

Construction Phase (1/5): Civil Engineering & Heavy Infrastructure

Materials, zones & commodity exposure

Reference case: EPR – Flamanville | Order of magnitude

Objective

Map **where raw materials are consumed** during civil works in order to identify **commodity exposure** and hedging potential.

1 Civil engineering zones (where materials concentrate)

A. Reactor & containment buildings

- Reactor building
- Containment structure
- Safety-related concrete structures

Material intensity

- Very high concrete volumes
- Extremely dense reinforcement steel

B. Cooling & water-related structures

- Cooling system foundations
- Pump buildings
- Water intake & discharge structures

Material intensity

- Massive concrete
- Significant earthworks
- Diesel-intensive construction phase

C. Auxiliary & safety buildings

- Control rooms

- Electrical & safety-related buildings
- Workshops and warehouses

Material intensity

- Structural concrete
- Structural steel frames
- Moderate reinforcement steel

D. Site infrastructure & access

- Internal roads
- Platforms & laydown areas
- Drainage and waterproofing systems

Material intensity

- Aggregates
- Bitumen / asphalt
- Diesel (logistics & earthworks)

2 Key raw materials involved (commodity view)

Concrete-related

- Ready-mix concrete (*non-traded*)
- Cement (energy-intensive production)
- Aggregates (sand, gravel, crushed stone)

Metals

- Reinforcement steel (rebar)
- Structural steel (frames, embeds, supports)

Energy

- Diesel (earthworks, cranes, generators)
- Electricity (temporary site power)

3 Indicative commodity exposure & € counter-value

Input (hedgeable / proxy)	Quantity (indicative)	How the number is built	Indicative unit price	Commodity exposure (€)
Concrete poured (<i>non-traded</i> → <i>proxy via cement & energy</i>)	~400,000 m ³	Reported Flamanville site figure	—	—
Cement embedded in concrete	~120,000 t	400,000 m ³ × 0.30 t cement/m ³ (nuclear-grade)	~€150/t	~€18m
Aggregates (sand, gravel, crushed stone)	~720,000 t	400,000 m ³ × 1.8 t aggregates/m ³ (typical)	~€15/t	~€11m
Reinforcement steel (rebar)	~50,000 t	Reported site figure	~€600/t	~€30m
Structural steel (frames, embeds, supports)	~10,000 – 20,000 t	Add-on vs rebar for heavy industrial civil works	~€700/t	~€7 – 14m
Diesel – construction equipment & generators	~15 – 25m liters	Earthworks, lifting, on-site generation (multi-year)	~€1.62/L	~€24 – 41m
Bitumen / asphalt (roads, platforms, waterproofing)	~10 – 20 kt	Internal roads, platforms, site access	~€500/t	~€5 – 10m

✓ Total civil works commodity exposure (illustrative): ~€95m – €125m

4 Commodity exposure logic (key message)

Civil engineering is an early-stage, CAPEX-heavy package where non-traded inputs (concrete) translate into hedgeable exposures via cement, steel and energy.

5 Methodological note (bottom of slide – very important)




- Segmentation is **functional**, not contractual
- Each material is allocated to its **dominant civil package**
- Figures are **order-of-magnitude estimates** for hedging analysis

🎯 Pourquoi cette slide est très solide

- Tu montres **où** (zones)
- Tu montres **quoi** (matières détaillées)
- Tu montres **combien** (€ exposure)
- Tu relies directement au **hedging commodities**

👉 C'est **exactement** le niveau attendu pour une présentation **Solutions Sales** crédible.

Si tu veux, on peut faire la **même version “deep”** pour :

-  Electrical infrastructure
-  Piping & fluid systems
-  Conventional island

Tu choisis la suivante.

pour les autres aprtie mnt

Parfait — on fait **exactement le même travail “deep + € + zones”** pour **toutes les autres parties**, **format PowerPoint prêt à coller**, **sans sur-ingénierie**, et **orienté hedging**.

Je te les donne **une par une**, dans l'ordre logique après le génie civil.

