QualyGridS

Unified and Standardized qualifying tests of electrolysers for grid services

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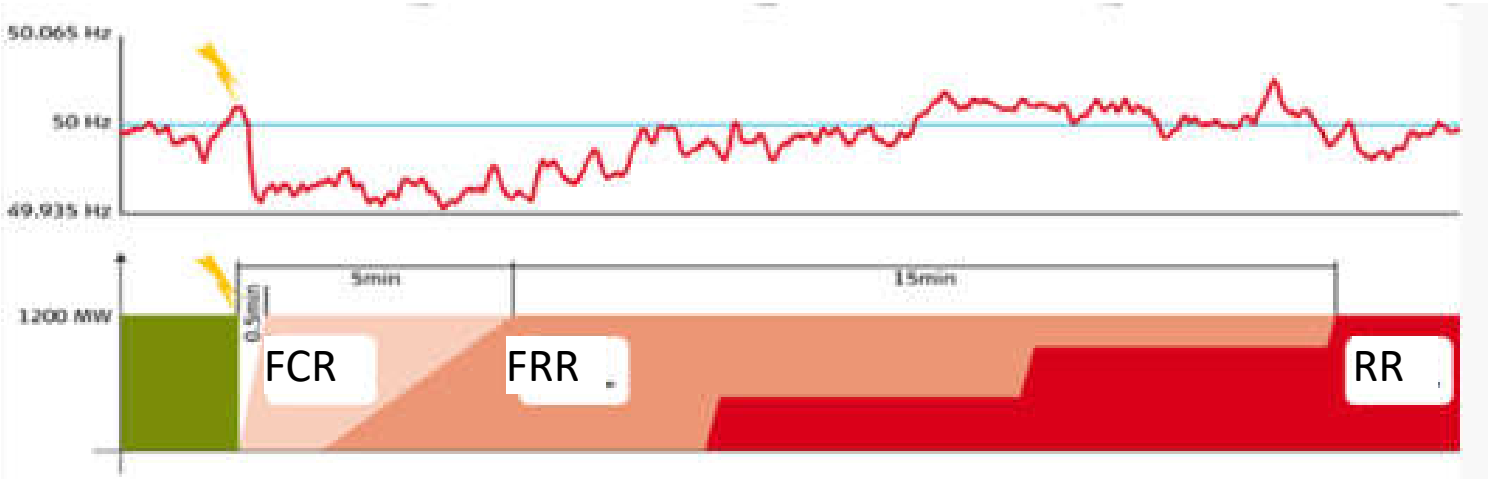
Overview grid services

Most wide spread with best defined technical requirements are TSO services



Recently uniformity of the services improved by COMMISSION REGULATION (EU) 2017/1485 of 2 August 2017 establishing a guideline on electricity transmission system operation

