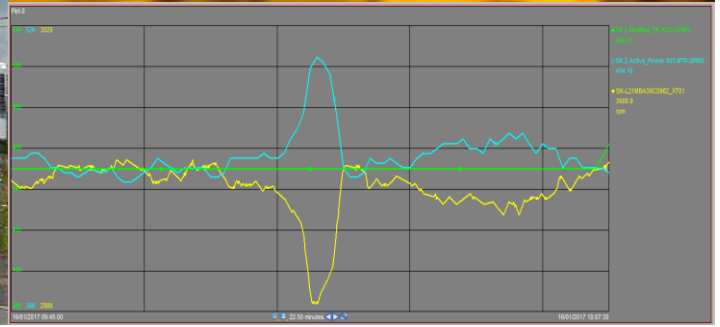
EFCC – Role of CCGTs?



Peter Wilkinson and Christopher Proudfoot

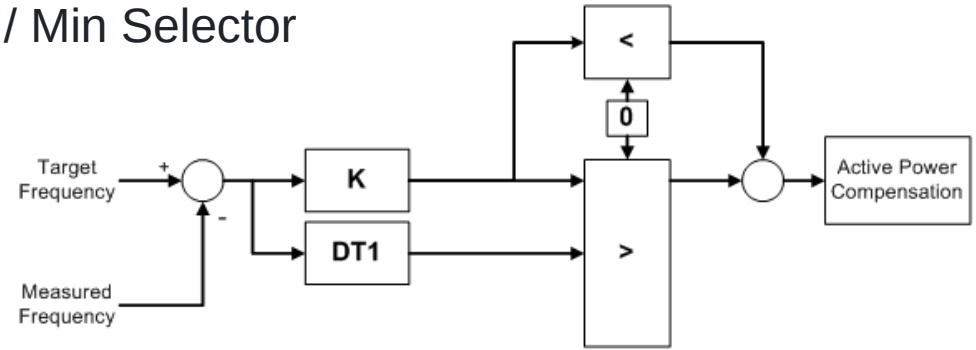
Centrica

Agenda

- Recap on previous works
- Progress through year 3
- Current status
- Existing and future role for CCGTs
- Learnings and observations

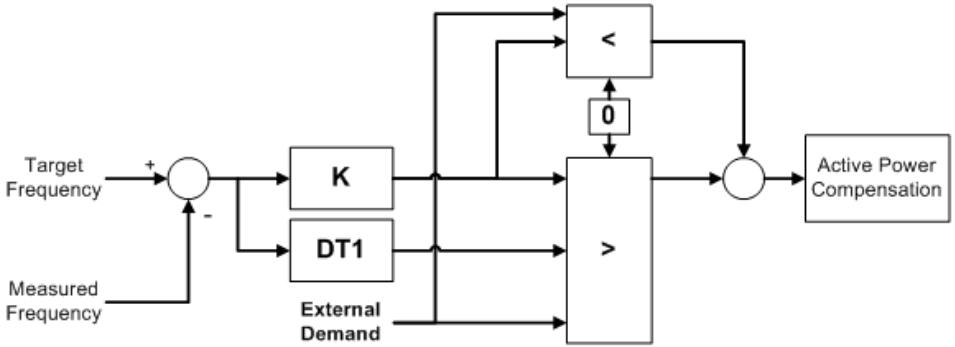
CCGT Multi-Option Integrated Strategy

- Local GT Controller (DCS) response
  - Retain Primary Secondary and High Proportional Response Modes
  - RoCoF derived from GT Speed Measurement
  - Compensation applied proportional to RoCoF
  - Estimated to match the Primary Response
  - RoCoF event detection
  - Max / Min Selector

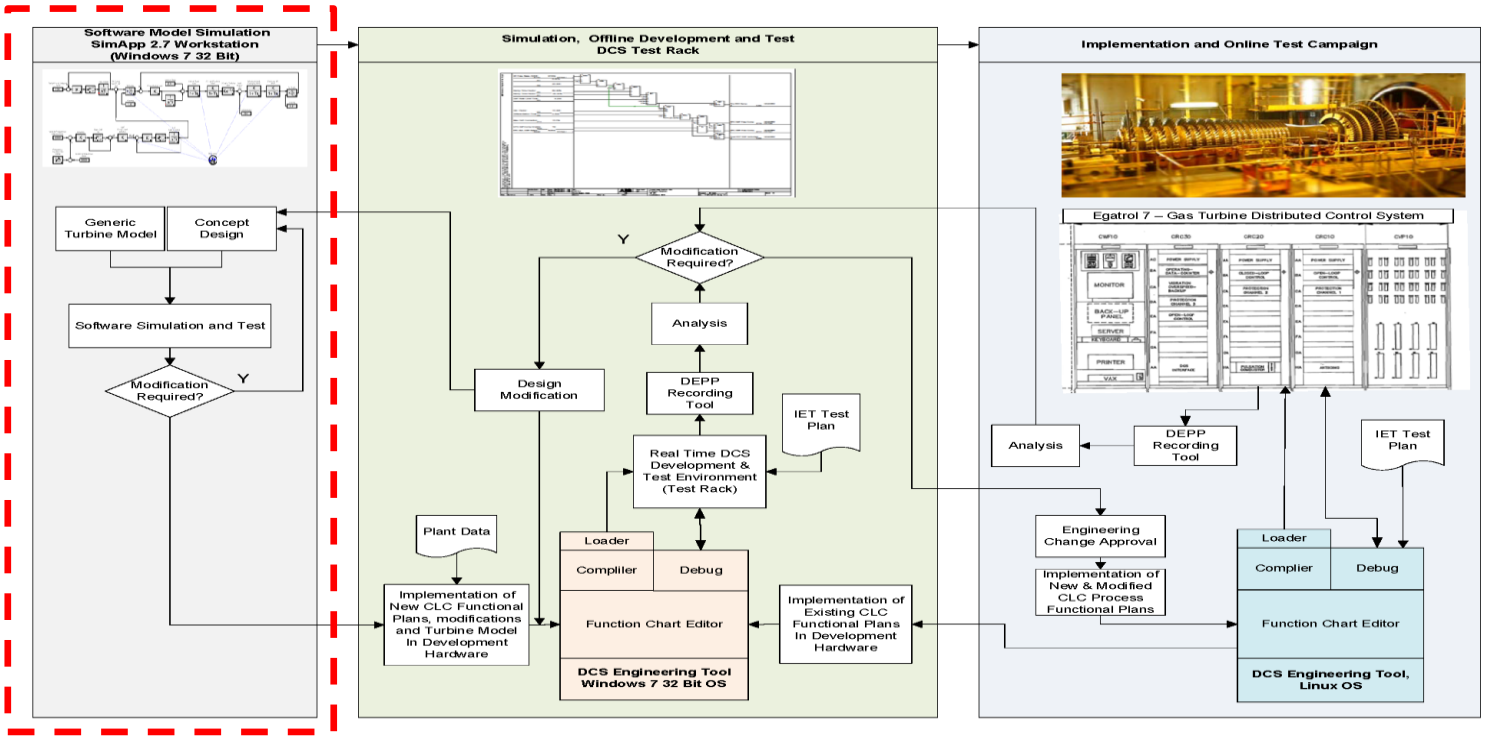


CCGT Multi-Option Integrated Strategy

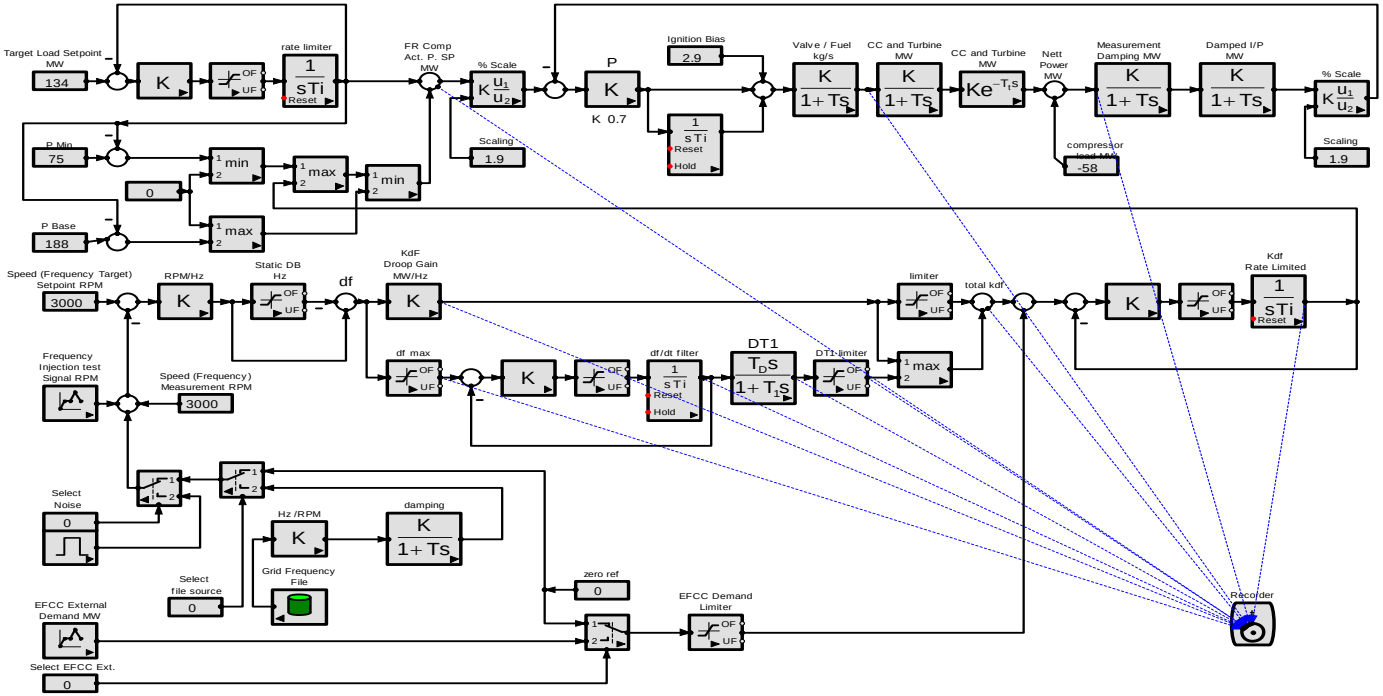
- GE External System
  - Commanded response based on Phasor Measurement
  - RoCoF measurement derived from PMU
  - Compensation scheduled from
    - Regional Aggregator (requires suitable network infrastructure)
    - Local Controller (detected RoCoF initiates a predefined response)



