Continuous level measurement on coke drum in DCU

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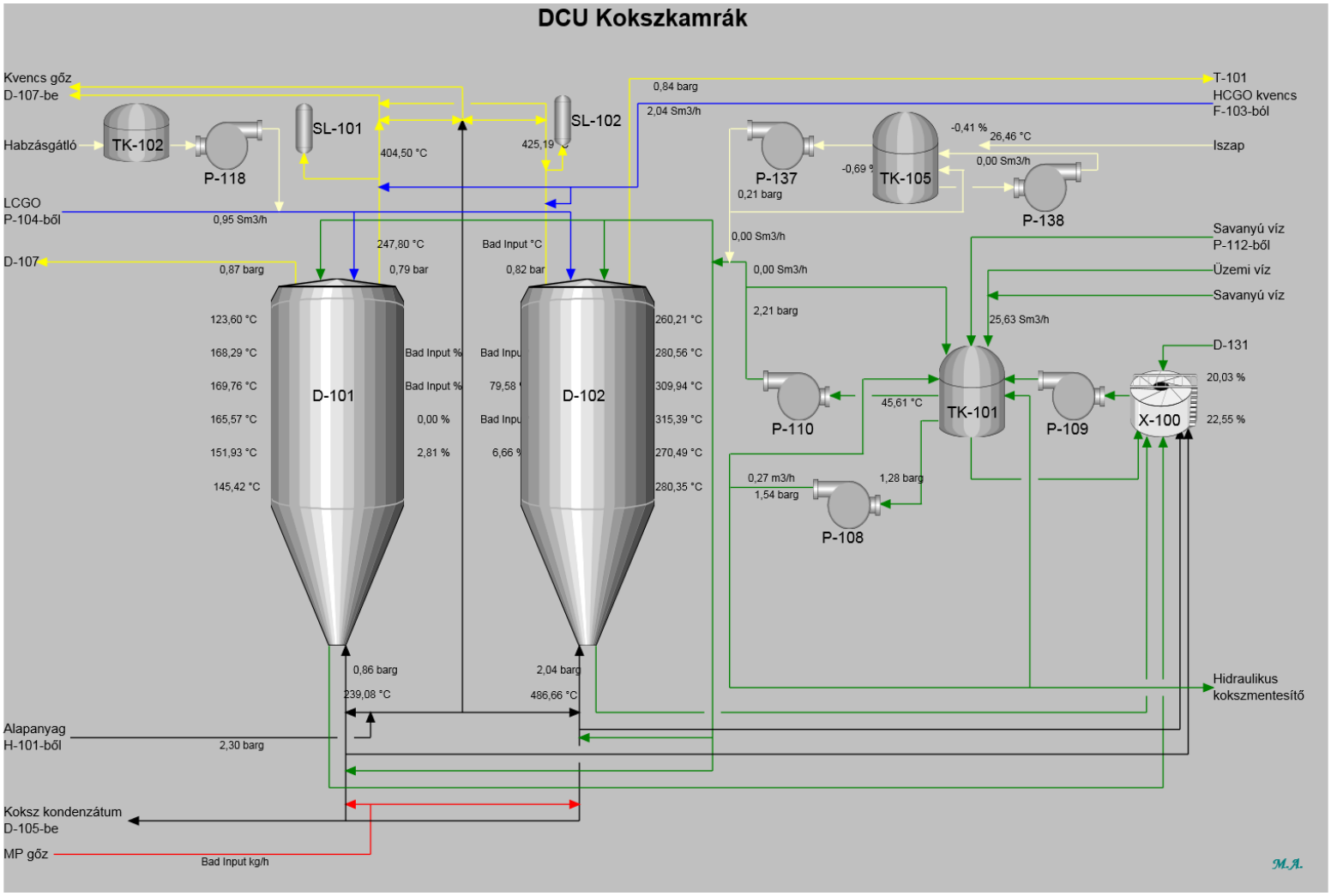


Technological background 1)

