Member Country Summary: Norway

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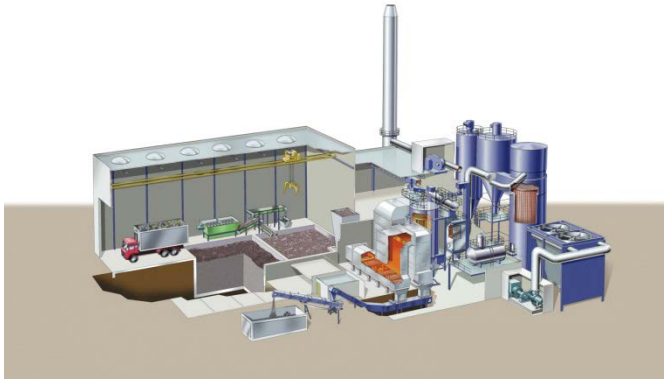
Biomass gasification in Norway

- Norway has large unused biomass ressources
- Still no economic advantages or incentives for biomass gasification in Norway:
  - Fundamental research at Universities
  - Applied research
  - No large scale gasification facilities
- Small scale waste-to-energy applications
- Some interested larger companies :
  - Statkraft
  - Akershus Energi
  - Avinor (BioJet-A1)

Small scale applications

- In Norway both the people and the biomass are spread
- The distances are large, hence high transportation costs

- Small scale applications
  - Energos
  - Agder Biocom



Energos plant

Both use two-step (gasification-combustion) technology for heat production

Biomass gasification in Norway

- So far 2014 has been a busy year for project applications:
  - An application has been sent to EEA (European Economics Area) grant with Romania (not a gasification project)
  - EU projects
    - Leader of one initiative within HTL
    - Partner in another (gasification)
  - In the process of applying for new competence building projects (deadline September 2014)
    - The bioenergy group will apply for 4 projects
    - One application will focus on gasification of biomass for liquid fuel production for the aviation industry

Biomass gasification Lab: SINTEF Energy Research

Bench-scale reactors for biomass reactivity and yield measurements

STA instrument (simultaneous thermal analyzer)

- Temperature range: RT up to 1100°C
- Vacuum: 10E-4mbar
- Heating rate: 0.1 up to 20°C/min
- Temperature resolution: ±0.1°C
- Temperature accuracy: ±0.3°C (substance calibration)
- Data evaluation rate: max. 10/s
- Pressure control: up to 50 Bar (adjustable, software controlled)
- Atmosphere: inert, red., vac., oxid. (SiC heater)

