# Cost Estimates, Schedule, Resources, and Risks

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Informal Cold Box Review

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DUNE

# Dual CRU Cold Box Price Estimate

Cost estimates based on materials and labor to fabricate elements of the system. LN plumbing not included.
Points of comparison;
Dec. 2022 Quote to reproduce BNL cold box SS Pan: $13,850 without freight

> "160"L x 74"W x 16"H stainless steel tank made from 11ga 304 stainless steel with 2x2x1/4" angle flange per drawing DUNE-CETT-AUGI" plus additional lid segments.

| | Est. Materials | Est. Fabrication | Est. Welding | Est. Total | Total + 25%* |
|---|---|---|---|---|---|
| 304SS Pan | $13,000 | $1,500 | $8,000 | $22,500 | $28,125 |
| Steel Base | $5,000 | $2,000 | $2,000 | $9,000 | $11,250 |
| Mobile Lid | $8,000 | $7,500 | $500 | $16,000 | $20,000 |
| CRP Support | $4,500 | $2,000 | $1,000 | $7,500 | $9,375 |
| Cable Tray | $1,500 | - | - | $1,500 | $1,875 |
| Lift Mechanism | $12,000 | $1,500 | $1,500 | $15,000 | $18,750 |
| Insulation | $1,500 | $500 | - | $2,000 | $2,500 |
| Slow Control | $14,000 | - | - | $14,000 | $17,500 |
| **Totals** | $59,500 | $15,000 | $13,000 | $87,500 | $109,375 |

*Contingency, Profit margin, etc.

# Cryogenics and Nitrogen Price Estimate

| Item | Unit Cost ($) | UOM | Qty | Total Cost ($) | Note |
|---|---|---|---|---|---|
| LN2 Bulk Storage Tank (monthly rental) | 1,405.00 | month | 60 | 84,300.00 | 5-year contract from previous quote |
| LN2 Deliveries | 0.21 | liter | 126900 | 26,650.00 | Total per test site |
| *LN2 sub-total* | | | | *110,950.00* | |
| Ambient Vaporizer | 3,600.00 | each | 1 | 3,600.00 | Price from recent BNL project (8500 SCFH) |
| Relief Valves | 150.00 | each | 3 | 450.00 | REGO 19434 PRV or similar |
| Solenoid Valve | 200.00 | each | 1 | 200.00 | McMaster 3/4" solenoid |
| Inline Heater | 1,000.00 | each | 1 | 1,000.00 | based on McMaster 1/2" NPT 2.5kW |
| Flowmeter | 1,000.00 | each | 1 | 1,000.00 | IFM inline thermal flowmeter |
| Warm valves | 150.00 | each | 1 | 150.00 | ~Average for globe valves 1/2"-1" NPT, McMaster-Carr |
| Vacuum-jacketed valves | 3,700.00 | each | 1 | 3,700.00 | Quote from PHPK 3/4" x 2" VJ globe valve |
| Vacuum-jacketed piping | 400.00 | ft | 75 | 30,000.00 | Budgetary estimate from Technifab – length TBD |
| Small warm piping (<=1") for purge line | 20.00 | ft | 75 | 1,500.00 | 3/4" 304 SST sch 40 |
| Large warm pipig (~2-3") for vent line | 60.00 | ft | 50 | 3,000.00 | 2-1/2" 304 SST sch 40 |
| Small pipe fittings | 20.00 | each | 10 | 200.00 | elbows, tees, etc. |
| Large pipe fittings | 100.00 | each | 3 | 300.00 | elbows |
| Kapton heaters, 500 W | 300.00 | each | 5 | 1,500.00 | DwyerOmega |
| Misc. pipe supports & fittings | 300.00 | group | 6 | 1,800.00 | pipe clamps, strut, etc. |
| *Parts sub-total* | | | | *48,400.00* | |
| **Total (per test site)** | | | | **159,350.00** | |

