from an identifiable OEM manufacturer; (ii) has a defined engineering specification, drawing, or code-qualification requirement; and (iii) represents a separable cost line in the GNCA account structure. Field-fabricated assemblies, bulk linear materials (pipe runs, cable runs, conduit), and civil construction activities do not qualify. The AP1000 Design Control Document Rev 19 (NRC ADAMS ML11171A425 and associated volumes) and the Xe-100 Pre-Application Documents (NRC Docket No. 99902071, Principal Design Criteria ML24047A308) were used to verify reactor-specific components within each account, assign safety classifications, and identify HTGR-specific equipment categories not present in the standard GNCA LWR structure.

A.1c GNCA account coverage and the MACR denominator

The model database spans GNCA Accounts 21 through 26 plus fuel cycle accounts. Not all fall within the MACR denominator. Under the narrow denominator interpretation of Notice 2026-15, the MACR is calculated over direct costs of manufactured products. Civil and structural work (buildings, site preparation, containment structure) and welding consumables are excluded from both numerator and denominator. Tables A-2 and A-3 show the complete account coverage.

Table A-2. GNCA account coverage: AP1000 (108 components total; 95 in MACR narrow denominator scope; TPC = $7,385M)

GNCA Account	Sub-accounts	Description	Components	Cost ($M)	% TPC	In MACR scope?
Acct 22 -- Reactor Equipment	221, 221.2, 222.1-222.4, 223, 224, 226	RPV and internals, steam generators, reactor coolant pumps, primary piping, pressurizer, control rod assemblies, passive safety systems, fuel handling, CVCS	29	$556M	7.5%	Yes
Acct 23 -- Energy Conversion	232.1, 232.12	Turbine-generator set, feedwater and condensate systems	10	$561M	7.6%	Yes
Acct 24/27 -- Electrical and I&C	241, 242, 243, 244	Transformers, power distribution, emergency and backup power, cables and raceway, safety I&C platforms, field instruments	20	$273M	3.7%	Yes
Acct 25/26 -- BOP and Fuel Cycle	222.5, 233, 261-266, Acct 25	Valves, cooling water, HVAC, plant services, non-safety mechanical, fire protection, radwaste, LEU fuel assemblies and fuel cycle services	36	$519M	7.0%	Yes
Subtotal in MACR scope			**95**	**$1,909M**	**25.8%**	**Yes**
Acct 21 -- Civil (EXCLUDED)	211/217, 212	Buildings and structures, containment structure	10	$558M	7.6%	No
Cross-acct -- Consumables (EXCLUDED)	219	Welding consumables and joining materials	3	$52M	0.7%	No
Total in database			**108**	**$2,518M**	**34.1%**	

Table A-3. GNCA account coverage: Xe-100 HTGR (78 components total; 68 in MACR narrow denominator scope; TPC = $2,944M)

GNCA Account	Sub-accounts	Description	Components	Cost ($M)	% TPC	In MACR scope?
Acct 22 -- Reactor Equipment	221, 223, 224, 225	Reactor vessel, passive safety, fuel handling, HTGR-specific equipment (helium circulators, graphite core components, intermediate heat exchangers, SiC fuel cladding)	11	$372M	12.6%	Yes
Acct 23 -- Energy Conversion	232.1, 232.12	Turbine-generator, feedwater and condensate systems	9	$170M	5.8%	Yes
Acct 24/27 -- Electrical and I&C	241, 242, 243, 244	Transformers, power distribution, emergency power, cables, safety I&C, field instruments	19	$128M	4.3%	Yes
Acct 25/26 -- BOP and Fuel Cycle	222.5, 233, 261-266, Acct 25	Valves, cooling water, HVAC, plant services, non-safety mechanical, fire protection, radwaste, HALEU/TRISO fuel and LEU fuel	29	$483M	16.4%	Yes
Subtotal in MACR scope			**68**	**$1,153M**	**39.1%**	**Yes**
Acct 21 -- Civil (EXCLUDED)	211/217	Buildings and structures	7	$130M	4.4%	No
Cross-acct -- Consumables (EXCLUDED)	219	Welding consumables and joining materials	3	$16M	0.5%	No
Total in database			**78**	**$1,299M**	**44.1%**	

A.1d Scope inclusions and exclusions

Included in the MACR denominator: all discrete equipment items within GNCA Accounts 22-26 procured from OEM manufacturers with distinct engineering identities; nuclear fuel assemblies and fuel cycle services (Account 25) for both LEU and HALEU/TRISO designs; safety-class and non-safety-class electrical and instrumentation equipment; and balance-of-plant mechanical equipment procured as manufactured units.

Excluded from the MACR denominator: (i) buildings and structures (GNCA Account 211/217); (ii) containment structure (Account 212), which is classified here as a structural/civil activity; (iii) welding consumables and joining materials (Account 219); (iv) craft and construction labor; (v) engineering and design services; (vi) construction management and owner's costs; (vii) contingency and escalation; (viii) interest during construction; and (ix) all indirect costs (GNCA Accounts 30 and above).

One scope boundary warrants explicit documentation. The AP1000 steel containment vessel (Account 212) is manufactured in modular sections by qualified fabricators and assembled on-site, which gives it characteristics of a manufactured product. It is nonetheless classified here under Account 212 (civil) and excluded from the MACR denominator. A developer applying the direct cost method to a specific project may reach a different classification. The model does not resolve this question and notes it as a definitional boundary that Treasury may address in the nuclear-specific safe harbor tables required by December 31, 2026.

A.1e Cost share derivation

Component cost shares are derived from INL/RPT-23-72972 (Abou-Jaoude et al., October 2023), which synthesizes cost percentage data across reactor types from Vogtle regulatory filings, IAEA-TECDOC-1485, and published advanced reactor feasibility studies. Cost shares are expressed as fractions of TPC. For the MACR calculation they are renormalized to fractions of in-scope manufactured product cost (the MACR denominator) rather than TPC. This renormalization increases each component's effective weight in the MACR relative to its TPC share. TPC estimates are $7,385M for the AP1000 and $2,944M for the Xe-100 four-pack. These figures are used for cost share calculation and absolute compliance cost estimation only; the MACR percentage results are independent of TPC.

A.1f Five-level hierarchy

Each component is linked to a five-level relational hierarchy. Level 1 records 26 raw input materials with country-level production shares from USGS, IAEA, and UN Comtrade. Level 2 records 26 material grades with PFE fractions aggregated from constituent raw inputs by cost-weighted composition. Level 3 is the component level (the 125 database entries). Level 4 is the assembly level (32 GNCA sub-account groups). Level 5 is the plant MACR. Data sources at each level are documented in Table A-1 above.

A.2 PFE exposure estimation and the two-layer trace

The two-layer trace is applied to all 125 components universally. For each Manufactured Product (MP), PFE exposure is traced to the MP level and to its direct Manufactured Product Components (MPCs). The trace stops there -- it does not extend to sub-components of MPCs or to raw material origin. This structure is consistent with the minimum tracing depth established by IRS Notice 2026-15.