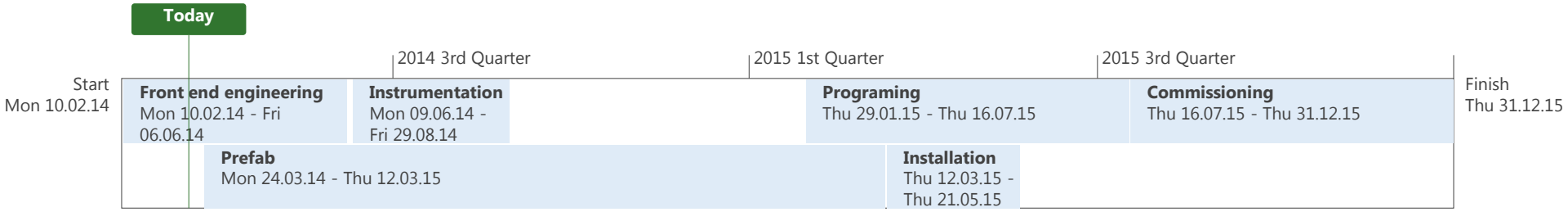
New entrained flow reactor

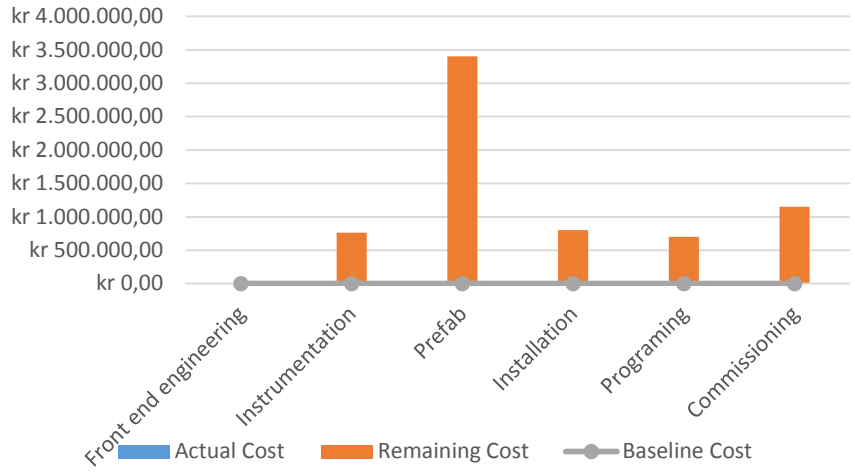
Current specification and purpose

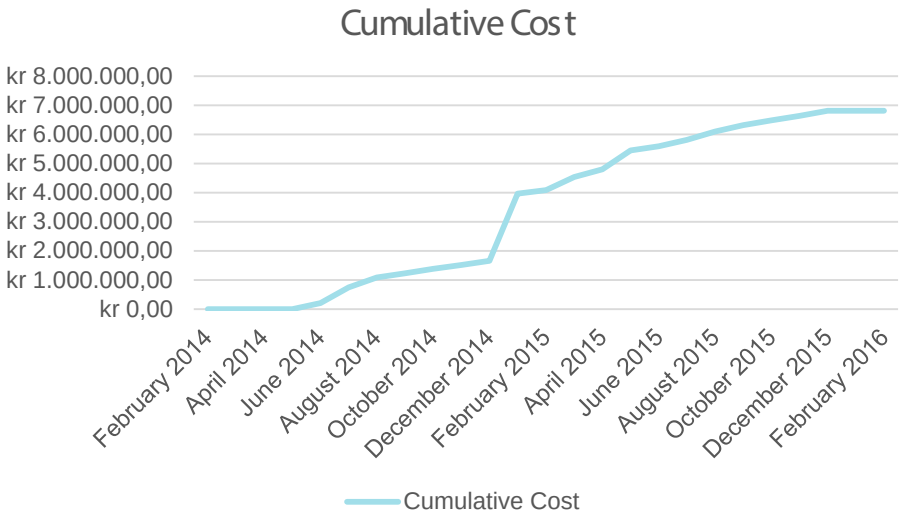
- Maximum fuel flow rate: 2 kg/h
- Maximum number of operators : 2
- Pressure: min 10 bar(g)
- Wall heater temperature: min 1500 ^{0}C
- Fuel particle size distribution: As large as possible
- Continues operating time: 6 h

- The reactor should be used to;
  - Study if a fuel is suitable for gasification
  - Study soot and tar formation from gasified biomass
  - Provide validation data to numerical models

