Budget profile and time line

The P5 presentation and what is needed for the next step.

Milind Diwan June 9, 2023

Agenda

- The current budget and timeline emerged from the work that was presented in FPF5. Intended for the P5 briefing document.
- For the next step we need to work on the largest pieces for the entire facility. This will capture largest fraction of the cost for the facility, and the experiments, and also capture the most of the integration issues. This is best done in experiment-agnostic way.
  - Civil construction and services.
  - Magnet(s) — what is really needed for various experiments.
  - Cryostat and cryogenics — Currently a conceptual plan exists for FLArE and no conceptual plan for the superconducting coils.
  - Integration — How does everything come together and flexibility in case some things get delayed or experimental plans change.
    - Integration needs to include considerations of needed safety systems, power, water, and installation options. All this is nominally host lab responsibility, but needs proper communication in an integration group.
- Common understanding of the above could be a central feature of the next document.

Constraints used for the budget and timeline

All this will require a critical joint review from the funding sponsors.

- P5 document has description of how the current numbers were put together.
  - CE and outfitting numbers came from CERN. These are CERN direct costs.
  - The non-US experimental cost numbers came from each of the teams. There was no attempt to review or add factors to them. They should be considered direct costs.
  - The US estimate is as much in US accounting system as possible. The US portion includes FLARE, FORMOSA, and some contribution to FASER2.
  - The US portion has a large contingency.
  - The costs have a range (this is range is NOT the contingency). The range is based on technical and management choices as we understand them now.
- The P5 document link is: https://www.osti.gov/biblio/1972463

Cost table and comments

Component	Cost Range	Comments
Facility Costs		
FPF civil construction	20-35 MCHF	Construction of shaft and cavern
FPF outfitting costs	7-15 MCHF	Electrical, safety, and other services
Total	**27-50 MCHF**	Total including integration
Int'l Experiment Costs		Labor, overhead, contingency not included
FASER2	17 MCHF	Non-US portion
FASERν2	16 MCHF	
ADV-SND	12 MCHF	
Total	**45 MCHF**	
US Experiment Costs		Labor, overhead, contingency included
FLArE	\$39-65 M	Contingency 40%
FORMOSA	\$7-8 M	Contingency 20%
FASER2	\$6-10.5 M	Contingency 50%, US portion
Total	**\$52-83.5 M**	

- This is as of May 2023.
- For the pre-CDR in November, we should make progress on the biggest technical items in a joint manner.

Strategy on the US side: keep the cost in this range so that we do not enter the zone where we must comply with project rules that require Critical Decision reviews.

CERN also has very tough review processes on large outlays.
It is best to keep numbers on the lower side so that management does not consume huge resources.

Nominal timeline (only the US portion was presented to P5)

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033-34
(HL)-LHC nominal schedule	Run3	Run3	Run3	Run3	LS3	LS3	LS3	Run4	Run4	Run4	Run4	LS4
FPF/FLARE milestones		Pre-CDR and physics proposal	R&D and detetor prototypes	CDR- long lead item magnet	Start of civil constr. TDR for detectors	Detector construction start	Long lead items for detector	End of civil constr. Install services	Detector install	Detector Commissioning and physics start	Physics running with full complement of detectors	
CERN infrastructure funding (kCHF)			500	2500	10000	15000	15000	7000				
Funding for detectors (kCHF) (non-US)	These numbers are going to go up		450	900	4500	4500	13500	9000	12150	1.1		
US-DOE FLARE (kUS$)						9750	19500	19500	13000	3250		
US-DOE FORMOSA (kUS$)						800	1600	4000	1600			
US-DOE-FASER2 (kUS$)			875	1750	3500	2625	1750					
Total US-DOE (kUS$)			875	1750	3500	13175	22850	23500	14600	3250		

- Key constraints: physics must start in Run4. civil construction needs to be funded during LS3. And key technical components must start early (such as the FASEr2 magnet)

Next steps. what, who and when ?

	Task	Engineering team	Scientific team	Date needed
CE, outfitting common services	First pass integration using current	CERN Engineerings team with input from others	Provide input on detector specs.	September 2023
	Finalize Major requirements		Scientific strategy	December 2023
Magnet(s)	Scientific requirements	Design choices for superconducting or normal coils.	Advance key simulations	September 2023.
Cryogenics/ cryostat	Preliminary design	Joint FLARE/CERN team		November 2023.
Integration	Interface definitions and requirements	Experimental engineering team jointly with CERN.		November 2023
	Installation model	Produce max of two installation choices.	Consider science priorities	November 2023

From this table, it is clear that we need (1) (modest) engineering resources, (2) communication channels, (3) an interim technical board and technical coordination with CERN.