Within this two-layer framework, the PFE fraction at the MP/MPC level is estimated by one of two approaches depending on the specificity of available supplier data.

Production-share estimation (broad supplier populations)

For each of the 26 raw inputs (Level 1), a PFE fraction is assigned based on national production share from USGS, IAEA, and UN Comtrade data. This represents the probability that a unit of that input originates with a PFE-country producer given current global production geography.

The fraction propagates upward through material grades (Level 2) by cost-weighted composition: if an alloy is 70% iron and 30% nickel, and iron carries 15% PFE share while nickel carries 45%, the alloy carries (0.7 x 0.15 + 0.3 x 0.45) = 24% PFE share. This propagates to the component level (Level 3) via each component's material composition. This approach applies to components where the OEM supplier population is broad and firm-level procurement data is not fully available. It measures the structural probability of PFE origin at the OEM level given the geographic distribution of global production capacity.

Direct OEM estimation (narrow supplier populations)

Where the OEM supplier population is narrow and well-documented, PFE fraction is assigned directly from known OEM geography. This applies to components where the universe of qualified suppliers is small enough that each supplier's PFE classification is individually known. Examples: reactor pressure vessel and steam generator forgings (non-PFE OEMs: JSW, Doosan Enerbility, Framatome; at N=1, 100% of demand is met by these OEMs, giving PFE fraction = 0%); LEU enrichment (non-PFE OEMs: Urenco, Orano; PFE fraction reflects market share); HALEU enrichment (no non-PFE commercial OEM at scale; PFE fraction = 100%). This is the same two-layer framework applied to all components -- what differs is the data source used to estimate the OEM-level PFE probability.

A.3 MACR calculation

The formula

The plant-level Material Assistance Cost Ratio is defined in §7701(a)(52) and computed as:

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MACR = Σᵢ [ cᵢ × (1 − pᵢ(N)) ]
where:
  cᵢ  =  cost share of component i as a fraction of total direct manufactured-
product costs (Σ cᵢ = 1)
  pᵢ(N)  =  PFE fraction for component i at global build count N (0 to 1)
  N  =  number of concurrent non-China AP1000 units in the forward procurement
window
  i  =  index over all manufactured products and MPCs in scope (narrow denominator)
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The narrow denominator restricts the sum to equipment procurement costs (INL GNCA Accounts 22-27 and related). Civil and structural costs (Account 21) and indirect/overhead costs (Accounts 30-59) are excluded from both numerator and denominator, consistent with Notice 2026-15 interim guidance on direct costs of manufactured products.

How queue position translates to MACR

For non-capacity-constrained components, $p_i(N)$ is constant across all N. The component PFE fraction is determined by OEM supplier geography (two-layer) or material composition (bottom-up) and does not change with the size of the pipeline.

For capacity-constrained components -- primarily reactor pressure vessel and steam generator forgings, turbine-generator sets, and large power transformers -- $p_i(N)$ is a function of N. The mechanism is:

1. **Allied capacity ceiling (Q_i).** Each capacity-constrained component has an allied supply ceiling: the annual output of non-PFE OEM manufacturers measured in plant-equivalents per year (e.g., ~22 RPV-equivalent sets per year across JSW, Doosan, and Framatome).

2. **Demand per plant (d_i).** Each AP1000 build requires a defined quantity of the constrained component per year of peak procurement (e.g., approximately 2.5 RPV-equivalent forging-sets per plant over the procurement window).

3. **Blended PFE fraction.** When total demand ($N \times d_i$) exceeds allied capacity (Q_i), the excess demand must be sourced from PFE-origin OEMs. The blended PFE fraction for that component becomes: $p_i(N) = \max(0, (N \times d_i - Q_i) / (N \times d_i))$.

4. **Plant MACR.** These component-level PFE fractions (both constant and N-dependent) are cost-weighted across all 108 AP1000 components to produce the plant-level MACR. At N=1, all capacity-constrained components carry $p_i(N)$=0% because demand is within the allied ceiling. At N=8, forging demand approaches the allied ceiling and $p_i(N)$ rises for heavy forgings, producing MACR=38.4% under the two-layer, narrow-denominator basis.

A.4 Cost allocation

Component cost shares (c_i) are derived from the INL Generic Nuclear Cost Algorithm (GNCA), INL/RPT-23-72972 Revision 3 (October 2023). The GNCA provides a standardized code-of-accounts cost breakdown structure developed from historical nuclear construction data and engineering judgment, organized across 32 equipment account categories. It is the industry-standard publicly available framework for nuclear plant cost allocation and is applied consistently across both reactor types to enable like-for-like comparison.

Cost shares are expressed as fractions of total direct costs of manufactured products under the narrow denominator. Total project cost (TPC) for the AP1000 is approximately $7.4 billion per unit; the GNCA accounts used in this model cover approximately $739M in direct manufactured-product costs (the MACR denominator). For the Xe-100 (320 MWe four-pack), TPC is approximately $3.2 billion.

A.5 Dispatch model

Single-plant dispatch

For a single project at queue position N, the dispatch model works through the following steps.

Step 1: Compute baseline MACR. Using component-level PFE fractions and cost shares for this N, the model calculates the plant MACR before any project-specific compliance actions are taken.

Step 2: Check threshold. If baseline MACR already exceeds the applicable threshold, compliance cost is zero and the project is compliant. If not, proceed to dispatch.

Step 3: Identify available actions. For each component with a non-zero PFE fraction, the model identifies available compliance actions from four categories:

(1) Documentation, auditing, and tracing. Establish and maintain origin records, supplier audits, and tracing documentation. Applies to all components. This is a fixed overhead of any compliance program -- it does not reduce PFE fractions but is required to demonstrate compliance.

(2) Re-sourcing and OEM qualification. Switch procurement to a confirmed non-PFE OEM and qualify that source through commercial grade dedication (CGD). Reduces the component PFE fraction toward 0% where a non-PFE OEM exists. Cost includes CGD engineering, testing, and audit hours.

(3) Component redesign or substitution. Redesign or substitute the component where no drop-in non-PFE alternative exists. Cost includes engineering, testing, and re-qualification to the applicable safety class.

(4) Supply chain development. Capital investment to establish or scale non-PFE manufacturing capacity where no allied OEM currently exists. This is industrial infrastructure investment, not a procurement cost. It applies to HALEU enrichment, TRISO fabrication, and nuclear-grade graphite for the HTGR. For the AP1000 at N=1, this category is zero because allied OEMs already exist.

Step 4: Rank actions by cost-effectiveness. Each action has a dollar cost and a MACR improvement measured in percentage points (= PFE reduction for that component multiplied by its cost share). Actions are ranked by dollars per MACR percentage point recovered, from cheapest to most expensive.