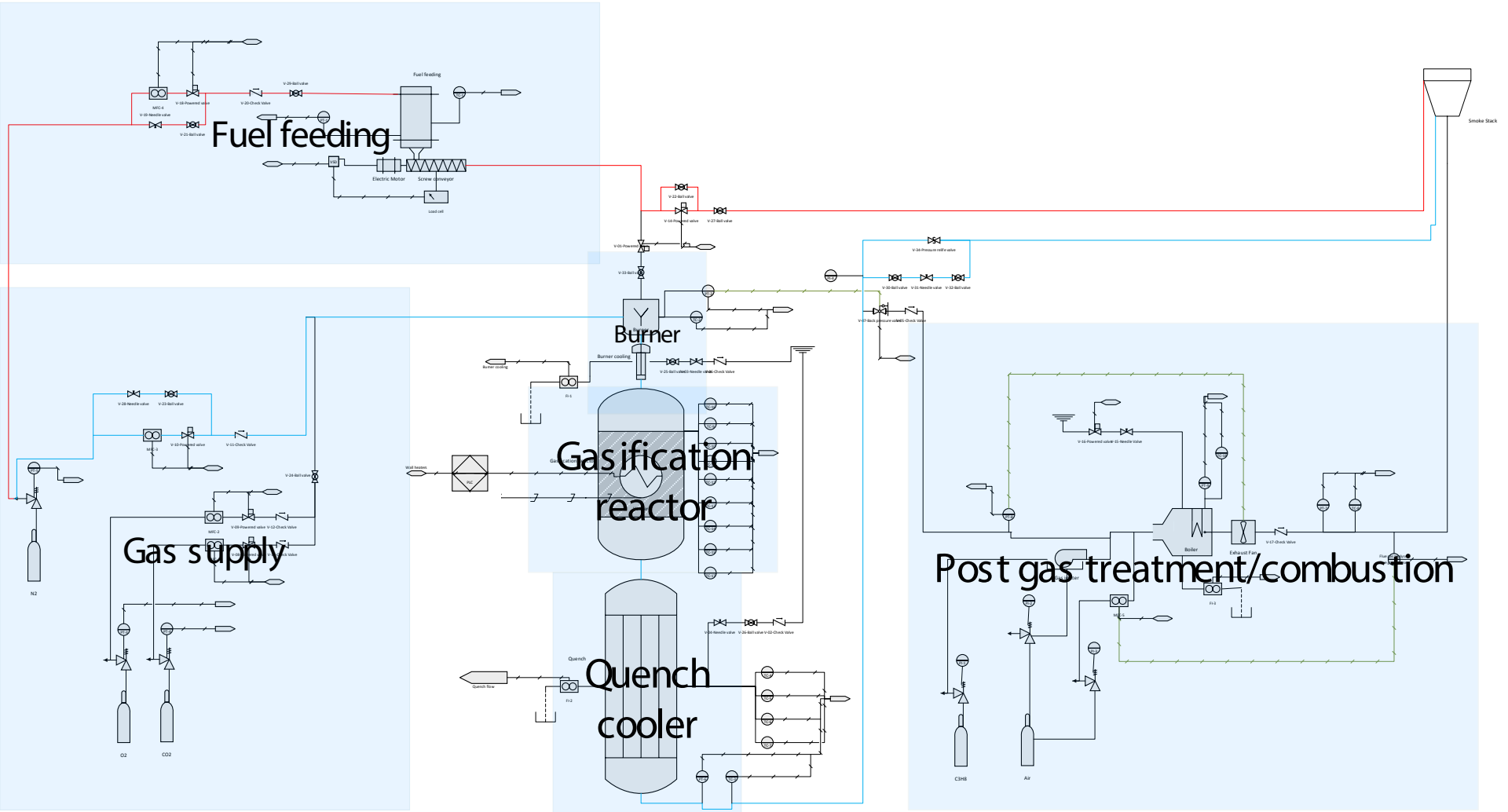
Project overview and cost estimates

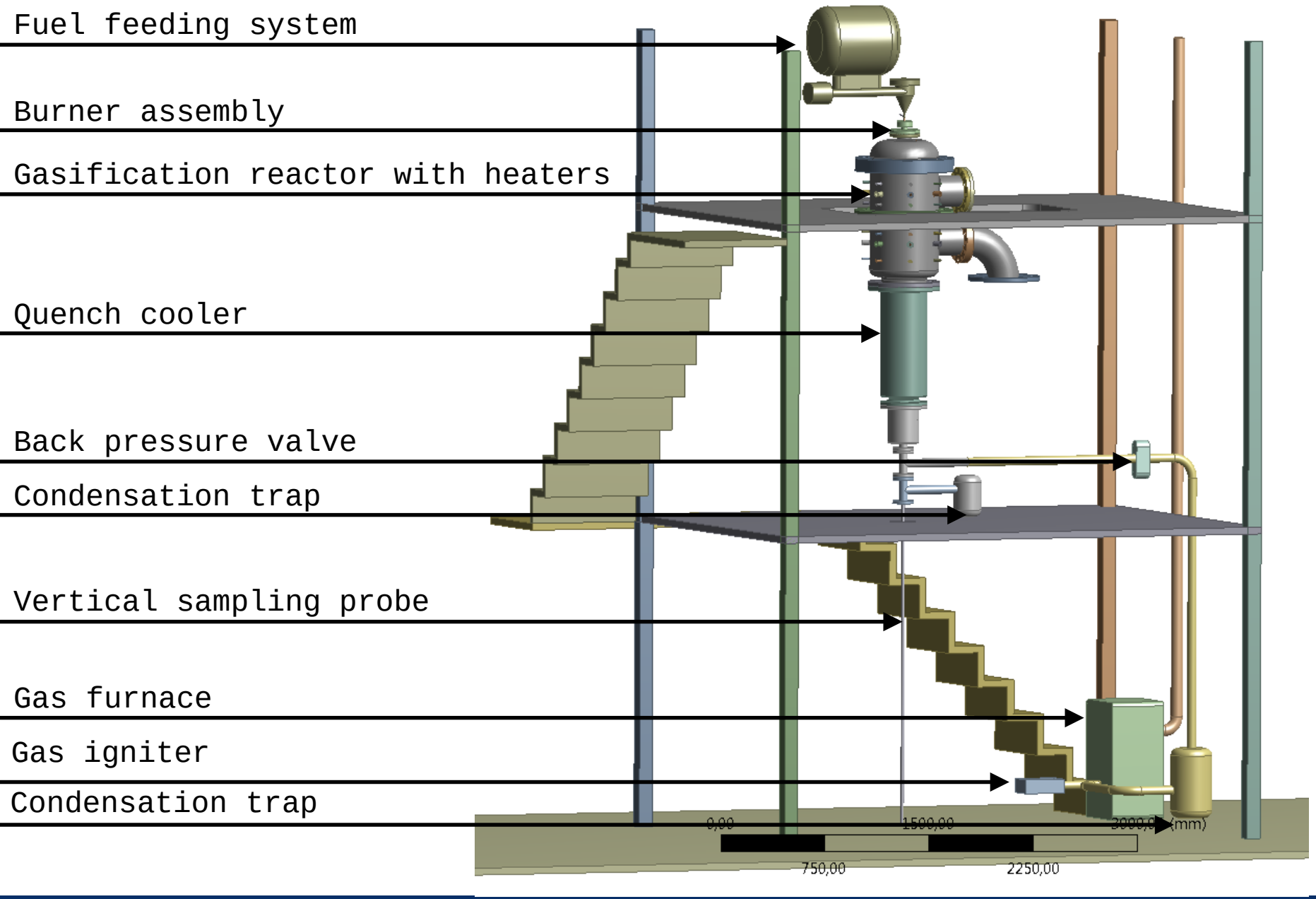




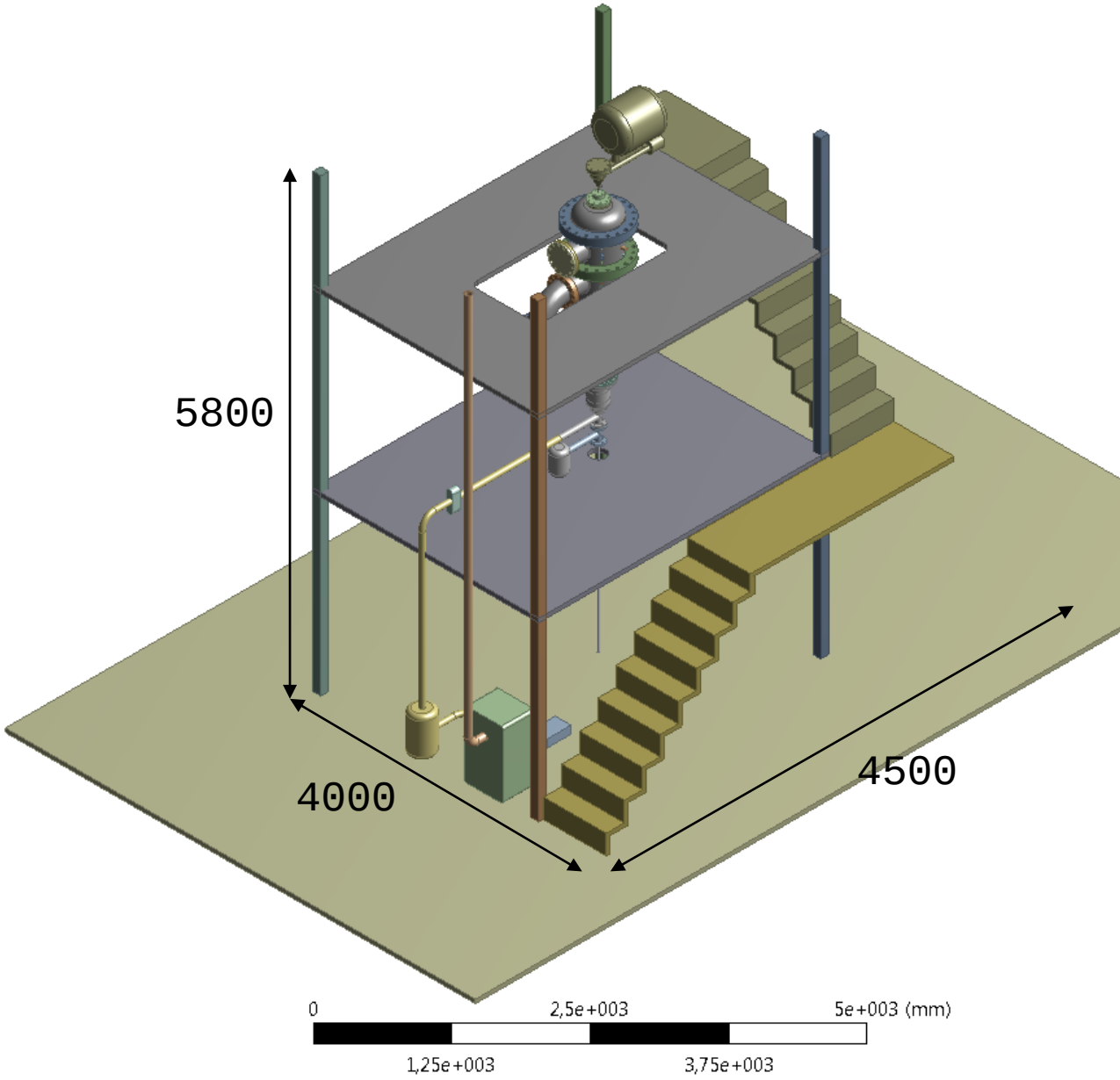


