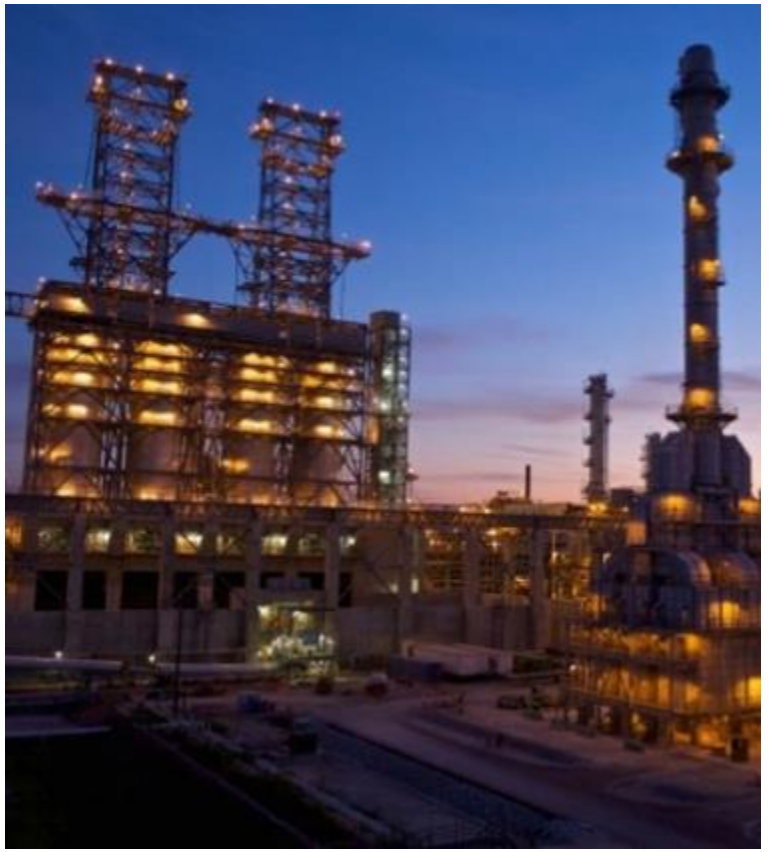
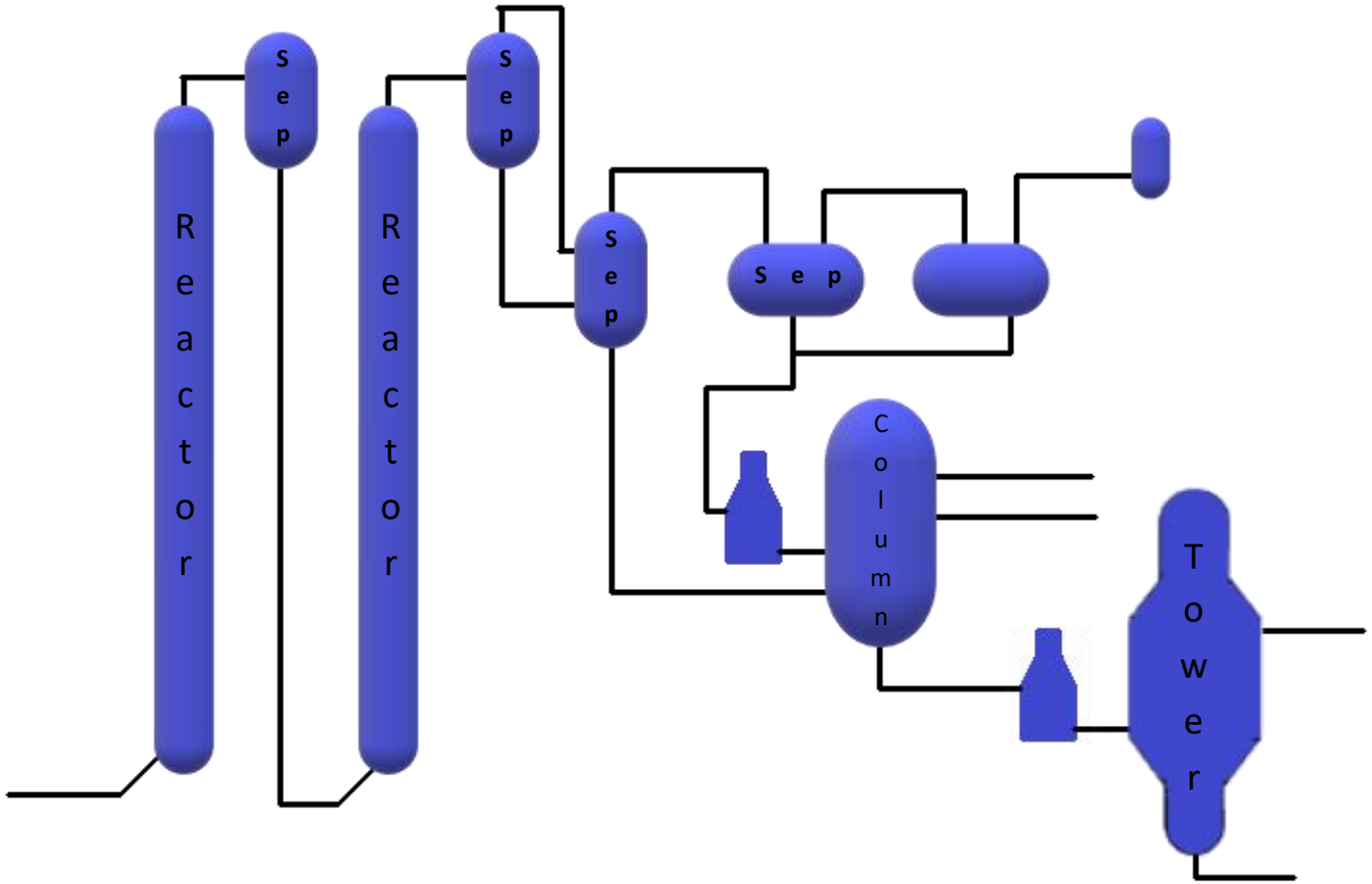

Resid Hydrocracking reactor bed density
Refining COMMUNITY

- **Units that typically use Radiometric**
  - Desalters
  - Alkylation
  - Tower Bottoms
  - Delayed Coker
  - Resid Hydrocrackers



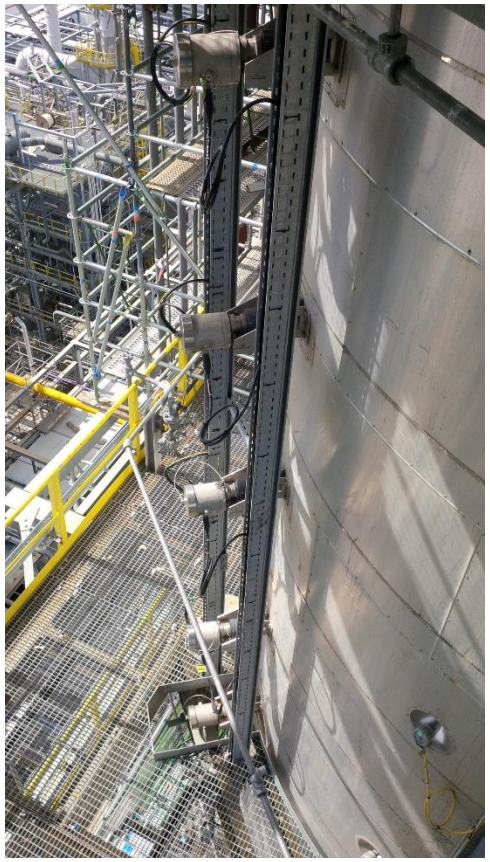
Experience

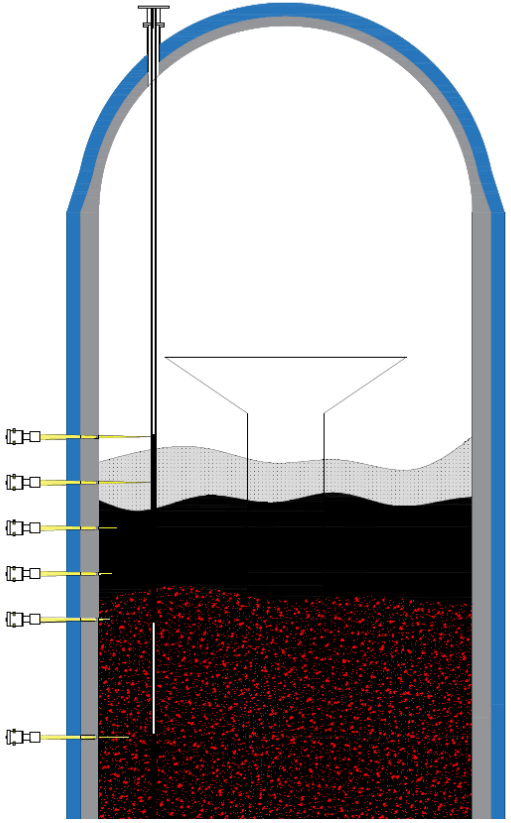
- Experience with
  - Axens – H-Oil (Shenua, Bourgas, Sinopec, PKN, etc)
  - CLG – LC-Fining (Eni/AGIP)
  - Eni's – EST (Sannazzaro)
  - KBR – VCC (Taif)
- 14 out of the 25 operating units
  - 5 of the last 7 projects