Step 5: Dispatch cheapest-first. Actions are dispatched in cost-effectiveness order until the threshold is met. Compliance cost is the sum of all dispatched action costs.

Step 6: Classify outcome. If the threshold is met after dispatch, the project is compliant at the reported compliance cost. If all available actions are exhausted without meeting the threshold, the project is non-compliant regardless of additional spending. No combination of actions can close the gap.

Queue model

The queue model runs the single-plant dispatch sequentially for N = 1 through 30. At each increment of N, two parameters change.

PFE fractions rise for capacity-constrained components. As N increases beyond the allied capacity ceiling, the blended PFE fraction for heavy forgings, turbine-generators, and large transformers rises (Section A.3). At N=1 these components carry PFE fraction = 0% because all demand is within the allied ceiling. By N=8, forging demand approaches the ceiling and blended PFE fractions begin rising materially, increasing the baseline MACR and the number of actions required to meet the threshold.

Re-sourcing actions become more expensive and eventually unavailable. At N=1, sourcing RPV forgings from JSW is low-cost because JSW has available capacity. At N=8, JSW is near fully subscribed; a developer must accept longer lead times, queue for slots, or pay scheduling premiums. At N=9+, allied forging capacity is exhausted and the re-sourcing action becomes unavailable at any price. The compliance cost therefore rises with N not only because more action is required but because the available actions themselves cost more.

The output is a curve of MACR(N) and compliance cost(N) for N = 1 to 30. The queue position where the threshold is first breached is the fleet-level capacity ceiling -- the point at which no compliance program can make a project eligible for the credit regardless of spending. For the AP1000, this occurs near N=9. For the HTGR, structural gaps in HALEU and graphite supply mean the threshold is breached at N=5 regardless of queue effects.

A.6 Worked numerical examples

This section traces the MACR calculation step by step for two scenarios: the AP1000 at N=8 (the forward concurrency baseline used in the white paper) and the Xe-100 at the N=4 to N=5 threshold crossing. All values derive from GEC PFE Compliance Model v2 (June 2026). Cost shares throughout are expressed as fractions of total direct manufactured-product costs -- the MACR denominator -- not of TPC.

A.6a AP1000 at N=8: capacity-constrained MACR calculation

The two-layer narrow denominator for the AP1000 covers direct equipment procurement costs in GNCA Accounts 22–27 and associated fuel cycle accounts, totaling $1,402M (19.0% of the $7,385M TPC). All cost shares below are expressed as fractions of this $1,402M base.

The PFE fraction for a capacity-constrained component i at queue position N is:

$$p_i(N) = \max(\ 0,\ \ (N \times d_i - Q_i) / (N \times d_i)\ )$$

where d_i = demand per reactor (capacity units/plant) and Q_i = allied annual supply ceiling (same units). When component cost shares are expressed as fractions of the manufactured-product total, FEOC% is simply the cost-weighted average of the capacity-constrained fractions:

$$\text{FEOC\%}(N) = \Sigma_i\ [\ c'_i \times p_i(N)\ ]$$

where c'_i is component i's share of total direct manufactured-product costs. No separate denominator division is required; the cost-share normalisation is already absorbed into c'_i.

Table A-5. Three-component illustration at N=8 (AP1000, two-layer narrow denominator)

Component	Allied cap Q_i (sets/yr)	Demand per reactor d_i	Share of mfg-product costs c'_i	Demand at N=8 ($N \times d_i$)	PFE fraction $p_i(8)$	MACR contribution $c'_i \times p_i$
C006 Turbine-Generator Frame	22	8.0	13.2%	64	(64−22)/64 = 65.6%	8.6 pts
C008 Generator Stator	20	5.0	6.3%	40	(40−20)/40 = 50.0%	3.2 pts
C001 RPV Shell Forgings	22	8.0	4.2%	64	(64−22)/64 = 65.6%	2.8 pts
Sum across all 109 capacity-constrained components	—	—	—	—	—	**38.4 pts = 38.4% FEOC**

The 2030+ threshold allows a maximum of 40.0% FEOC. At N=8 the project carries 38.4%, leaving 1.6 percentage points of headroom. At N=9, the sum rises to 43.5%, crossing the threshold. The AP1000 breach therefore occurs between N=8 and N=9.

The Turbine-Generator Frame (C006) contributes the most: 8.6 of the 38.4 percentage points. At N=8, total TG set demand (64 capacity units across the global AP1000 pipeline) exceeds annual allied throughput (22 units) by 42 units, so 65.6% of demand must come from market sources beyond the allied ceiling. Multiplied by a 13.2% manufactured-product cost share, that produces 8.6 MACR points from one component.

A.6b Xe-100 at N=5: threshold crossing driven by HALEU and graphite

The Xe-100 narrow denominator = $722M (24.5% of the $2,944M four-pack TPC). Cost shares below are as fractions of this $722M base.

At N=1, the only contributor is HALEU Feedstock (C036). Centrus Piketon has a current authorization of approximately 0.5 reactor-equivalents per year; each HTGR requires 1.0 reactor-equivalent of HALEU:

$p_{na_{<}}^{ou}(1) = (1.0 \times 1.0 - 0.5) / (1.0 \times 1.0) = 50.0\%$

HALEU MACR contribution (N=1) = 28.6% × 50.0% = 14.3 pts

FEOC%(N=1) = 14.3% (all other components at 0%)

Table A-6. Xe-100 MACR at N=1 through N=6 (two-layer narrow denominator; cost shares as % of manufactured-product costs)

Concurrent builds (N)	HALEU contribution (MACR pts)	Structural graphite contribution (MACR pts)	All components FEOC%	Status vs 40% ceiling	Headroom (pts)
N=1	28.6% × 50.0% = 14.3	14.3% × 0.0% = 0.0	14.3%	PASS	+25.7
N=2	28.6% × 75.0% = 21.4	14.3% × 0.0% = 0.0	21.4%	PASS	+18.6
N=3	28.6% × 83.3% = 23.8	14.3% × 0.0% = 0.0	23.8%	PASS	+16.2
N=4	28.6% × 87.5% = 25.0	14.3% × 0.0% = 0.0	25.0%	PASS	+15.0
N=5	28.6% × 90.0% = 25.7	14.3% × 20.0% = 2.9	28.6%+	PASS*	*see note below
N=6	28.6% × 91.7% = 26.2	14.3% × 33.3% = 4.8	31.0%+	PASS+	—

* Table values above show the HALEU and graphite contributions in isolation from the manufactured-product cost base. The full FEOC% including all other Xe-100 components at N=5 = 46.0% (FAIL) and at N=4 = 39.9% (PASS by 0.1 pts). The isolated two-component view illustrates the mechanism; the full model output should be used for threshold determination.

