Performance Monitoring Workshop

6th June 2013 - Belfast

11th June 2013 - Dublin

Opening Remarks – Anne Trotter

#	Topic	Time	Presenter
	Registeration	10:00	-
1	**Opening Remarks**	**10:15**	**Anne Trotter (Chair)**
2	**A Day in the Life of Performance Monitoring 2013**	**10:20**	**Amanda Kelly / Norman Watson**
3	**Performance Monitoring from a Generators Perspective (Part 1)**		
	AES	**10:40**	**Brian Mongan**
	Bord Gáis	**11:00**	**Ed Long**
	Tea/Coffee Break	11:20	-
4	**Performance Monitoring from a Generators Perspective (Part 2)**		
	ESB Generation & Wholesale Markets	**11:35**	**Ruairí Costello**
	SSE Renewables	**11:55**	**Jane McArdle**
5	**Round Up of Current Approach & Questions**	**12:15**	**Anne Trotter (Chair)**
	Lunch	12:45	-
6	**A Day in the Life of Performance Monitoring 2015 (Part 1)**		**David Carroll & Norman Watson**
	Overview of proposal	**13:30**	
	Functional/Non-Functional Requirements	**13:35**	
	Active Power Performance	**13:50**	
	Break	14:30	-
7	**A Day in the Life of Performance Monitoring 2015 (Part 2)**		**David Carroll & Norman Watson**
	Available Active Power Performance	**14:40**	
	Frequency Response Performance	**15:00**	
	Reactive Power Performance	**15:15**	
8	**Round Up of Proposed Enhanced Approach**	**15:30**	**Anne Trotter (Chair)**
9	**Next Steps**	**15:45**	**David Carroll**
	Finish	16:00	-

A Day in the Life of Performance Monitoring 2013

Amanda Kelly (EirGrid) /
Norman Watson (SONI)

Performance Monitoring Context

- The TSOs have an obligation to carry it out under the Grid Codes
- The TSOs in both jurisdictions have always monitored the performance of the plant they dispatch
- The basis of secure and economic system operation relies on the expected plant performance to match actual performance

Now, tomorrow and beyond….

- The challenges ahead with a changing plant portfolio, such as increased non-synchronous penetration and different types of technologies, requires a greater degree of plant performance from all units.

Current Conventional Performance Monitoring Process

Daily

- Failure to synchronise (not SONI)
- Trips
- Failure to follow dispatch instructions
- Failure to make correct declarations
- Operating reserve
- Fault Ride Through

Quarterly

- Active power duration
- Reactive power range
- Operating reserve
- Technical Offer Data:
  - Min generation
  - Ramp up/down rates
  - Min up/down time
  - Loading/deloading times
- Secondary fuel capability

Current Wind Farm Performance Monitoring Process (10 Day Notification)

Daily

- Failure to follow dispatch instructions
- Failure of available active power signal

Monthly

- Available active power accuracy
- Active power control accuracy

Other Monitoring

- If a wind farm fails to perform as expected during an event, for instance low voltage ride through.

Benefits of Current Approach

Feeds into Operational Policy

- Improve all island Operating Reserve (OR) policy:
  - Actual reserve performance supports overall OR requirement (holding less reserve compare to previous practices);
  - Provide confidence and assurance to all.

Benefits of Current Approach example

- Generator Performance Incentive (GPI) provide improvement to the overall system
- For example importance of minimum generation in night valley.
- Fairness and consistent approach to all units

Processing of Performance Non-Compliances

- Managed by the TSOs performance monitoring team
  - Operational Services and Performance (EirGrid)
  - Near Time (SONI)
- Mixture of Manual / automatic processing of performance monitoring data

Communication to Generator

- Communication via performance monitoring team email to generator
- Information to generator includes notification, details of non-compliance and any other relevant information.