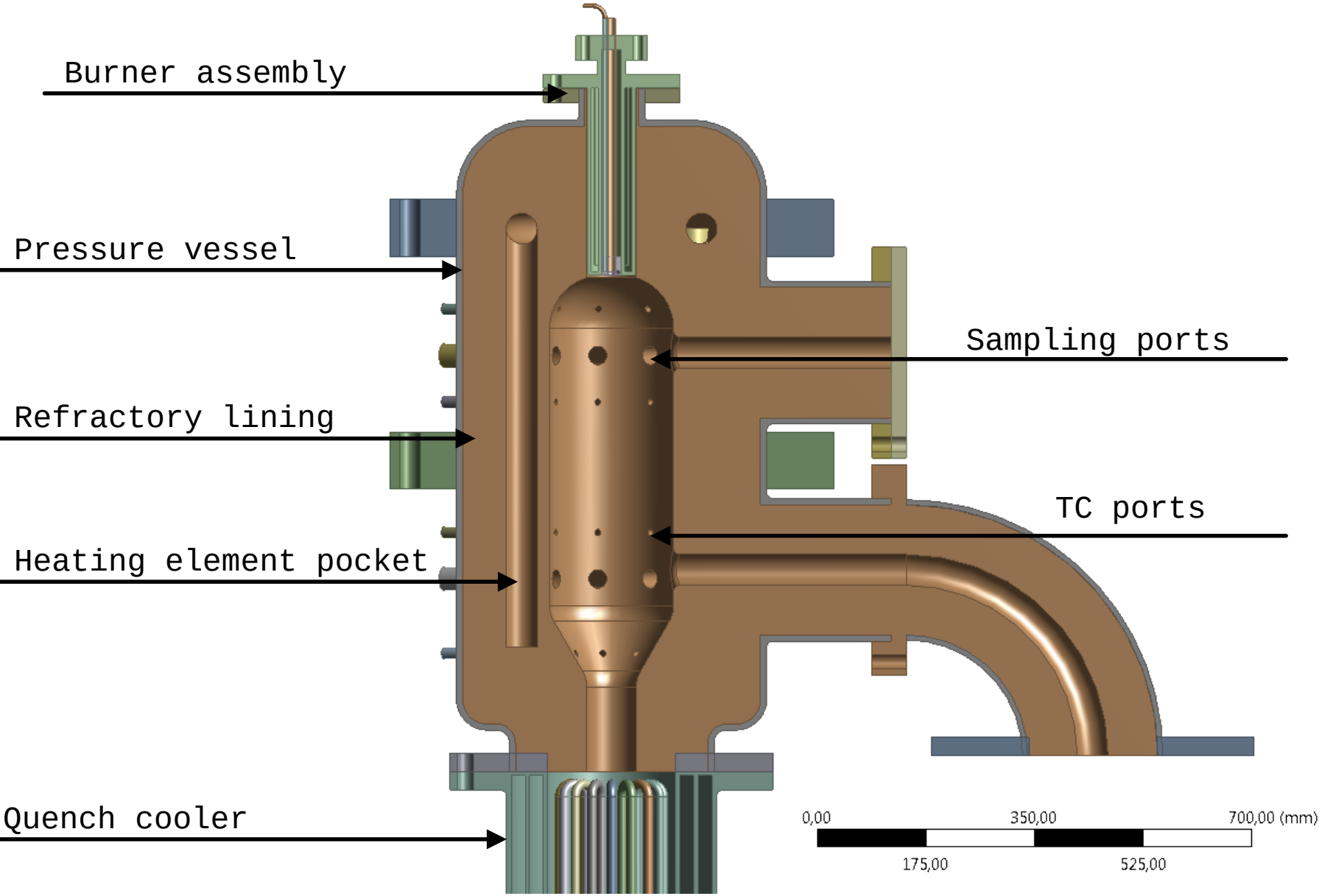
System overview



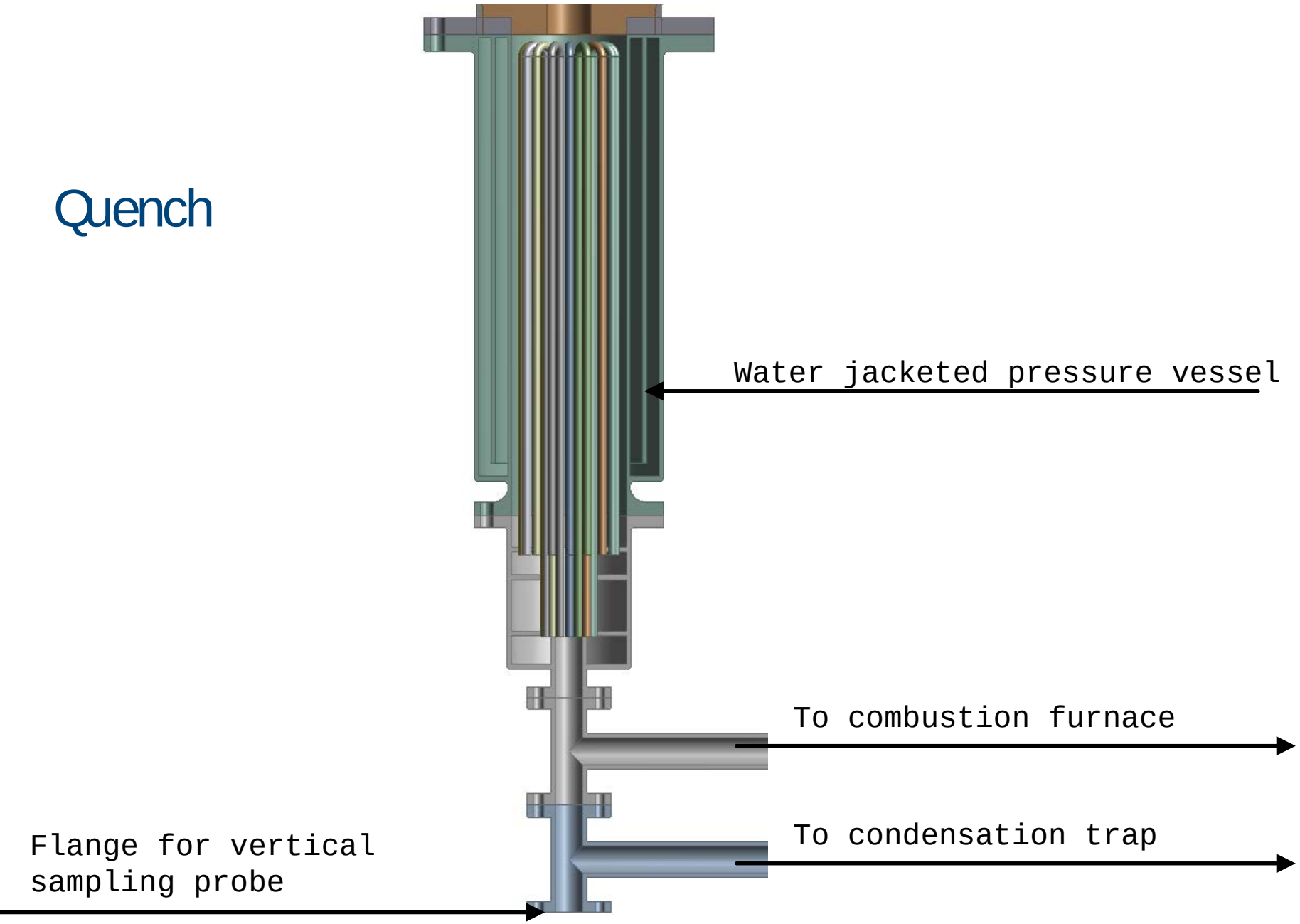

Fuel feeding system
Burner assembly
Gasification reactor with heaters