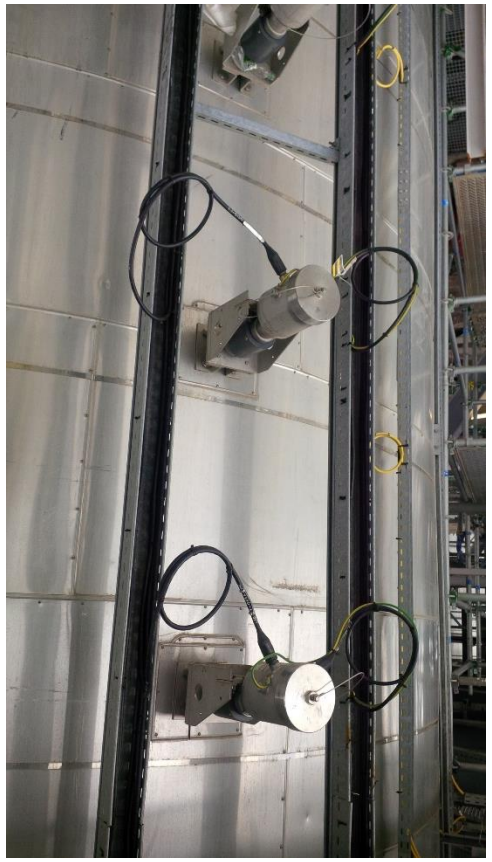

Sep
Sep
Reactor
Reactor
Sep
Sep
Column
Tower

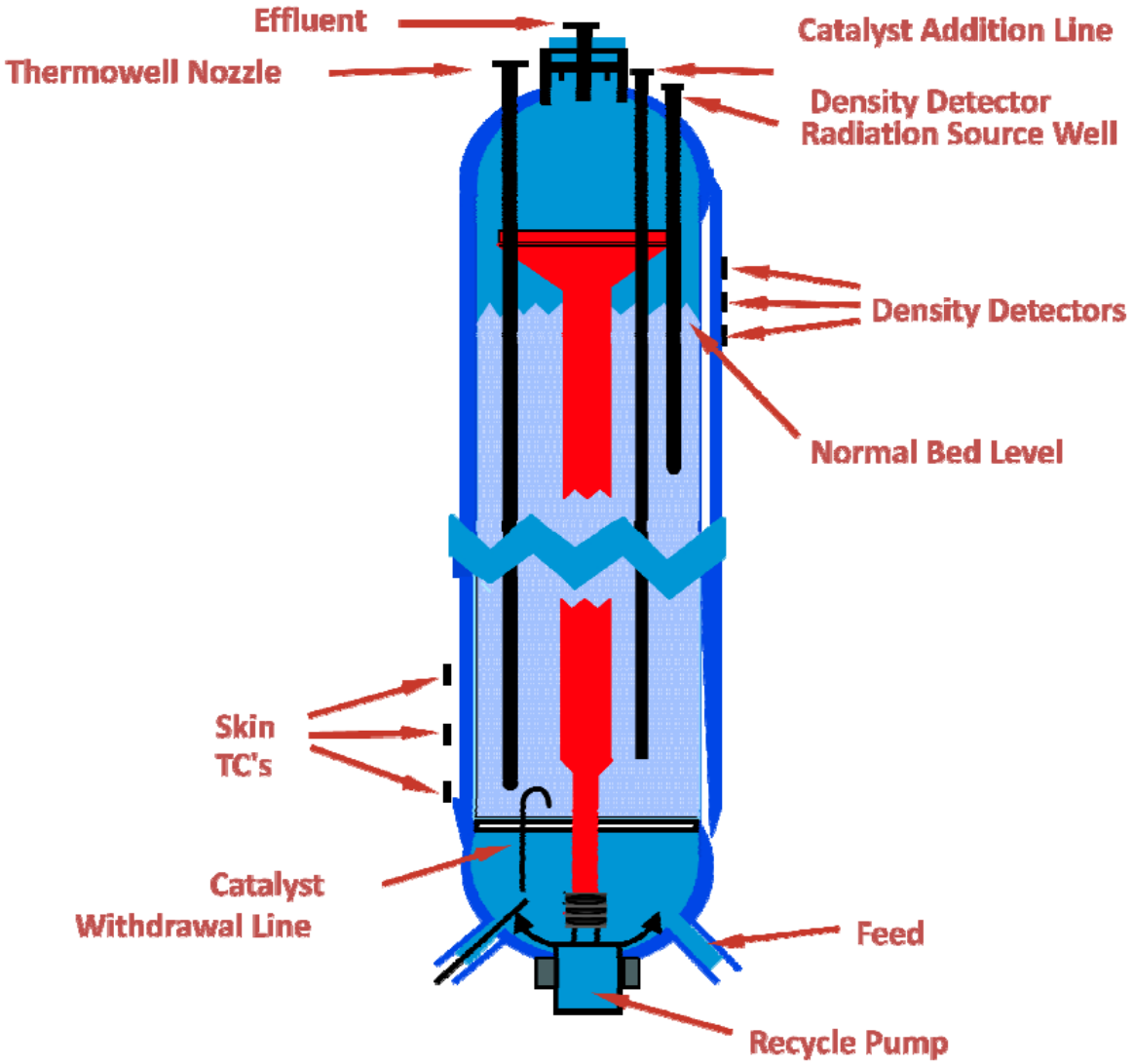
Vessels with Radiometric

- Reactors
- Separators
- Catalyst Handling/Transfer
- Towers/Columns



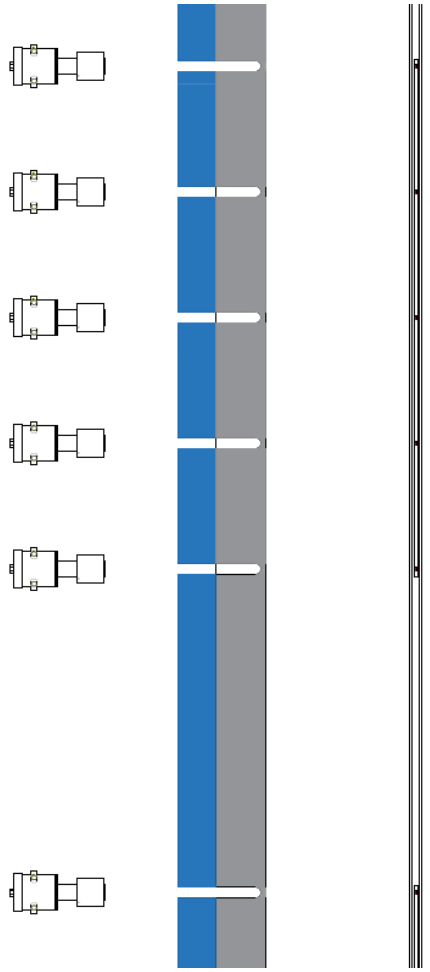






Drawing from CLG's Website

- Using Drilled Bore
  - Reactors
  - Liquid/Vapor Separators
    - High Temperature and High Pressure
  - Catalyst Transfer Vessels



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  - Reactors
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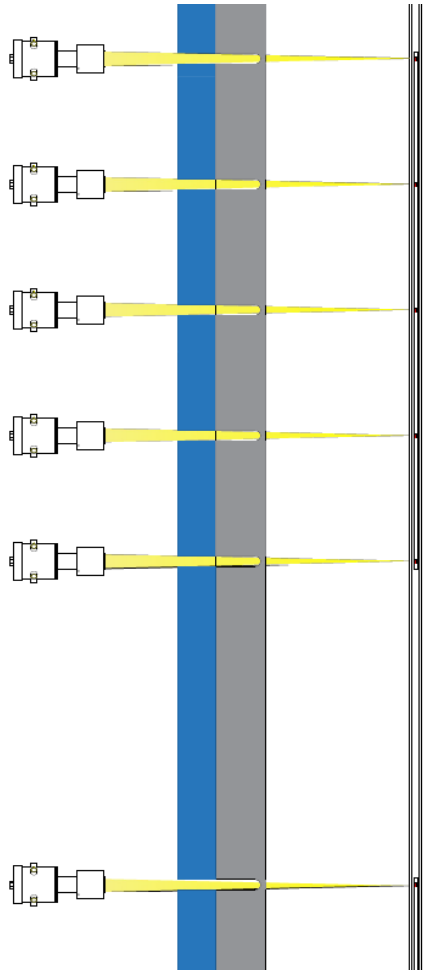
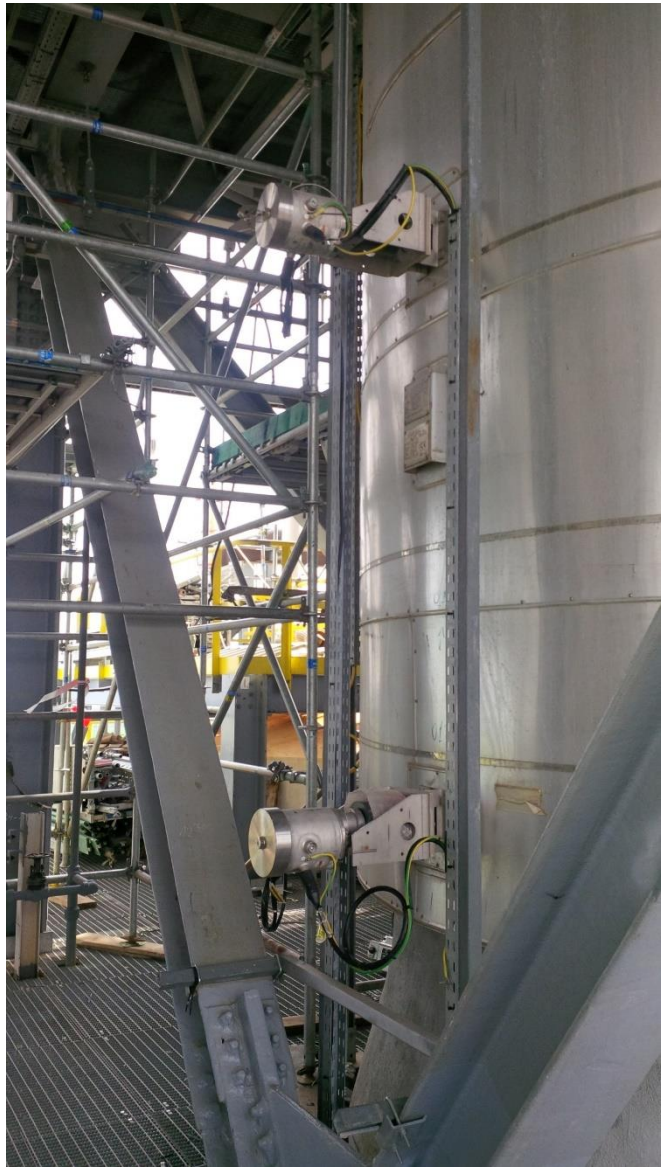
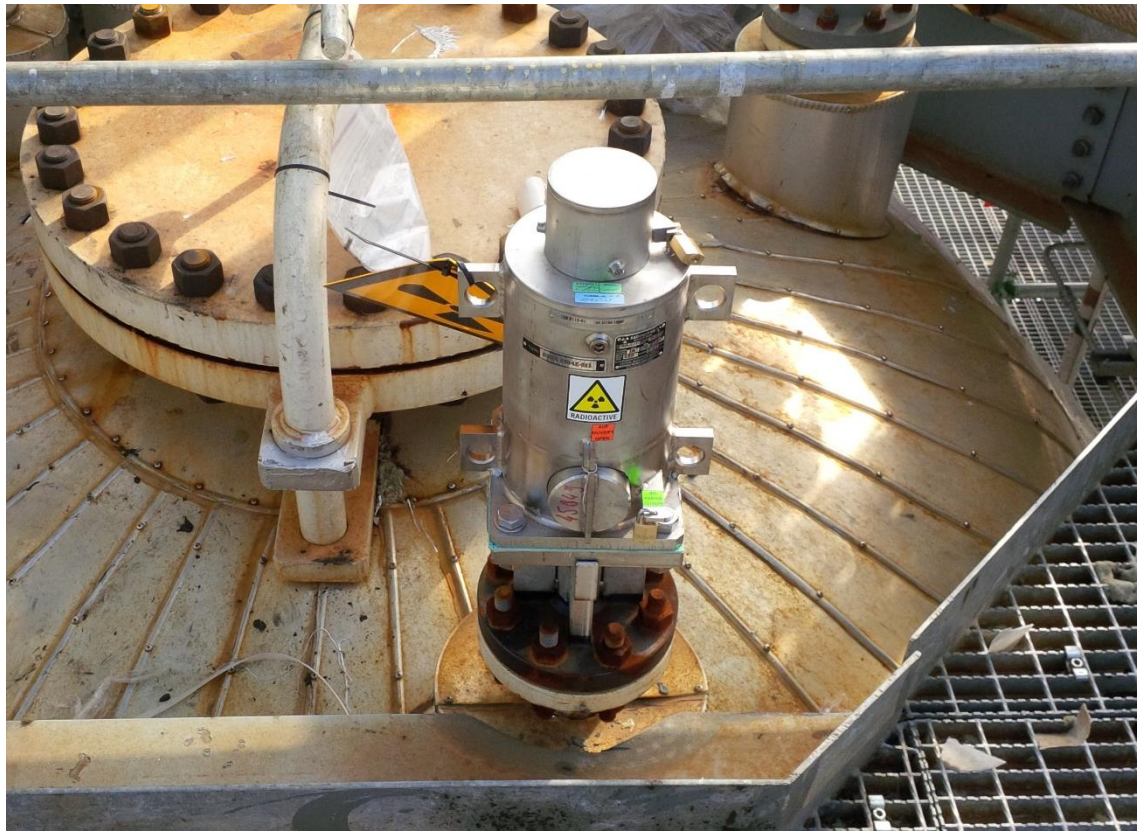
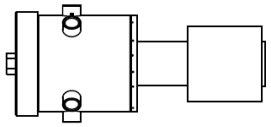
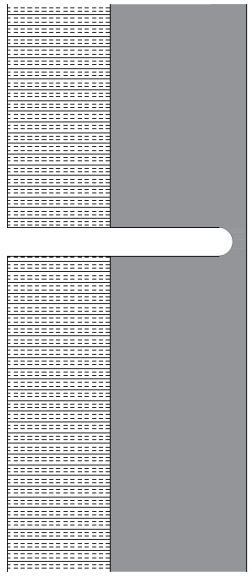