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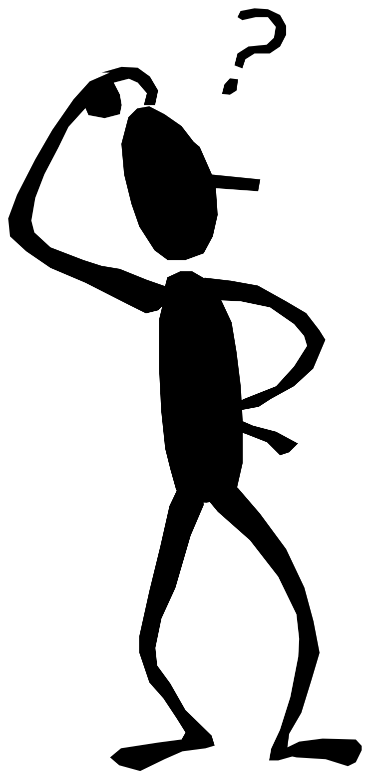
System Services DS3
Enhanced performance monitoring

- DS3 system Services Project
- Efficient communication of performance monitoring data to all providers
- Consistent approach in line with DS3 program

Questions?



Performance Monitoring from a Generator's Perspective (1)

Denis McBride / Brian Mongan
AES

Performance Monitoring from a Generator's Perspective (2)

Ed Long
Bord Gáis

Tea/Coffee Break

Performance Monitoring from a Generator's Perspective (3)

Ruairí Costello
ESB International

Performance Monitoring from a Generator's Perspective (4)

Jane McArdle
SSE Renewables

Round Up of Current Approach & Questions

Anne Trotter

Lunch

A Day in the Life
of
Performance Monitoring 2015

Dave Carroll (EirGrid) /
Norman Watson (SONI)

Overview of Presentation

1. Scope of Project
2. Functional Requirements
3. Non Functional Requirements
4. Active Power
5. Available Active Power
6. Frequency Response
7. Reactive Power
8. Operational Process
9. Next Steps

Objective

- Increase certainty and understanding of how plant is performing
- Use information to improve modelling of system
- Facilitate appropriate regulation and incentivisation of necessary products to ensure necessary performance is delivered

Utilise performance capability to efficiently and securely manage power system with up to 75% non synchronous generation

Delivering a Secure Sustainable Electricity System (DS3)

System Services
Performance Monitoring
Grid Code
Demand Side Management

Frequency Control
Voltage Control
Renewable data
System inertia

Models Development
Control Centre Tools
AI Wind Security Assessment Tool

Scope of Enhanced Monitoring Project

- Standardised and harmonised on all-island basis
- Automated monitoring
- Transparent and improved communications
- Monitoring of proposed new System Service products
- Investigate use of improved data i.e. high speed recorders
- Industry Involvement
- Operational Readiness

Progress to date

- Internal project approval granted
- High level Requirements for Enhanced Performance Monitoring developed in Q4 2012
    - Data
    - Analysis
    - Reporting
    - Functional Spec
- Detailed business requirements specification being developed at present

High Level Requirements - Intro

- A ‘wish list’ has been developed through a number of internal workshops on what the enhanced process should include – inputs from today will be added to this ‘wish list’

- These high level requirements will be translated into detailed business rules so that a detailed cost benefit analysis can be undertaken and ultimately so that an IT system can be developed

- This workshop focuses on the requirements and not on the business processes i.e. the follow up

High Level Requirements - Numbers

- Currently 193 individual units bound by Grid Code for which enhanced performance monitoring needs to be carried out for

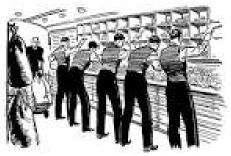
- Huge volume of data and complexity of business rules

- Number of units expected to increase to ~300 by 2020

	Conventional		Interconnectors		TSO Wind		DSO Wind		Total	
	IRE	NI	IRE	NI	IRE	NI	IRE	NI	IRE	NI
Current No. units	55	23	1	1	19	3	69	22	144	49

Functional Requirements – (1) Customer Facing

- Secure web based portal
- Summary of main issues to clearly show main issues (assigned Priority order)
- Customer can view, download and upload content
- Investigating whether correspondence tracking system can be added
- Aim is to reduce need for emails



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Functional Requirements – (2) Data

- Business case being developed to roll out GPS time stamped, high speed data recording (kV, MW, MVAr)

- If progressed this will require installation on LV side of generator transformer (reactive power)

- EDIL, SEM TOD, SCADA will be used

- Data will be made available to customers

Functional Requirements – (3) Reporting

- Reporting will focus on trends of non-compliance removing follow up for individual events for most part
- Non-compliance items will have a priority
  - Need to develop priority order for each trend (at a later date)
- Detailed standardised reports will be developed
- Calculation steps and raw data would be available in .xls, etc

Functional Requirements – (4) System Services

- Enhanced system will be utilised for new System Services if approved by SEM Committee