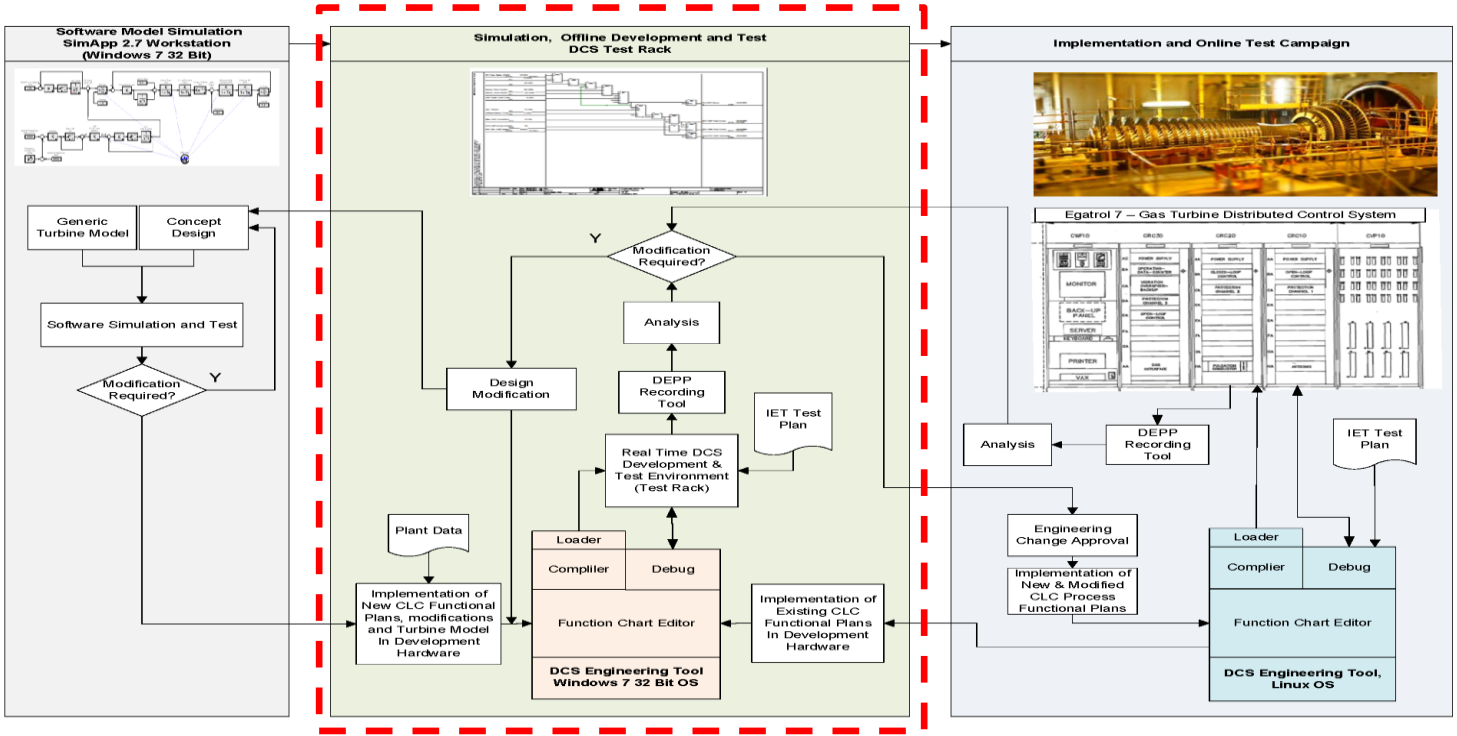
GT DCS Control Development Cycle



Computer Based Simulation



GT DCS Control Development Cycle



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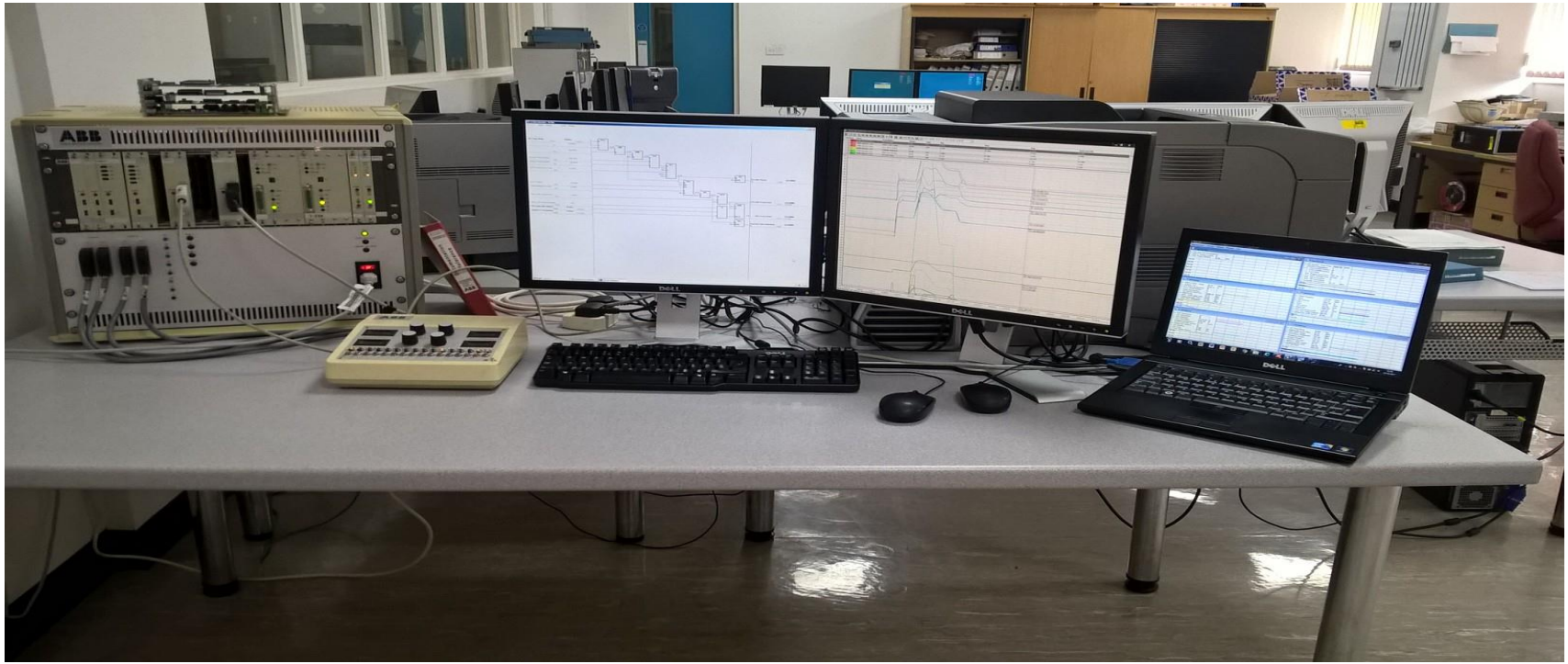
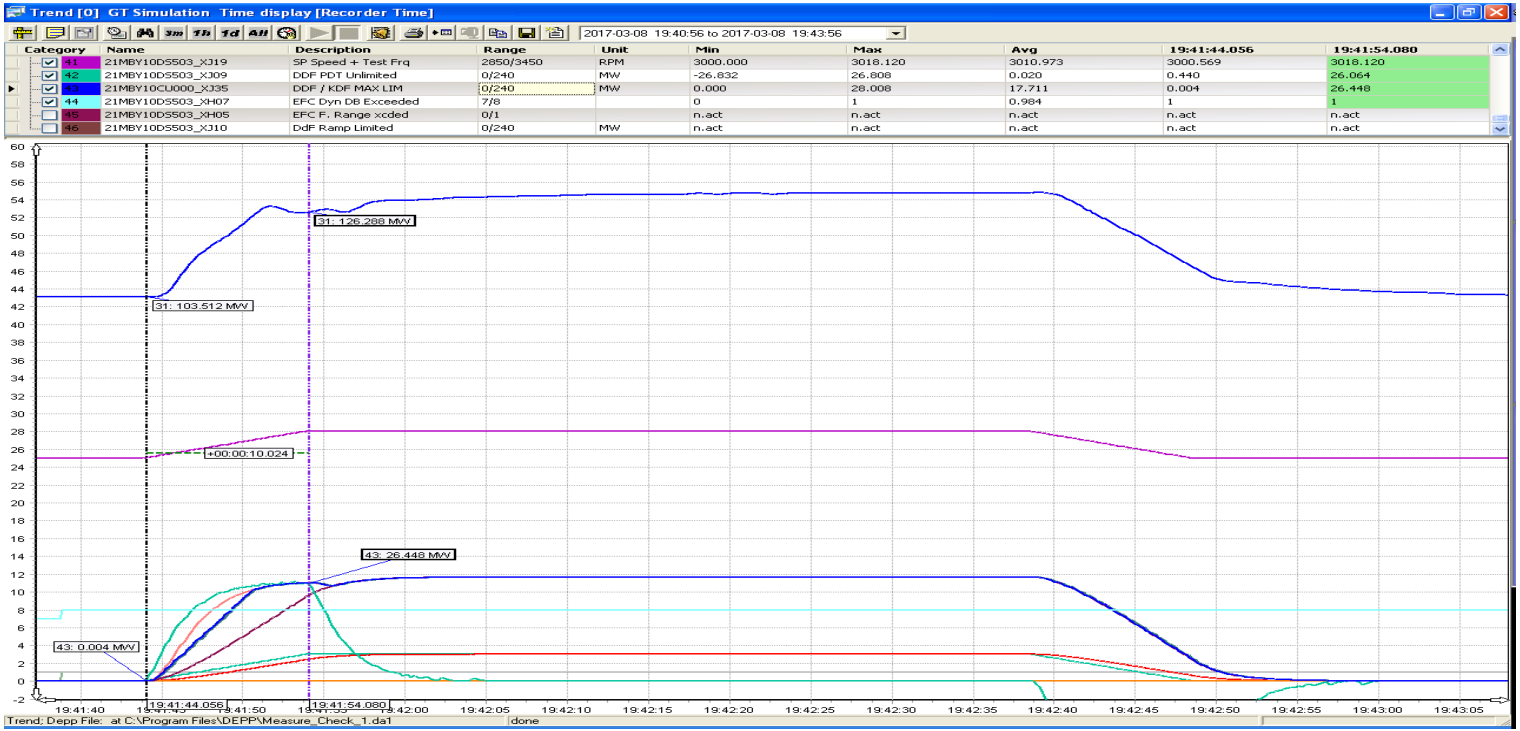
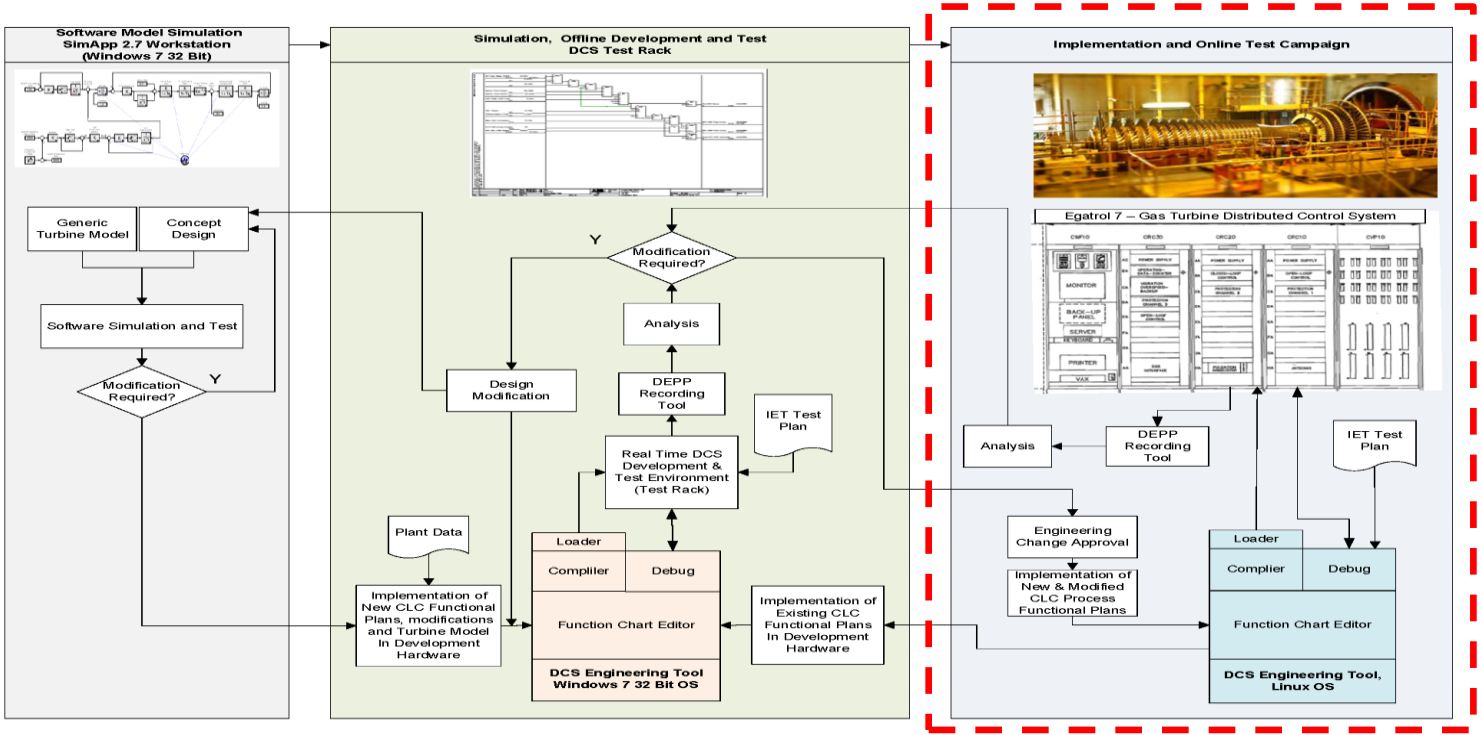
Offline DCS Test Environment



