

The National HVDC Centre 2019 Operators Forum

26th June 2019

Stephen Hemphill





premier
TRANSMISSION

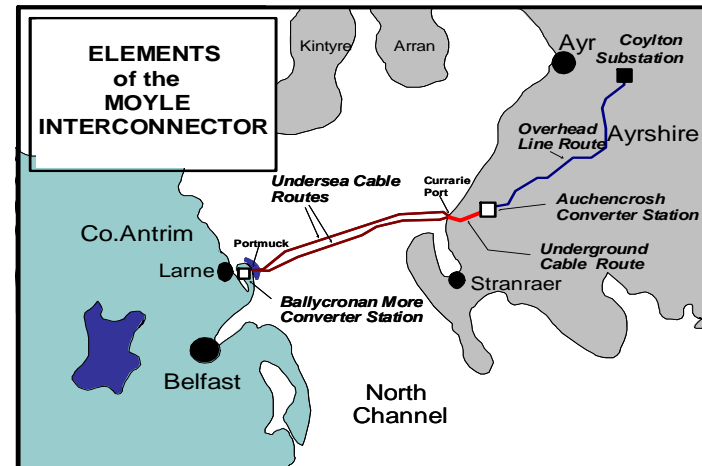
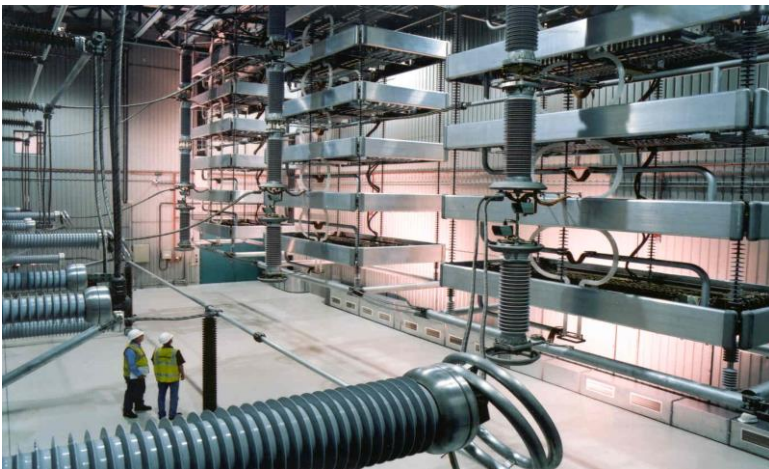
Scotland to Northern Ireland High Pressure natural gas transmission pipeline providing all natural gas to NI & Belfast Gas Transmission Pipeline

 **moyle**
interconnector

500MW HVDC Interconnector providing market link between Irish & GB Electrical wholesale markets

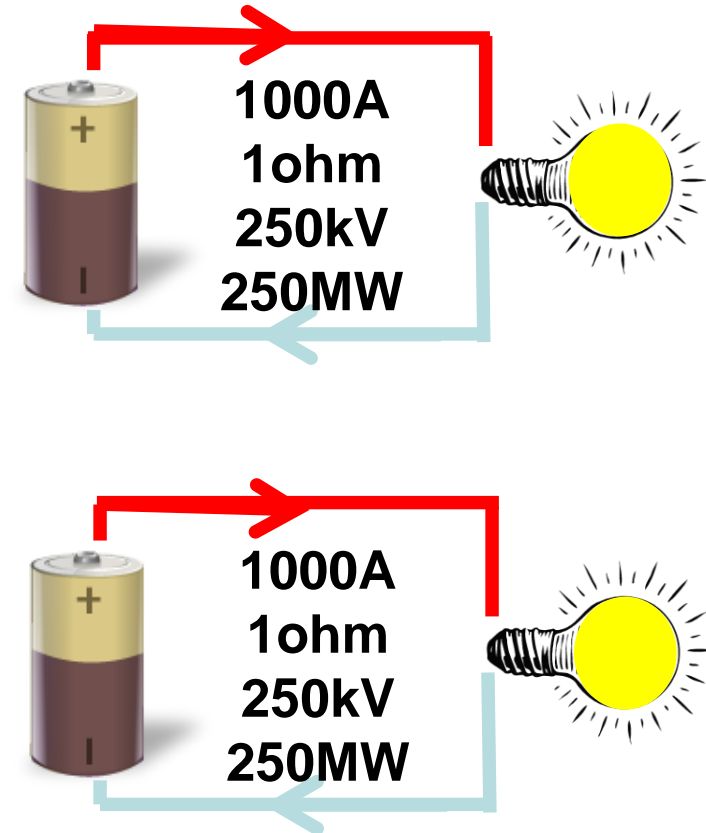
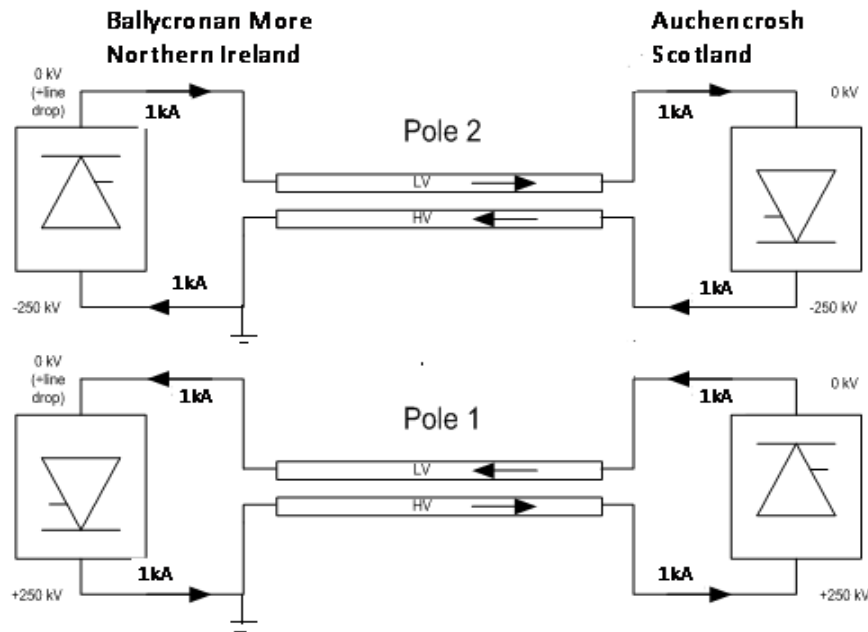
Moyle Interconnector – The Asset