- Output will feed into settlement system

- Customers will know whether they achieved the required level of product delivery

Non- Functional Requirements – (1)

- Security of commercially sensitive data
- Access to online portal – what should e.g. OEMs see?
- Archiving of data – trends will be available, however detailed reports will be archived
- Availability - Proposal to have (most) data available as close to real time once quality controlled (e.g. D + 3). A real-time system would be too onerous from a cost and quality control perspective
- Usability – User guides will be developed and training will be provided

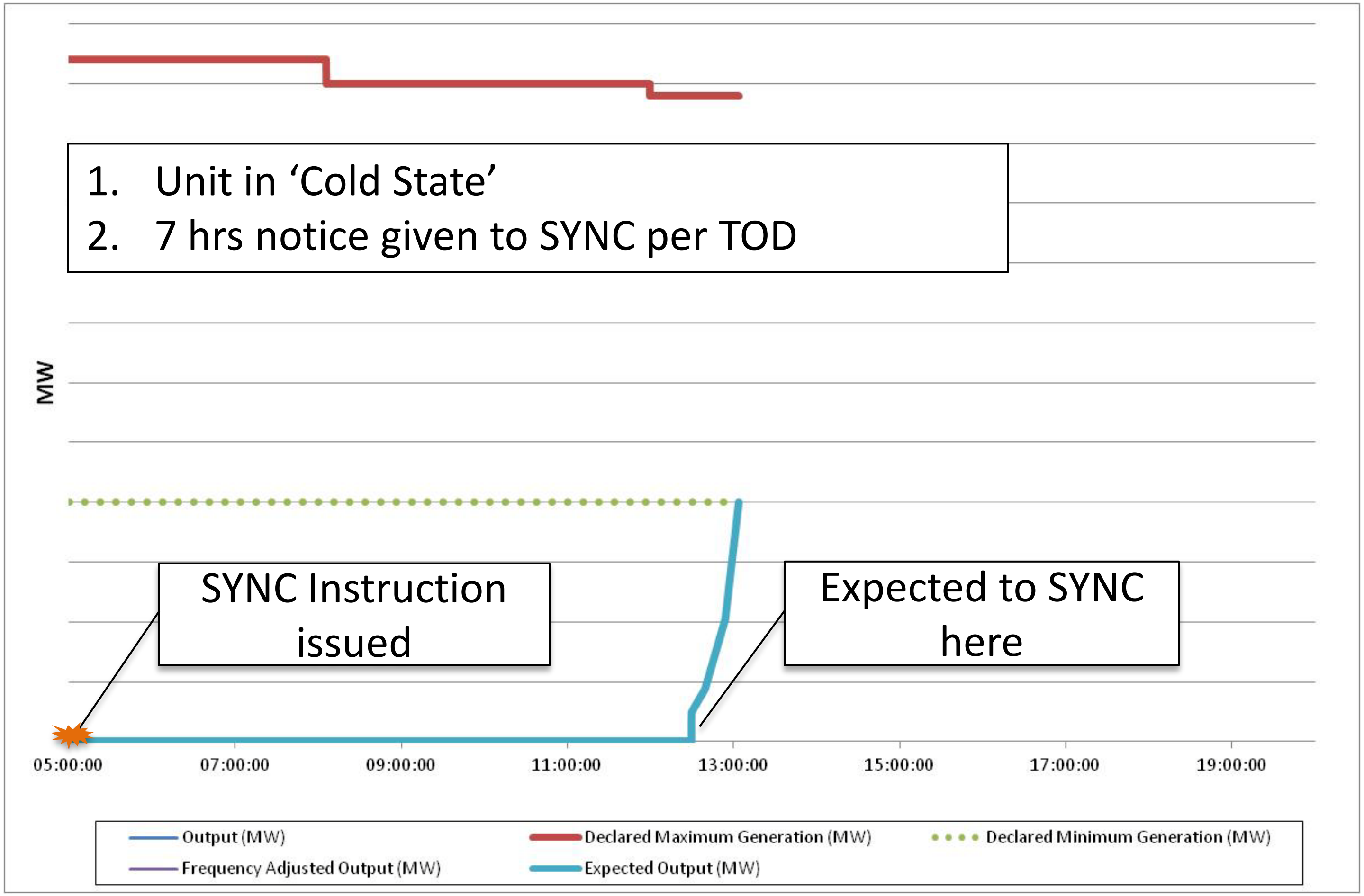
DISCUSSION

Active Power

WHY? - Frequency Control

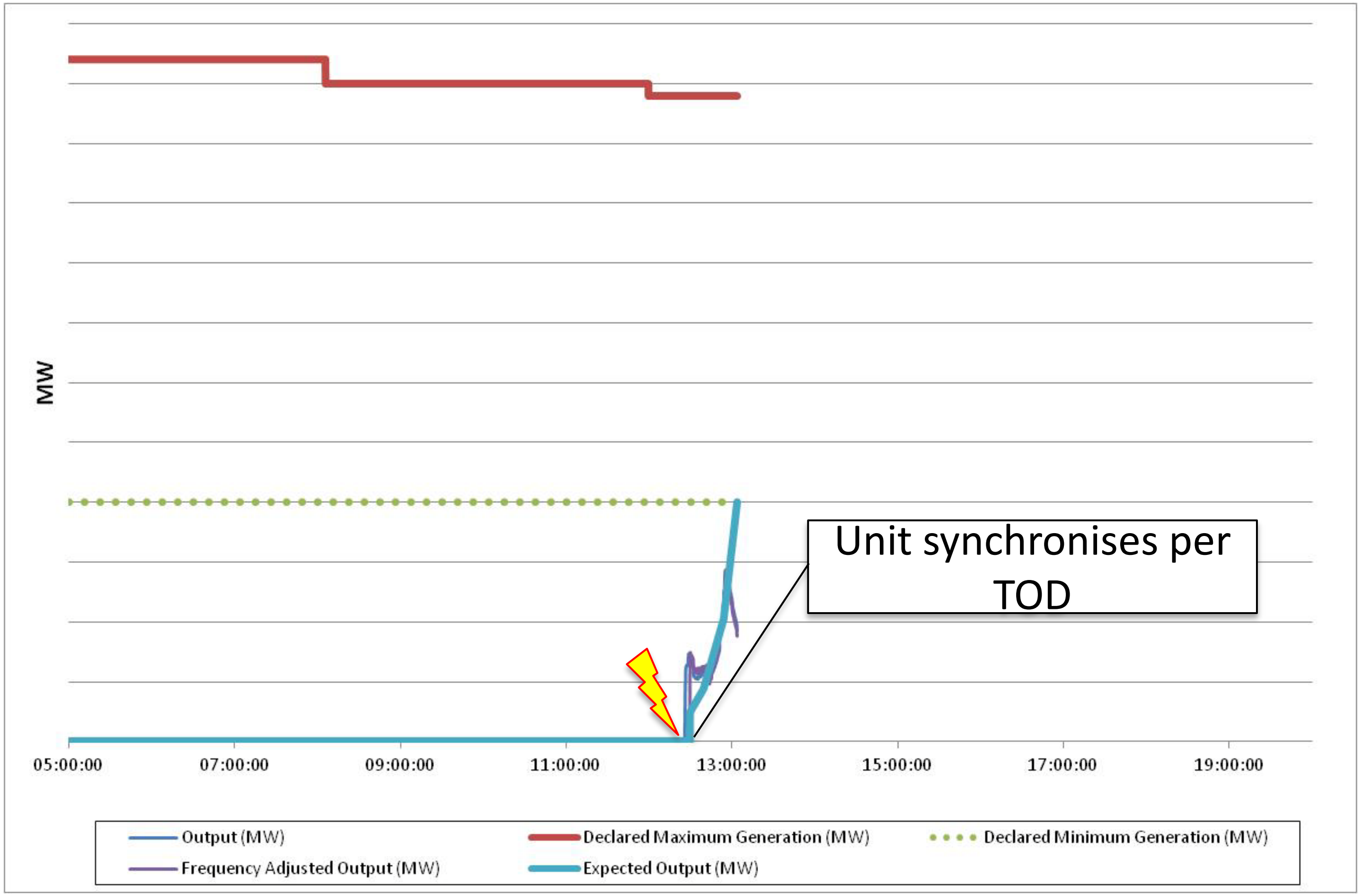
1. Synchronising
2. Block Load
3. Loading/De-Loading
4. Ramping
5. Compliance with Dispatch Instructions
6. Unexpected Load Drops/Trips
7. Secondary Fuel
8. Max Starts per 24 hours