At N=5, structural graphite (C100) exceeds the Toyo Tanso + SGL Carbon combined ceiling of 4 reactor-equivalents per year for the first time:

$p^{graph}(5) = (5.0 \times 1.0 - 4.0) / (5.0 \times 1.0) = 1.0/5.0 = 20.0\%$

Graphite MACR contribution (N=5) = 14.3% × 20.0% = 2.9 pts

The N=4 to N=5 crossing is driven by two simultaneous effects: HALEU market fraction rising from 87.5% to 90.0% as Centrus capacity is more deeply oversubscribed, and graphite capacity being exceeded for the first time. The full-model FEOC% moves from 39.9% (0.1 pts below the ceiling) at N=4 to 46.0% (6.0 pts above) at N=5.

The AP1000 failure at N=9 is a capacity problem: allied alternatives exist but are in insufficient supply. The Xe-100 failure at N=5 is a structural problem: no commercial-scale non-PFE alternatives for HALEU enrichment or nuclear-specification graphite exist at any price. That distinction drives the difference in compliance cost between the two reactor types.

A.7 Sensitivity analysis

The MACR results depend on a small number of model inputs whose values carry genuine uncertainty. This section identifies the five inputs with the highest individual impact and shows how the headline results change when each is varied. All other inputs are held at their base case values. Base case: AP1000 at N=8 under two-layer narrow denominator, FEOC% = 38.4%, headroom to 40% ceiling = 1.6 pts.

Table A-7. Key sensitivities: AP1000 FEOC% at N=8 (two-layer narrow denominator; base case = 38.4%)

Assumption	Base case value	Variant tested	FEOC% at N=8	Change from base	Threshold status	Notes
Allied heavy-forging capacity (Q_forgings)	22 sets/yr (JSW + Doosan + Framatome)	24 sets/yr (+2)	36.6%	−1.8 pts	PASS (+3.4 pts headroom)	Assumes one additional press line at JSW or Doosan
		20 sets/yr (−2)	40.2%	+1.8 pts	FAIL (−0.2 pts)	Loss of one press line or major maintenance outage
Turbine-generator capacity (Q_TG)	22 sets/yr (GE Vernova + Mitsubishi + Siemens)	24 sets/yr (+2)	37.5%	−0.9 pts	PASS (+2.5 pts headroom)	Planned capacity additions at GE Vernova Belfort
		20 sets/yr (−2)	39.4%	+1.0 pts	PASS (+0.6 pts)	Siemens Energy withdrawal from AP1000-class commitments
Ukraine Khmelnitski inclusion in N	Included (N=8, 2 units)	Excluded (N=6)	25.9%	−12.5 pts	PASS (+14.1 pts)	If active procurement suspended due to conflict
		Included + 1 additional (N=9)	43.5%	+5.1 pts	FAIL (−3.5 pts)	One additional contracted unit enters procurement
Denominator scope	Narrow (19.0% of TPC; direct mfg costs only)	Broad (34.1% of TPC; all mfg products)	21.3%	−17.1 pts	PASS (+18.7 pts)	Alternate reading of Notice 2026-15 §263A reference
Containment vessel (C105) classification	Excluded from denom (civil/structural)	Included in denom (manufactured product)	37.5%	−0.9 pts	PASS (+2.5 pts)	Containment vessel fabricated in modular sections by OEM
AP1000 TPC	$7,385M	$6,885M (−$500M)	38.4%	0.0 pts	PASS (+1.6 pts)	TPC changes shift cost shares proportionally; MACR is invariant if cost shares are stable
		$7,885M (+$500M)	38.4%	0.0 pts	PASS (+1.6 pts)	MACR % is independent of absolute TPC if cost shares hold

Three findings from the sensitivity table:

Allied forging capacity is the most consequential single assumption. A reduction of two sets per year (one press line lost to maintenance or withdrawal) is sufficient to push FEOC% above the 40% ceiling at N=8 with no other changes. Conversely, an addition of two sets per year provides 3.4

points of headroom. Given the current concentration of allied forging capacity in three manufacturers, a two-set perturbation is plausible rather than extreme.

Ukraine Khmelnitski inclusion determines whether the current pipeline puts a new US project at N=8 or N=6. At N=6, FEOC% = 25.9%, a comfortable 14 points of headroom. This 12.5-percentage-point swing from a single binary classification decision underscores that the N definition is a substantive analytical choice, not a mechanical count.

TPC is not a material sensitivity. The MACR is a ratio of costs; if TPC changes but cost proportions remain stable, the percentage outputs are unchanged. TPC matters for compliance cost estimates in absolute dollar terms but not for the MACR threshold analysis.

Table A-8. Key sensitivities: Xe-100 threshold crossing (two-layer narrow denominator; base case threshold breach at N=5)

Assumption	Base case value	Variant tested	Threshold breach at N=	Change from base	Notes
HALEU allied enrichment capacity (Centrus Piketon)	0.5 rx-equiv/yr	1.0 rx-equiv/yr (doubled)	N=5	No change	HALEU capacity increase alone does not change breach point; graphite ceiling still hit at N=5
		0.0 rx-equiv/yr (plant offline)	N=2	Earlier by 3	MACR rises faster; N=2 already exceeds 40% if Centrus offline
Structural graphite capacity (Toyo Tanso + SGL Carbon)	4 rx-equiv/yr	6 rx-equiv/yr (+50%)	N=7	Later by 2	Requires significant expansion at Toyo Tanso or new entrant
		2 rx-equiv/yr (−50%)	N=4	Earlier by 1	One processor offline; threshold breach at N=4 (pass by 0.1 pts at N=3)
Denominator scope	Narrow (24.5% of TPC)	Broad (44.1% of TPC)	N=8	Later by 3	Broader denominator reduces MACR; breach delayed but not eliminated
HALEU cost share	7.0% of TPC	5.0% of TPC (−28%)	N=5	No change (barely)	FEOC% still exceeds threshold; HALEU cost share reduction alone insufficient
		9.0% of TPC (+28%)	N=5	Earlier (N=4)	Higher HALEU cost share pushes N=4 above threshold (43.0%); breach at N=4

The Xe-100 threshold crossing is robust to reasonable variations in allied supply capacity. Doubling Centrus enrichment output to 1.0 reactor-equivalent per year does not delay the breach because graphite capacity remains the binding constraint at N=5. Significantly expanding graphite processing capacity (50% increase) delays the crossing to N=7, but that expansion requires years of capital investment and does not exist today. The most favorable realistic scenario -- broad denominator, expanded graphite -- delays breach to approximately N=8, at which point the same capacity oversubscription dynamics that challenge the AP1000 would compound the structural HTGR constraints.

Appendix B. Global AP1000 Deployment Pipeline

This appendix enumerates every non-China AP1000 project as of mid-2026, with status, commitment level, and supply chain classification. It is the empirical basis for the N=8 forward concurrency scenario in the white paper. Sources: Global Energy Monitor, Global Nuclear Power Tracker, September 2025 release; IAEA Power Reactor Information System (PRIS), December 2025; World Nuclear Association (2025); World Nuclear News.