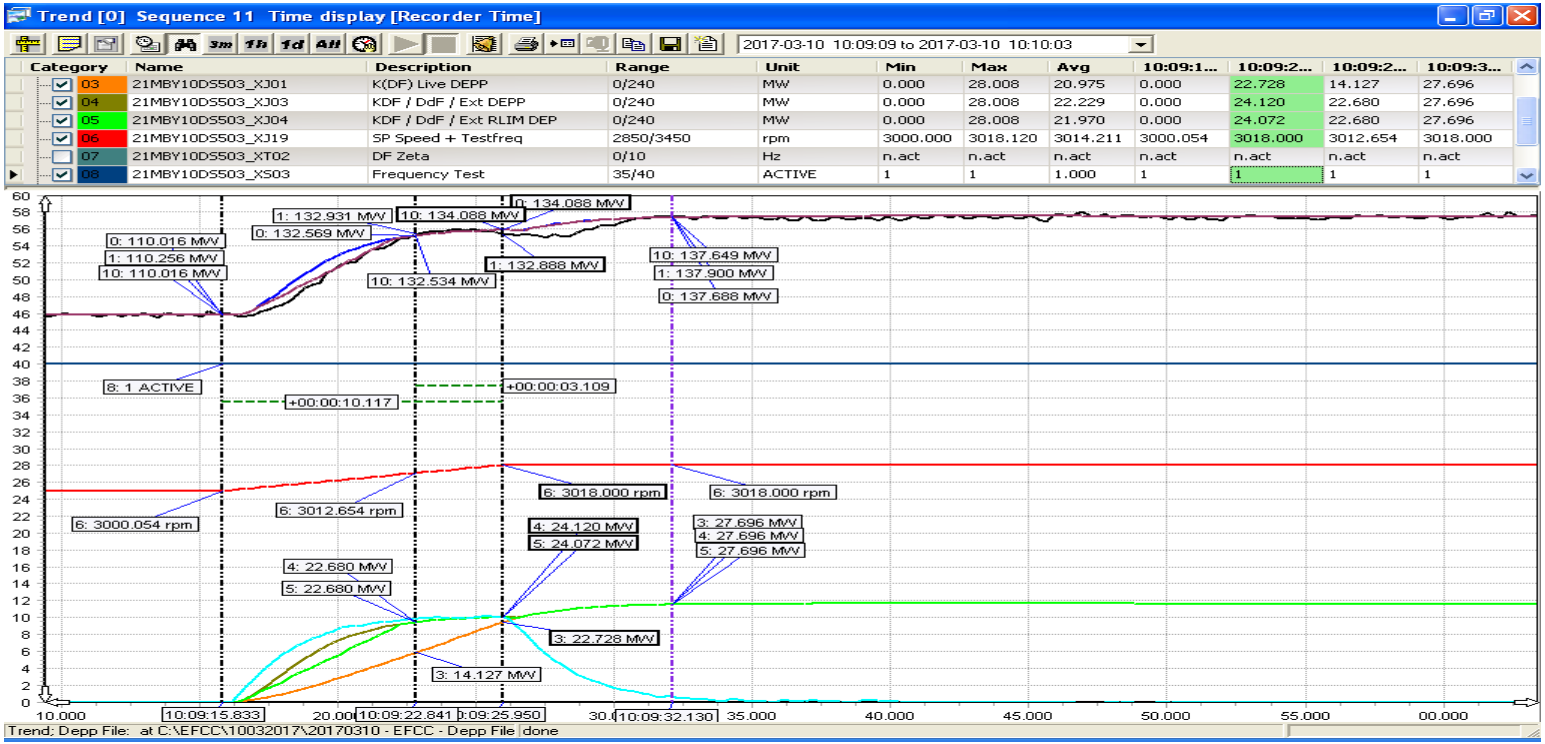
Off Line Simulation of Grid Compliance Tests