# Total Cost

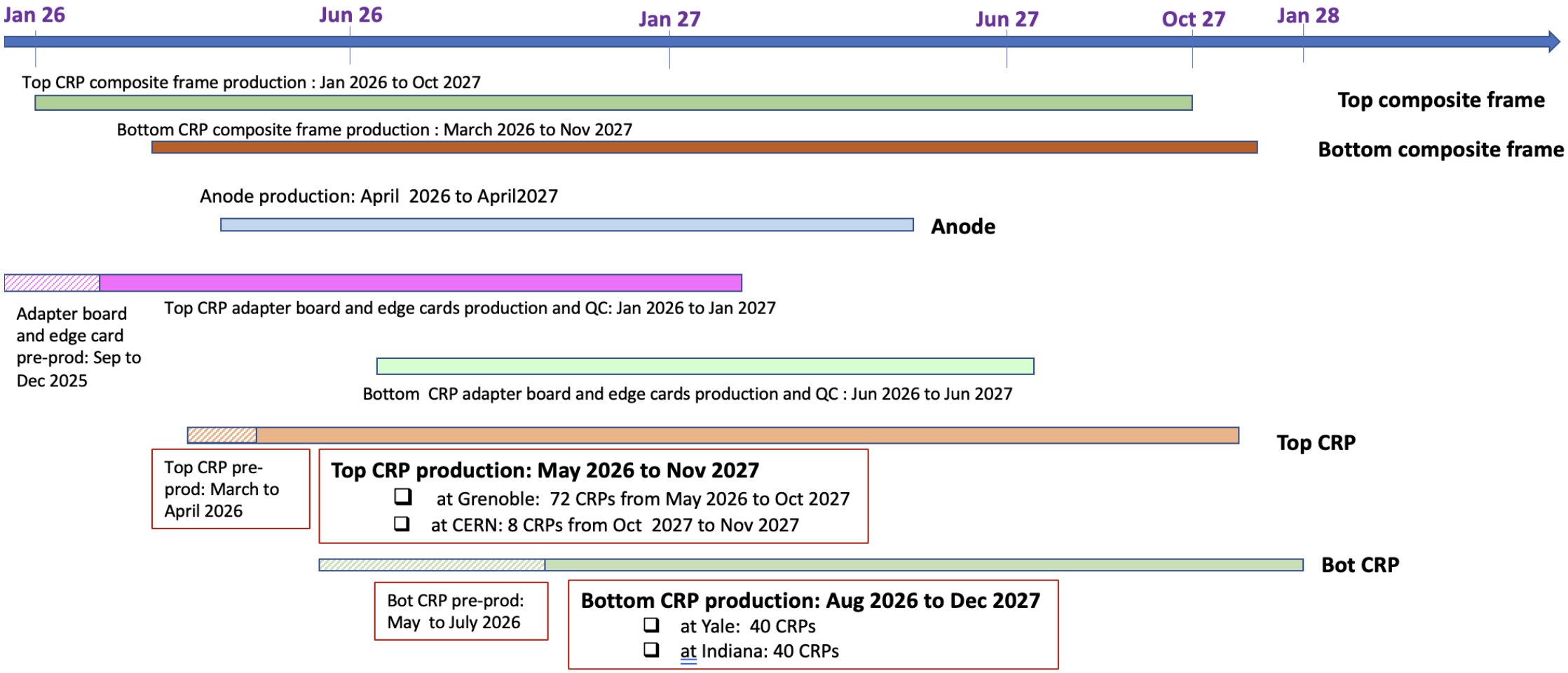
| | Current Estimate (cold gas) | Previous Estimate (liquid) | Cost reduction |
|---|---|---|---|
| Cold Box | $109,000 | $121,000 | $12,000 |
| Cryogenics + Nitrogen | $159,000 | $288,000 | $129,000 |
| Total per site | $269,000 | $409,000 | $140,000 |
| Total for both sites | $537,000 | $818,000 | $281,000 |

- Cost reduction compared to what was presented in May
- We believe that this is the cheapest available option that allows testing of all CRPs
- Note that labor costs for any additional value engineering are on same order of magnitude as cost reductions.