(1) Synchronising



ACTIVE POWER

(1) Synchronising



ACTIVE POWER

(1) Synchronising - DATA

- EDIL – Sync instruction (send time, effective time)
- TOD – Notification time, hot/warm cooling boundary
- Generator CB close time
- Frequency data
- MW output

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ACTIVE POWER

(1) Synchronising - ANALYSIS

- Is TOD Grid Code compliant
- Determine heat state
- Determine actual sync performance:
  - Actual Sync Time vs. Expected Sync Time
  - If fail to sync how long did it take to sync after original instruction
  - Notice time given by control centres
- Determine system frequency at time of sync'ing

(1) Synchronising - REPORTING

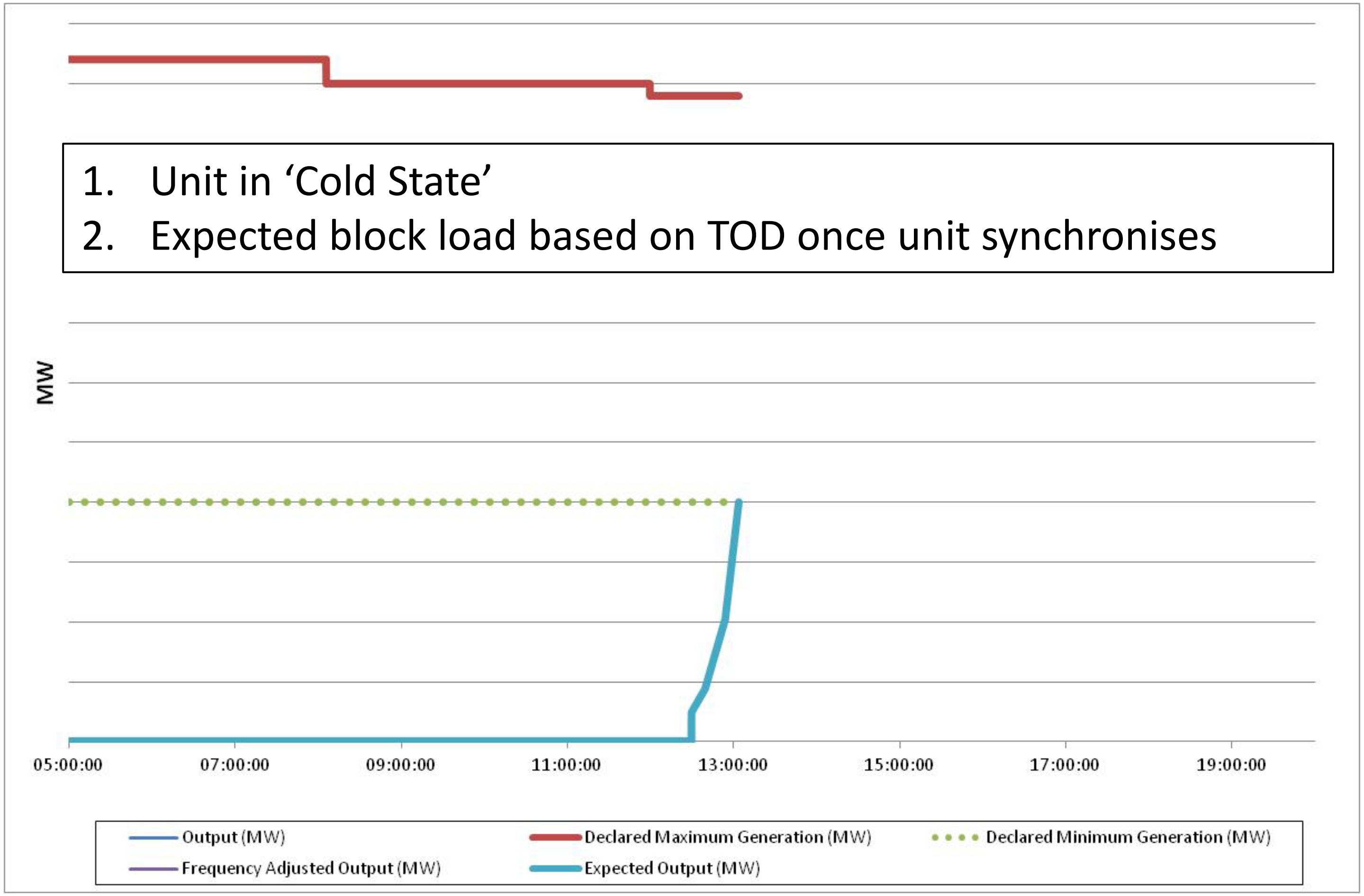
Detailed Report for each event:

- Actual SYNC Time vs. Expected SYNC Time
- If *Failsyn* what was system frequency
- Was unit requested to sync again? What was performance?