- **Physical link** between the 275kV electrical transmission networks of Scotland and Northern Ireland
 - Static reserve
 - Emergency power
 - Security of supply
- Vital tool for Transmission System Operators on both sides to **keep lights on!**



- **Commercial link** between the wholesale markets in GB (BETTA) and NI (SEM):
 - Energy Suppliers buy capacity at auction
 - Flow energy from the cheaper market
- **Delivers circa £100m** benefit per annum by a combination of market forces and more efficient system operation
- **Value and benefits set to increase** going forward:
 - Increase penetration renewables
 - Market mechanisms e.g. Intraday trading

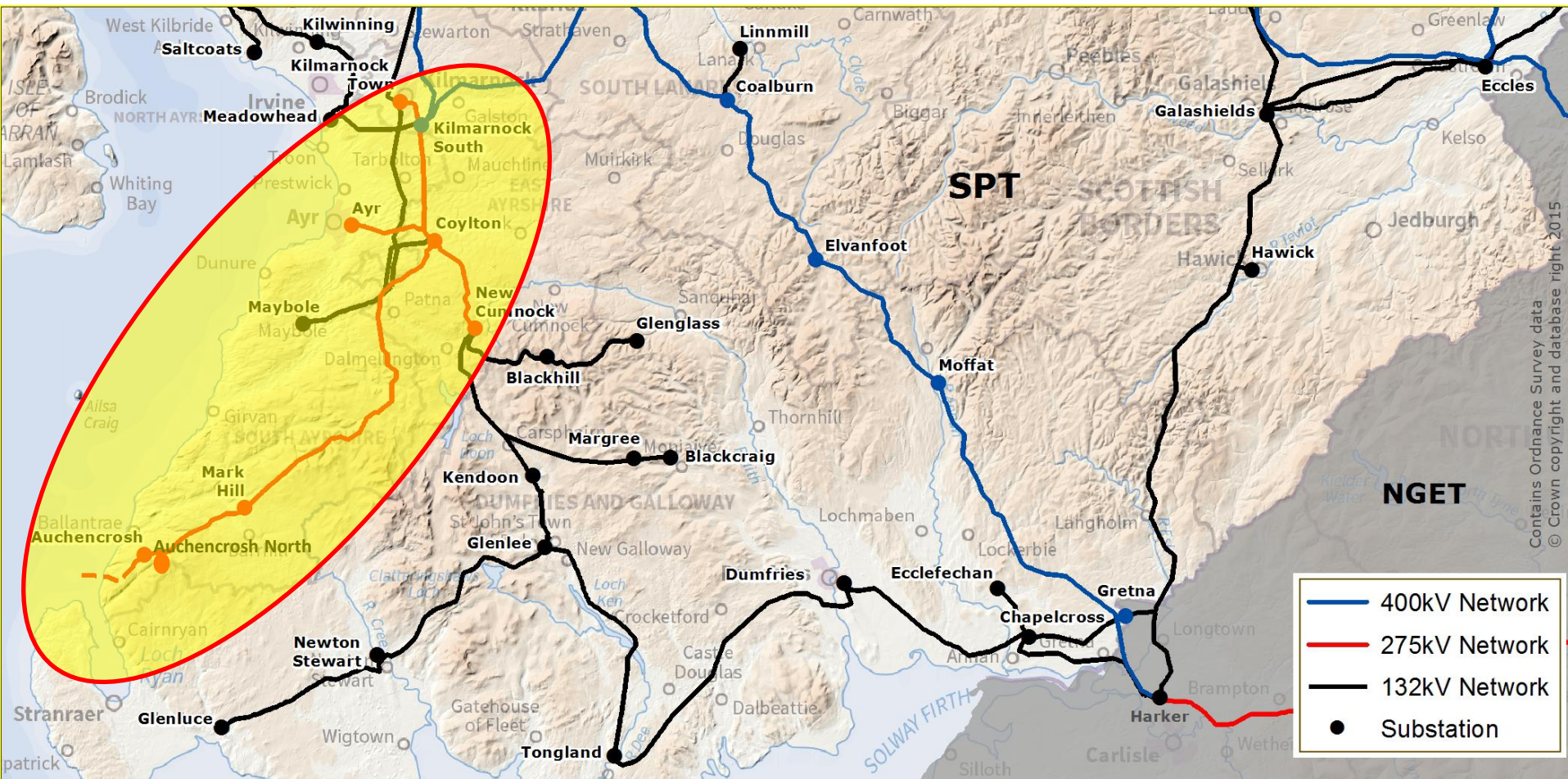
Dual Monopole HVDC 2 x 250MW separate poles



Context for Moyle – A Changed & Changing Environment

- Regulation very different than before
- Significant renewables now connected on both sides of Moyle
- Fault levels very different than before
- Capacity market very different than before
- Flows very different than before
- Ancillary services products very different than before
 - Ireland – Eirgrid/SONI dynamic frequency response - FFR, POR, SOR, TOR
 - GB - NGESO – Static frequency currently but what's to come
- Revenue very different than before

Weak connection point on GB grid



Fault levels and constraints

Grid Code Compliance

- Move of point of common coupling closer to convertor station brought voltage step issues which required Ofgem derogation until upstream ac network strengthened
- High import into Scotland at low fault levels and reaction to some kind of 'germ cell' on the network led to several bouts of oscillation late 2016
 - Interim solution was to operate at a reduced DC voltage (237.5kV) for import to GB which reduces maximum import from 500MW to 475MW
 - We remain under LON from NGENSO, pending agreement of an updated Connection Agreement;
 - Permanent solution to be addressed in control system upgrade project