Development Process Overview

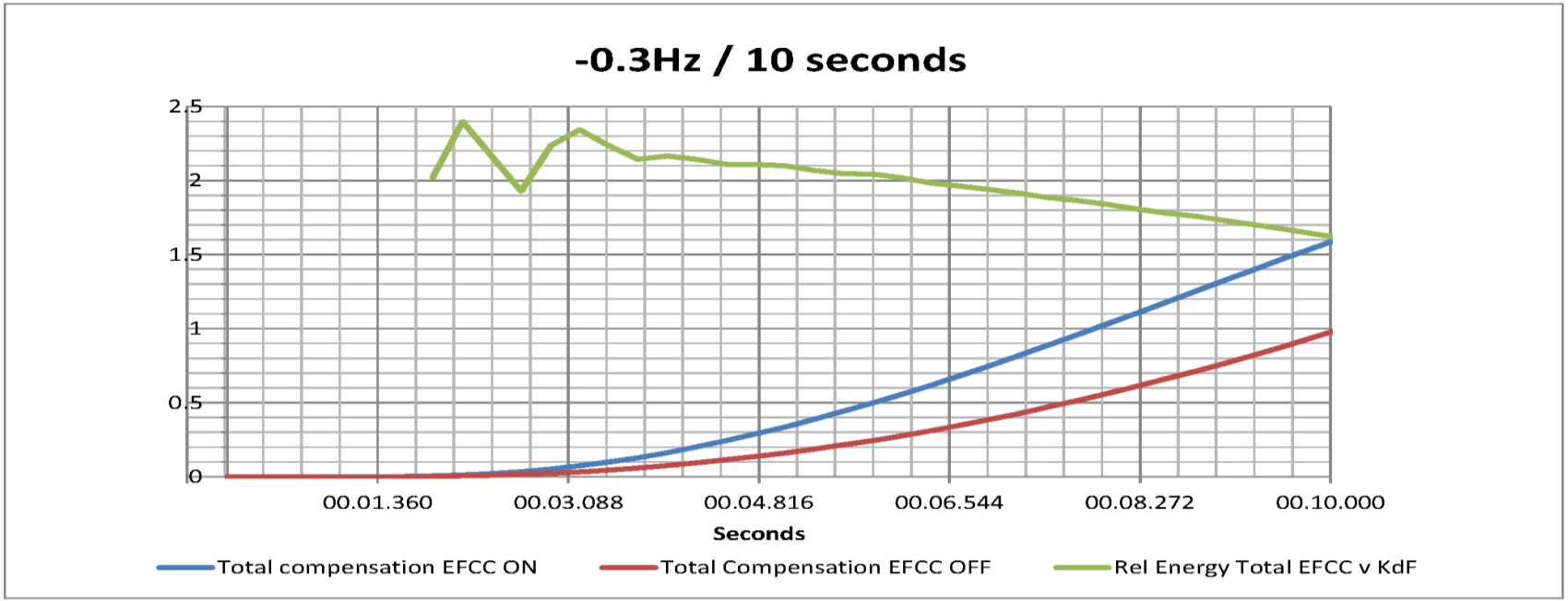


Grid Compliance Test - EFCC ON -0.3Hz / 10s



Potential Scale of Benefit

- Increased area under the curve

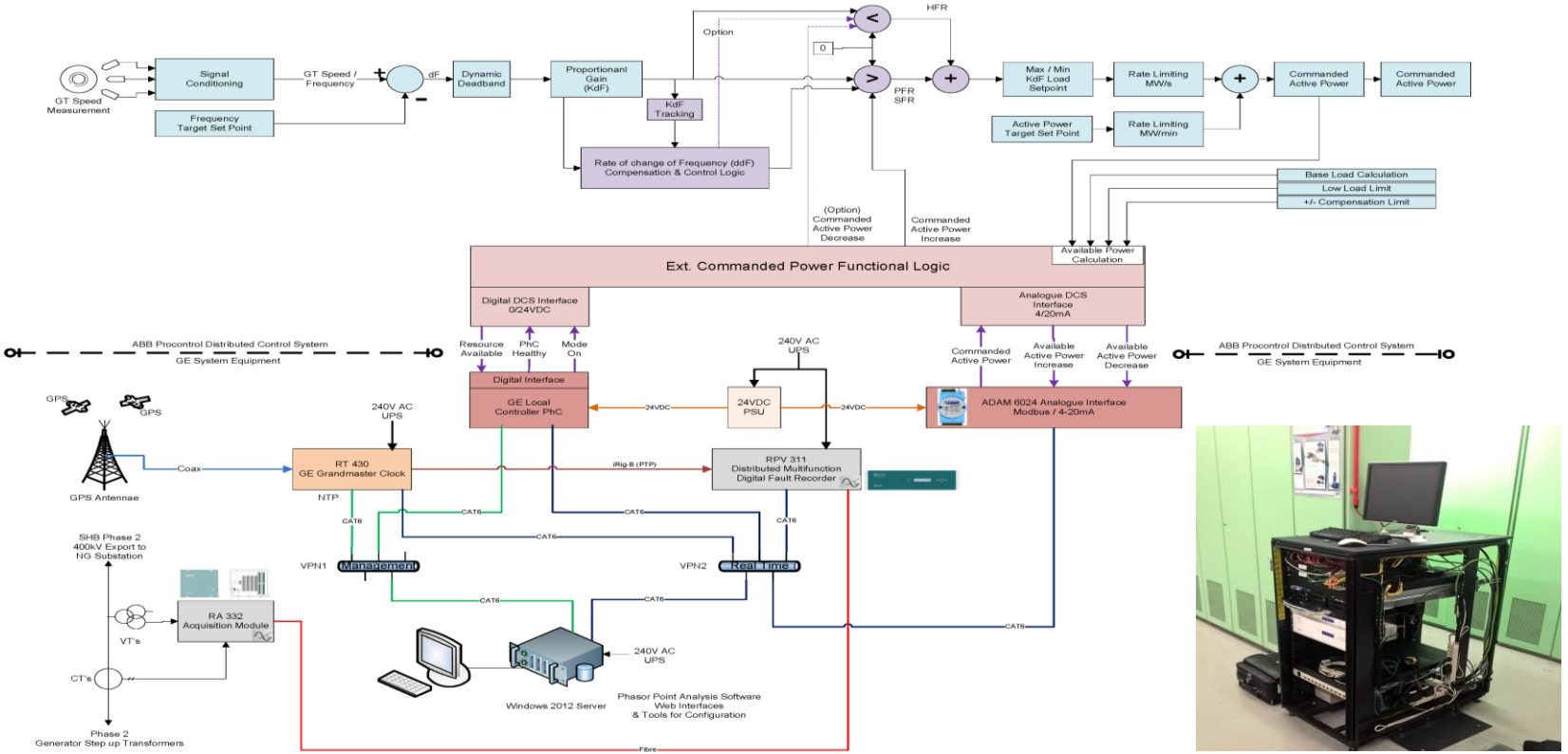


Steps for Year 3

- Monitor installed software in passive mode
- Optimise utilisation to minimise thermal stress
- Analyse events and optimise parameters using offline model
- Optimise offset tracking
- Potentially go live……

- Install GE Equipment and Complete Site Acceptance Tests

GE Equipment Installation September / October 2017

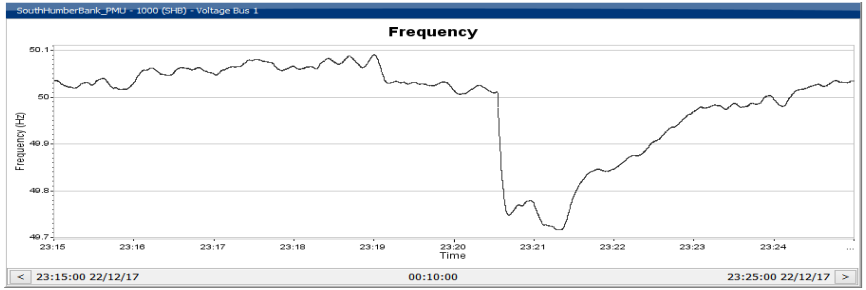


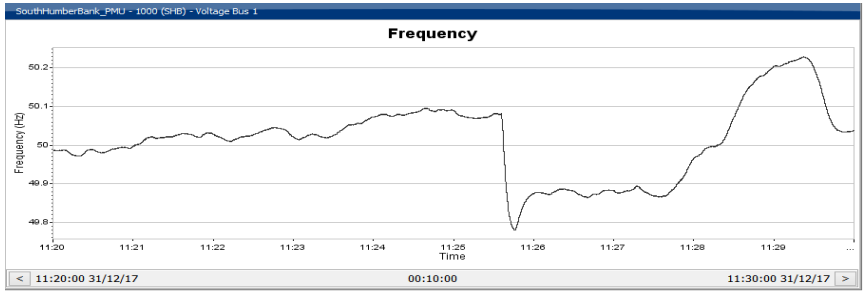
GE Site Acceptance Testing

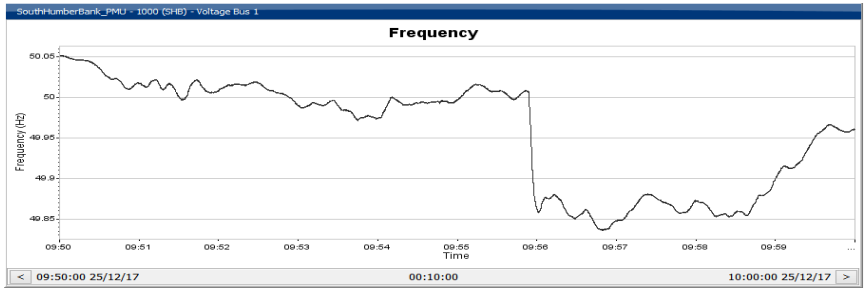
- Site Acceptance Testing Completed 22nd November 2017
  - Equipment Installation Checks
  - Software Tests
  - Hardware Tests
  - Connectivity Tests
  - Operational Changes
  - Algorithm Testing