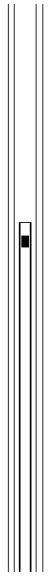



RADIOACTIVE

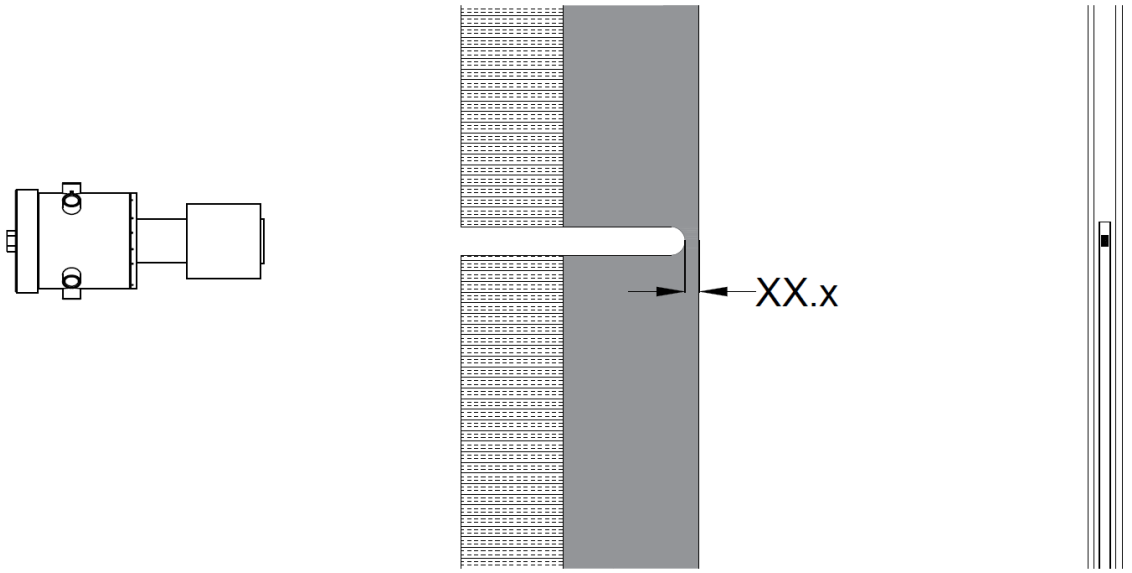
- Parameters



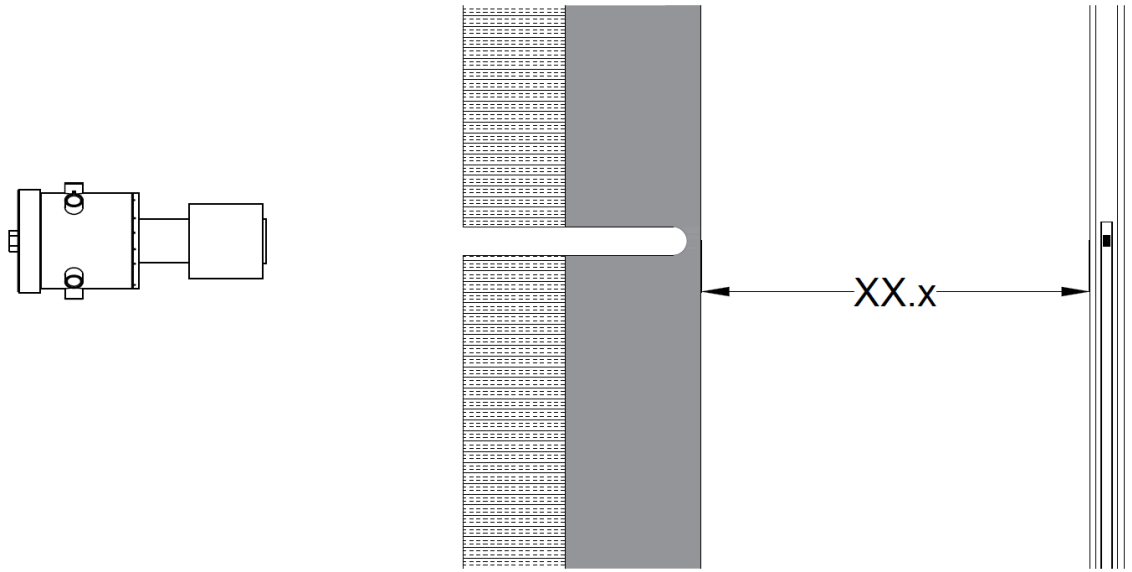




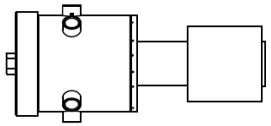
- Parameters
  - Depth of Bore hole (remaining wall thickness)

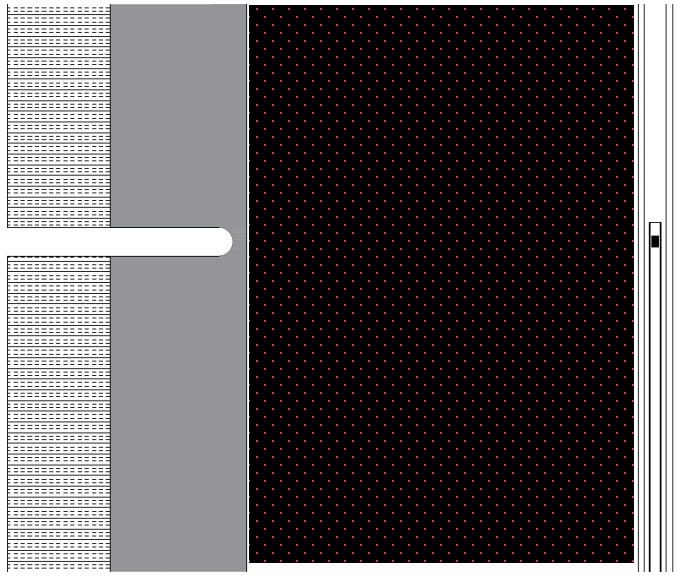


- Parameters
  - Depth of Bore hole (remaining wall thickness)
  - Process Path (distance from wall to source well



- Parameters
  - Depth of Bore hole (remaining wall thickness)
  - Process Path (distance from wall to source well
  - Max Density reading