However still differences between countries

We tried to include all, make a generic test

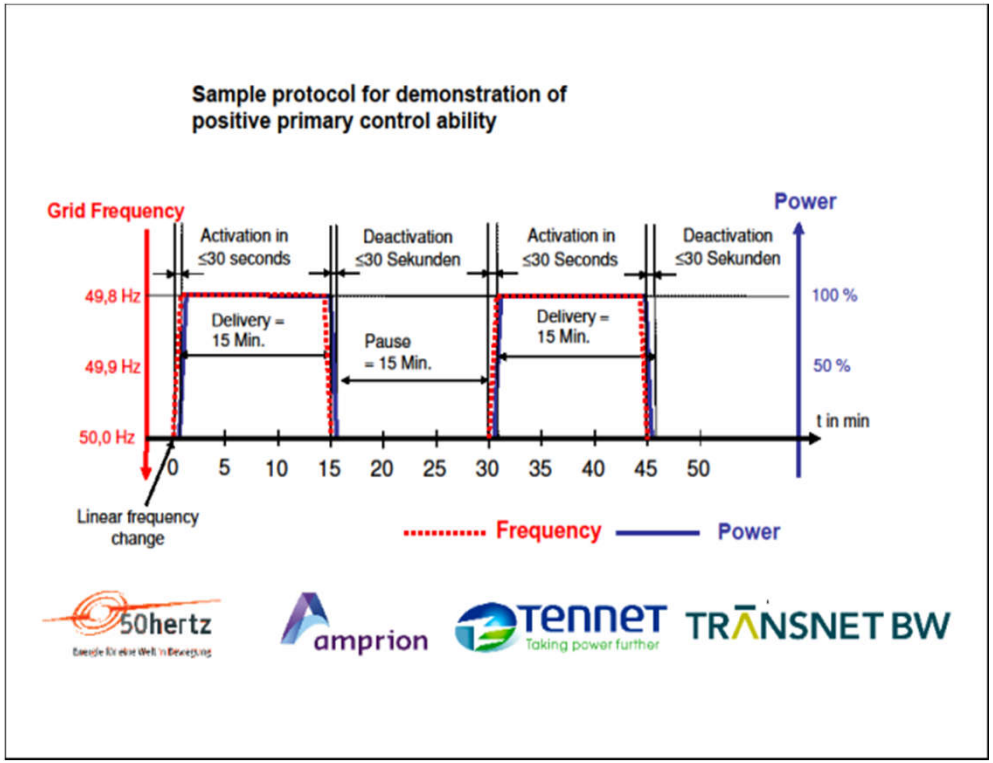
Basic characteristics tests for other services

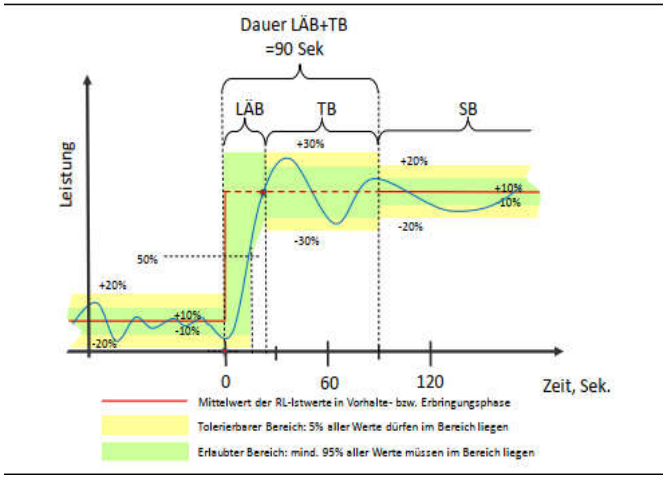
FCR

(Frequency Control Reserve)

Similarities in Prequalifications but differences in pass-criteria between the countries

Germany:





FCR

(Frequency Control Reserve)