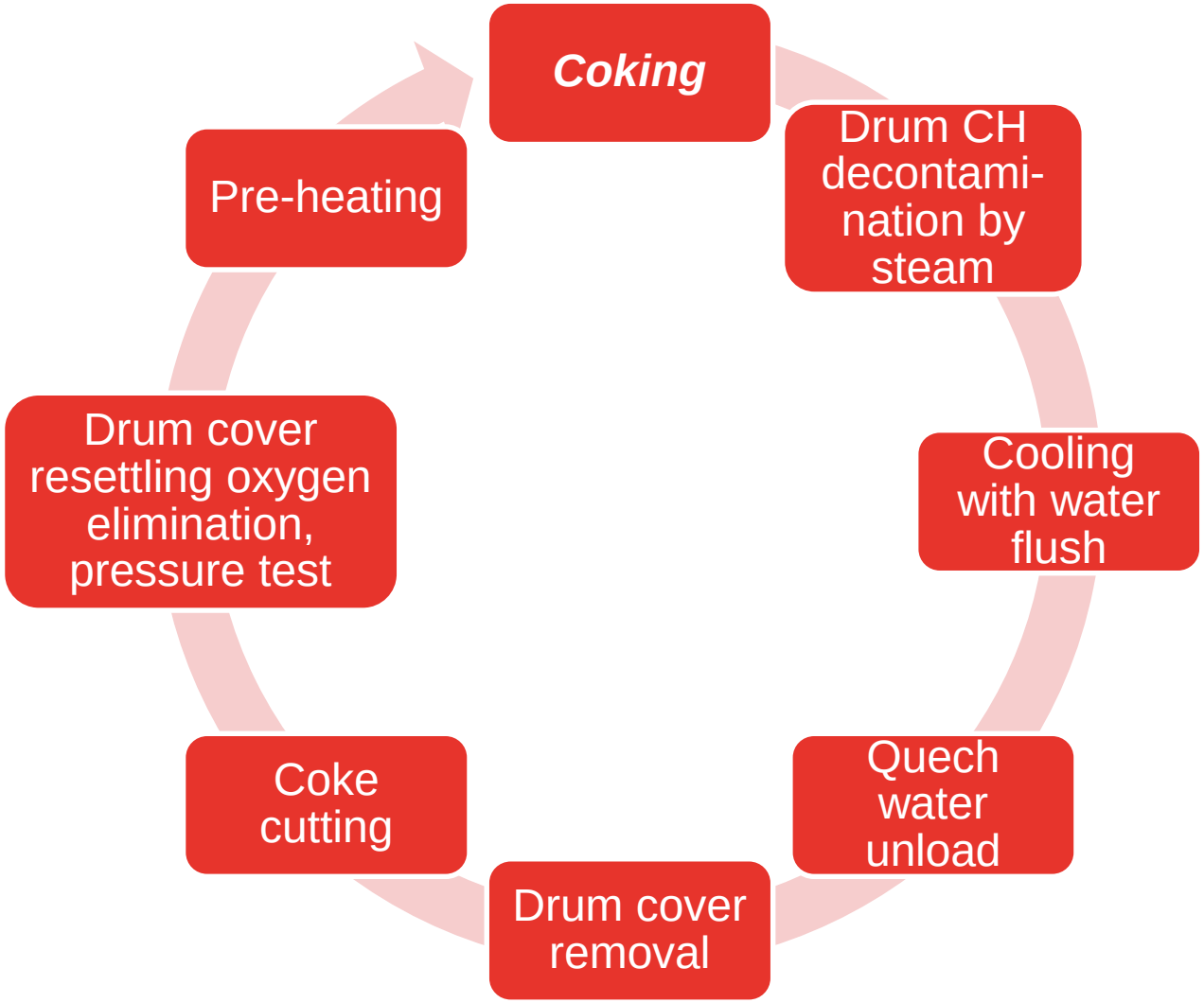
DR	Unit commissioned in 2001
Delayed Coker Unit	Technology licensor is Foster Wheeler
	Refinery product portfolio showed a robust change, light product ratio increased with 15%
	Feedstock: 1Mt/year vacuum residual with high sulphur- and heavy metal content
	Relatively lower quality products requiring desulphurisation technologies
	Unit processes FCC C3 compound as well
	Unit is equipped with steam turbine and CH sludge treatment

Technological background 2)

Unit areas

- Feedstock system
- Coking including furnace, coke drums, main fractioning, blow-off, slugde treatment, coke cutting
- Gas separation
- C3/C4 sweetener (Merichem)
- Amine regeneration
- Amine cleaning
- Sour water stripper
- Coke storage and logistics
- Flare
- Steam turbine and generator

Technological background 3)- Coking process phases



Conversation reactions

- No exact reactions can be discussed
- The next three main steps are known
- Feed passing furnace tubing is partially evaporated and mildly cracked (viscosity cut)
- CH vapor passing coke drum is cracked ahead
- Liquid trapped in coke drum is converted to steam and coke after polymerisation and cracking reactions

Process control background 1)