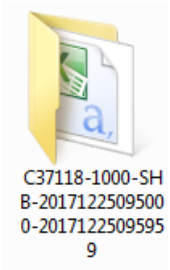
Post SAT Feedback of Data

- RPV311 Log files, PMU (CSV) Event Files



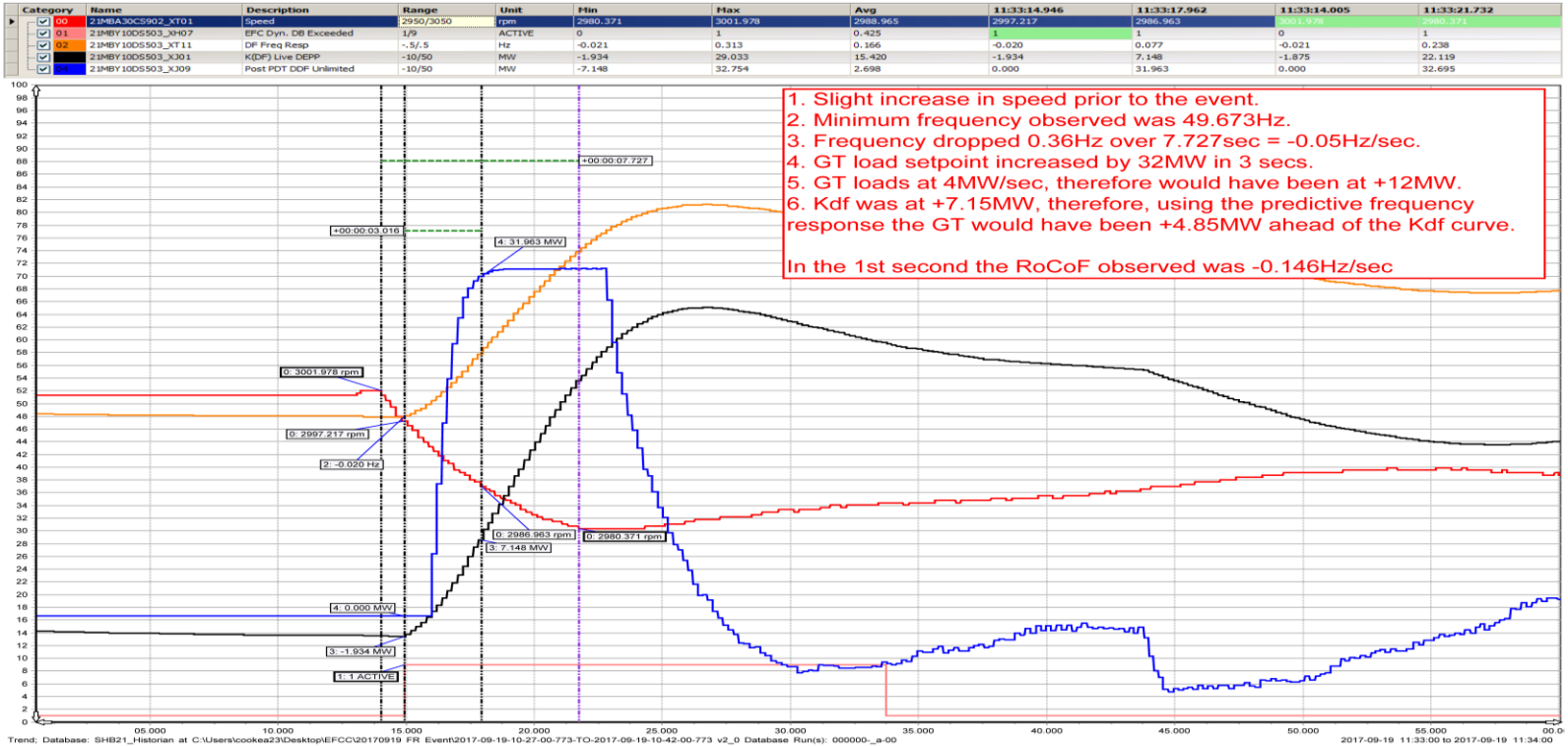






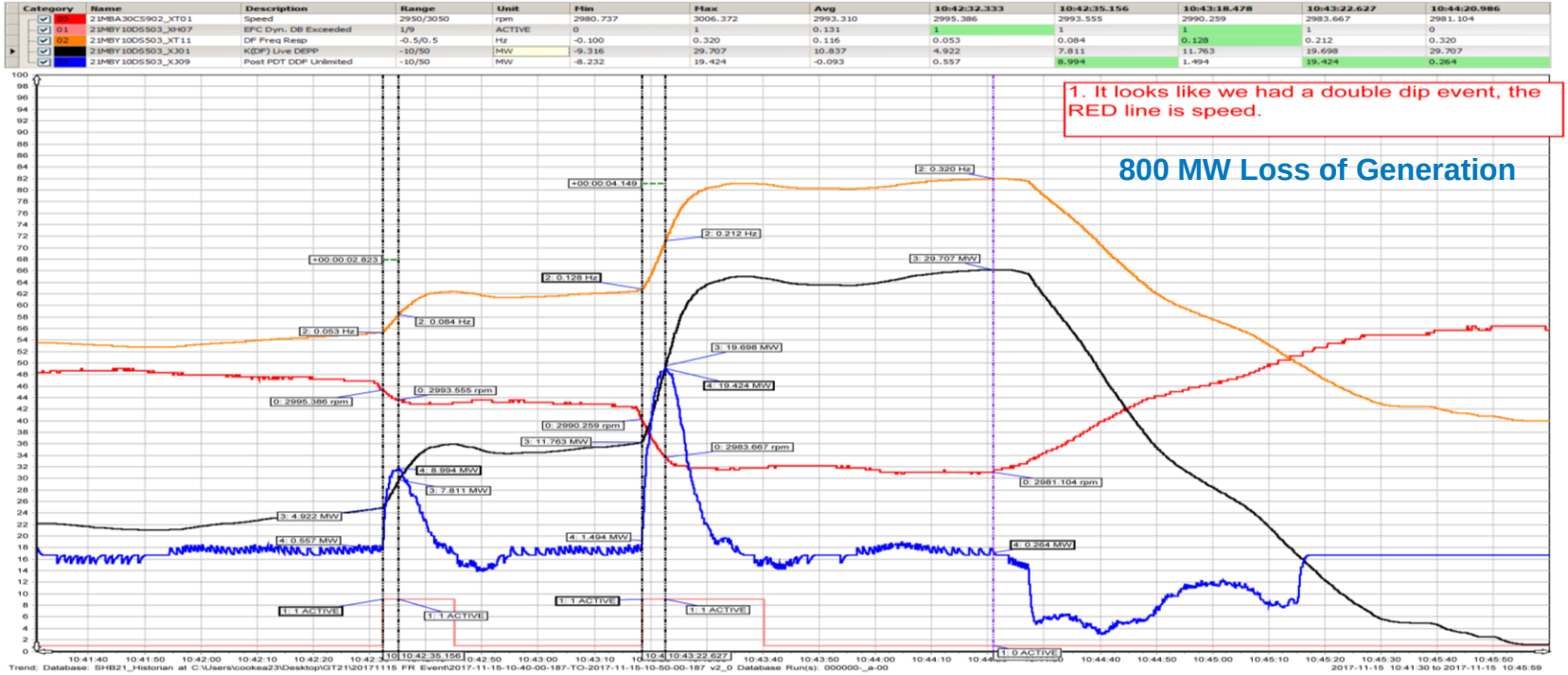
Frequency Event 19th September 2017

- **Passive measurement - GT21 – IFA trip (1000MW)**



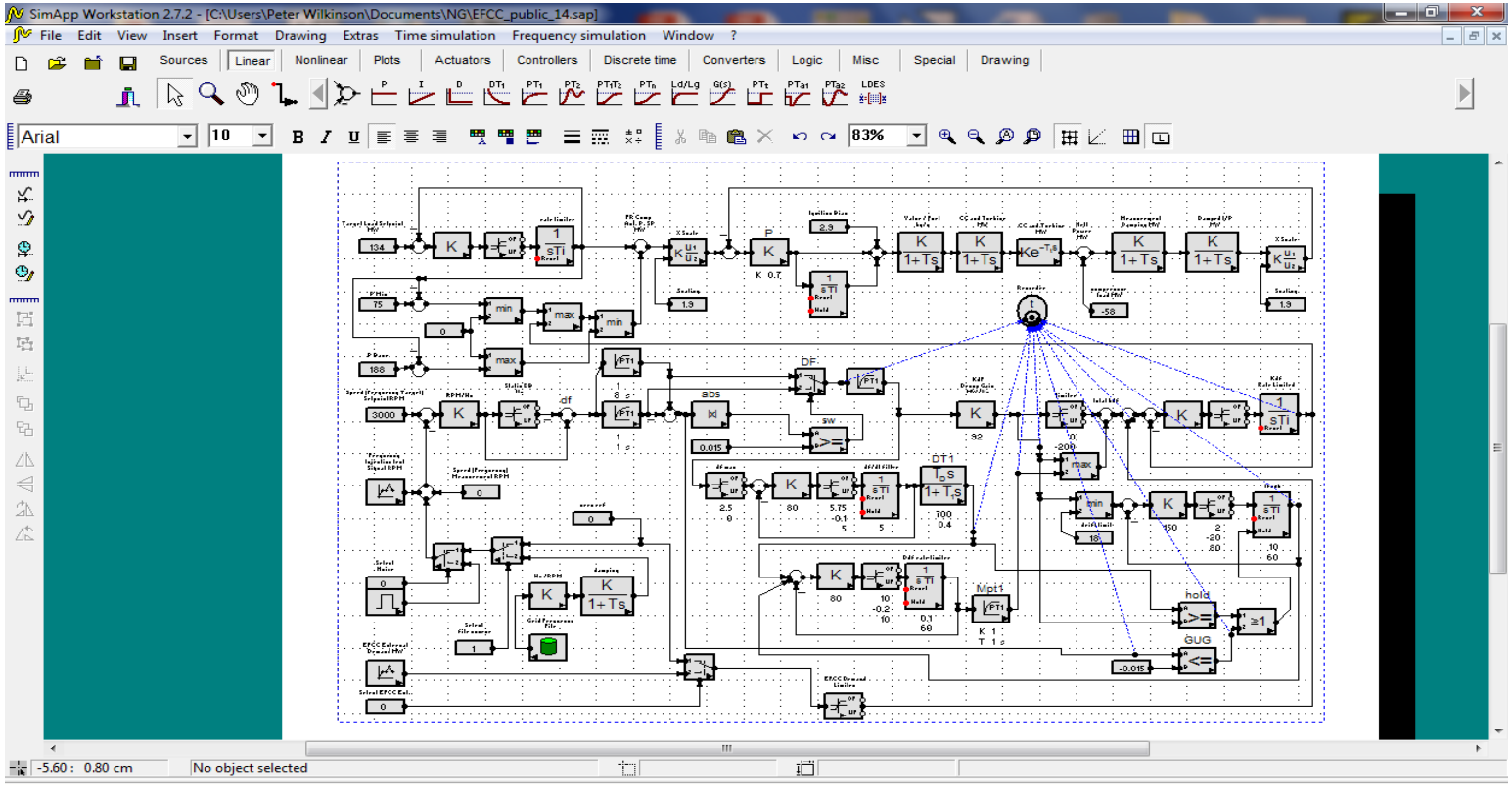
Frequency Event 15th November 2017

- **Passive measurement - GT21 – requirement for tracking**



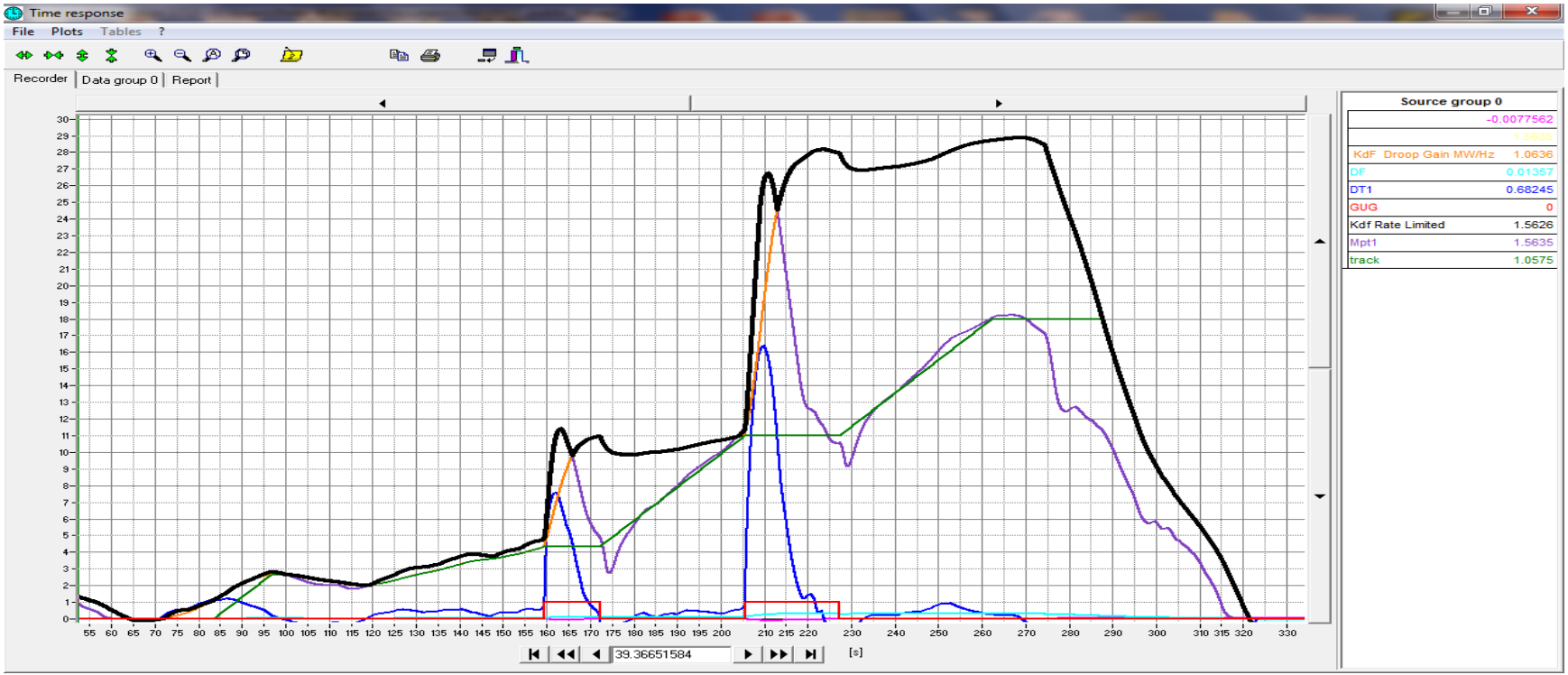
Category	Name	Description	Range	Unit	Min	Max	Avg	10:42:32.333	10:42:35.156	10:43:18.478	10:43:22.627	10:44:20.986
00	21MBA30CS902_XT01	Speed	2950/3050	rpm	2980.737	3006.372	2993.310	2995.386	2993.555	2990.259	2983.667	2981.104
01	21MBY10DS503_XH07	EFC Dyn. DB Exceeded	1/9	ACTIVE	0	1	0.131	1	1	1	1	0