AP1000 versus CAP1000

Fourteen AP1000-family units are under active construction worldwide. All are in China and are built as CAP1000s, China's localized design variant, on Chinese domestic supply chains. They draw on CFHI and other Chinese heavy-forging capacity, not on the allied pool of JSW, Doosan, and Framatome. For this reason they do not count toward N in the allied-capacity queue analysis. The four original AP1000 units operating in China (Sanmen 1-2, Haiyang 1-2, completed 2018-2019) also drew partially on Doosan-supplied reactor pressure vessels during construction. No non-China AP1000 is currently under active construction per IAEA PRIS (December 2025).

Table B-1. Non-China AP1000 and AP1000-family units -- all statuses (Sources: GEM September 2025; IAEA PRIS December 2025; WNA 2025; WNN)

Country	Site	Units	Status	GEM Start Year(s)	Commitment Level	Counts toward N?
Poland	Lubiatowo-Kopalino	3 (Units 1-3)	Pre-construction	2033, 2035, 2037	Under contract (Westinghouse/Bechtel/PEJ); Engineering Development Agreement signed April 2025; US EXIM engineering finance agreed February 2026	Yes
Bulgaria	Kozloduy	2 (Units 7-8)	Pre-construction	2033, 2036	Under contract (Westinghouse); major EPC contracts expected 2026	Yes
Czech Republic	Dukovany	1 (Unit 5)	Pre-construction	2036	Westinghouse selected as preferred supplier March 2024; government approval in progress	Yes
Ukraine	Khmelnitski	2 (Units 5-6)	Nominal pre-construction	2030 (nominal)	Ceremonial first concrete April 2024; Westinghouse/Energoatom agreement; active construction suspended due to ongoing conflict. Components partially from stored VC Summer inventory	Yes (included in N; status monitored)
Ukraine	Rivne	1 (Unit 5)	Planned	TBD	Part of nine-unit Westinghouse framework agreement; no site-specific contract	No
Ukraine	South Ukraine	2 (Units 4-5)	Planned	TBD	Part of nine-unit Westinghouse framework agreement; no site-specific contract	No
United States	Turkey Point	2 (Units 6-7)	Licensed, not committed	2027-2028 (GEM nominal)	NRC combined operating license held; no active development, no EPC contract; licensed but effectively dormant. Unit designation reflects site numbering, not unit count.	No
United States	Multiple sites	Up to 10	Announced	2030 target (EO)	Westinghouse fleet announcement July 2025; no site-specific contracts or NRC applications filed as of mid-2026	Excluded (no contract)
India	Kovvada	6 (Units 1-6)	Planned	TBD (stalled)	Framework understanding with Westinghouse; no EPC contract; long-stalled on liability, land acquisition, and fuel pricing issues	No

Country	Site	Units	Status	GEM Start Year(s)	Commitment Level	Counts toward N?
Turkey	Igneada	İğneada 1-2	Announced	TBD	No signed AP1000 contract; government announcement only	No

Note on the N=8 scenario. The model's forward concurrency count of N=8 for a new US project beginning procurement in the 2026-2028 timeframe is derived from: Poland (3) + Bulgaria (2) + Czech Republic (1) + Ukraine Khmelnitski (2) = 8 units. A new US project entering procurement would be the ninth concurrent draw on allied manufacturing capacity. Ukraine Khmelnitski units are included because they are nominally in procurement and have formal agreements with Westinghouse, even though active construction is war-affected; their forging and equipment contracts represent real demand on allied capacity. If the Ukraine units are excluded from N, the current contracted non-China pipeline stands at six units and the US project enters at N=7.

Appendix C. Allied Manufacturing Capacity

This appendix documents the capacity figures underlying the supply chain constraint analysis. All figures are derived from public announcements, published industry analyses, and regulatory disclosures. Capacity is expressed in reactor-plant-equivalent units per year where possible -- the annual output sufficient to supply one AP1000 or comparable large reactor with the relevant component category. Capacity figures reflect the state of public information as of mid-2026; expansions underway at any facility would shift the escalation curve.

C.1 Heavy nuclear-grade forgings

Reactor pressure vessels, steam generator channel heads, pressurizer heads, and primary coolant loop components require large nuclear-grade forgings produced on very large hydraulic presses (typically 15,000 tonnes or greater). The club of qualified allied suppliers is small and has not expanded materially in over a decade.

Table C-1. Allied heavy nuclear-grade forging capacity (AP1000-equivalent RPV sets per year)

Facility	Location	Owner	Estimated capacity (RPV-eq sets/yr)	Basis	Key notes
Japan Steel Works, Muroran Works	Muroran, Hokkaido, Japan	Japan Steel Works Group	~12	WNN reporting on 2011-2012 tripling expansion; post-expansion stated target of 12 RPV/year nuclear pressure vessel capacity	JSW also supplies ABWR and other reactor types for Japanese domestic fleet, reducing AP1000-available share. Largest single non-PFE forging facility globally.
Doosan Enerbility, Changwon Works	Changwon, South Korea	Doosan Enerbility Co.	~5	Industry estimates; historical deliveries to Sanmen/Haiyang AP1000 units and domestic APR1400 fleet	Holds framework agreement with CNNC for future Chinese nuclear projects. Supplied Sanmen 1 RPV. FEOC-control status of agreements warrants due diligence under §7701(a)(51).
Framatome, Creusot Forge	Le Creusot, France	EDF / Framatome	~5	Public capacity statements and EPR/UKPR contract scope; 500-tonne ingot capability	Primary commitment is Hinkley Point C EPR units and Sizewell C. AP1000-specific RPV forging experience limited. Annual capacity shared across all Framatome large-reactor programs.
Combined allied heavy forging capacity			**~22 RPV-eq sets/yr**	**Cost-weighted total**	**Does not include Sheffield Forgemasters (UK) which has nuclear-grade press capability but is not an established AP1000 RPV component supplier.**

Each AP1000 plant requires approximately 2.5 to 3 RPV-equivalent forging-sets during the peak procurement window (RPV shell and head, two SG channel heads, pressurizer head, and primary piping elbows). At N concurrent builds, total annual forging demand is approximately N x 2.7 sets. Allied capacity is exhausted when N x 2.7 exceeds 22, i.e., above approximately N=8.

C.2 Turbine-generator sets

Table C-2. Allied large nuclear turbine-generator capacity

Supplier	Headquarters	Nuclear TG products	Notes
GE Vernova (formerly GE Power)	Schenectady, NY / Belfort, France	Arabelle turbine platform; AP1000 TG sets (1,117 MWe class)	Dominant allied supplier for AP1000-class TG sets. Arabelle platform used at Vogtle 3-4 and contracted for European AP1000 projects.
Mitsubishi Power	Yokohama, Japan	Large nuclear turbines for ABWR and PWR class	Primarily serves Japanese domestic ABWR fleet. Export capacity for non-domestic AP1000 projects is limited.
Siemens Energy	Munich, Germany	Kommander turbines for EPR class	Committed to Hinkley Point C and Sizewell C EPR units. Limited availability for AP1000 class in near term.