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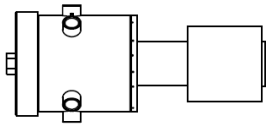
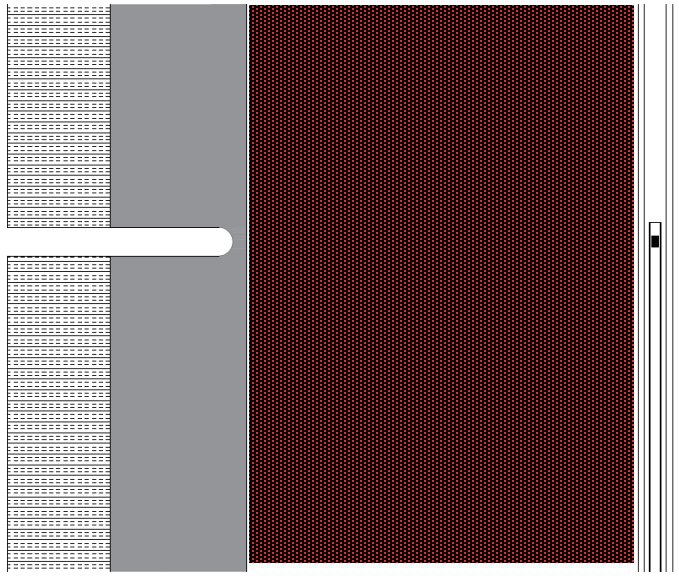
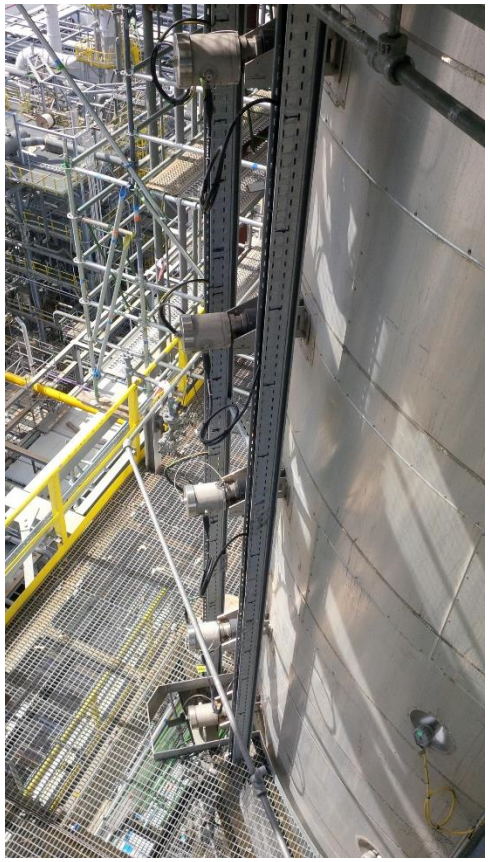
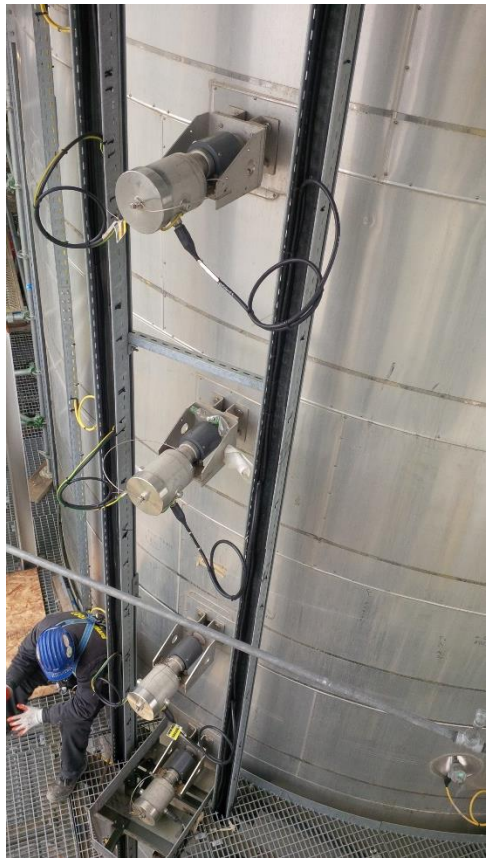
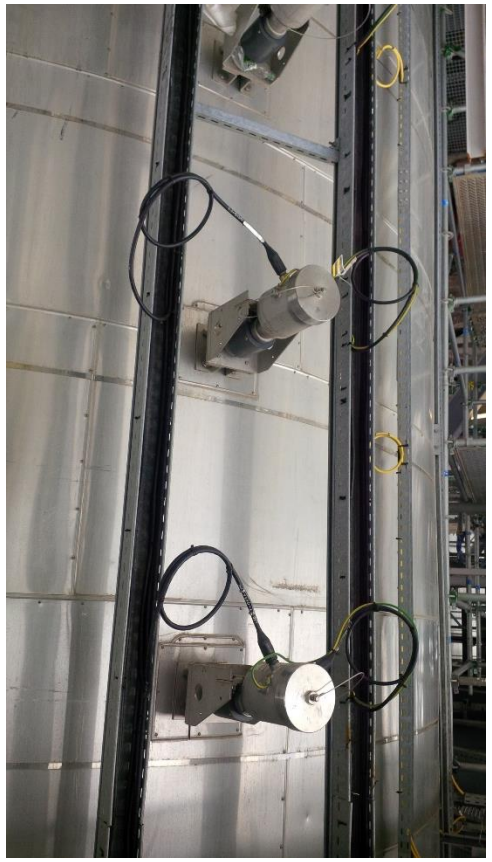