# Schedule Overview

## Timeline

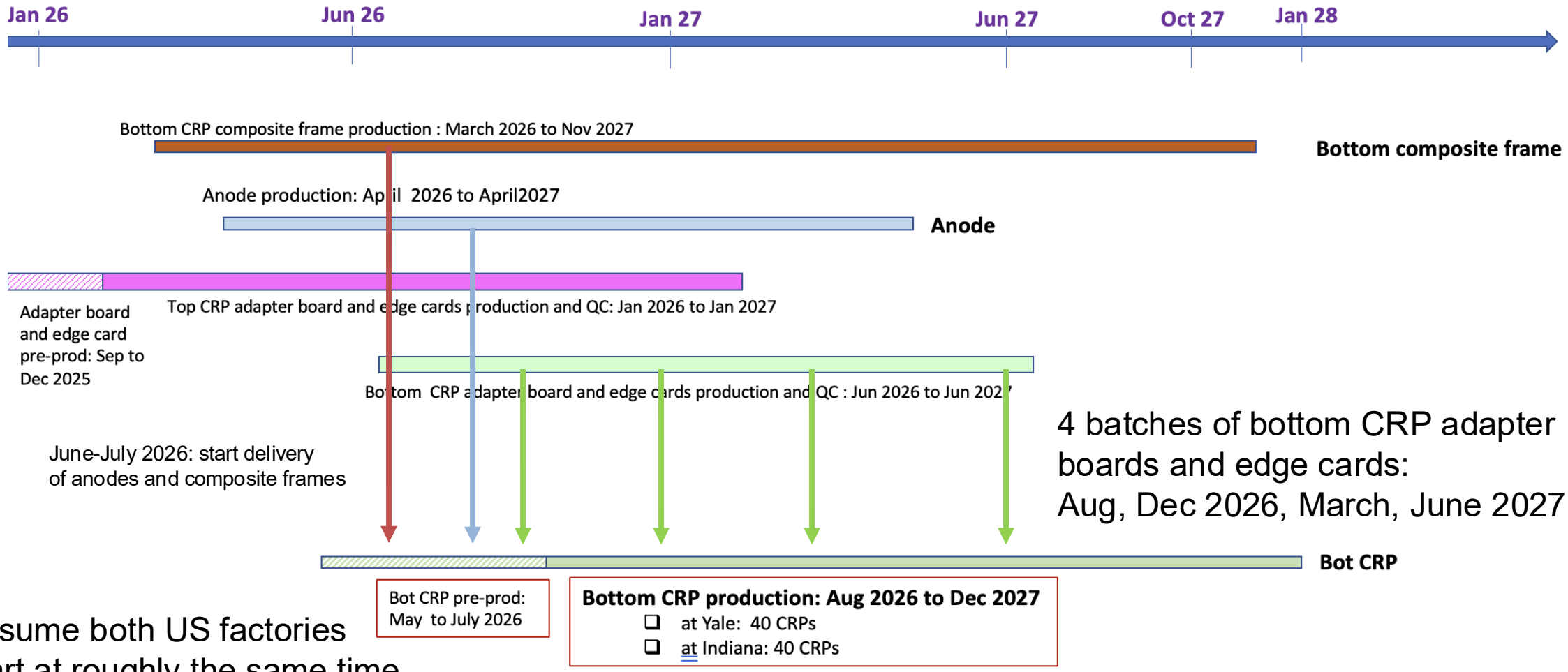
Sept 29th, 2025



# Schedule US CRP Factories

## Timeline

Sept 29th, 2025