FCR France

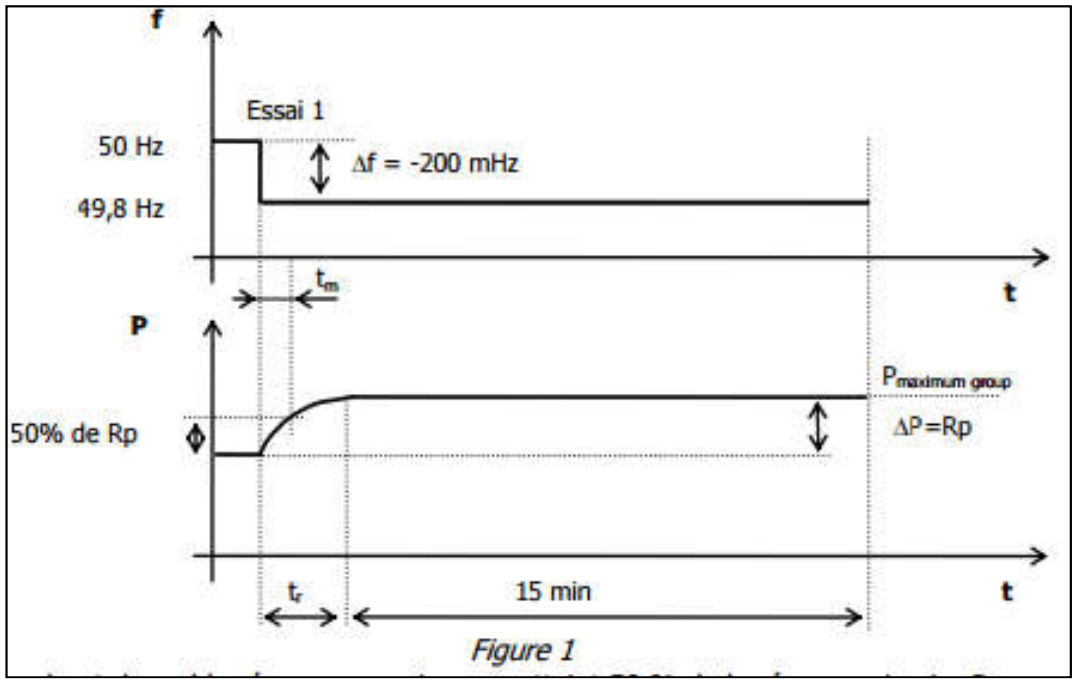


Figure 1

and several other, smaller steps

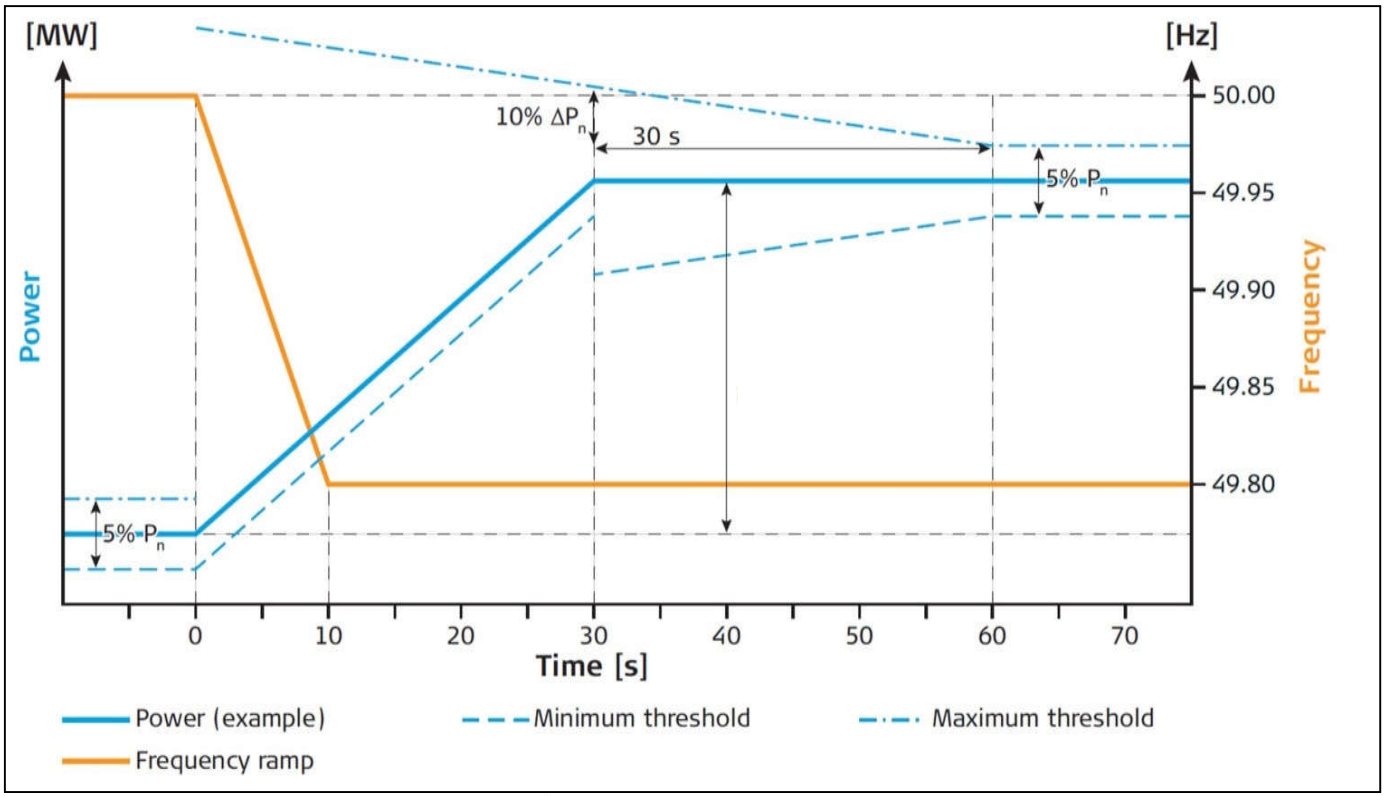
Pass criteria:

- Non oscillating waveform response
- Time t_r < 30 sec
- Time t_m < 15 sec
- The variation $\Delta P = R_p$ maintained for 15 min (after t_r)

FCR

(Frequency Control Reserve)

FCR Switzerland

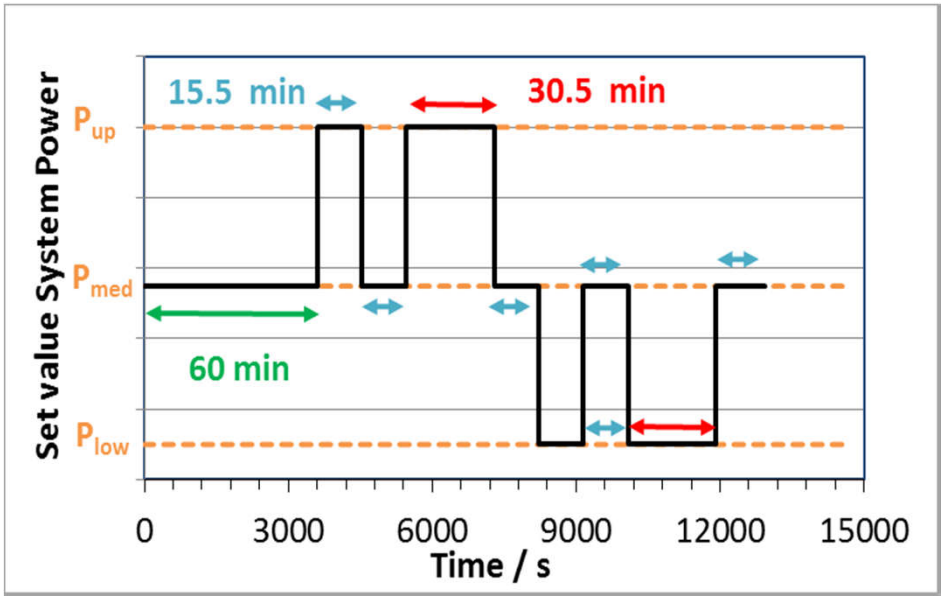


Testing protocols for electricity grid services

Protocols draft worked out for FCR, aFRR, mFRR, RR, both positive and negative.