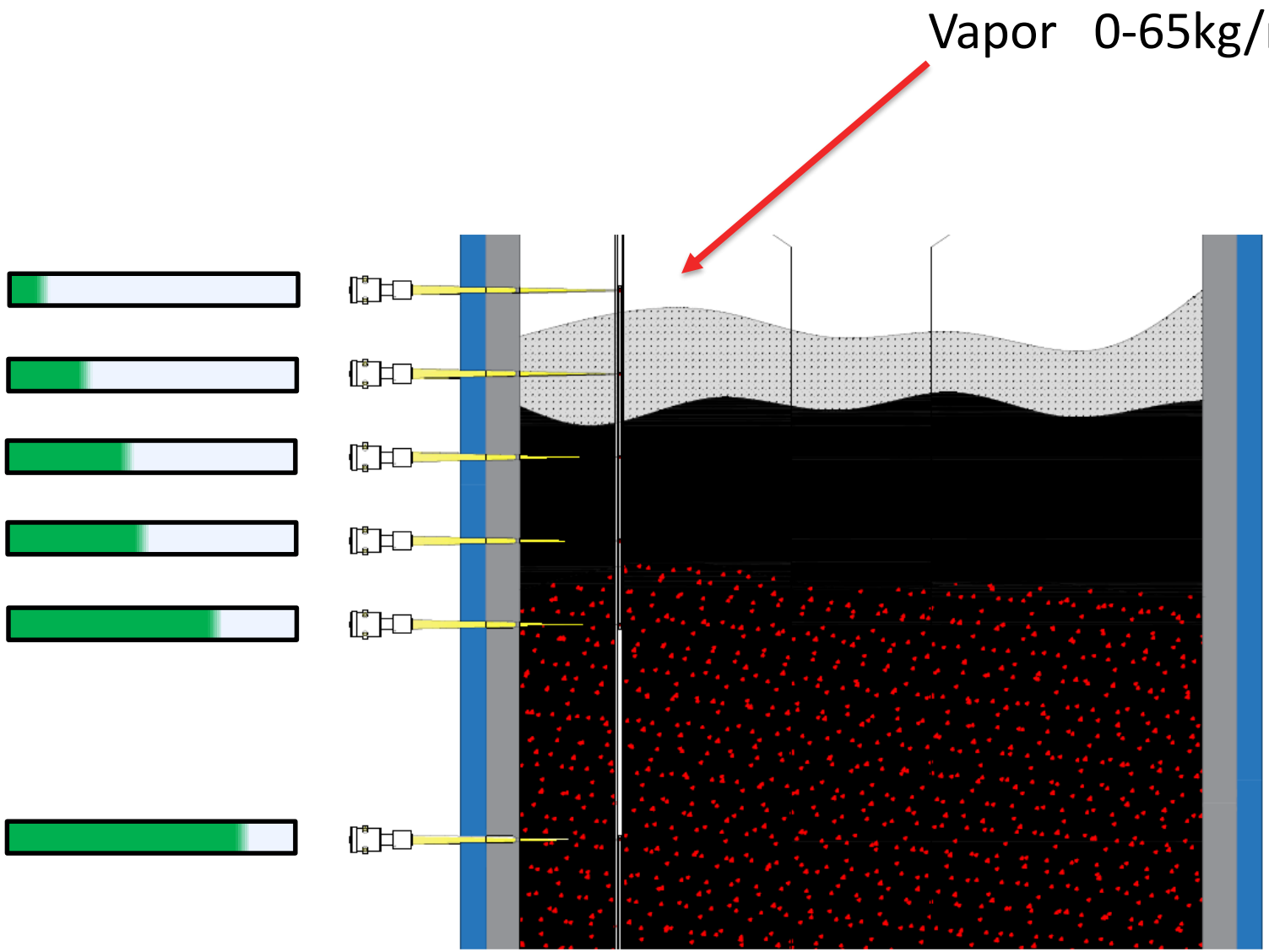


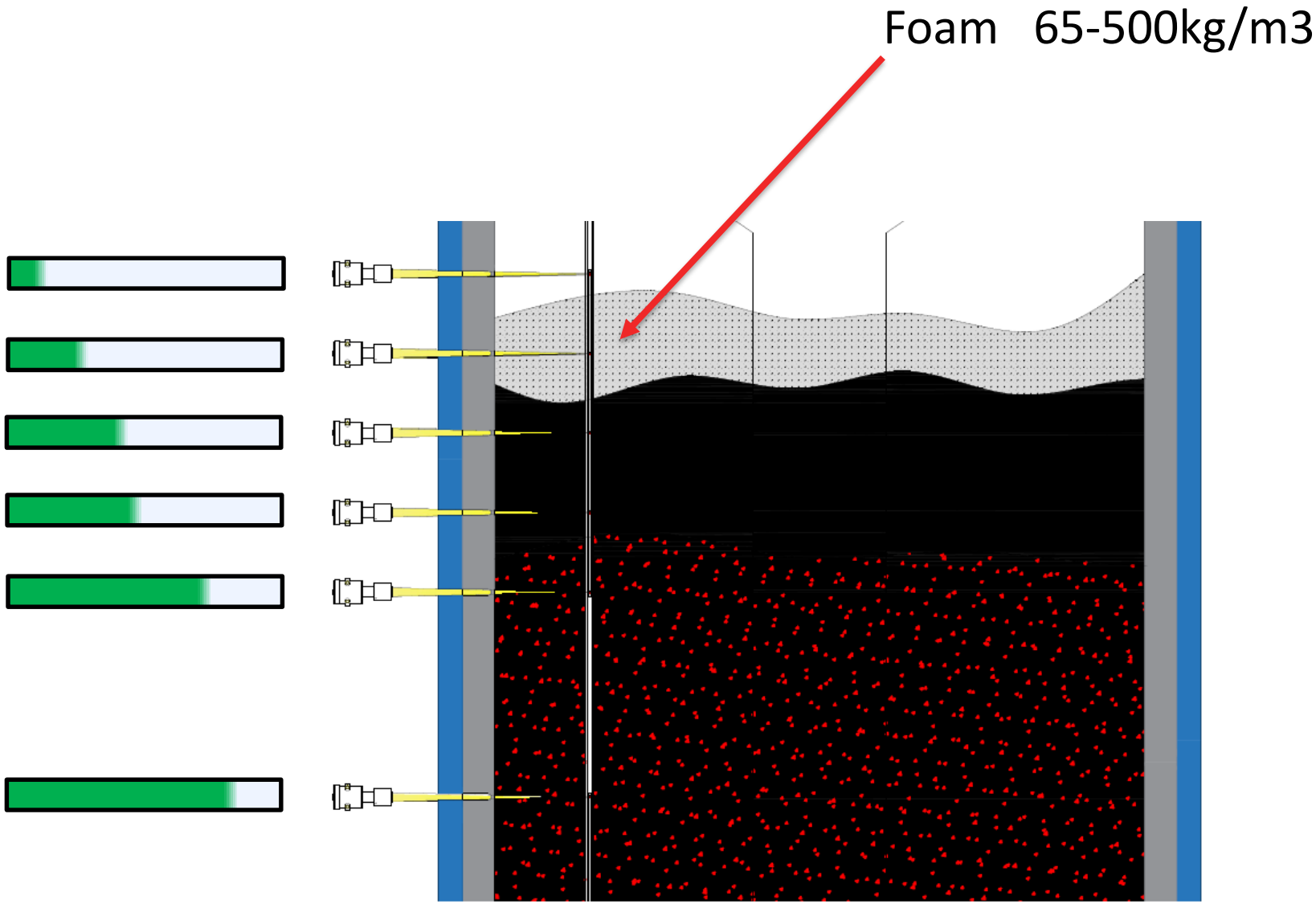


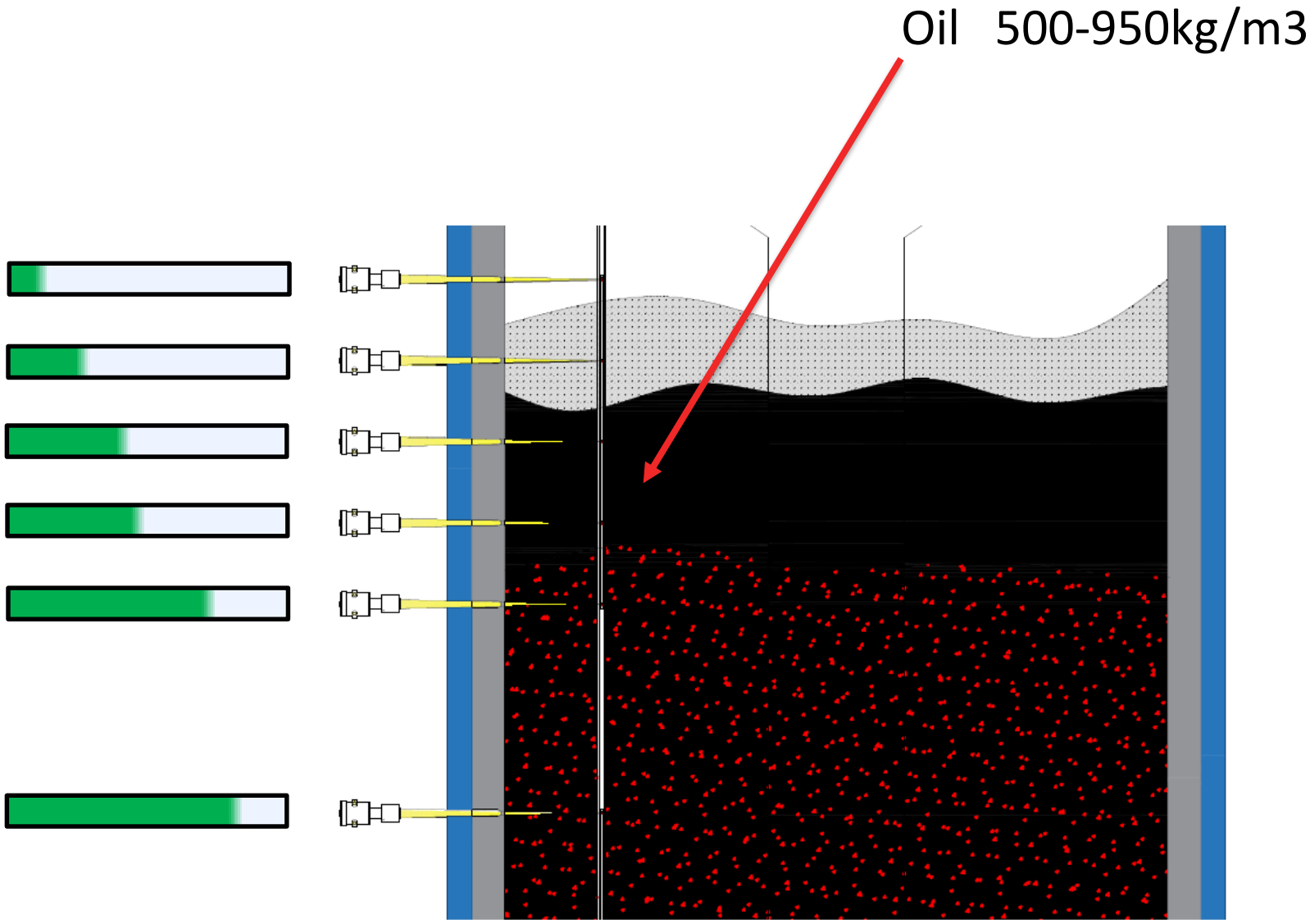


Typical operating densities

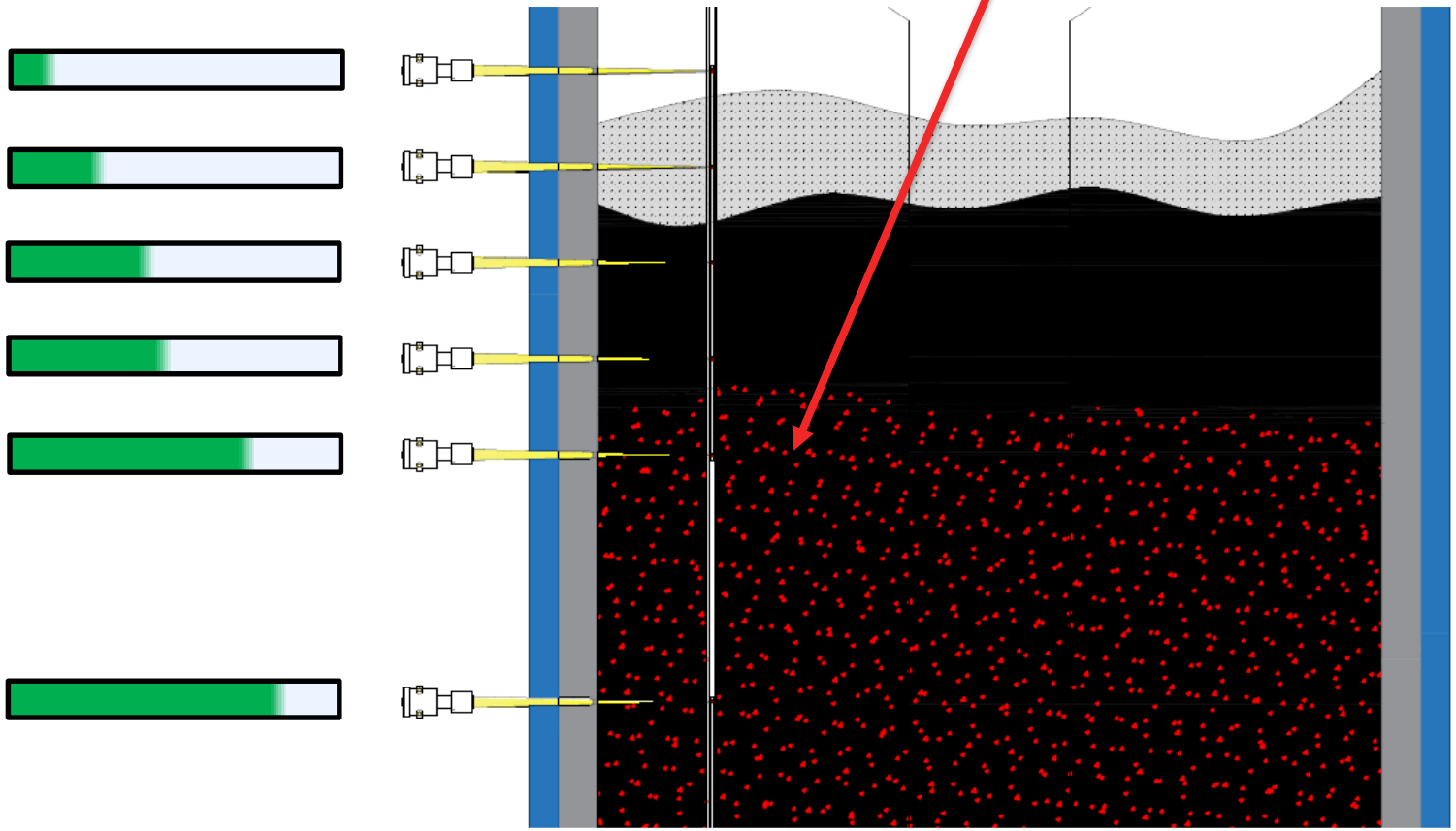
- Bed Density
  - 0-65kg/m3 – Vapor
  - 65- 500kg/m3 – Foam
  - 500-950 kg/m3 – hydrocarbon liquid
  - 800-1200kg/m3 – hydrocarbon liquid and catalyst (ebulliated/suspended)
  - 1200-1400+kg/m3 – Slumped bed