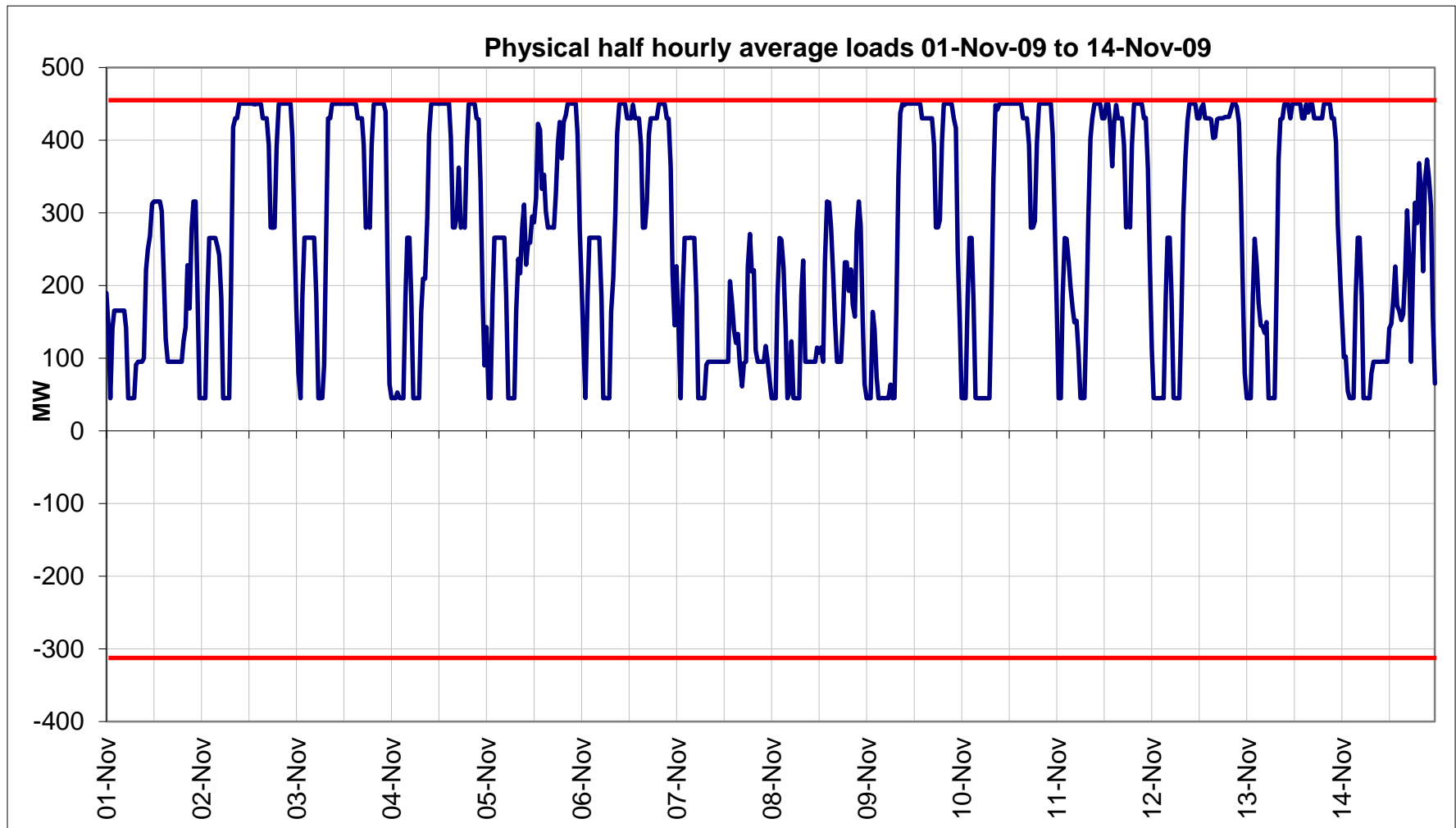
TEC

- On NI side we are 500MW on a 2GW system however some conventional generators are going and some circuits are being refurbished and upgraded and SONI have just agreed to revised constraints;
 - 500MW into NI (from 410MW summer)
 - 400MW into Scotland (from 295MW)
- Still constrained on GB side;
 - 450MW out of Scotland
 - 80MW into Scotland (but with 2 day head release of headroom)

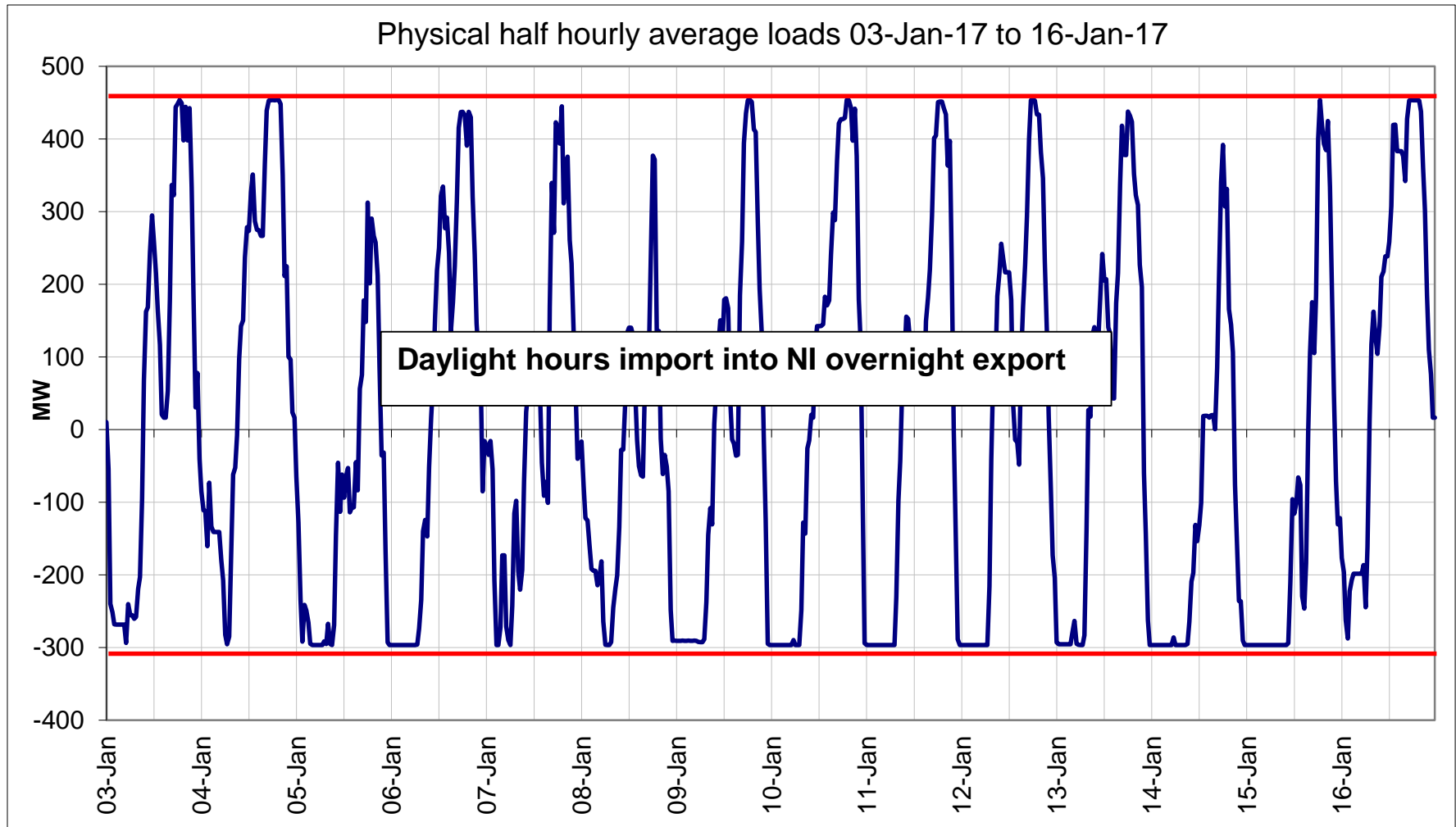
**Increased levels of TEC against
contracted position, plus the ability to
flow above this where conditions allow**