Summary Report:

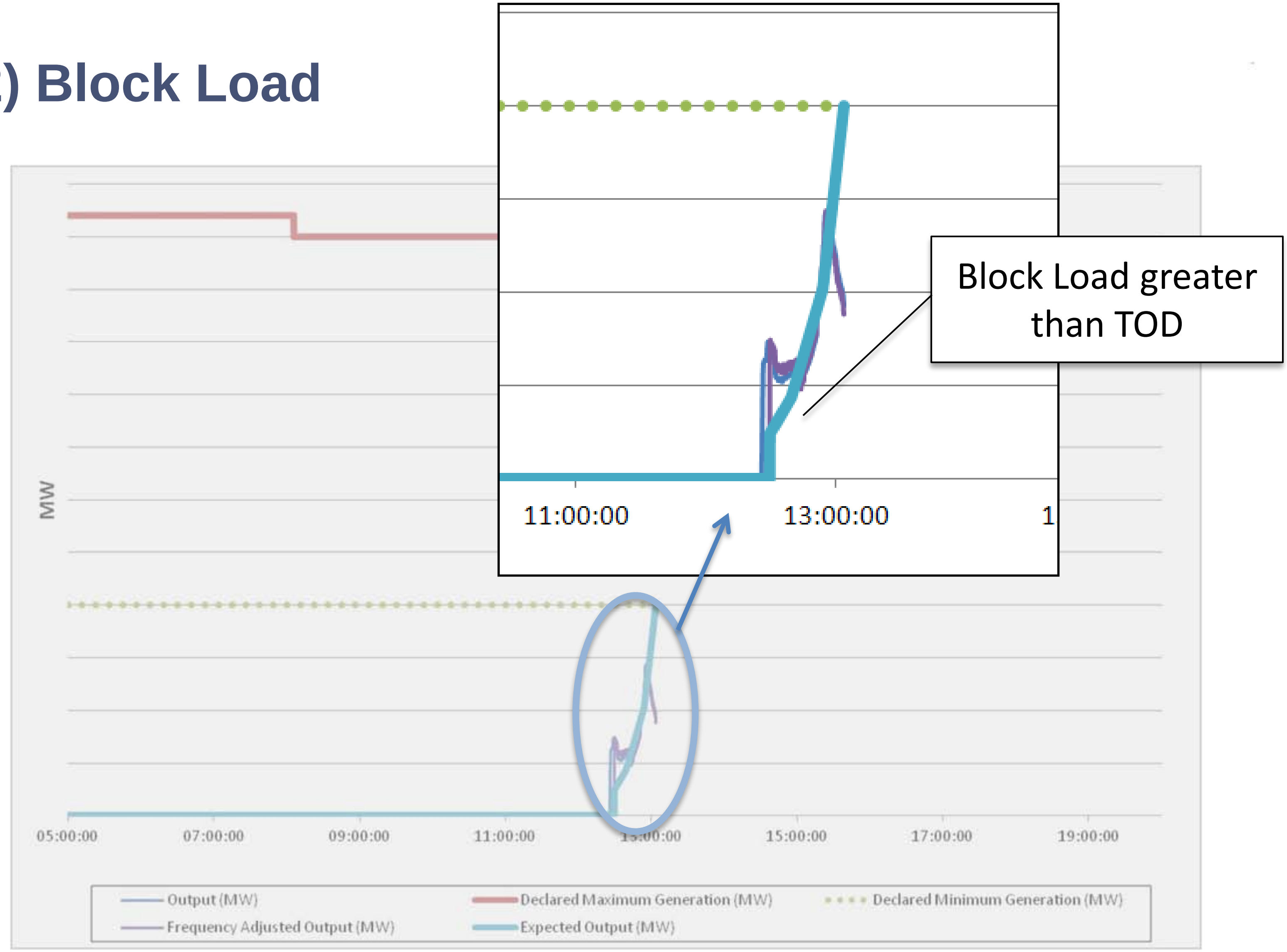
- Trend in compliance - % Fail / % Syncs
- Average time taken to SYNC following FAILSYN
- Plot of time taken to SYNC against notification time
- Last time unit synchronised
- Grid Code compliance