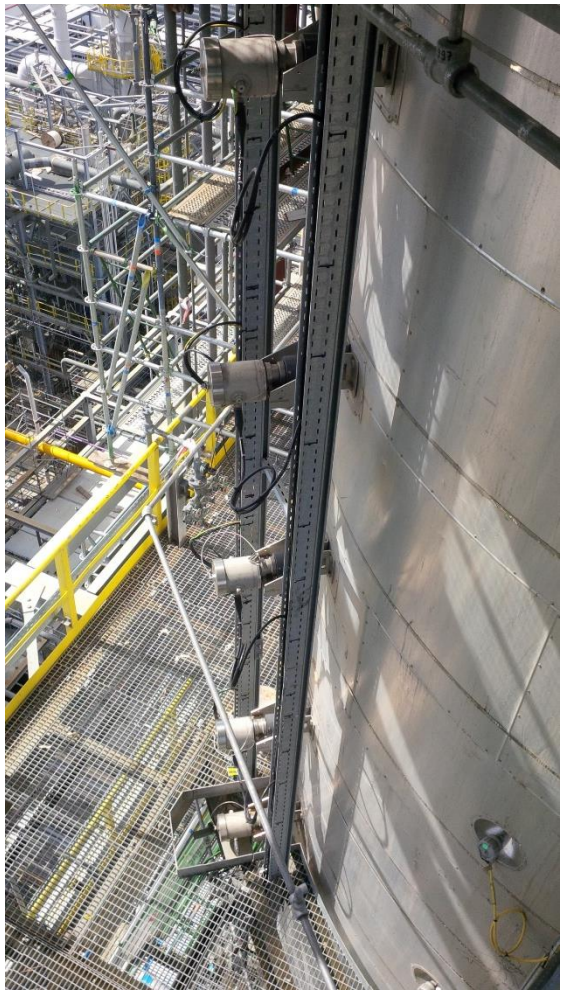

Vapor 0-65kg/m3


Foam 65-500kg/m3

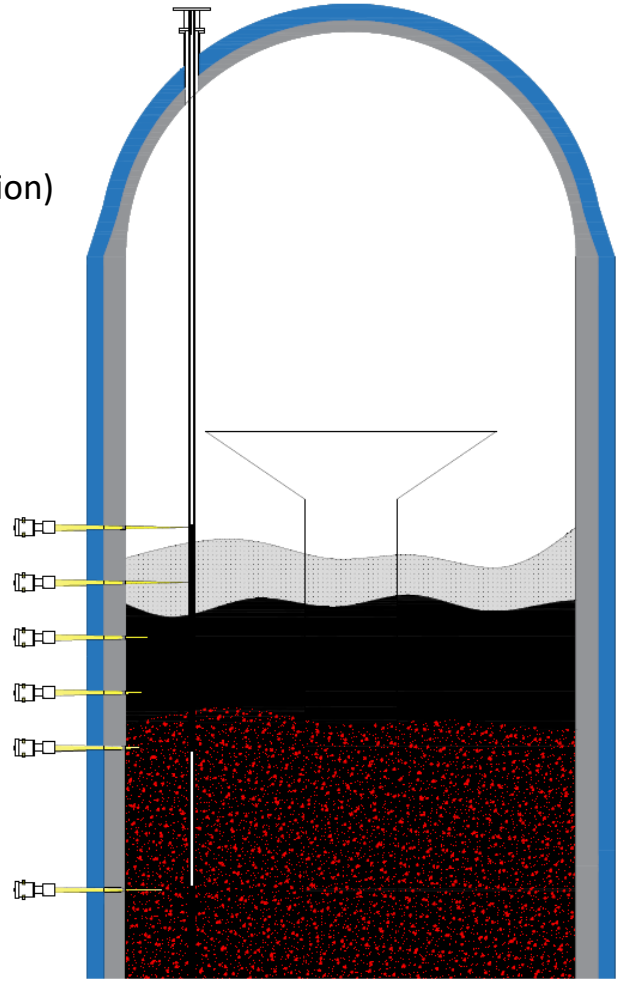

Oil 500-950kg/m3

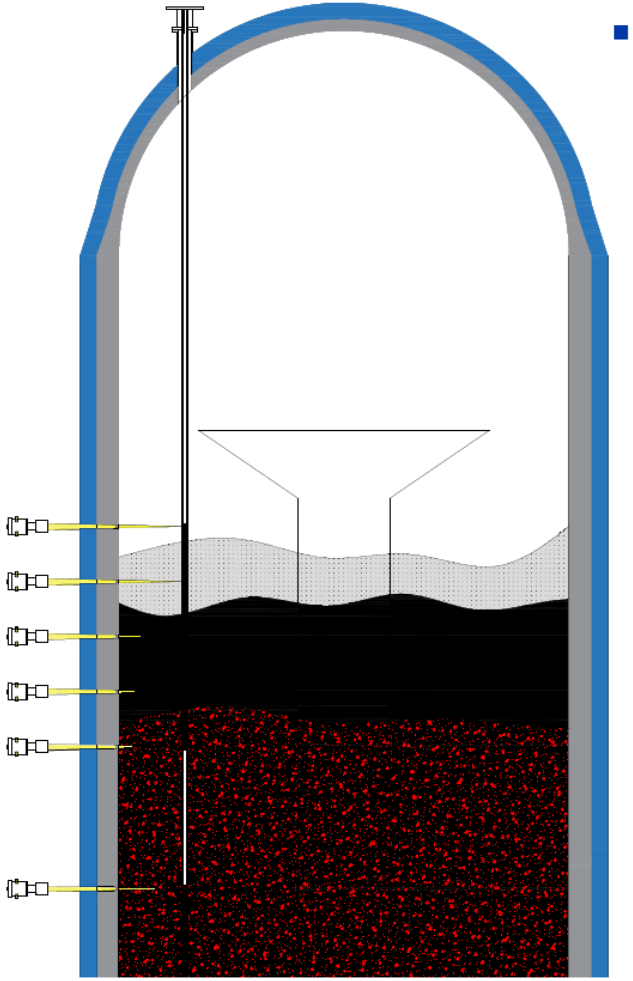
Oil/Catalyst 950-1600kg/m3



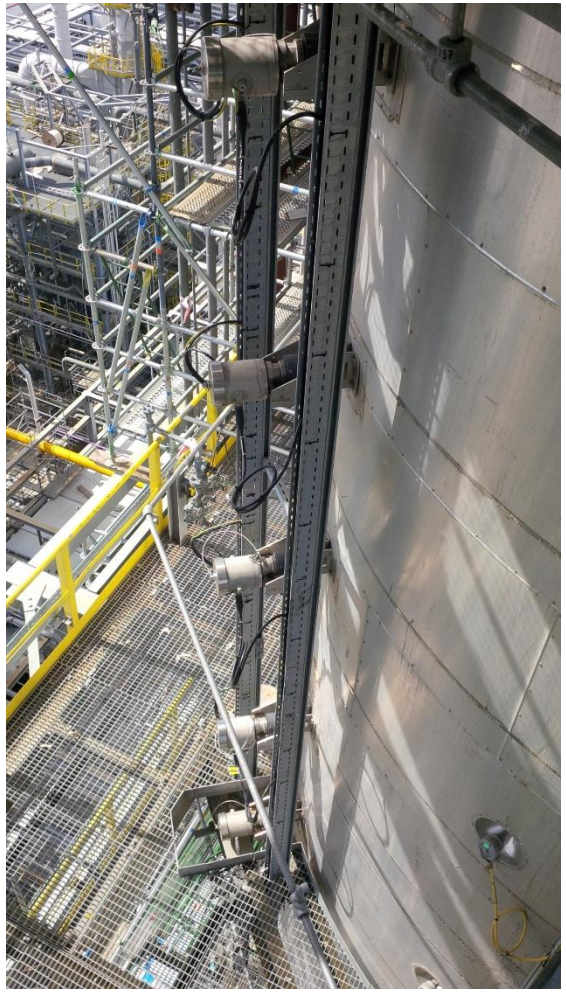


- Level Control
  - Too Low
    - Slumping of the bed (bed compression)
    - Poor distribution of catalyst
    - Can create “hot spots”
  - Too High
    - Catalyst carryover
    - Pump damage
    - Long repair time





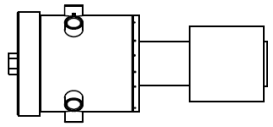
- Advance Controls
  - Vapor/Solids Holdup Calculations
    - Increased Unit Performance
    - Increased Unit Reliability
  - Needs Better Resolution

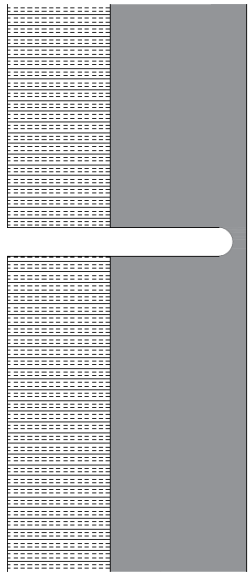


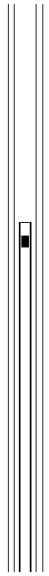
Making Density Measurement

Parameters - Fixed

- Distance from Detector to Vessel wall
- Insulation Thickness
- Process Path
- Source well thickness
- Distance from source to well wall