- Semi-consecutive process
- Switched operation of coke drums
- No catalyst, thermal cracking
- Temperature has to be kept within a short range to maintain VCM and HGI
- Process can be controlled by pressure, recirculation ratio and retention time
- Pressure transmitters on feed streams before and following to drum switching valve
- Drum wall temperature transmitters to check drum swithing phases
- Material layers in drum
  - Gases
  - Foam –separation of gas outlet and liquids
  - Liquid – coking and cracking reactions
  - Coke – fluid phase at the beginning of coking

Drum level supervisory installed at unit commissioning

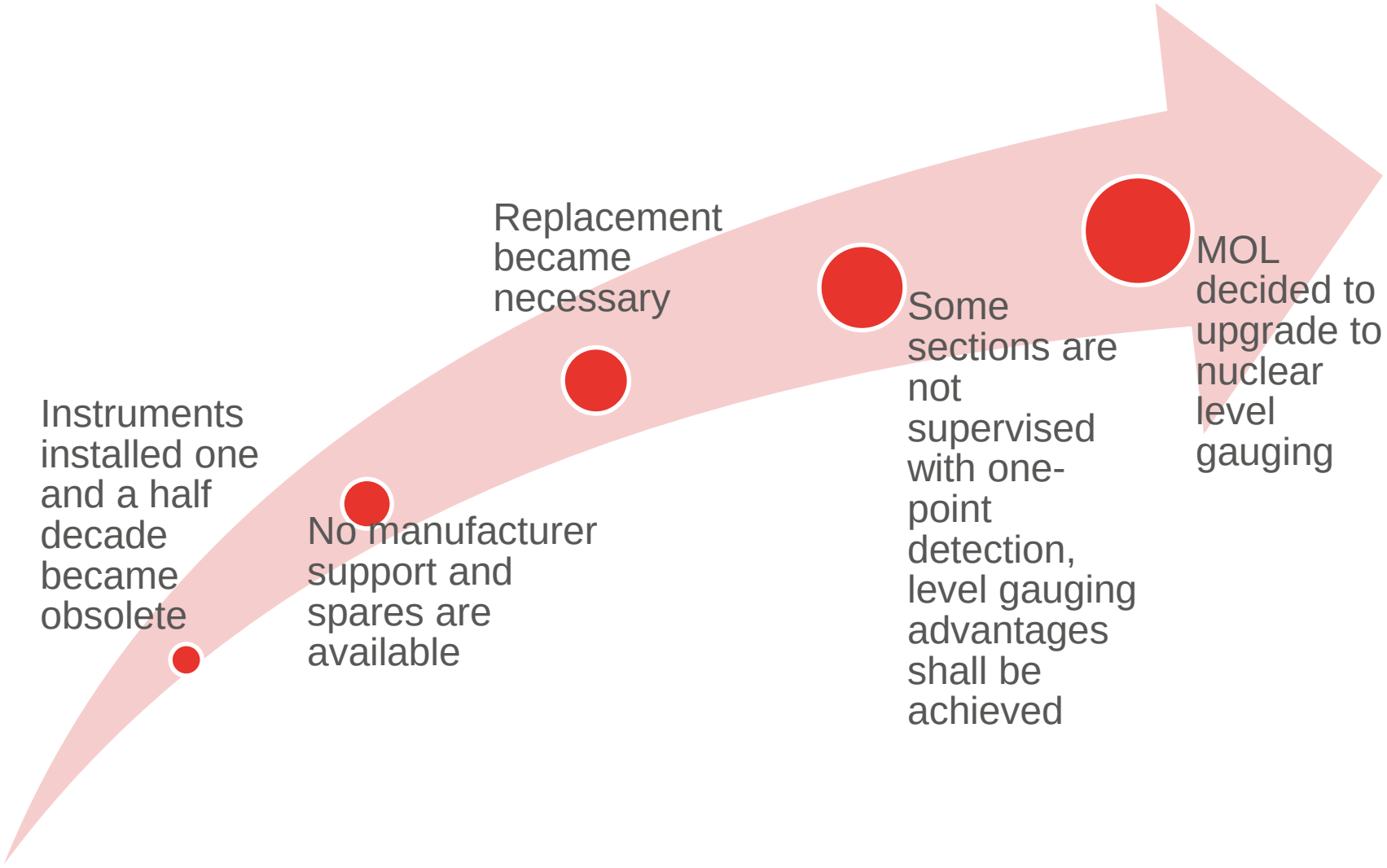
- Four nuclear level switches with vertical installation
- Principle based on different absorbaton of neutron radiation in materials with different hydrogen-content
- Three instrument near to the drum bottom are calibrated to detect coke, water and foam presence
- Fourth level switch is only calibrated for water and foam as coke level can only approach the level of third instrument
- Foam amount is controlled by adding detergent

