

Lifecycle analysis

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Aim

- Make a thorough list of lifecycle steps (from the module point of view)
- Use them as evaluation criteria for proposed solutions

Module lifecycle

- Preparation
- Transportation
- Tunnel installation
- Operation
- Machine upgrade?

Preparation

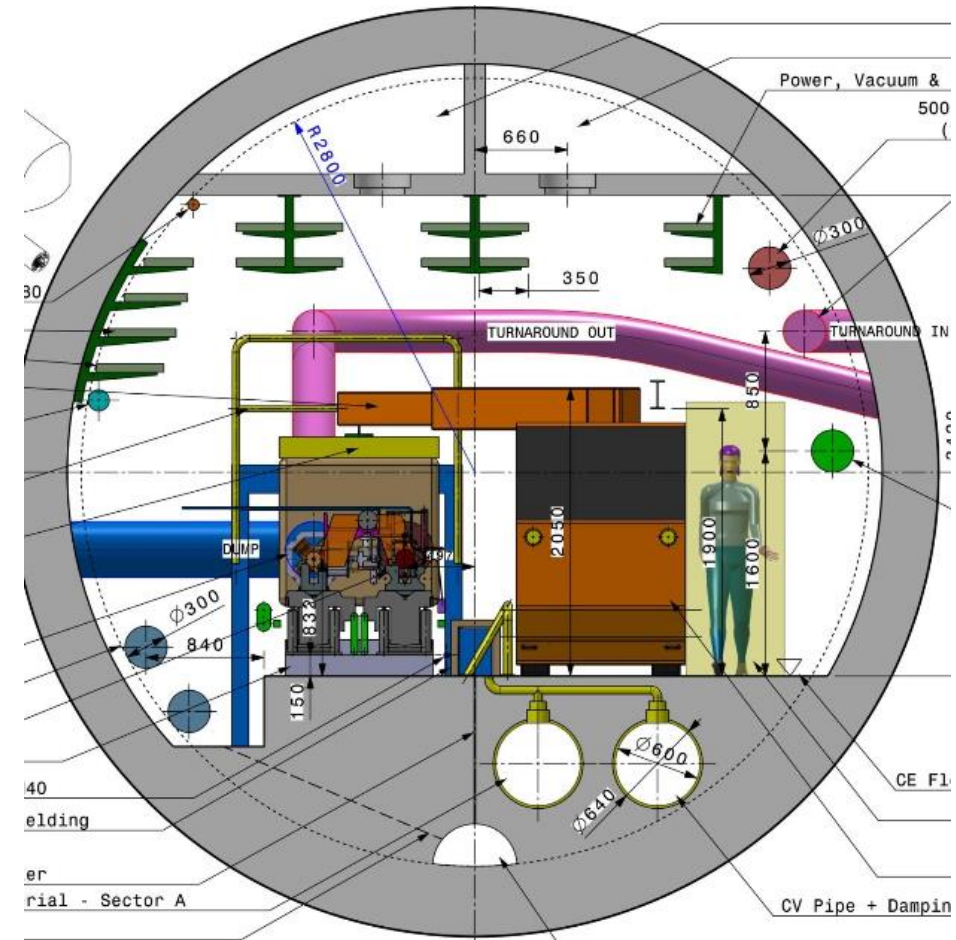
- Fabrication
 - Girder tolerances are critical -> adjustable supports
 - Material choice -> SiC or steel, etc
- Parts acceptance
- Assembly
 - Number of parts, processes -> working on it
 - Optimisation needed
- Testing (leaks, etc)
 - Minimise connections -> working on it
- Pre-conditioning
 - needs all subsystems (vacuum, loads, cooling)
 - so makes sense to 'condition' full modules?
 - Then assembly and conditioning should be done close to tunnel

Transportation

- transport from assembly hall to shaft
 - 0.5g acceleration possible for remote shafts?
 - Shafts every 5km(?) -> 380GeV has only one shaft at each end (31/3/17)
- lowering of modules
 - Very slow, possible bottleneck
 - Pack many modules together
- transportation to final place
 - Fill the tunnel from the centre to the extremities
 - Pack many modules together
 - Strategy for sectorisation
- installation in final position
 - Lifting and positioning the module (<1mm precision)
 - Separate lifting and transporting devices

Tunnel installation

- connections of water, power, electronics
- vacuum pumping (external pump)
 - Vacuum sector length (current 200m, not realistic)?
- leak tests, electronics tests
- final alignment-adjustment
 - Space for survey equipment
 - Not necessary for active alignment solutions
- beam-based final conditioning



Operation

- temperature sensitivity
 - Alignment/phasing during on/off cycles, day/night, etc
- active re-alignment
- ground movement manual compensation (every year)
- robustness against human interaction
- failure rate
 - Actuators, sensors, RF components
- maintenance (swap modules, etc)
 - Vacuum sector important