Making Density Measurement

Parameters - Variable

- Process Density
  - Calculate Absorption

$$\Delta I = e^{-\mu \Delta \rho t}$$

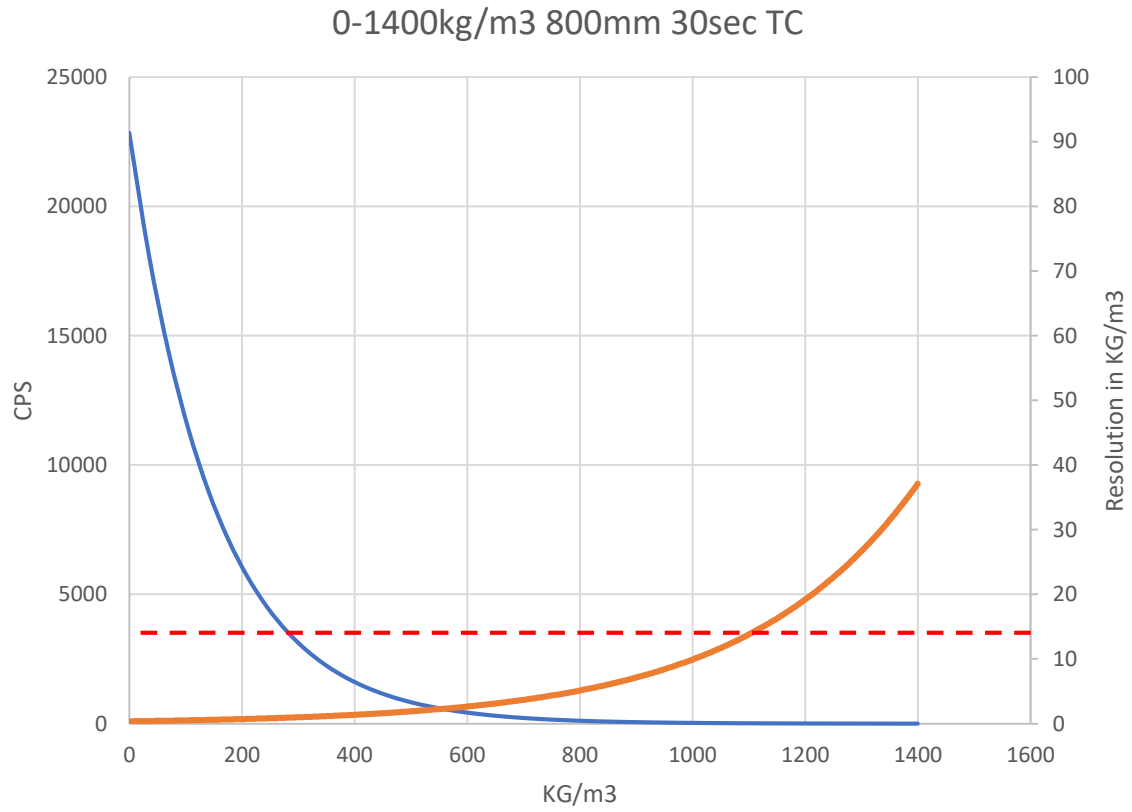
μ = Absorption Coefficient

ρ = Material Density

t = Material Thickness

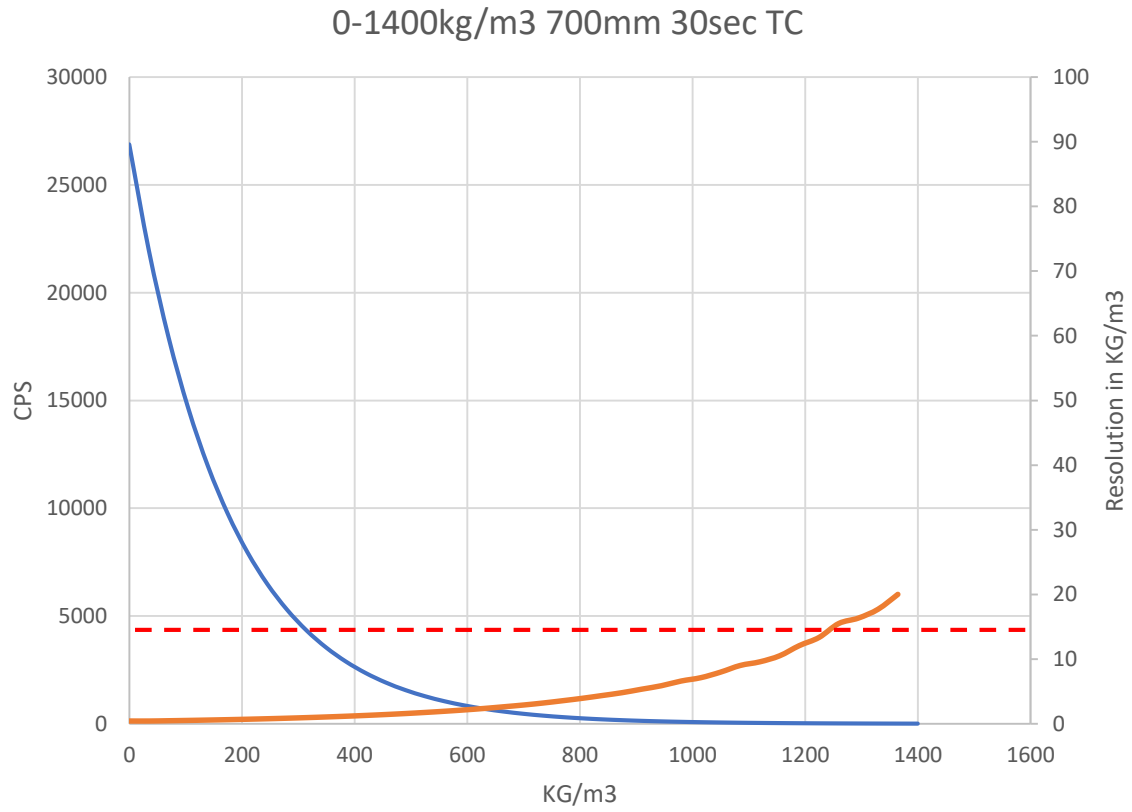
Making Density Measurement

- Density span – 0-1400kg/m3
- Source Size – 1000mCi Cs-137
- Process Path – 800mm



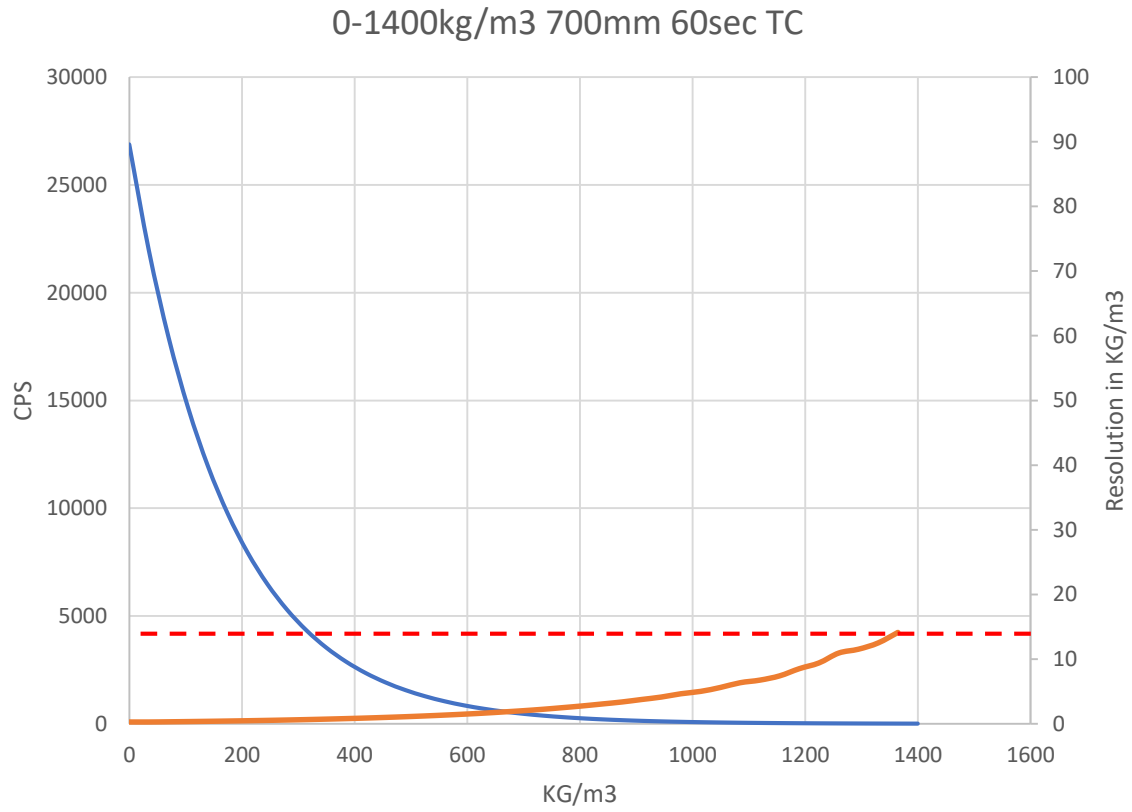
Making Density Measurement

- Density span – 0-1400kg/m3
- Source Size – 1000mCi Cs-137
- Process Path – 700mm

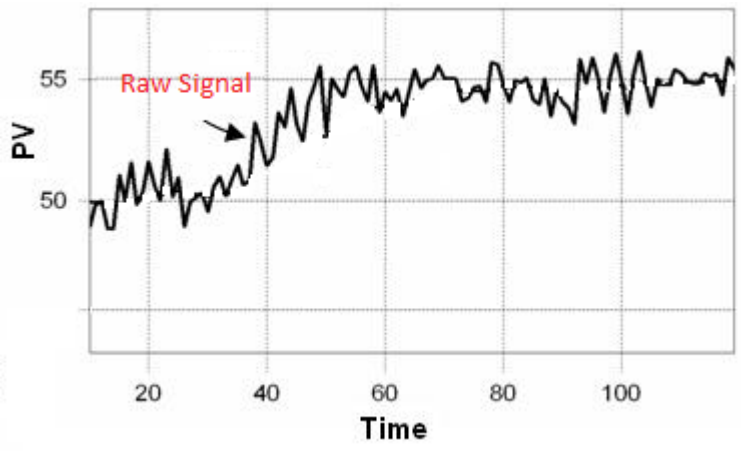


Making Density Measurement

- Density span – 0-1400kg/m3
- Source Size – 1000mCi Cs-137
- Process Path – 700mm



Filtering



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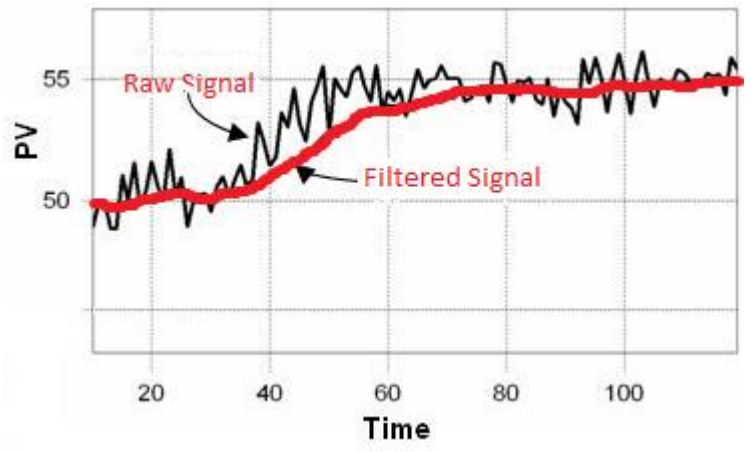