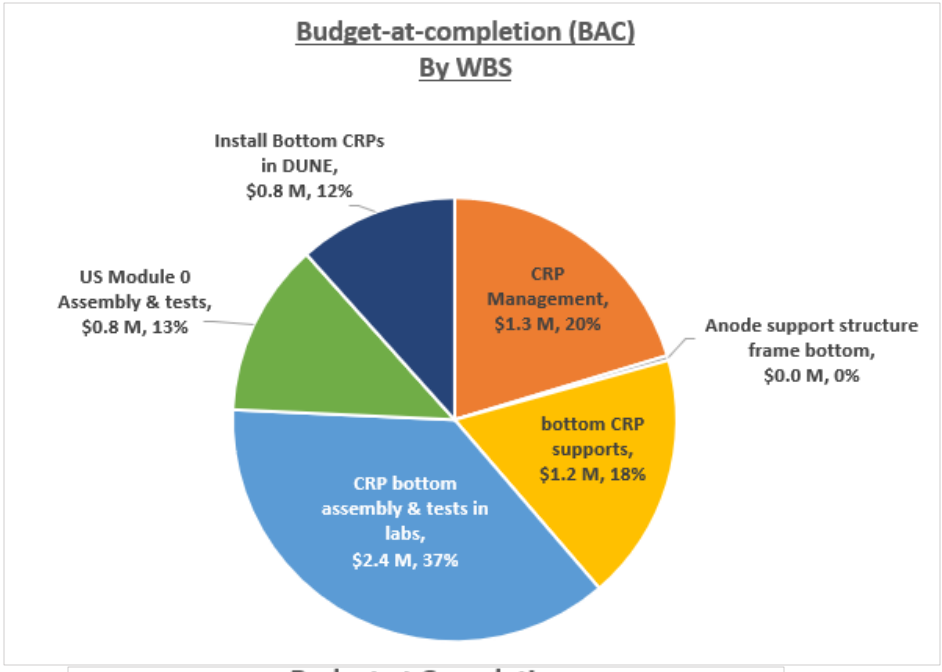


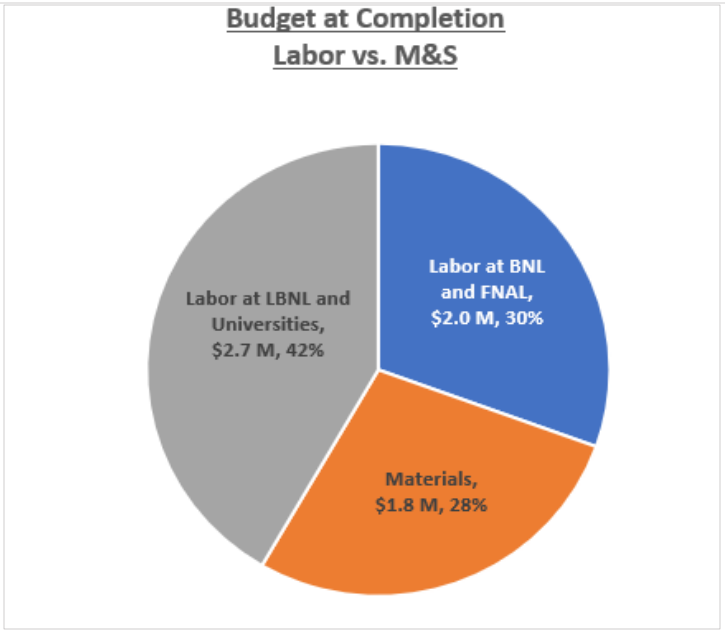

4 batches of bottom CRP adapter boards and edge cards:
Aug, Dec 2026, March, June 2027