Dates	Contracted	TEC	CACM	Solution
Up to 2017	~295	~295	~295	~295
Nov 2017	80	80	80	500 (80)
Dec 2019	80	307	500 (307)	500 (307)
Jun 2020	80	250	500 (250)	500 (250)
Nov 2021	80	160	500 (160)	500 (160)
Apri 2022	80	500	500 (500)	500 (500)
Beyond 2022	80	500	500 (500)	500 (500)

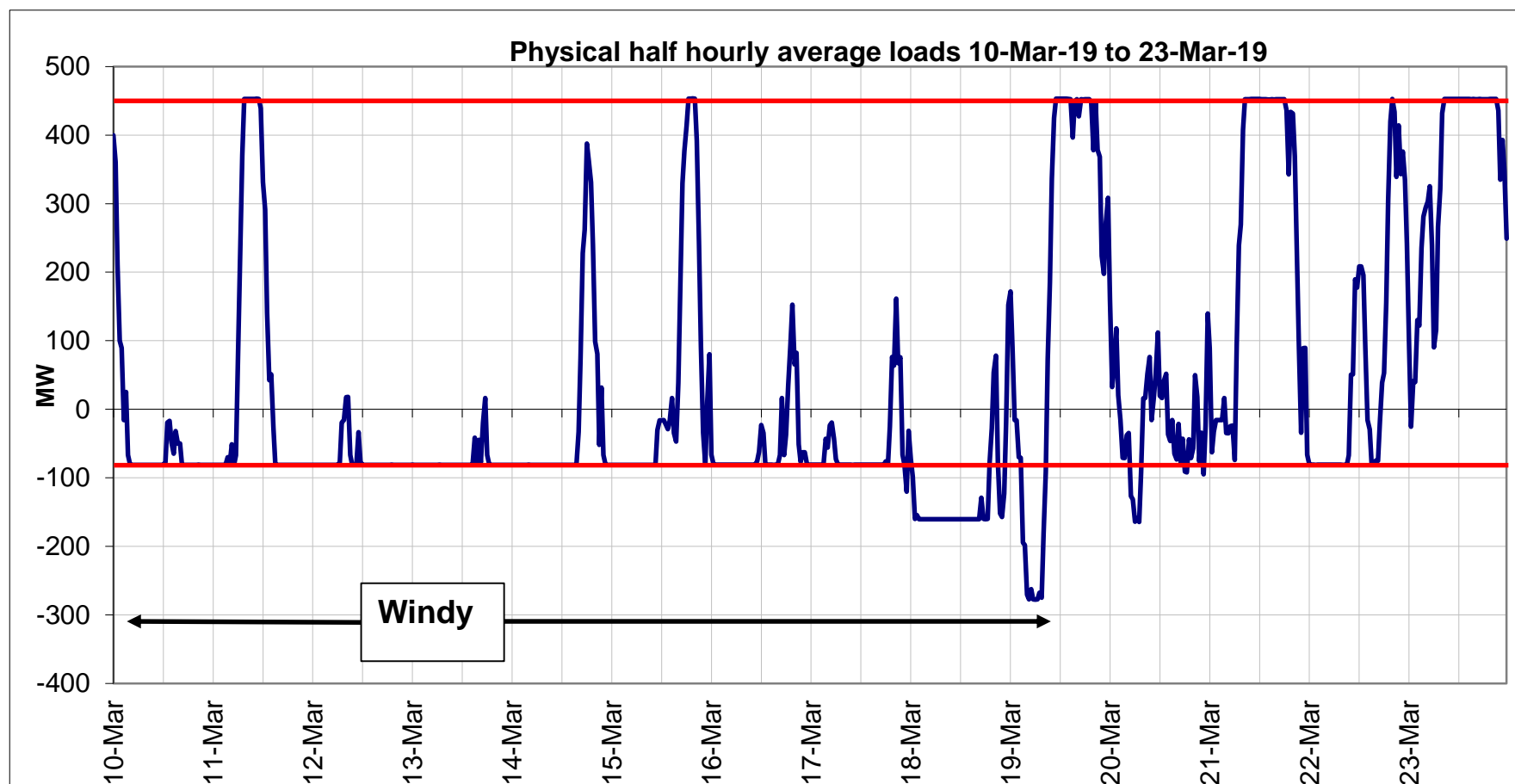
Typical flow in the early days of operation