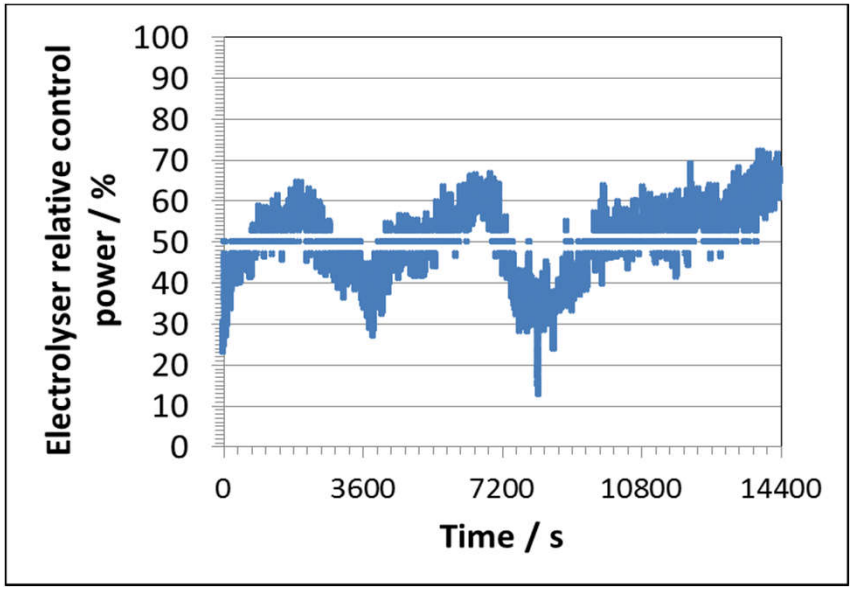
Example: FCR testing Protocol

Protocol first test



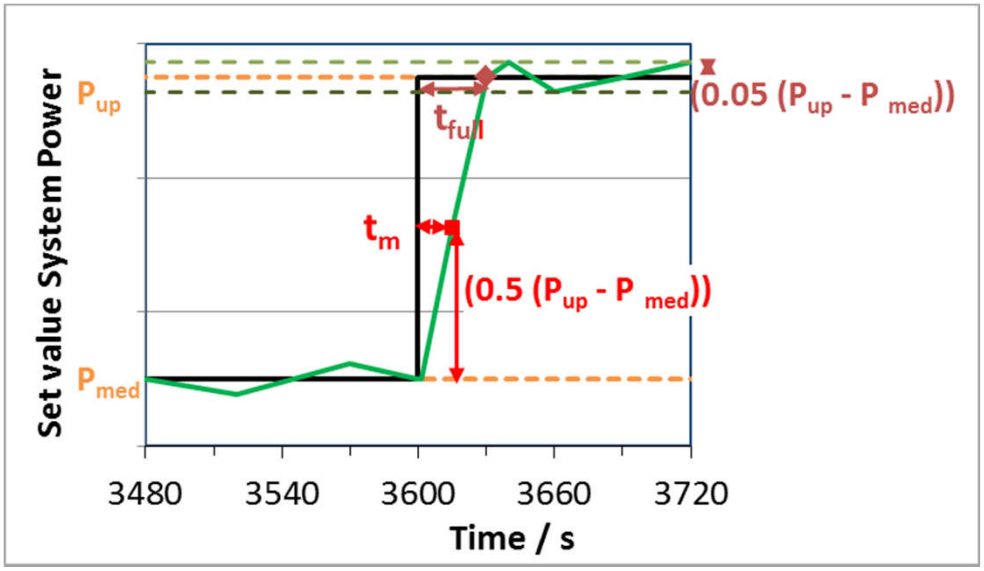
Protocol second test

(based on real frequency profile)



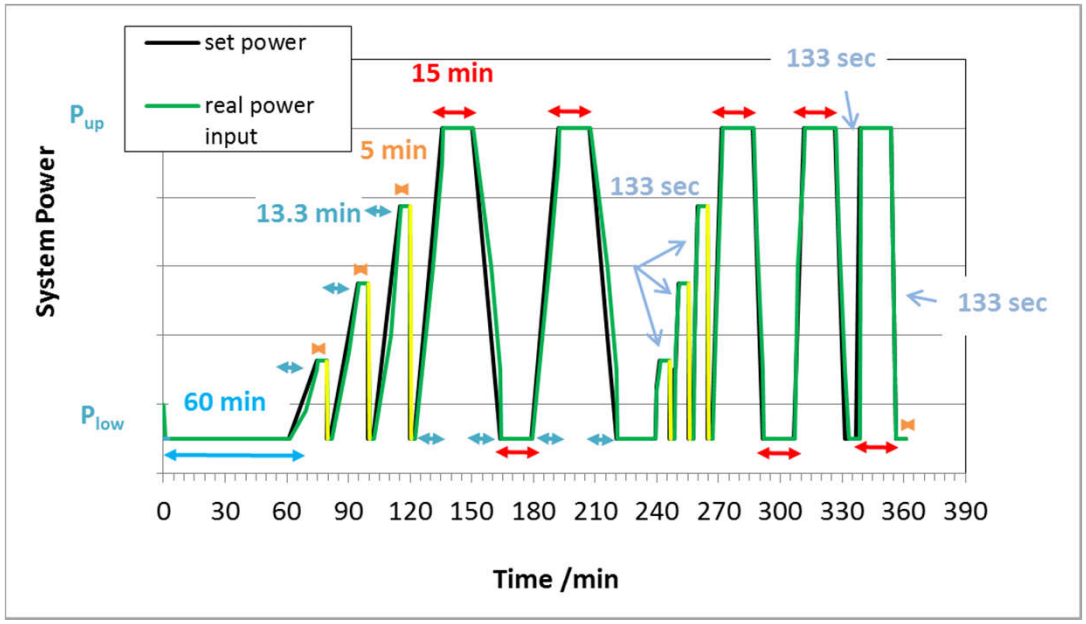
Testing protocols for electricity grid services