Process control background 3)

Nuclear level gauging has advantages

- Continuous monitoring of coke and foam amount
- Level increment supervisory, operator intervention, cycle optimization, more adaptive feed quality
- More effective foam detergent amount control
- Cycle time reduction
- Less amount of sour water
- Less cooling and coke cutting needs
- Higher safety

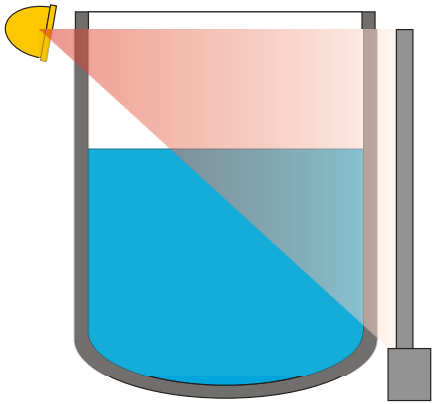
New aim: nuclear level gauging



Basics of measurement 1)

- Gamma radiation
- Scintillation couter detector (polymer or crystal)
- Transmitted intensity is measured: $I = I0 \cdot Exp(-m \cdot r \cdot D)$
- Trapping of scintillation light, transport of light along the scintillator
- Conversion in photomultiplier: light to voltage pulse

Measuring solutions

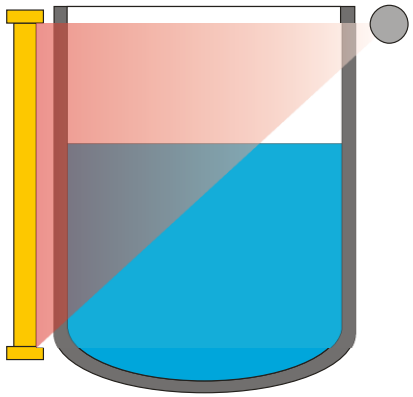


Point source – Rod detector

Most economic

Long measuring ranges

Industry „standard"



Rod source – point detector

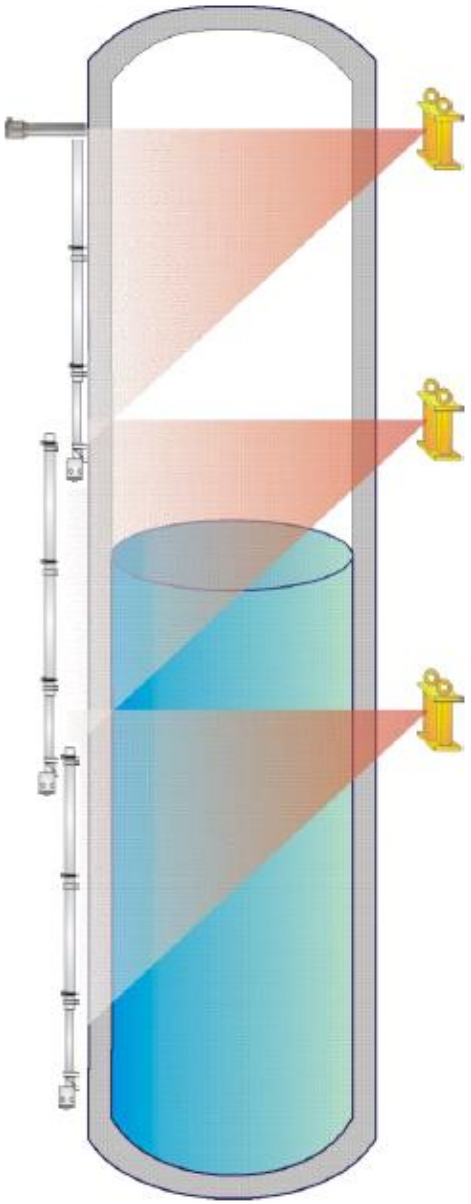
More expensive

Higher accuracy & reliability

Berthold only

Installed solution 1)

- Manufacturer: Berthold
- 3 point sources with one ROD type detectors on coke drum D101
- 3 main detectors with 3x2 pices of additional detector modules and a top level switch
- ***Total lenght of measuring range is 18m of cascade – all time high!***
- LB490-TS „TOWER SENS” level gauging module
- 2000mm scintillation detectors
- LB490-11 detector, NaI 50x50 crystal