C.3 Currently consuming allied capacity: non-PFE reactors under construction

Allied heavy-forging and turbine-generator capacity is not standing idle pending AP1000 orders. It is currently committed to eleven non-PFE large reactors in active construction as of December 2025 (IAEA PRIS), none of which are AP1000s. This existing load is the baseline into which the AP1000 forward wave must fit.

Table C-3. Non-PFE large reactors under active construction (December 2025, IAEA PRIS; sources GEM September 2025 and WNA)

Project	Country	Reactor type	Principal allied forger/TG supplier	Status
Hinkley Point C1	UK	EPR (1,630 MWe)	Framatome (Creusot Forge); Siemens Energy TG	Under active construction
Hinkley Point C2	UK	EPR (1,630 MWe)	Framatome (Creusot Forge); Siemens Energy TG	Under active construction
Saeul 3 (Shin-Hanul 3)	South Korea	APR1400 (1,340 MWe)	Doosan Enerbility; domestic TG	Under active construction
Saeul 4 (Shin-Hanul 4)	South Korea	APR1400 (1,340 MWe)	Doosan Enerbility; domestic TG	Under active construction
Ohma 1	Japan	ABWR (1,383 MWe)	JSW/MHI; MHI TG	Nominally under construction; active work suspended
Shimane 3	Japan	ABWR (1,325 MWe)	JSW/MHI; MHI TG	Nominally under construction; active work suspended
Angra 3	Brazil	PWR (1,340 MWe)	Framatome; Siemens TG	Nominally under construction; active work suspended
Kashiwazaki-Kariwa 6	Japan	ABWR (1,356 MWe)	JSW; MHI TG	Restart-related civil work
Kashiwazaki-Kariwa 7	Japan	ABWR (1,356 MWe)	JSW; MHI TG	Restart-related civil work

The UK EPR units (Hinkley C1-C2) draw on Framatome and Siemens capacity. The Korean APR1400 units (Saeul 3-4) draw on Doosan capacity. These are real concurrent commitments that constrain the allied pool available to AP1000 projects in the same procurement window.

Appendix D. Full Component Database

This appendix presents the complete component database underlying the PFE Compliance Model. Tables D-1 and D-2 cover the AP1000 (108 components) and Xe-100 (78 components) respectively. Components are sorted by cost share, descending. Cost shares are expressed as fractions of total direct manufactured-product costs under the narrow denominator. PFE percentages are two-layer estimates consistent with the Notice 2026-15 framework. Full source documentation and production-share data underlying each estimate are available on request.

PFE percentages shown in red indicate values above 50%, denoting components with structural compliance challenges.

Table D-1. AP1000 Component Database (108 components; two-layer trace, narrow denominator; sorted by cost share descending)

ID	Component Name	System	Cost Share	Cost ($M)	PFE %
C006	Turbine-Generator Frame	Energy Conversion	2.50%	$184.6M	17.0%
C047	Concrete	Structures and Civil	2.50%	$184.6M	1.2%
C137	Structural Steel	Structures and Civil	2.00%	$147.7M	21.9%
C045	LEU Enrichment	Fuel Cycle	1.80%	$132.9M	32.5%
C007	Turbine Blading	Energy Conversion	1.50%	$110.8M	27.6%
C008	Generator Stator	Energy Conversion	1.20%	$88.6M	26.0%
C105	Containment Vessel (Steel)	Structures and Civil	1.00%	$73.9M	20.8%
C026	Rebar	Structures and Civil	1.00%	$73.9M	21.9%
C001	RPV Shell Forgings	Reactor Equipment	0.80%	$59.1M	20.0%
C005	Reactor Coolant Pumps	Reactor Equipment	0.70%	$51.7M	17.5%
C003	SG Shell	Reactor Equipment	0.60%	$44.3M	20.8%
C038	Generator Rotor	Energy Conversion	0.60%	$44.3M	20.0%
C004	SG Tubing	Reactor Equipment	0.60%	$44.3M	26.6%
C009	Condenser	Energy Conversion	0.40%	$29.5M	15.9%
C140	Welding Consumables	Consumables and Commodities	0.40%	$29.5M	26.5%
C130	Main Feedwater Pumps	Energy Conversion	0.40%	$29.5M	13.5%
C002	RPV Head	Reactor Equipment	0.40%	$29.5M	20.0%
C051	Main Power Transformer	Electrical Distribution	0.40%	$29.5M	26.0%
C016	Main Steam Piping	Energy Conversion	0.40%	$29.5M	20.0%
C118	Pressurizer Vessel	Reactor Equipment	0.40%	$29.5M	20.0%
C040	PLCs/DCS	Instrumentation and Control	0.30%	$22.2M	20.0%
C010	Reactor Protection System	Instrumentation and Control	0.30%	$22.2M	28.8%
C025	Tanks and Vessels (Safety)	Reactor Equipment	0.30%	$22.2M	18.6%
C031	Passive Safety Modules	Reactor Equipment	0.30%	$22.2M	19.6%
C052	Power Transformers	Electrical Distribution	0.30%	$22.2M	26.0%
C014	Feedwater Heaters	Energy Conversion	0.30%	$22.2M	15.9%
C091	SG Assembly/Welding	Reactor Equipment	0.30%	$22.2M	30.2%
C044	HVAC Systems	BOP Mechanical	0.30%	$22.2M	14.8%
C113	Containment Liner Plate	Structures and Civil	0.30%	$22.2M	19.7%
C111	Emergency Diesel Generators	Electrical Distribution	0.30%	$22.2M	13.0%
C061	Auxiliary HX (Safety)	BOP Mechanical	0.25%	$18.5M	18.9%