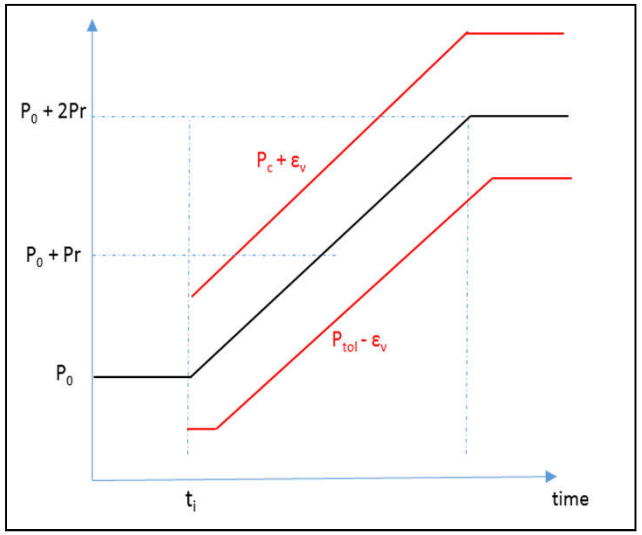
FCR testing protocol
Data evaluation



$t_m \leq 15$ sec
$t_{full} \leq 30$ sec
Initial response time ≤ 1.5 sec
Stability ($\pm 0.05 (P_{up}-P_{med})$)

Testing protocols for electricity grid services - aFRR





Precisely running ramps of different speeds

Testing protocols for electricity grid services – basic characterisation values

- Available Power Range ΔP
- Time to power up t_{up}
- Time to power down t_{down}
- Power stability
- Duration of maximum power
- The Total Response Time Maximum Power to Minimum Power $t_{max->min}$
- Time from nominal to standby state:

  $t_{down\_to\_standy}$

Test protocols verified and electrolyzers qualified

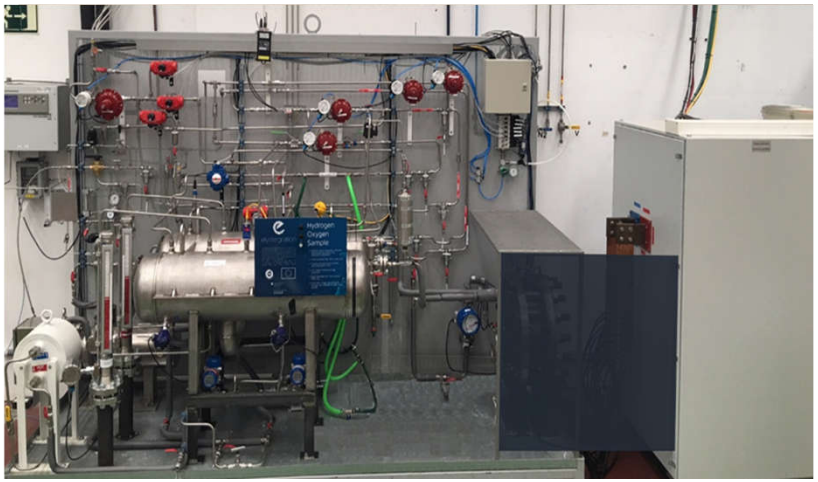
ITM 35 kW PEM electrolyzer operated at DTU