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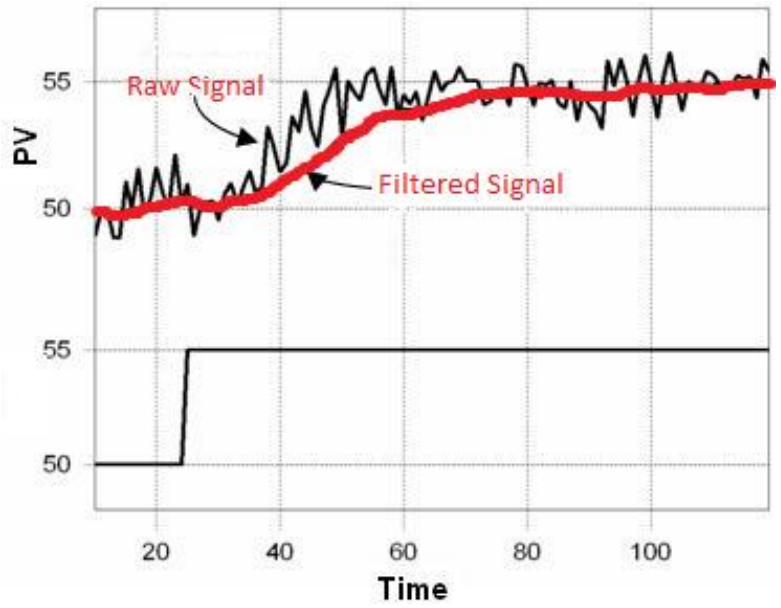
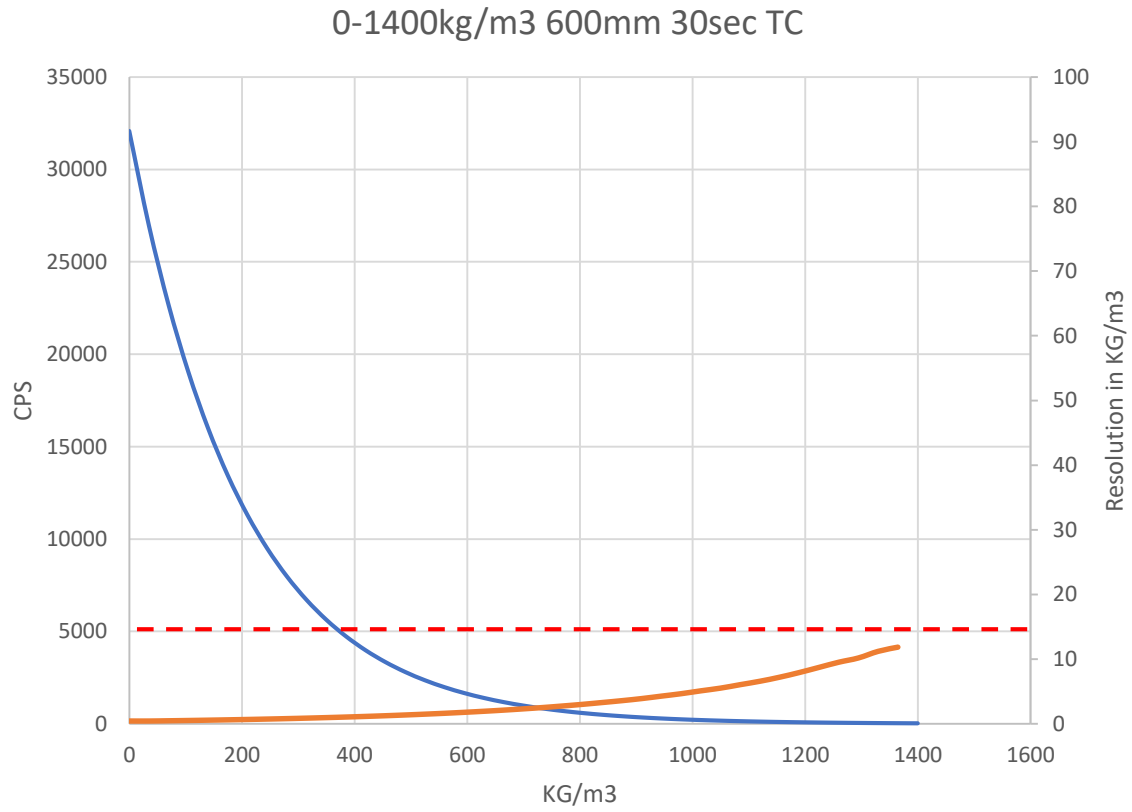


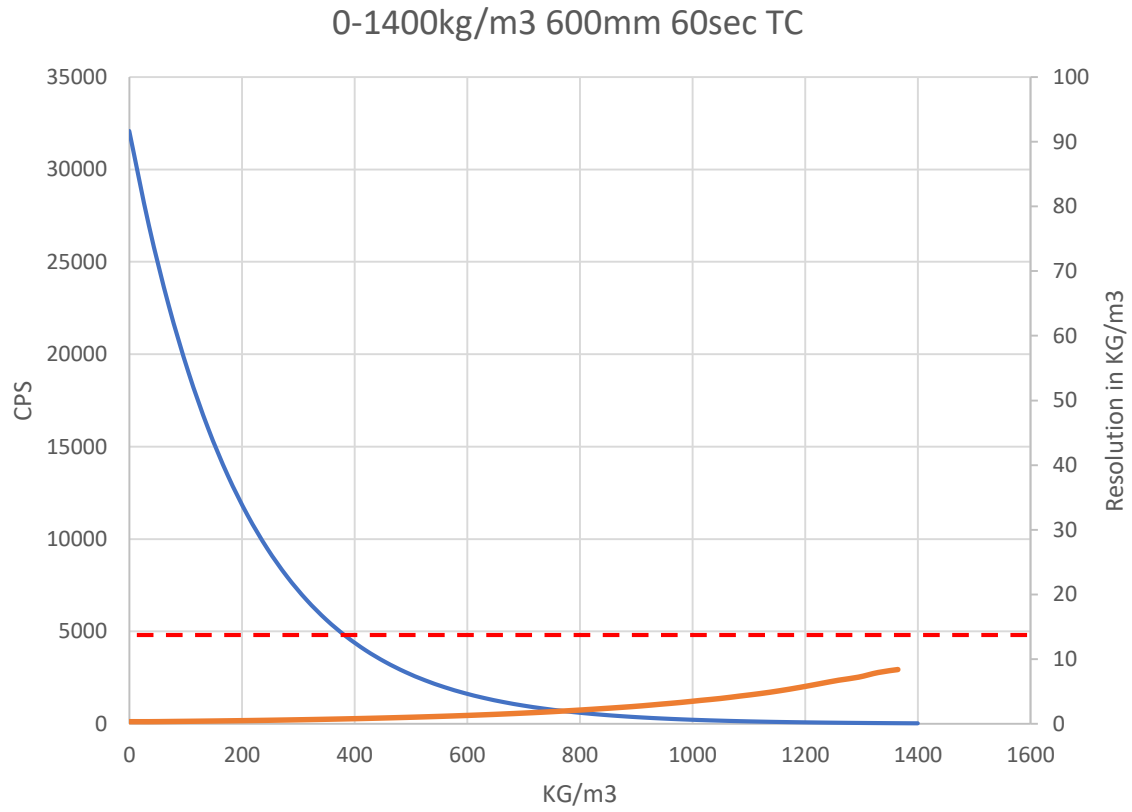
Making Density Measurement

- Density span – 0-1400kg/m3
- Source Size – 1000mCi Cs-137
- Process Path – 600mm



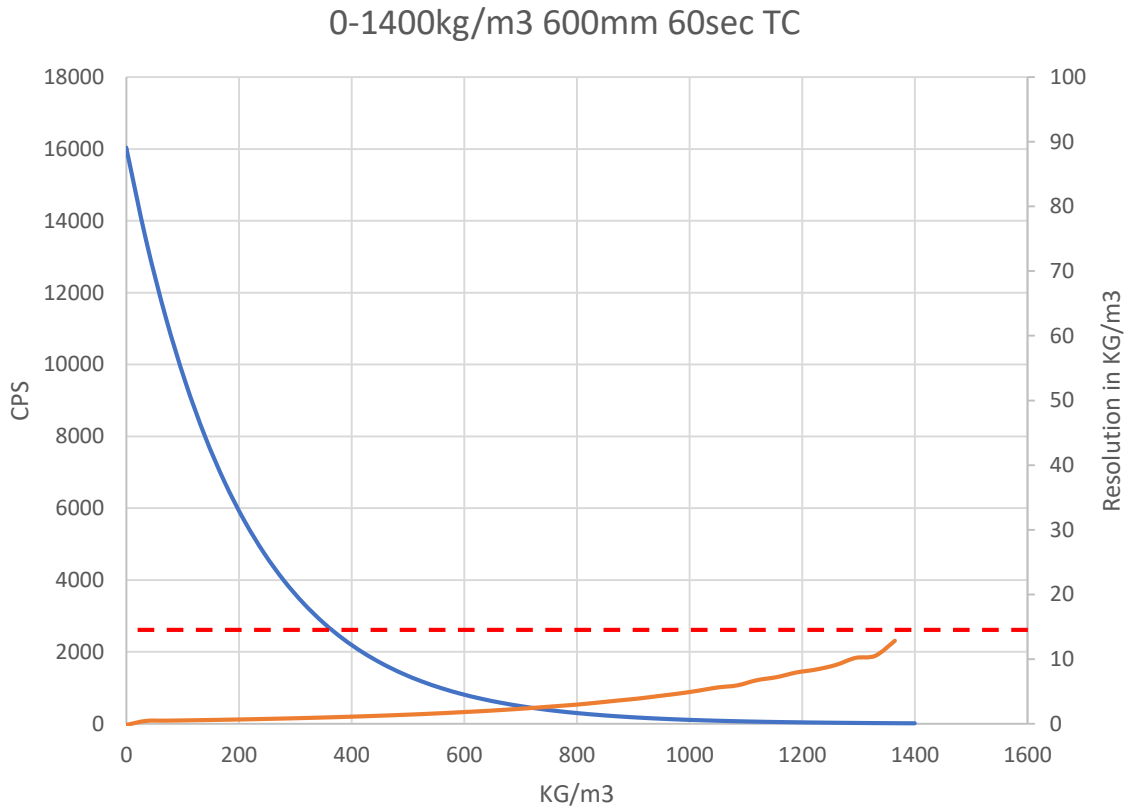
Making Density Measurement

- Density span – 0-1400kg/m3
- Source Size – 1000mCi Cs-137
- Process Path – 600mm



Making Density Measurement

- Density span – 0-1400kg/m3
- Source Size – 500mCi Cs-137
- Process Path – 600mm



- Parameters effecting density measurement
  - Process path (fixed)
  - Density range (fixed)
  - Size of Source
    - Increased source to increase resolution/decrease time constant
  - Increase Time constant
    - Increased Time constant to increase resolution, but delays reading
  - Detector Sensitivity
    - Higher sensitivity is the same as increasing the source size.
    - Increased Resolution/decerease time constant/reduce source size or keep existing sources

Thank you for your attention!!!!

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