02	21MBY10DS503_XT11	DF Freq Resp	-0.5/0.5	Hz	-0.100	0.320	0.116	0.053	0.084	0.128	0.212	0.320
	21MBY10DS503_XJ01	K(DF) Live DEPP	-10/50	MW	-9.316	29.707	10.837	4.922	7.811	11.763	19.698	29.707
	21MBY10DS503_XJ09	Post PDT DDF Unlimited	-10/50	MW	-8.232	19.424	-0.093	0.557	8.994	1.494	19.424	0.264

SimApp Model – Offset Tracking

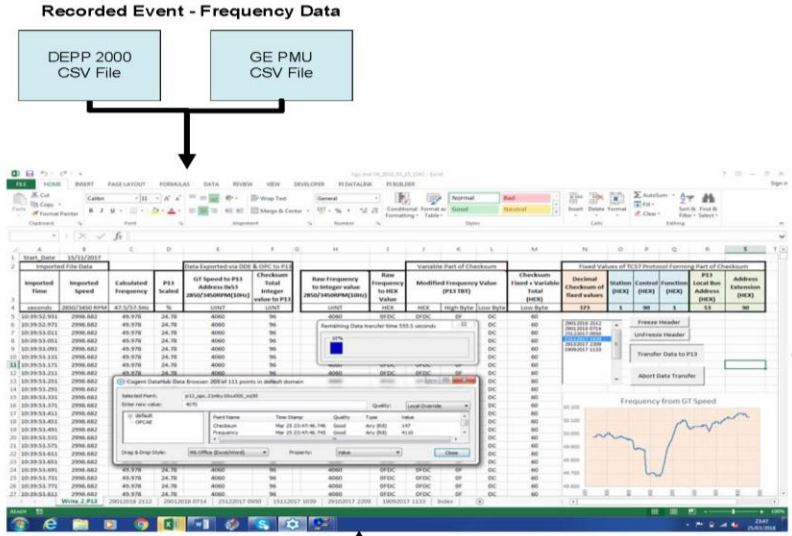


SimApp Model – Frequency Event 15th November 2017

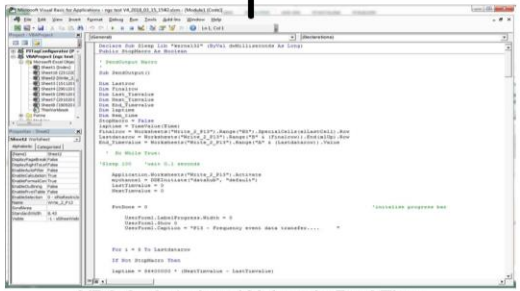
- **Offset Tracking Active – Simulation using real time event data**



Development of Capability to Simulate Real Events



Frequency Value and Checksum in real time (TC57 Protocol)



VBA Code to Load Values in Real Time

Procontrol GT Simulation and Code Test Environment

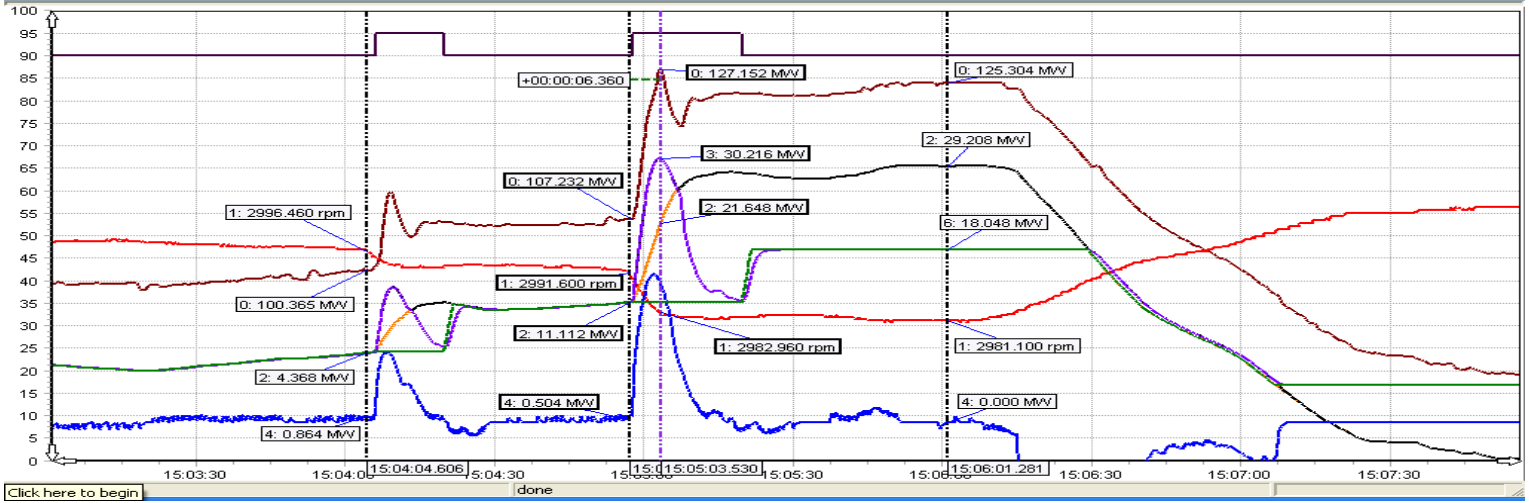
Simulation of Frequency Event 15/11/2017