Construction Phase (2/5): Electrical Infrastructure

Embedded metals, zones & commodity exposure

EPR – Flamanville reference | Order of magnitude

Zones électriques

A. Internal LV / MV distribution

- Bâtiments réacteur & auxiliaires
- Réseaux de sûreté, redondances

B. Instrumentation & Control (I&C)

- Capteurs, automatismes, safety systems

C. HV connection & switchyard

- Poste électrique, connexion réseau

Matières premières clés

- **Cuivre** (conducteurs LV/MV, I&C)
- **Aluminium** (HV, longues distances)
- **Acier** (chemins de câbles, supports)
- **Polymères** (isolation – non cœur hedging)

3 Exposition matière & contre-valeur €

Embedded metal	Quantity (indicative)	Build-up	Price	€ exposure
Copper	~15–20 kt	1,500–2,000 km × 8–10 t/km	€8,500/t	€130–170m
Aluminium	~8–12 kt	HV conductors	€2,300/t	€18–28m
Steel (supports)	~8–12 kt	trays & ladders	€700/t	€6–8m

Total electrical embedded metal exposure: ~€155–205m

Finished cables are non-traded; exposure refers to embedded metals.

Construction Phase (3/5): Piping & Fluid Systems

Stainless steel, nickel & alloys exposure

1 Zones

A. Primary & secondary circuits

B. Steam & condensate lines

C. Safety & auxiliary cooling

2 Matières clés

- **Acier carbone** (auxiliaires)
- **Acier inoxydable** (circuits critiques)
- **Nickel** (alliage clé de l'inox)

3 Exposition matière & €

Material	Quantity	Build-up	Price	€ exposure
Carbon steel	25–35 kt	~55–60% piping	€700/t	€18–25m
Stainless steel	15–20 kt	safety & primary	€3,000/t	€45–60m
Nickel (embedded)	1.2–2.0 kt	8–10% inox	€17,000/t	€20–34m

Total piping exposure: ~€85–120m

Nickel is the main volatility driver → proxy hedge via LME Ni.

Construction Phase (4/5): Conventional Island

Turbines (Arabelle-type), alternators & mechanics

Zones

- A. Steam turbines
- B. Alternators / generators
- C. Condensers & heat exchangers

Matières clés

- Aciers forgés & alliés
- Cuivre (bobinages alternateur)
- Alliages Ni/Cr (hautes contraintes)

Exposition matière & €

Material	Quantit y	Build-up	Price	€ exposure
Steel (forged & plates)	45–60 kt	turbines + mechanics	€700/t	€32–42m
Copper	3–5 kt	alternator windings	€8,500/t	€26–43m
Alloy steels / Ni alloys	2–4 kt	high-temp parts	€4,000/t	€8–16m

Total conventional island exposure: ~€70–105m

Construction Phase (5/5): Nuclear Island

Strategic materials & fuel exposure

Zones

- A. Reactor internals
- B. Fuel assemblies (initial core)
- C. Control & safety components

2 Matières clés

- **Uranium** (fuel cycle)
- **Zirconium alloys** (cladding)
- **Nuclear-grade steels**

3 Exposition économique (moins hedgeable)

Material	Quantity	Price	€ exposure
Uranium (U₃O₈ eq.)	450–550 t	€70/kg	€30–40m
Zirconium alloys	400–600 t	€40,000/t	€16–24m
Nuclear-grade steel	15–20 kt	€3,000/t	€45–60m

Strategic exposure – limited standard hedging instruments.

OPEX Phase: Maintenance & Fuel

Recurring annual exposure

Commodity	Annual qty	Price	€/year
Steel & alloys	3–5 kt	€1,200/t	€4–6m
Copper	300–500 t	€8,500/t	€2.5–4m
Nickel	80–120 t	€17,000/t	€1.5–2m
Uranium	20–25 t	€70/kg	€1.4–1.8m
Diesel	3–5m L	€1.6/L	€5–8m

Total OPEX commodity exposure: ~€15–25m / year