As renewable penetration increased but pre-coupling



Flows Following in ISEM – Wind Driven & Efficient

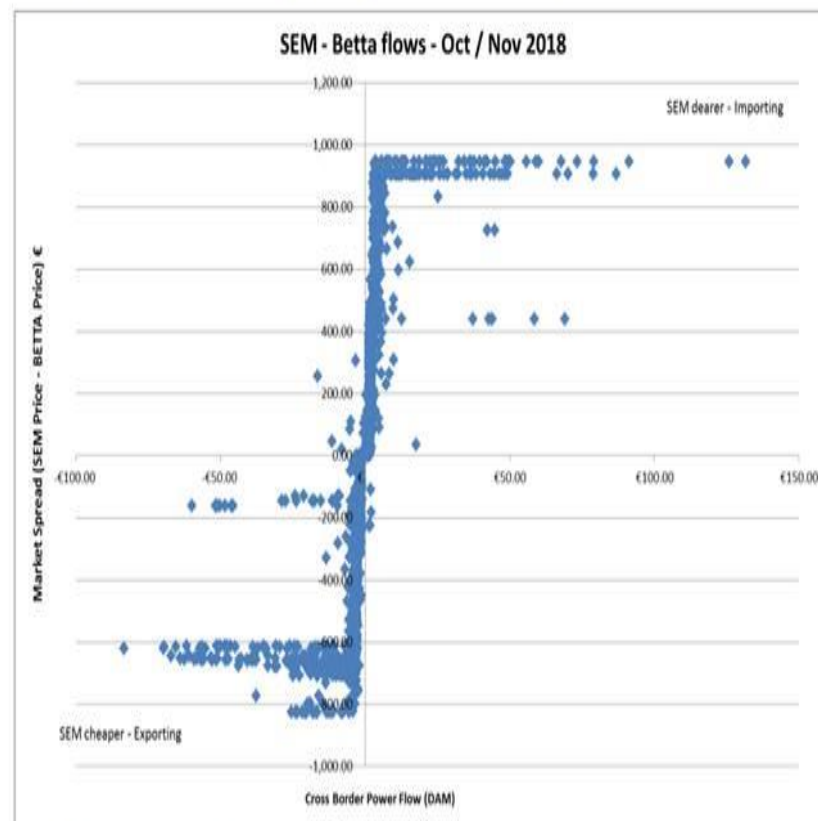


Flows before and after

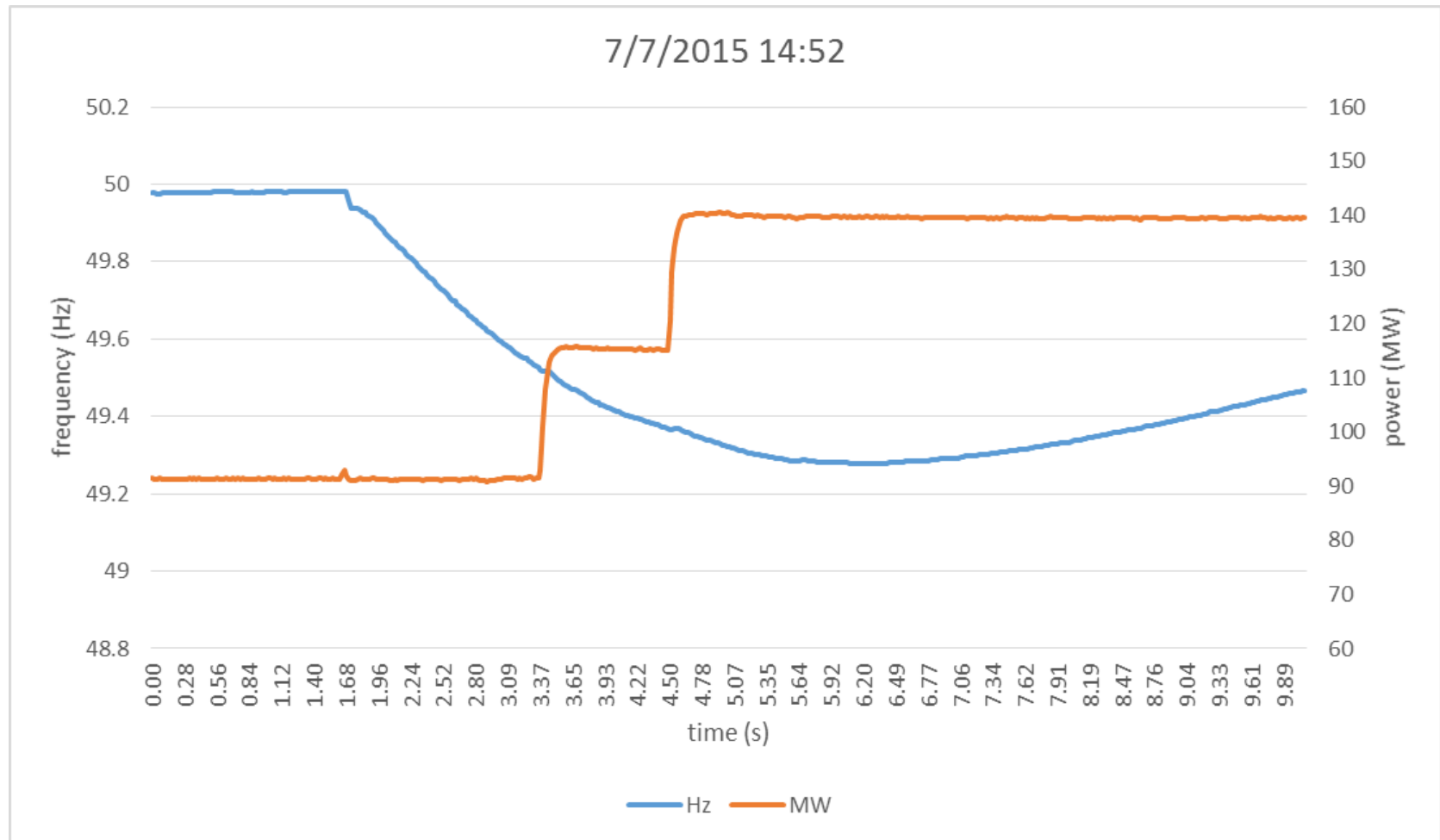
- cross border flows from EA runs in the last months of the SEM