Assume both US factories start at roughly the same time

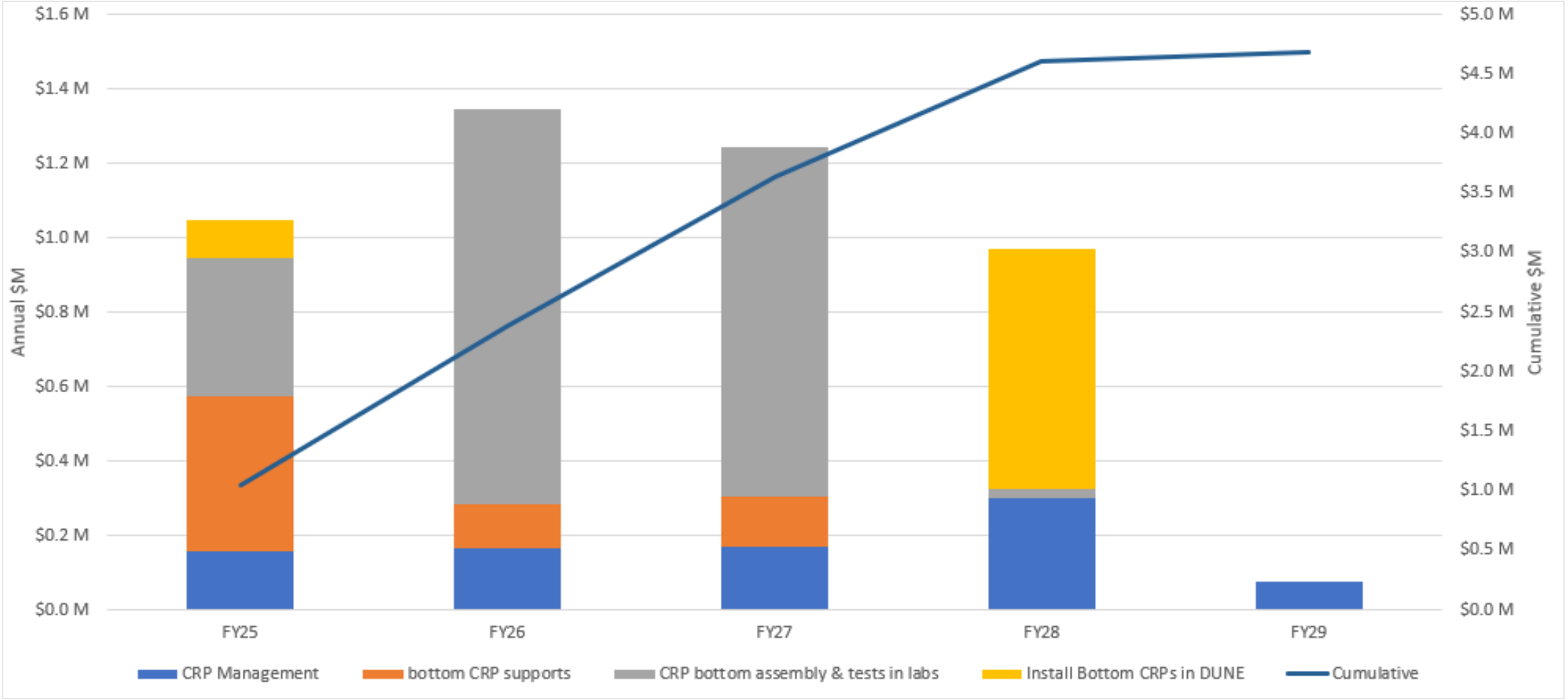
# US CRP Factory Resources and Labor

- $1.2M in project plan for each US CRP factory
  - Each site has been awarded ~$300k for setup costs (Yale contract for CRP4/5 was from module0 funds)
  - Each site has ~$900k remaining in planned funds for factory operation
  - Carrying ~37% contingency overall on these funds
  - **US cold boxes not included**
- Labor profile during operation (each factory) in FTE
  - Factory oversight
    - **0.5 engineer (on project)**
  - CRP assembly
    - **2 technician (on project)**
    - 2 student
  - CRP electronics installation and testing
    - 0.5 post-doc
    - 1.2 student