Hydrogenics 50 kW PEM electrolyzer operated at DLR

NEL 300 kW alkaline electrolyzer operated at NEL

IHT 25 kW alkaline electrolyzer at FHA

IHT 120 kW electrolyzer at IHT



Test setup for ITM PEMWE at DTU: FCR first test

Protocol

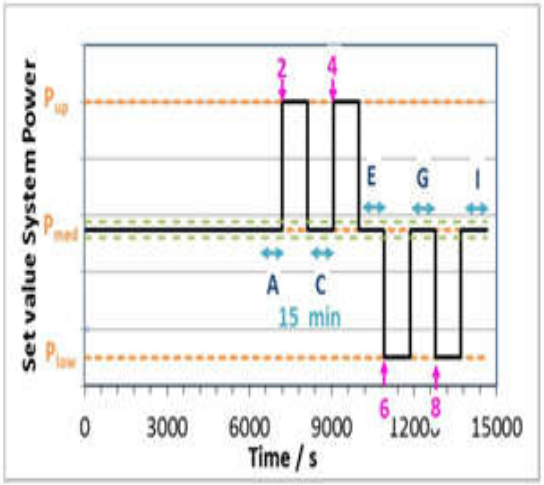


Figure 9 – Illustration of phases A, C, E, G, I for stability evaluation, allowed range for system power during these phases (marked with green dashed line) and steps 2, 4, 6, 8.

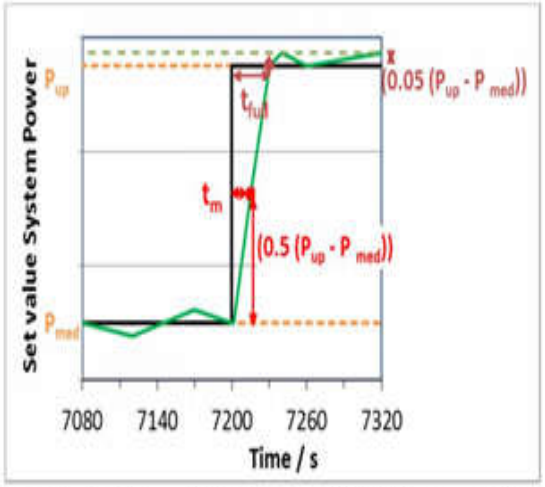
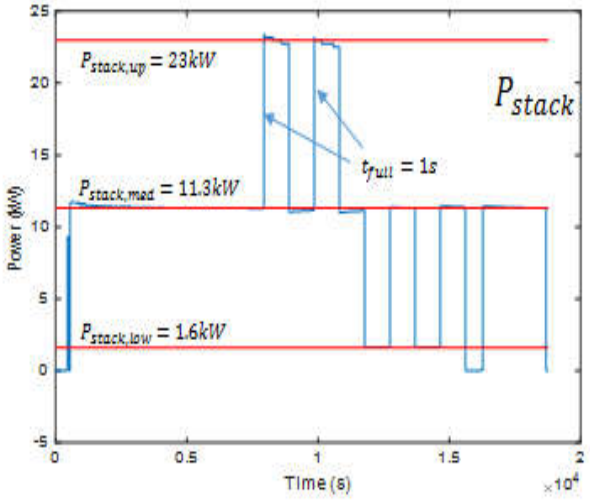
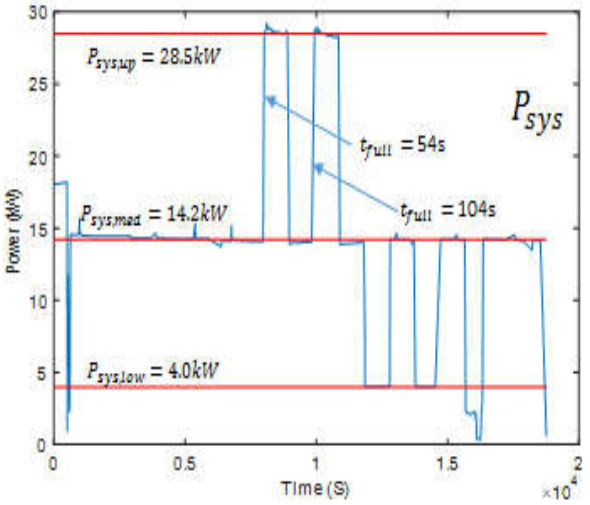