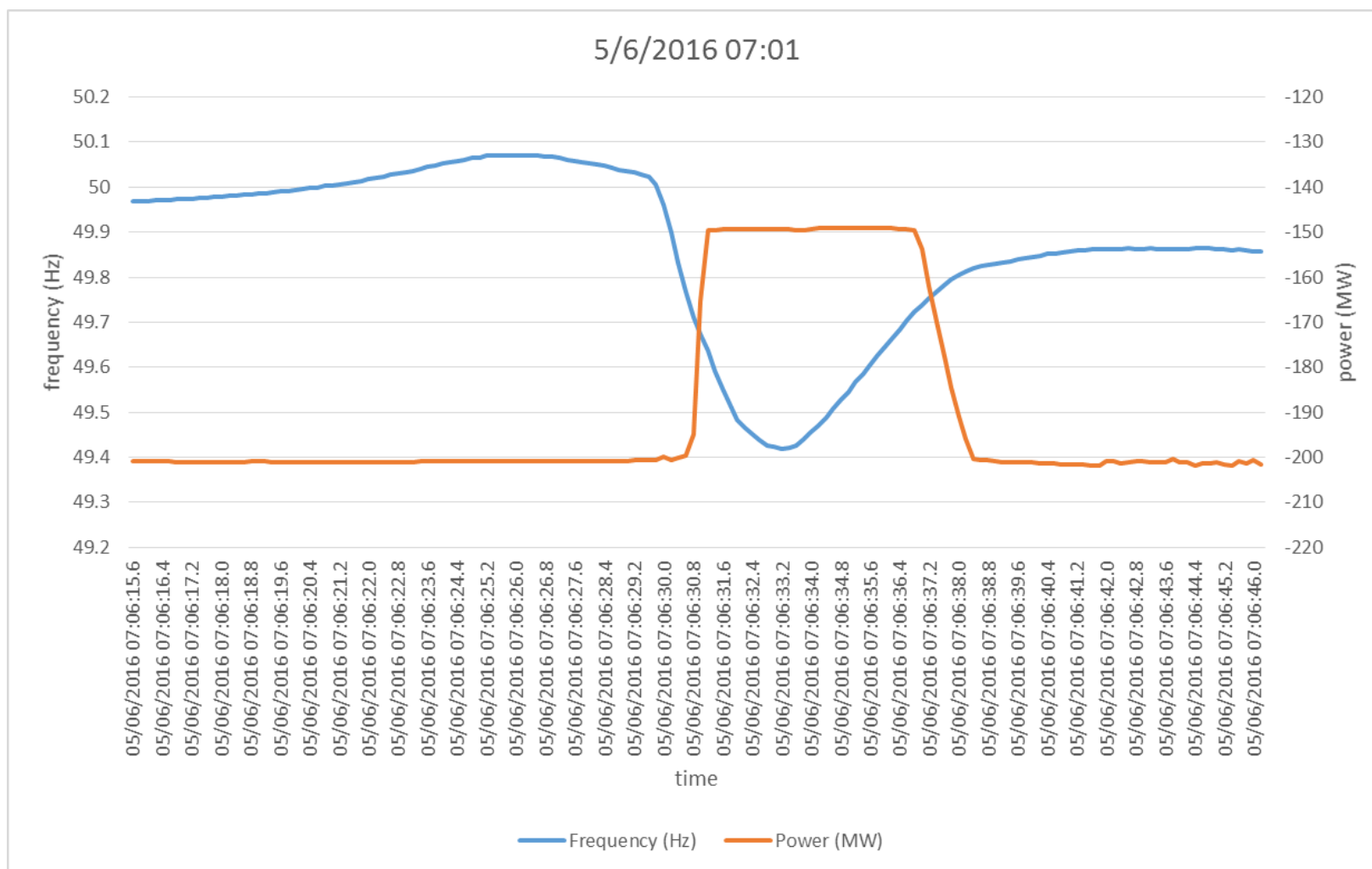
Cross border positions after the DAM for the first two months of I-SEM



System Service - Static



System Service - Dynamic

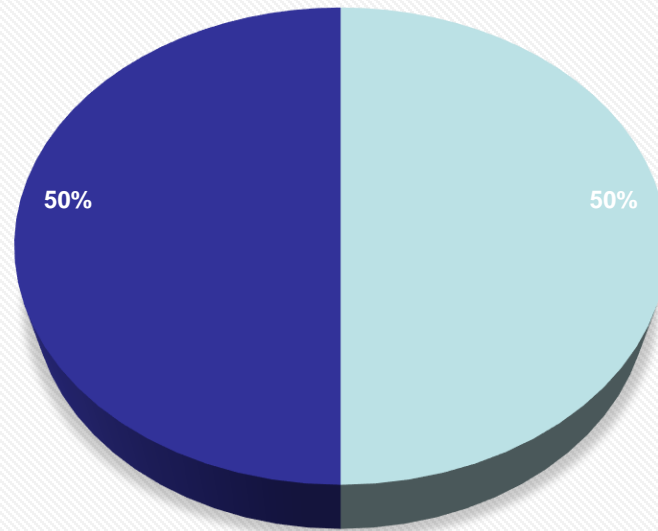


Revenue

2014 Income

2017 Income

2020 Income?



Capacity Ancillary services

Observation from the graduate engineer..

“We transferred 1,913,780MWh in 2019/20

5MWh was for ancillary service on the IRE side

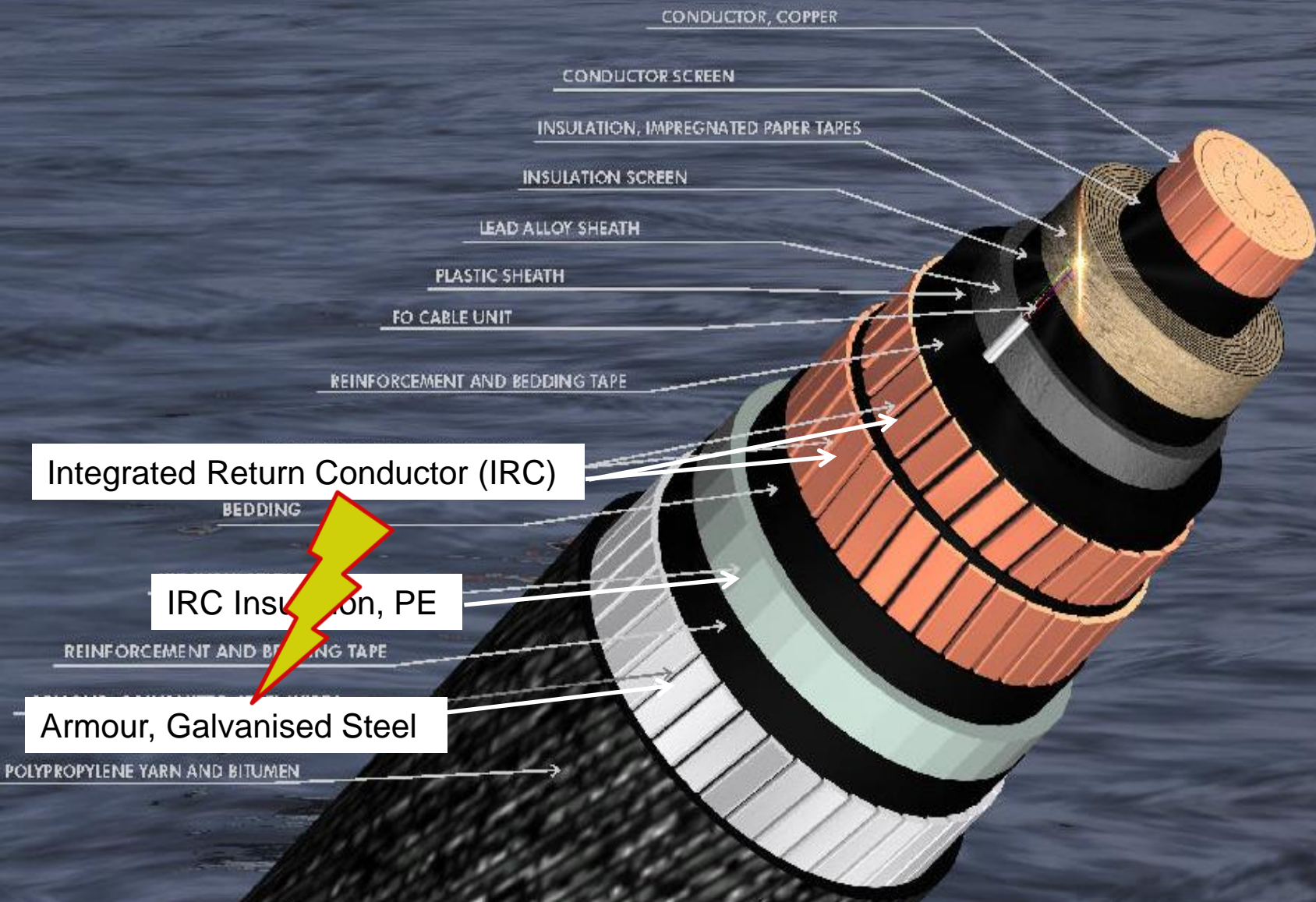
This is **0.000261% of the total energy** transferred...