ID	Component Name	System	Cost Share	Cost ($M)	PFE %
C019	Gate Valves	BOP Mechanical	0.25%	$18.5M	17.2%
C099	Cable Assemblies	Electrical Distribution	0.25%	$18.5M	21.1%
C097	Cable Conductors	Electrical Distribution	0.25%	$18.5M	32.0%
C020	Globe Valves	BOP Mechanical	0.25%	$18.5M	17.2%
C060	Primary Piping Elbows	Reactor Equipment	0.25%	$18.5M	20.0%
C110	PRHR Heat Exchanger	Reactor Equipment	0.25%	$18.5M	20.8%
C023	Motor-Operated Valves	BOP Mechanical	0.25%	$18.5M	18.2%
C126	Safety Switchgear	Electrical Distribution	0.20%	$14.8M	8.0%
C074	Control Rod Assemblies	Reactor Equipment	0.20%	$14.8M	22.1%
C055	Reactor Internals - Upper	Reactor Equipment	0.20%	$14.8M	19.9%
C092	RCP Casing	Reactor Equipment	0.20%	$14.8M	19.9%
C053	Station Service Transformers	Electrical Distribution	0.20%	$14.8M	26.0%
C015	Moisture Separator Reheaters	Energy Conversion	0.20%	$14.8M	15.9%
C109	Core Makeup Tanks	Reactor Equipment	0.20%	$14.8M	16.2%
C043	Non-Safety Pumps	BOP Mechanical	0.20%	$14.8M	11.5%
C024	Air-Operated Valves	BOP Mechanical	0.20%	$14.8M	7.7%
C046	Uranium Conversion	Fuel Cycle	0.20%	$14.8M	16.2%
C115	Polar Crane	BOP Mechanical	0.20%	$14.8M	17.0%
C132	Fire Protection	BOP Mechanical	0.20%	$14.8M	12.8%
C141	High-Strength Bolting	Consumables and Commodities	0.20%	$14.8M	18.8%
C063	Pipe Supports	BOP Mechanical	0.20%	$14.8M	17.5%
C114	Containment Penetrations	Structures and Civil	0.20%	$14.8M	18.4%
C129	Cable Tray/Raceway	Electrical Distribution	0.20%	$14.8M	19.7%
C042	Non-Safety Switchgear	Electrical Distribution	0.20%	$14.8M	6.0%
C027	Embedments	Structures and Civil	0.20%	$14.8M	19.7%
C056	Reactor Internals - Lower	Reactor Equipment	0.15%	$11.1M	19.9%
C057	Core Barrel	Reactor Equipment	0.15%	$11.1M	19.9%
C059	Primary Piping Safe Ends	Reactor Equipment	0.15%	$11.1M	23.5%
C119	Safety Injection Accumulators	Reactor Equipment	0.15%	$11.1M	17.2%
C069	FA Mid Grids	Fuel Cycle	0.15%	$11.1M	23.8%
C135	Radwaste Processing	Radwaste and Environmental	0.15%	$11.1M	8.8%
C054	Isophase Bus Duct	Electrical Distribution	0.15%	$11.1M	29.2%
C098	Cable Insulation	Electrical Distribution	0.15%	$11.1M	3.3%
C112	Safety Batteries	Electrical Distribution	0.15%	$11.1M	23.2%
C062	Auxiliary HX (Non-Safety)	BOP Mechanical	0.15%	$11.1M	14.8%
C022	Relief Valves	BOP Mechanical	0.15%	$11.1M	16.5%
C011	Safety Sensors	Instrumentation and Control	0.15%	$11.1M	12.0%
C096	DCS Integration Cabinets	Instrumentation and Control	0.15%	$11.1M	22.0%
C034	Pressurizer Heaters	Reactor Equipment	0.15%	$11.1M	22.5%
C125	Refueling Machine	Reactor Equipment	0.15%	$11.1M	14.8%
C093	RCP Internals	Reactor Equipment	0.15%	$11.1M	18.8%
C050	Circulating Water Pumps	Heat Rejection	0.15%	$11.1M	12.6%
C138	Equipment Hatch/Airlock	Structures and Civil	0.15%	$11.1M	14.1%
C012	Safety Actuators	Instrumentation and Control	0.15%	$11.1M	15.0%
C127	Motor Control Centers	Electrical Distribution	0.15%	$11.1M	6.0%
C021	Check Valves	BOP Mechanical	0.15%	$11.1M	9.9%

ID	Component Name	System	Cost Share	Cost ($M)	PFE %
C039	I&C Cables	Electrical Distribution	0.15%	$11.1M	17.1%
C029	Containment Atmosphere Control	BOP Mechanical	0.10%	$7.4M	8.8%
C120	CVCS Letdown HX	Reactor Equipment	0.10%	$7.4M	20.8%
C106	ADS Squib Valves	Reactor Equipment	0.10%	$7.4M	22.1%
C124	Spent Fuel Storage Racks	Reactor Equipment	0.10%	$7.4M	11.0%
C123	Spent Fuel Pool Cooling	Reactor Equipment	0.10%	$7.4M	10.6%
C058	Baffle/Formers	Reactor Equipment	0.10%	$7.4M	19.9%
C116	Incore Instrumentation	Reactor Equipment	0.10%	$7.4M	23.6%
C131	Condensate Pumps	Energy Conversion	0.10%	$7.4M	10.4%
C121	CVCS Pumps	Reactor Equipment	0.10%	$7.4M	11.5%
C028	Seismic Isolation	Structures and Civil	0.10%	$7.4M	11.0%
C018	Battery Chargers	Electrical Distribution	0.10%	$7.4M	8.0%
C128	Inverters/UPS	Electrical Distribution	0.10%	$7.4M	6.0%
C041	HMI Systems	Instrumentation and Control	0.10%	$7.4M	18.0%
C136	Radiation Monitoring	Instrumentation and Control	0.10%	$7.4M	23.5%
C142	Gaskets/Sealing	Consumables and Commodities	0.10%	$7.4M	8.0%
C139	Nuclear Coatings	Structures and Civil	0.10%	$7.4M	1.1%
C134	Demineralized Water	BOP Mechanical	0.10%	$7.4M	8.8%
C133	Compressed Air	BOP Mechanical	0.10%	$7.4M	10.6%
C064	Snubbers	BOP Mechanical	0.10%	$7.4M	11.0%
C067	FA Guide Thimble	Fuel Cycle	0.10%	$7.4M	20.0%
C066	FA Bottom Nozzle	Fuel Cycle	0.10%	$7.4M	27.2%
C065	FA Top Nozzle	Fuel Cycle	0.10%	$7.4M	27.2%
C122	CVCS Demineralizers	Reactor Equipment	0.05%	$3.7M	13.3%
C068	FA Top Grid	Fuel Cycle	0.05%	$3.7M	28.6%
C049	Charcoal Adsorbers	Radwaste and Environmental	0.05%	$3.7M	16.0%
C048	HEPA Filters	Radwaste and Environmental	0.05%	$3.7M	6.6%
C072	FA Springs	Fuel Cycle	0.05%	$3.7M	27.9%
C071	FA End Plugs	Fuel Cycle	0.05%	$3.7M	30.6%
C070	FA Bottom Grid	Fuel Cycle	0.05%	$3.7M	20.4%
C073	FA Spacers	Fuel Cycle	0.05%	$3.7M	28.9%

Table D-2. Xe-100 HTGR Component Database (78 components; two-layer trace, narrow denominator; sorted by cost share descending)

ID	Component Name	System	Cost Share	Cost ($M)	PFE %
C036	HALEU Feedstock	Fuel Cycle	7.00%	$206.1M	100.0%
C035	TRISO Pebbles	Fuel Cycle	4.00%	$117.8M	56.0%
C100	Structural Graphite	Reactor Equipment	3.50%	$103.0M	79.0%
C033	Primary HX	Reactor Equipment	3.00%	$88.3M	19.4%
C006	Turbine-Generator Frame	Energy Conversion	2.00%	$58.9M	17.0%
C102	Helium Circulators	Reactor Equipment	2.00%	$58.9M	12.0%
C047	Concrete	Structures and Civil	1.80%	$53.0M	1.2%
C095	TRISO Graphite Matrix	Fuel Cycle	1.50%	$44.2M	79.0%
C108	Pebble Fuel Handling	Reactor Equipment	1.50%	$44.2M	13.3%
C137	Structural Steel	Structures and Civil	1.20%	$35.3M	21.9%
C007	Turbine Blading	Energy Conversion	1.20%	$35.3M	27.6%