Figure 10 – Illustration evaluation of ramps up. Black full line: power set points, green full line example of real system power

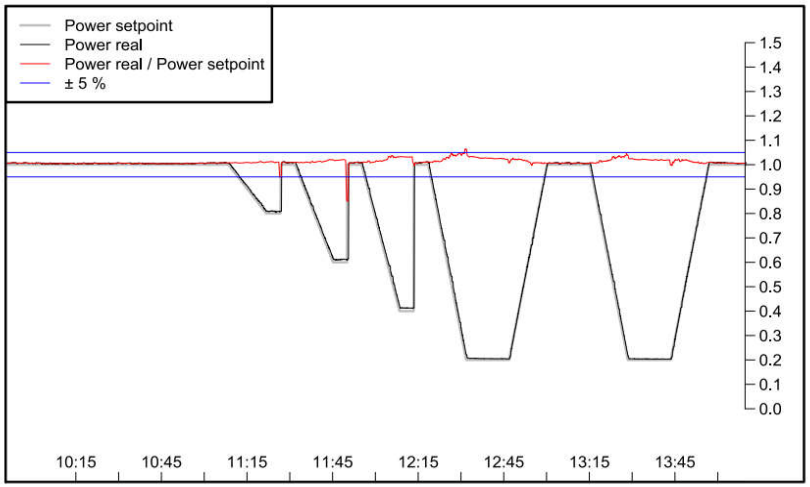
Results

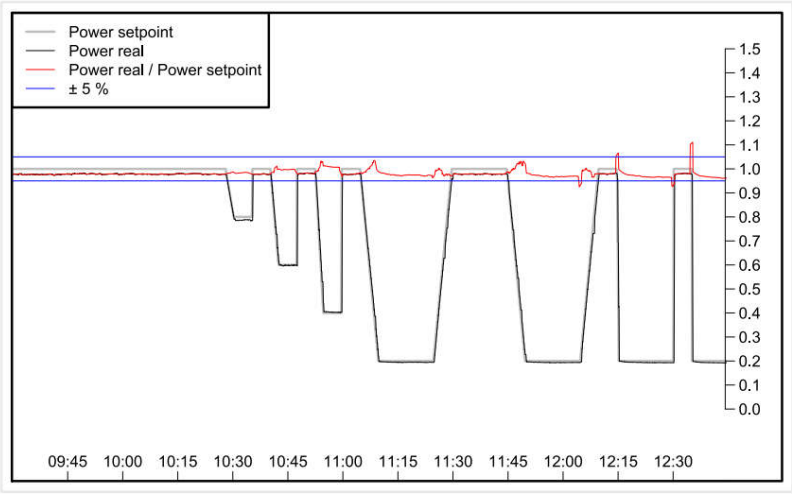




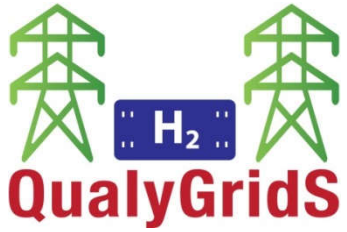
aFRR experimental verification with alkaline electrolyser

NEL 300 kW alkaline electrolyser operated at NEL: state of the art electrolyser as used for refuelling stations but with faster rectifier and pressure controllers





Status Electrolysers for Grid Services



- Can do FCR, aFRR, mFRR
- System adaptations compared to standard product: precise power control, BOP power consumption smoothened or on separate grid connection point

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Thank you

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