but worth circa **25% of total revenue**”

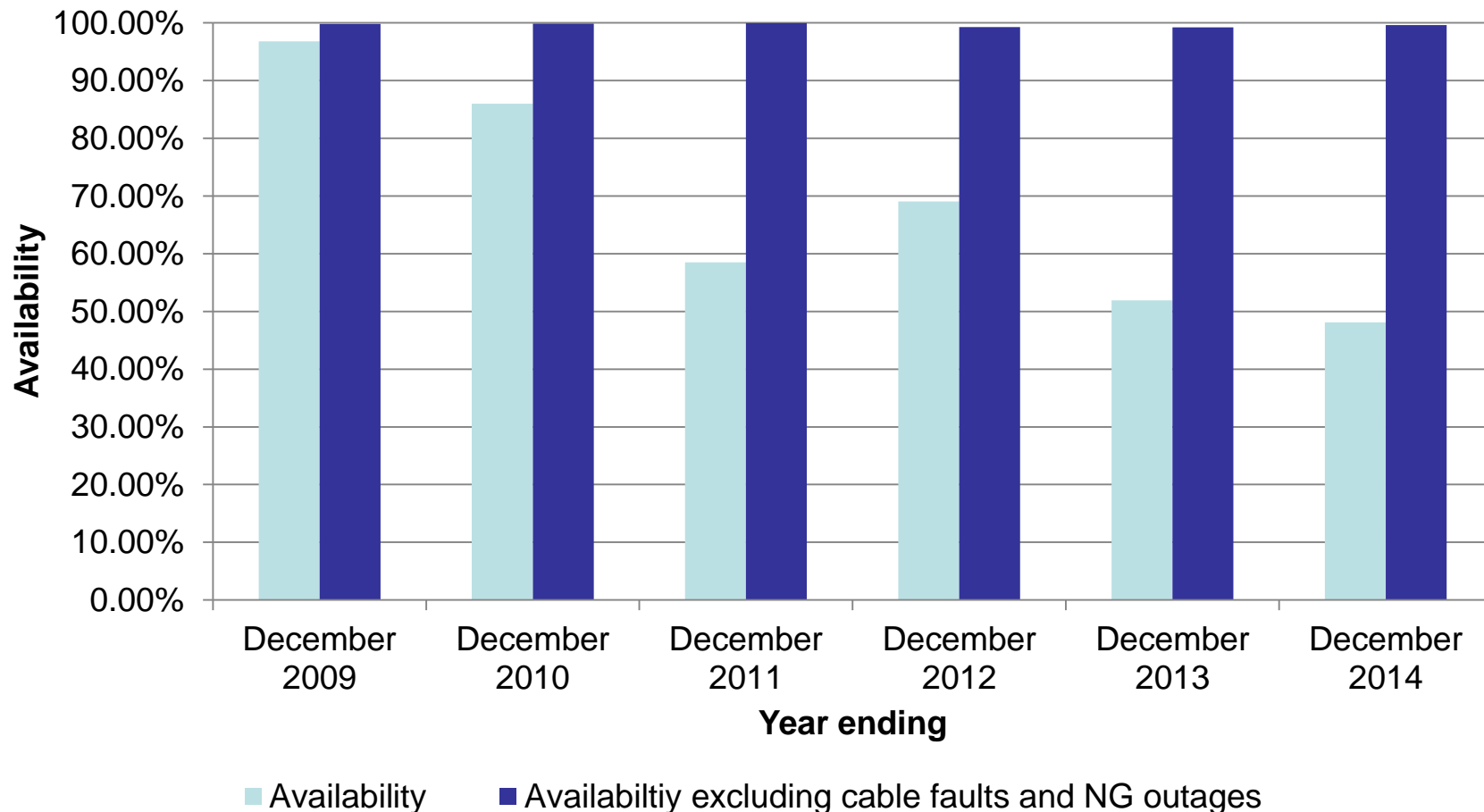
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- Same technology but changing
 - Different cable system and approach to fault finding & preparedness
 - Control system refurbishment
- Same strong relationship with OEMs from commissioning driving high availability

