WP6: Design and Integration Part 1

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What were the main missing items from the pre-CDR?

- Design of the main three challenging components:
  - Gabor Lens (subject of focus of the Capture WP)
    - Mitigating solenoid
  - FFA main magnet design (~1 RA's FTEy)
    - Additional costs for the simulation software
  - MA cavity (1.5 RA's and/or RF engineer FTEy)
    - Additional costs for the simulation software
    - Additional costs for MA core material samples and their measurements

Items for completion of Phase I CDR

- Apertures
- Radiation protection estimation and beam dump
- Vacuum system
- Arc magnets design
- Collimators
- Error study+ correctors
- Diagnostics
- Power consumption/cooling requirements
- Support for the vertical arc line
- RF system for phase rotation and bunch length control
- Feedback and controls
- RF system

Items for completion of Phase II CDR

- Apertures
- Radiation protection estimation and beam dump
- Vacuum system
- Injection line magnets
- Injection and extraction septa and kickers
- Extraction line magnets
- Arc magnets design -> similar to Phase I
- Collimators
- Error study + correctors
- Diagnostics
- Power consumption/cooling requirements
- Support for the vertical arc line
- Feedback and controls
- RF system (mainly MA cavity)

Summary

- It looks at the moment the delivery of CDR requires ~4 FTEy of the RA effort
  - At least two people for 2 years, but we may not have all done…
    - We could accommodate three PhD students
      - One for magnet design and transverse dynamics
      - Second for MA cavity design and longitudinal dynamics
      - Third for beam diagnostics development (for both Phase I and Phase II)

+ extra costs for software and materials + usual consumables

  - Extra costs for consulting with experts (for CDR effort – first two years)
    - Magnet designer 0.2 FTEy
    - RF engineer 0.15 FTEy
    - Vacuum engineer 0.1FTEy
    - Diagnostics expert 0.2 FTEy
    - Accelerator mechanical engineer 0.1 FTEy
    - Mechanical services expert 0.2 FTEy
    - Pulsed magnet expert 0.2 FTEy
    - Electrical engineer 0.2 FTEy
    - Control expert 0.2 FTEy
  - Extra effort for engineers (design of the collimator, for example)

- Effort for the next three years
  - 6 FTEy of RA effort
  - Full engineer effort from the start of year 3 onwards (to be able to deliver TDR for Phase I at the end of year 3 and continue to deliver TDR for Phase II at the end of year 5) – 3FTEy
  - 1 FTEy of expert effort
  - FFA magnet construction will be subcontracted to a company for manufacturing at the beginning of year 3 with magnetic measurements at year 4 (manufacturing costs + RA and PhD effort)
  - MA RF cavity will be constructed in the lab (at RAL or at one of unis), RF engineer needs to be hired from the start of year 2 – 3FTEy

Milestones/Deliverables

- Finalisation of the conceptual design of LhARA accelerator system and its integration with the source and the end stations (24 months)
  - Contribution to the CDR
- Finalisation of the technical design of LhARA accelerator system for Phase 1 and its integration with the source and the end station (36 months)
  - Contribution to the TDR for Phase 1
- Construction, magnetic measurement and tracking validation of the FFA main magnet prototype
  - Technical report on the design and performance of the FFA main magnet prototype (58 months)
- Construction and commissioning of the MA cavity system prototype
  - Technical report on the design and performance of the MA cavity system(58 months)
- Finalisation of the technical design of LhARA accelerator system for Phase 2 and its integration with the source and the end station (60 months)
  - Contribution to the TDR for Phase 2

Some of the main risks

- Gabor Lens does not work
  - Mitigating solenoid
- FFA magnet does not have required field distribution
  - Not a high risk -> similar magnets already constructed
- MA RF cavity cannot be constructed in time (if project underfunded)
  - Similar cavities are in operation (at CERN, in J-PARC, in KURNS, etc.)