Quench cooler
Back pressure valve
Condensation trap
Vertical sampling probe
Gas furnace
Gas igniter
Condensation trap
0,00
1500,00
3000,00
(mm)
750,00
2250,00

Current dimensions




Burner assembly
Pressure vessel
Refractory lining
Heating element pocket
Quench cooler
Sampling ports
TC ports
0,00
350,00
700,00 (mm)
175,00
525,00

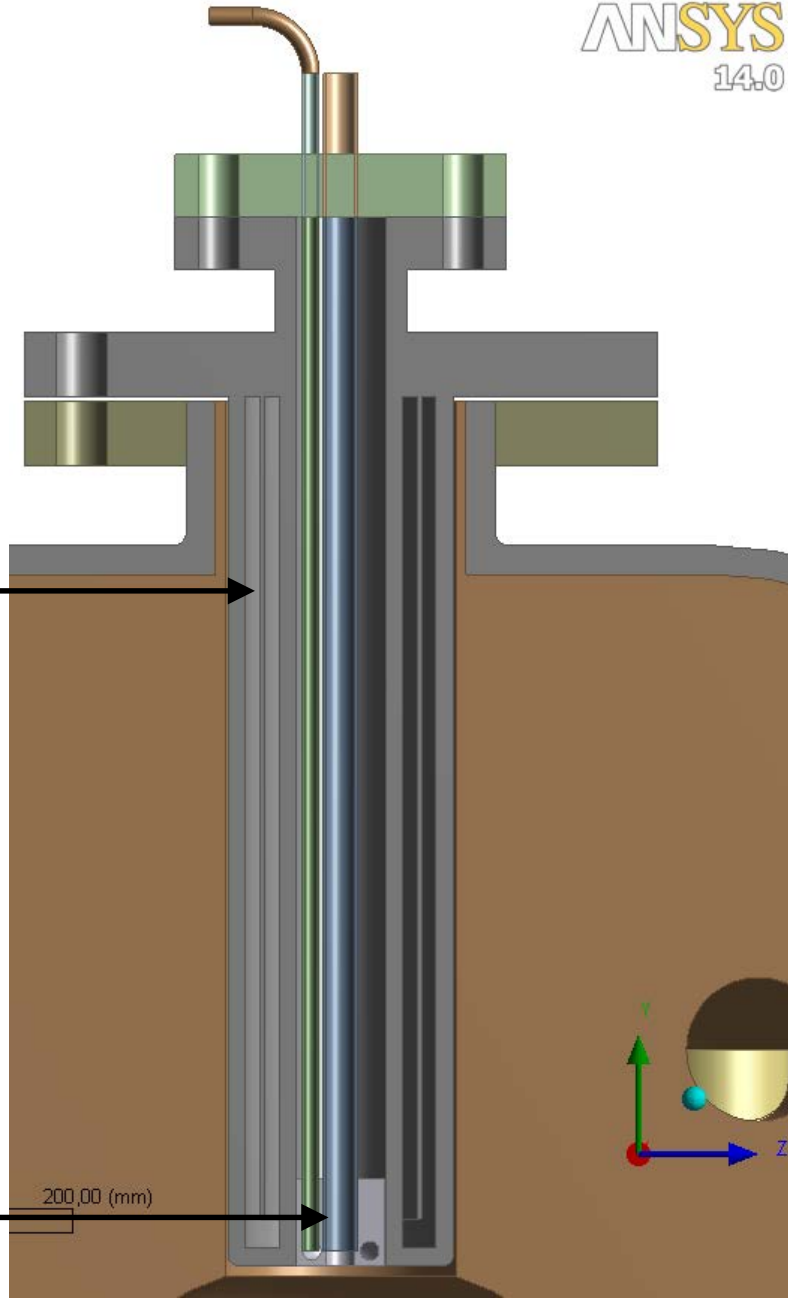
Quench


Water jacketed pressure vessel
To combustion furnace
To condensation trap
Flange for vertical sampling probe