- **Offset Tracking Active – Simulation using real time event data**

Trend [0] MyTrend Time display [Recorder Time]

2018-03-26 15:03:01 to 2018-03-26 15:07:56

Category	Name	Description	Range	Unit	Min	Max	Avg	15:04:04...	15:04:57...	15:06:01...	15:05:03...
00	21MBY10CU000_XJ11	Act. Power Undelayed	75/135	MW	86.400	127.152	107.047	100.365	107.232	125.304	127.152
01	21MBY10CU000_XJ50	Speed	2950/3050	rpm	2980.740	3006.360	2993.180	2996.460	2991.600	2981.100	2982.960
02	21MBY10DS503_XJ01	K(DF) Live DEPP	-10/50	MW	-9.864	29.328	10.589	4.368	11.112	29.208	21.648
	21MBY10DS503_XJ03	KDF / DdF / Ext DEPP	-10/50	MW	-9.864	30.216	10.940	4.368	11.112	29.208	30.216
04	21MBY10DS503_XJ09	Post PDT DDF Unlimited	-5/55	MW	-8.064	19.896	-0.081	0.864	0.504	0.000	18.696
05	21MBY10DS503_XJ10	DdF Ramp Limited DEPP	0/240	MW	n.point	n.point	n.point	NaN	NaN	NaN	NaN
06	21MBY10DS503_XJ10	DdF Ramp Limited DEPP	-10/50	MW	0.000	30.216	9.092	4.272	11.040	18.048	30.216
07	21MBY10DS503_XJ30	EFC KdF Tracking Offset	-10/50	MW	0.000	18.048	8.269	4.368	11.112	18.048	11.160
08	21MBY10DS503_XH07	EFC Dyn. DB Exceeded	90/95	ACTIVE	0	1	0.122	0	0	0	1



Present Status

- Limited Operational Notification (LON)
  - Issued for South Humber Bank Power Station
  - Effective from 1st January 2018 to 30th April 2018
- Current Situation
  - EFCC ddF system live since 27th February 2018
  - No events to date with unit on frequency response
  - Low level of utilisation to date as mandatory FR is increasingly being displaced by commercial FR
  - GE system only providing monitoring role at present

Load following, frequency response, reactive power and inertia!

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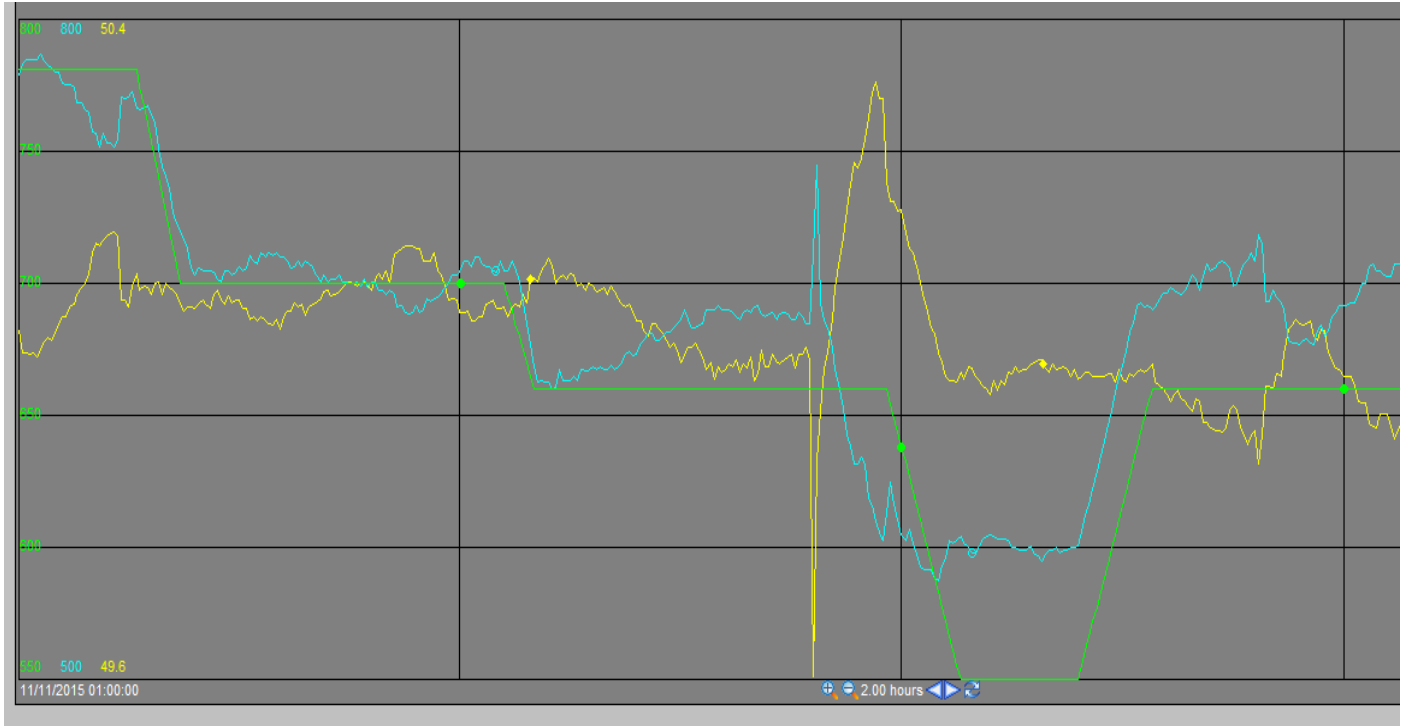
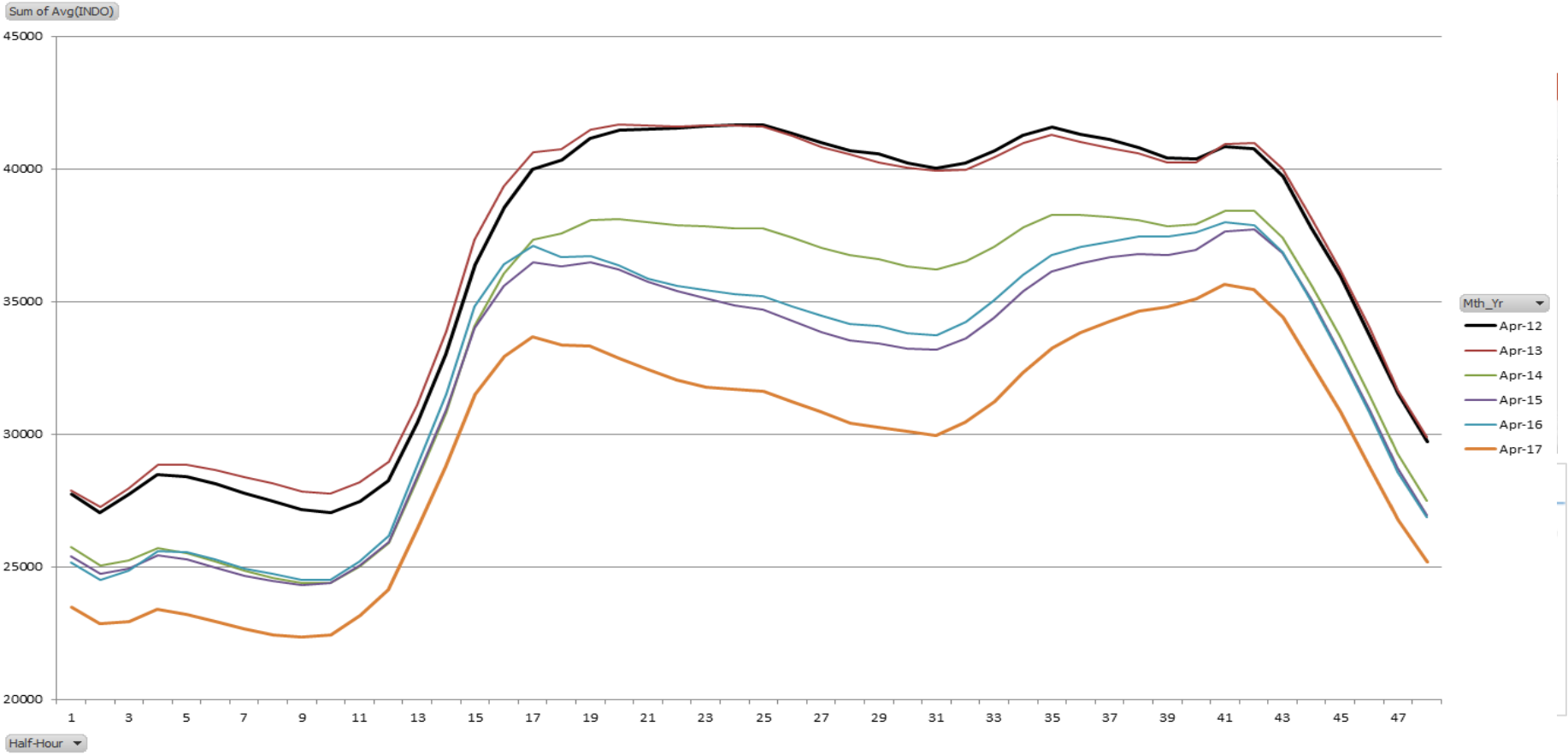
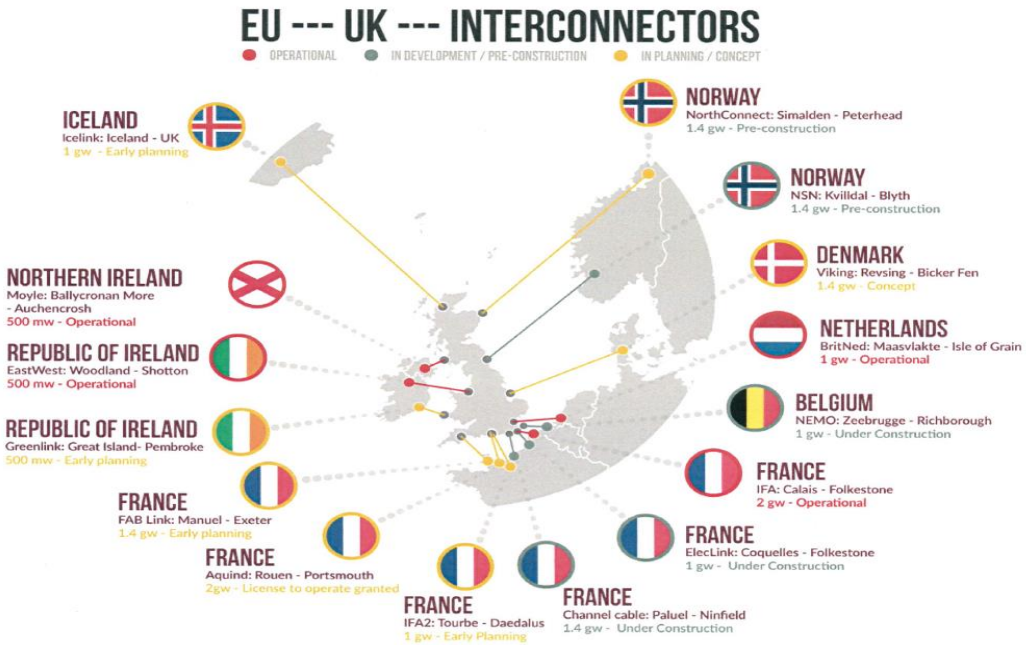