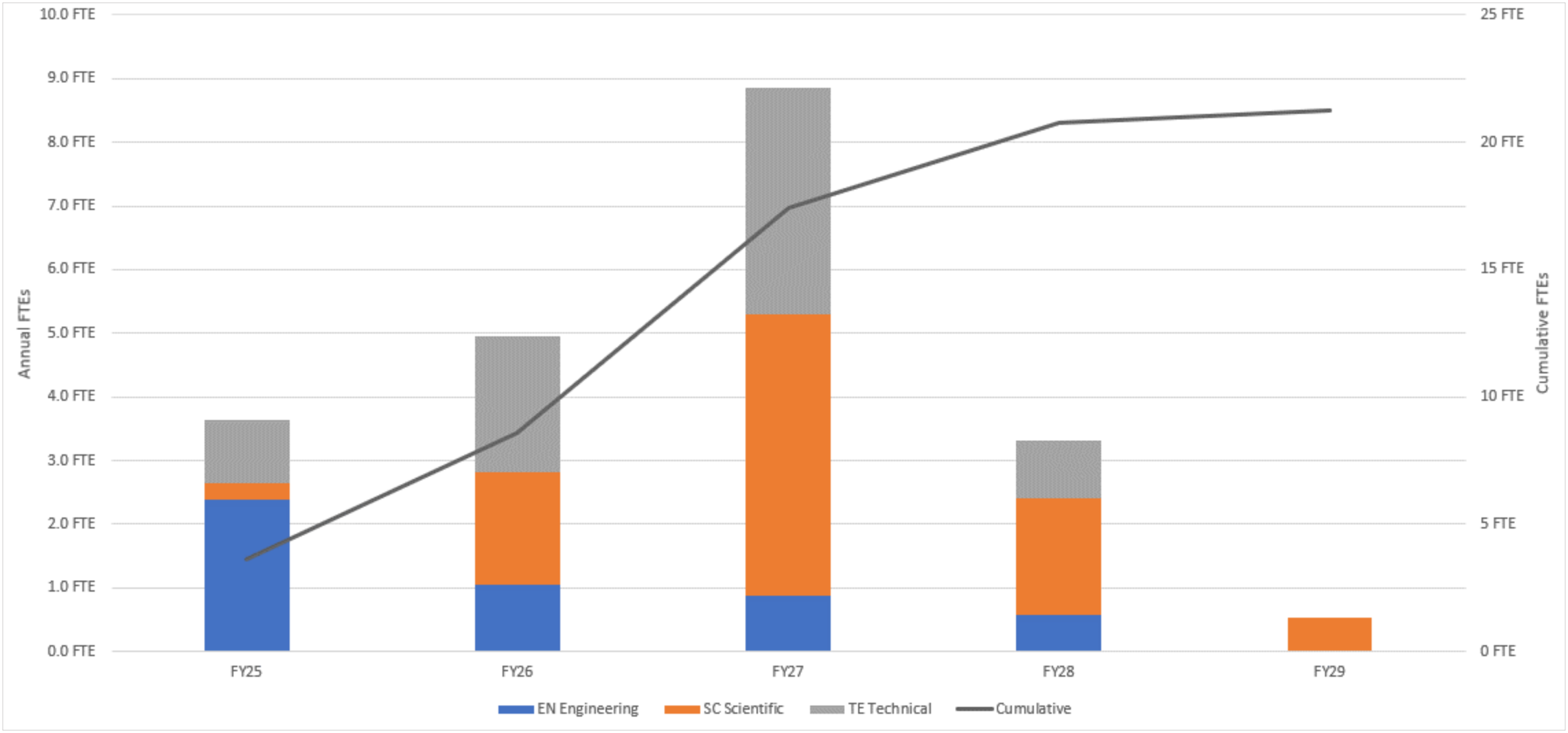


# US CRP Costs by Fiscal Year



# US CRP Labor by Fiscal Year



## Risks and Mitigations

- Bottom CRP assembly and testing more complex than anticipated
  - Several prototype (“spare”) CRP to be assembled at each factory site
  - US project still carrying a risk mitigation to add ~1 FTE of technician labor to each factory
- Deliveries of components (anodes, frames, adapter boards) are delayed
  - Anode and frame schedules can be re-optimized between top and bottom CRP production
  - **Two factories with full QC test setup prevent bottle-neck in testing**
- Bottom CRP/BDE are damaged in transport to SURF
  - Ship bottom CRP back to factories for repair and retesting
  - **Two factories with full QC test setup would allow one factory to repair CRPs while second site finishes production**