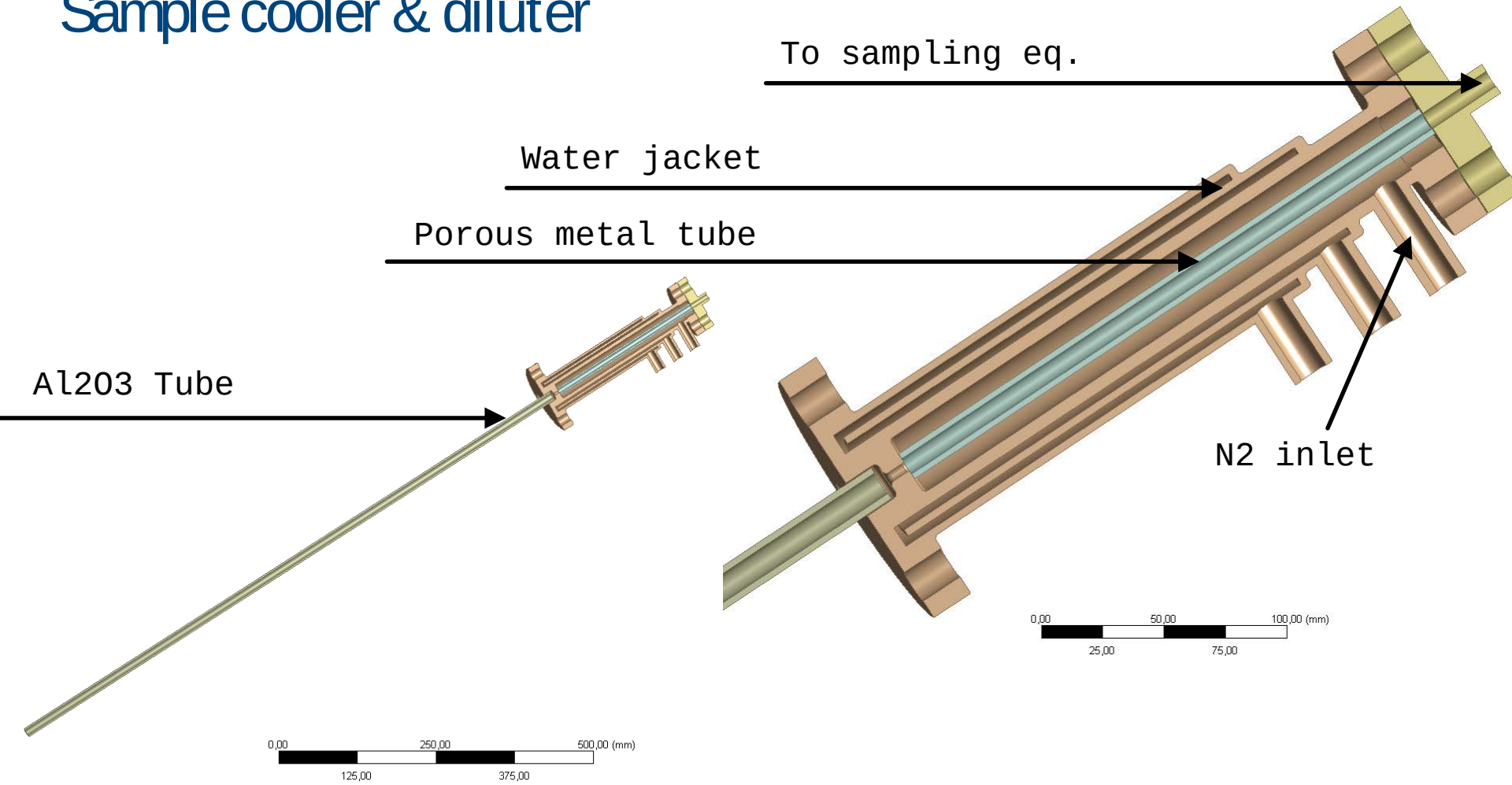
Burner

Water jacket

Exchangeable burner head



Sample cooler & diluter



Upcoming activities

- HAZOP together with revision of existing P&ID
- Project meeting with manufactures of pressure vessels, refractory and heaters

That is it!

Thank you for listening