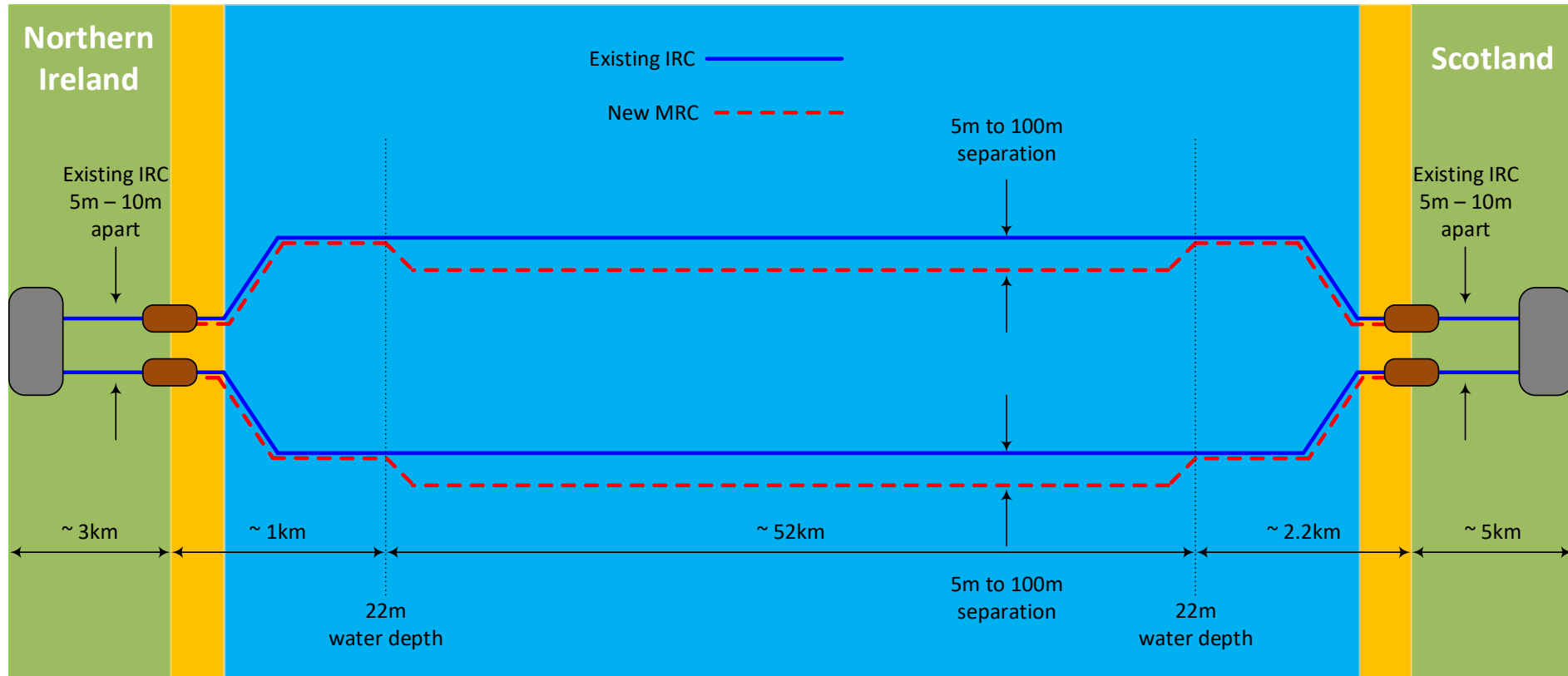
Nature of faults – failure of low voltage return insulation



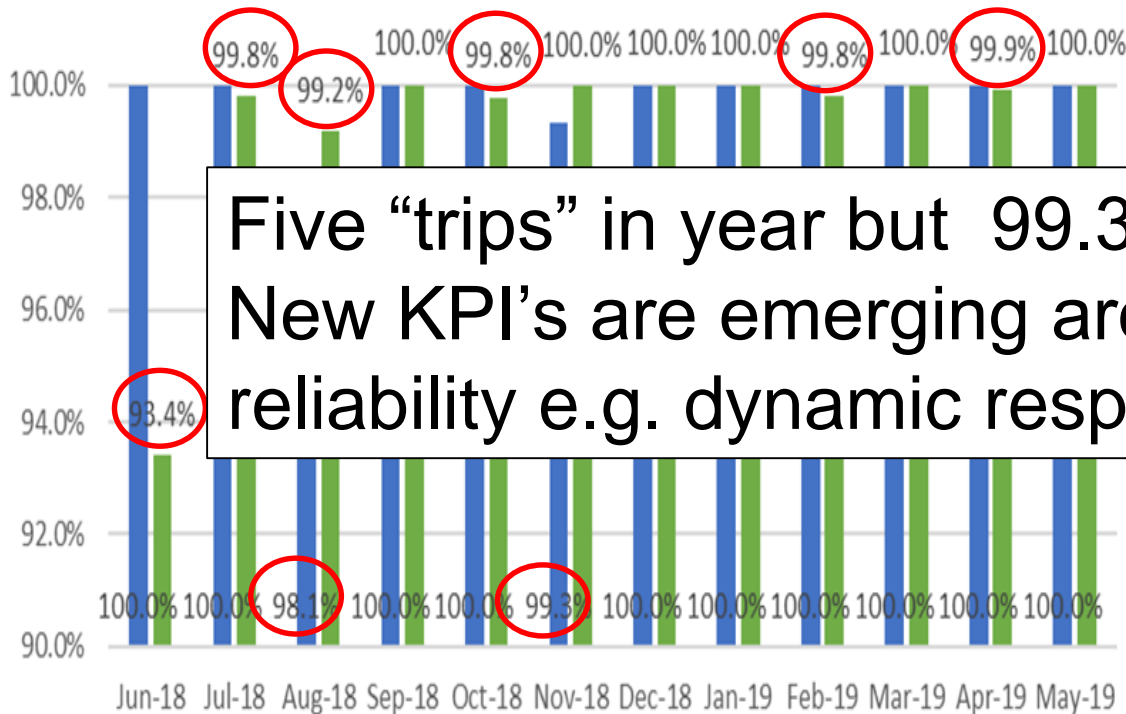
Impact of submarine cable faults – dark years



Permanent Solution - Low Voltage Return Replacement



Past Twelve Months Availability



1. Pole 2 planned 48hr annual outage
2. Pole 2 trip UPS issue 1hr27m
3. Pole 1 trip activation of fire protection system 5h32m
4. SP planned works ac line 5h49m
5. Pole 2 VC pump exchange 40min
6. Pole 2 VC pump exchange 38min
7. Pole 2 tap changer out of step 41min
8. Pole 2 tap changer out of step 41min
9. Pole 2 VC pump exchange 40min
10. Pole 2 VC pump exchange 38min
11. Pole 2 tap changer out of step 41min

Forced outage	8hr 38m
Scheduled outage	55hr 48m
Total	64hr 26m

Control System Upgrade

- Notified by OEM in 2008 that Simadyn-D would be unsupported from 2016
- Economic depreciation of C&P system 15 years so refurbishment was targeted 2017 but we were focused on recovering the cables
- Eventually got focused on this 2018
- Scope
 - Rip everything out to doing nothing?
 - Valve based electronics became the ebb and flow line
- Supplier
 - Tender to market place or single source
- Advisors – technical, commercial, legal
- Timeline – aimed for 2021 but now slipped to 2022 because of difficulties getting dynamic data from both TSOs
- Managing obsolesce whilst awaiting delivery
- Detailed functionality – loop power control to remove our dead band
- Include a replica?

To finish...

- How important are events like today to help inform and de-risk the development of HVDC schemes?
 - Still pioneering
 - Small network
 - Sharing information and technical engagement with the TSO
- What do you see as the key challenges for the integration of future HVDC schemes into the GB Network?

Commercial

- Financial underpinning driven by ever-changing commercial markets

Technical

- Weakening ac networks
- Interaction of schemes with the weakening ac networks and with each other
- How do you think the HVDC Centre can support and coordinate the future deployment of HVDC schemes in GB?
 - To use steal off Ben's JFK analogy "**Huston we have a problem**"