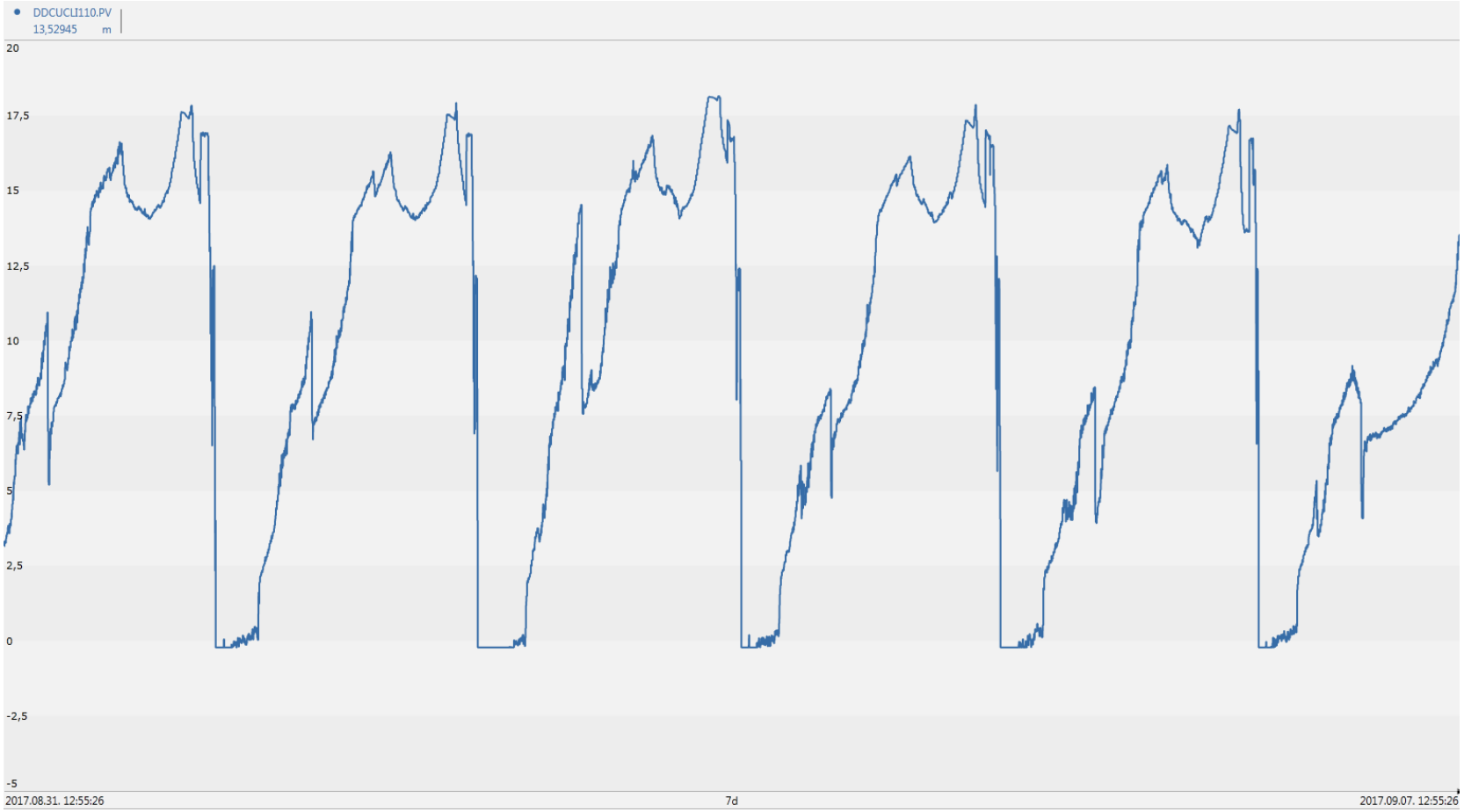


Installed solution 2)

- Cs-137 closed radiation source with 7400 MBq of activity
- 5-15 times less radiation needed compared to flexible detectors
- Automatic compensation of activity decreament
- HART compatibility
- ATEX II 2 GD Ex d IIC T6
- ISO/C 66646 conformity

Experiences of installation and operation 1)

Continuous level measurement on coke drum D101



Experiences of installation and operation 2)

- Challenges of steel support structure arrangement
  - To ensure support for more rigid and large detector
  - To ensure accesibility of source shields for isolation (maintenance)

- Positioning of sources and detectors required high attention due to
  - Banane effect (asimmetric bending)
  - Dilatation
  - Coke drum vibration

- Calibration difficulties
  - It has to be performed by filling up drums with water
  - Strict scheduling caused that calibration had to be performed during unit operation, Filling up with water could be realised during turnaround

- Unit leader and operators are satisfied with solution, installation on D102 drum soon

Thank you for your kind attention!
Do you have questions?