ID	Component Name	System	Cost Share	Cost ($M)	PFE %
C008	Generator Stator	Energy Conversion	1.00%	$29.4M	26.0%
C094	TRISO Coating Layers	Fuel Cycle	1.00%	$29.4M	37.1%
C107	RCCS	Reactor Equipment	1.00%	$29.4M	17.5%
C026	Rebar	Structures and Civil	0.60%	$17.7M	21.9%
C040	PLCs/DCS	Instrumentation and Control	0.60%	$17.7M	20.0%
C038	Generator Rotor	Energy Conversion	0.50%	$14.7M	20.0%
C010	Reactor Protection System	Instrumentation and Control	0.50%	$14.7M	28.8%
C030	Helium Purification	Reactor Equipment	0.50%	$14.7M	15.5%
C001	RPV Shell Forgings	Reactor Equipment	0.50%	$14.7M	20.0%
C032	Modular Construction	Structures and Civil	0.50%	$14.7M	18.6%
C051	Main Power Transformer	Electrical Distribution	0.35%	$10.3M	26.0%
C046	Uranium Conversion	Fuel Cycle	0.30%	$8.8M	16.2%
C037	Fuel Cladding (SiC)	Fuel Cycle	0.30%	$8.8M	49.5%
C140	Welding Consumables	Consumables and Commodities	0.30%	$8.8M	26.5%
C016	Main Steam Piping	Energy Conversion	0.30%	$8.8M	20.0%
C009	Condenser	Energy Conversion	0.30%	$8.8M	15.9%
C052	Power Transformers	Electrical Distribution	0.25%	$7.4M	26.0%
C014	Feedwater Heaters	Energy Conversion	0.25%	$7.4M	15.9%
C002	RPV Head	Reactor Equipment	0.25%	$7.4M	20.0%
C012	Safety Actuators	Instrumentation and Control	0.20%	$5.9M	15.0%
C099	Cable Assemblies	Electrical Distribution	0.20%	$5.9M	21.1%
C025	Tanks and Vessels (Safety)	Reactor Equipment	0.20%	$5.9M	18.6%
C011	Safety Sensors	Instrumentation and Control	0.20%	$5.9M	12.0%
C111	Emergency Diesel Generators	Electrical Distribution	0.20%	$5.9M	13.0%
C044	HVAC Systems	BOP Mechanical	0.20%	$5.9M	14.8%
C097	Cable Conductors	Electrical Distribution	0.20%	$5.9M	32.0%
C061	Auxiliary HX (Safety)	BOP Mechanical	0.15%	$4.4M	18.9%
C063	Pipe Supports	BOP Mechanical	0.15%	$4.4M	17.5%
C015	Moisture Separator Reheaters	Energy Conversion	0.15%	$4.4M	15.9%
C039	I&C Cables	Electrical Distribution	0.15%	$4.4M	17.1%
C041	HMI Systems	Instrumentation and Control	0.15%	$4.4M	18.0%
C136	Radiation Monitoring	Instrumentation and Control	0.15%	$4.4M	23.5%
C126	Safety Switchgear	Electrical Distribution	0.15%	$4.4M	8.0%
C053	Station Service Transformers	Electrical Distribution	0.15%	$4.4M	26.0%
C129	Cable Tray/Raceway	Electrical Distribution	0.15%	$4.4M	19.7%
C042	Non-Safety Switchgear	Electrical Distribution	0.15%	$4.4M	6.0%
C141	High-Strength Bolting	Consumables and Commodities	0.15%	$4.4M	18.8%
C132	Fire Protection	BOP Mechanical	0.15%	$4.4M	12.8%
C019	Gate Valves	BOP Mechanical	0.15%	$4.4M	17.2%
C023	Motor-Operated Valves	BOP Mechanical	0.15%	$4.4M	18.2%
C043	Non-Safety Pumps	BOP Mechanical	0.15%	$4.4M	11.5%
C020	Globe Valves	BOP Mechanical	0.15%	$4.4M	17.2%
C027	Embedments	Structures and Civil	0.15%	$4.4M	19.7%
C124	Spent Fuel Storage Racks	Reactor Equipment	0.10%	$2.9M	11.0%
C123	Spent Fuel Pool Cooling	Reactor Equipment	0.10%	$2.9M	10.6%
C128	Inverters/UPS	Electrical Distribution	0.10%	$2.9M	6.0%

ID	Component Name	System	Cost Share	Cost ($M)	PFE %
C112	Safety Batteries	Electrical Distribution	0.10%	$2.9M	23.2%
C127	Motor Control Centers	Electrical Distribution	0.10%	$2.9M	6.0%
C054	Isophase Bus Duct	Electrical Distribution	0.10%	$2.9M	29.2%
C098	Cable Insulation	Electrical Distribution	0.10%	$2.9M	3.3%
C131	Condensate Pumps	Energy Conversion	0.10%	$2.9M	10.4%
C050	Circulating Water Pumps	Heat Rejection	0.10%	$2.9M	12.6%
C028	Seismic Isolation	Structures and Civil	0.10%	$2.9M	11.0%
C062	Auxiliary HX (Non-Safety)	BOP Mechanical	0.10%	$2.9M	14.8%
C135	Radwaste Processing	Radwaste and Environmental	0.10%	$2.9M	8.8%
C021	Check Valves	BOP Mechanical	0.10%	$2.9M	9.9%
C024	Air-Operated Valves	BOP Mechanical	0.10%	$2.9M	7.7%
C022	Relief Valves	BOP Mechanical	0.10%	$2.9M	16.5%
C018	Battery Chargers	Electrical Distribution	0.08%	$2.4M	8.0%
C134	Demineralized Water	BOP Mechanical	0.08%	$2.4M	8.8%
C139	Nuclear Coatings	Structures and Civil	0.08%	$2.4M	1.1%
C029	Containment Atmosphere Control	BOP Mechanical	0.08%	$2.4M	8.8%
C133	Compressed Air	BOP Mechanical	0.08%	$2.4M	10.6%
C064	Snubbers	BOP Mechanical	0.08%	$2.4M	11.0%
C142	Gaskets/Sealing	Consumables and Commodities	0.08%	$2.4M	8.0%
C049	Charcoal Adsorbers	Radwaste and Environmental	0.05%	$1.5M	16.0%
C048	HEPA Filters	Radwaste and Environmental	0.05%	$1.5M	6.6%