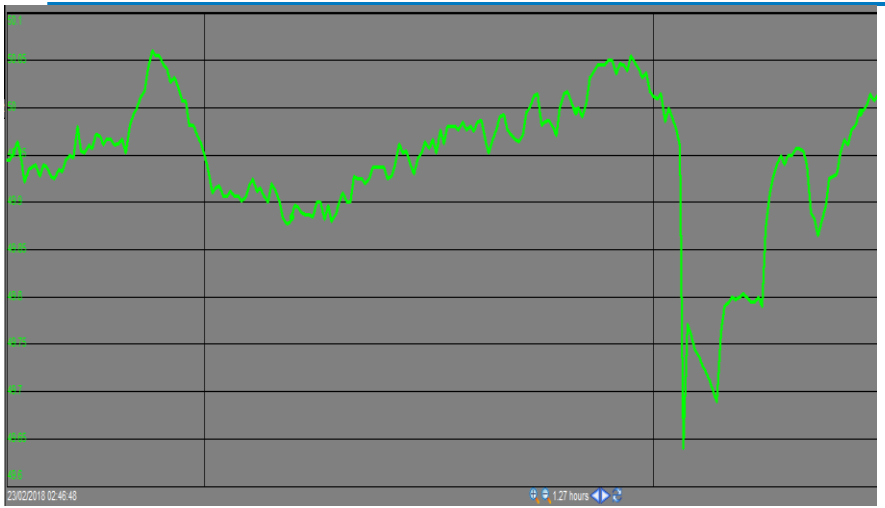
Average weekday April demand (net of “behind the meter” generation)

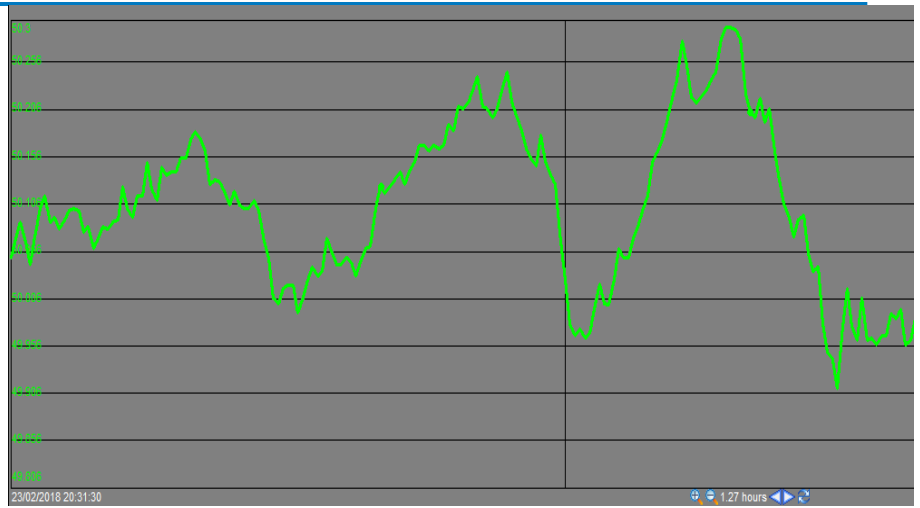


More interconnectors but less synchronous plant and therefore less inertia



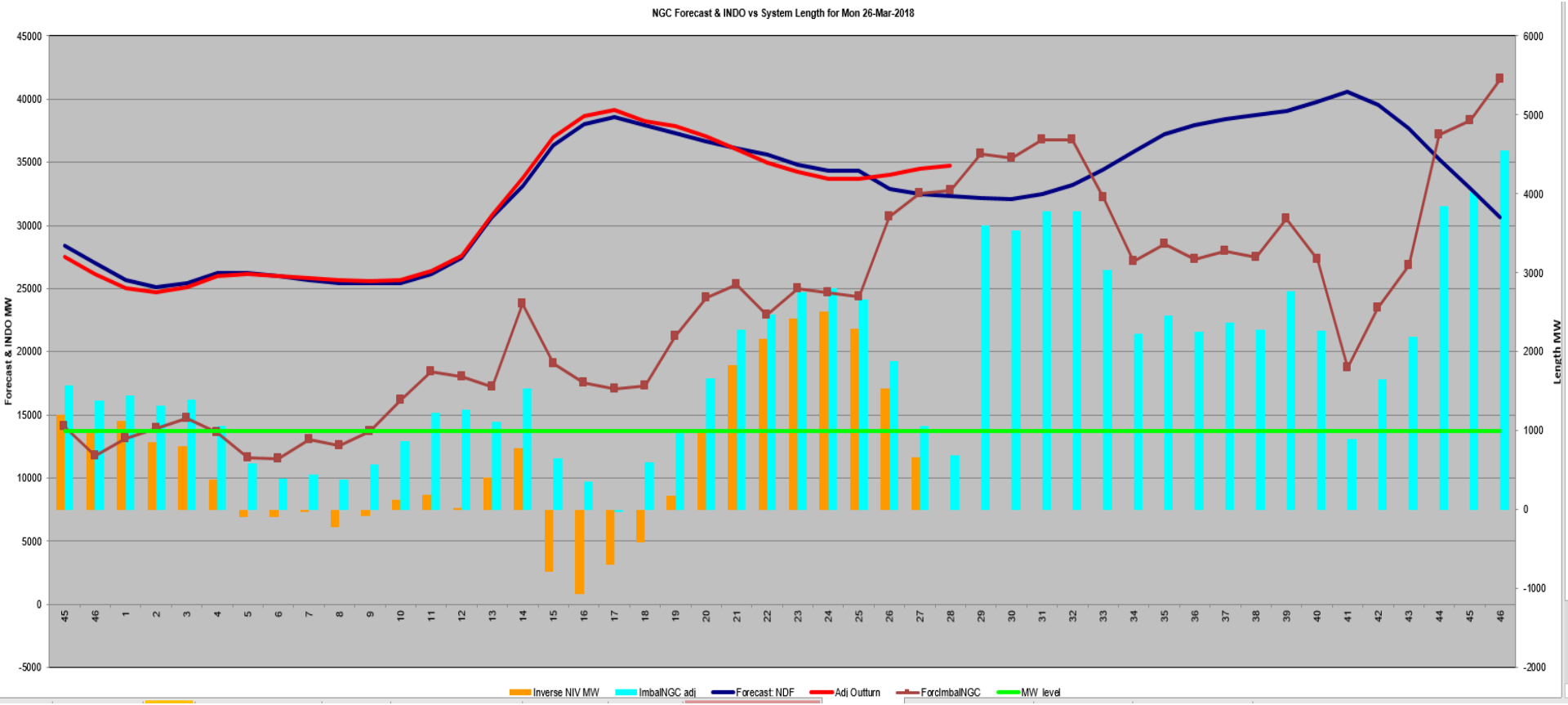
Anyone Remember 23/02/18?





- The highest and lowest frequency (as measured at Brigg PS) over X day period occurred, fortunately not a few mins apart
- Theoretical and practical response requirements may differ, at least on occasions

We need to avoid unintended consequences



Learnings and Observations

- As part of the EFCC project, CCGTs have been shown to be able to respond more quickly to frequency events, response delivery at 6 seconds is approximately double that of conventional response

- The need for some faster acting response (faster than CCGTs can deliver) is beyond question

- There remain large quantities of very fast acting response (wind and solar) which remain completely under utilised due to outdated commercial arrangements

Learnings and Observations

- CCGTs can continue to offer a range of services, in addition to faster frequency response – flexibility, load following, reactive power (steady state and transient), short circuit levels and inertia

- When every plant was synchronous, arguably there was no need to pay for inertia but the composition of plant on the system has changed significantly

- Conventional plant operators may argue that the full benefits of thermal plant are not being incentivised whilst their future need is highly likely to remain

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