(2) Block Load



ACTIVE POWER

(2) Block Load



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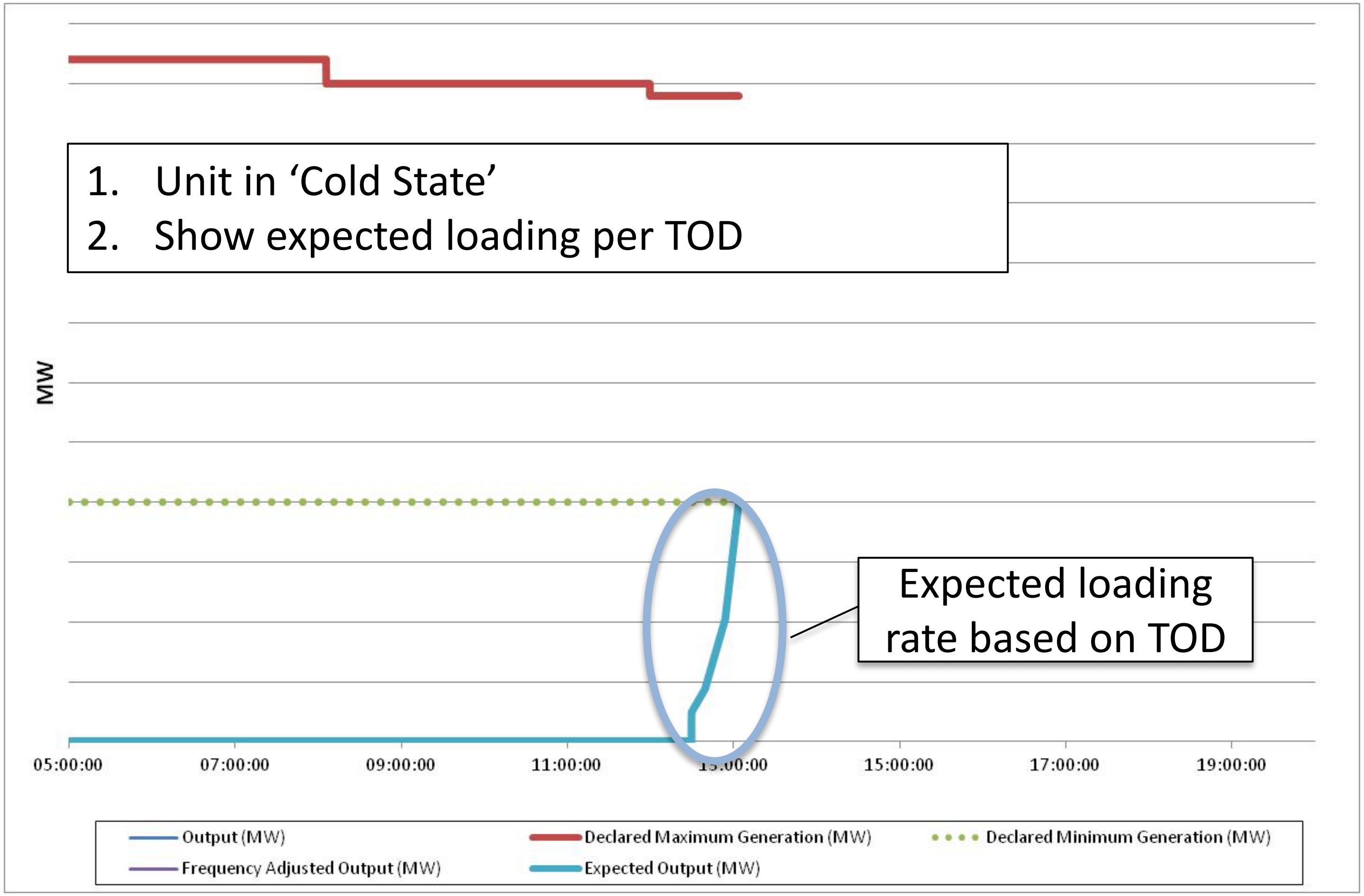
ACTIVE POWER

(2) Block Load

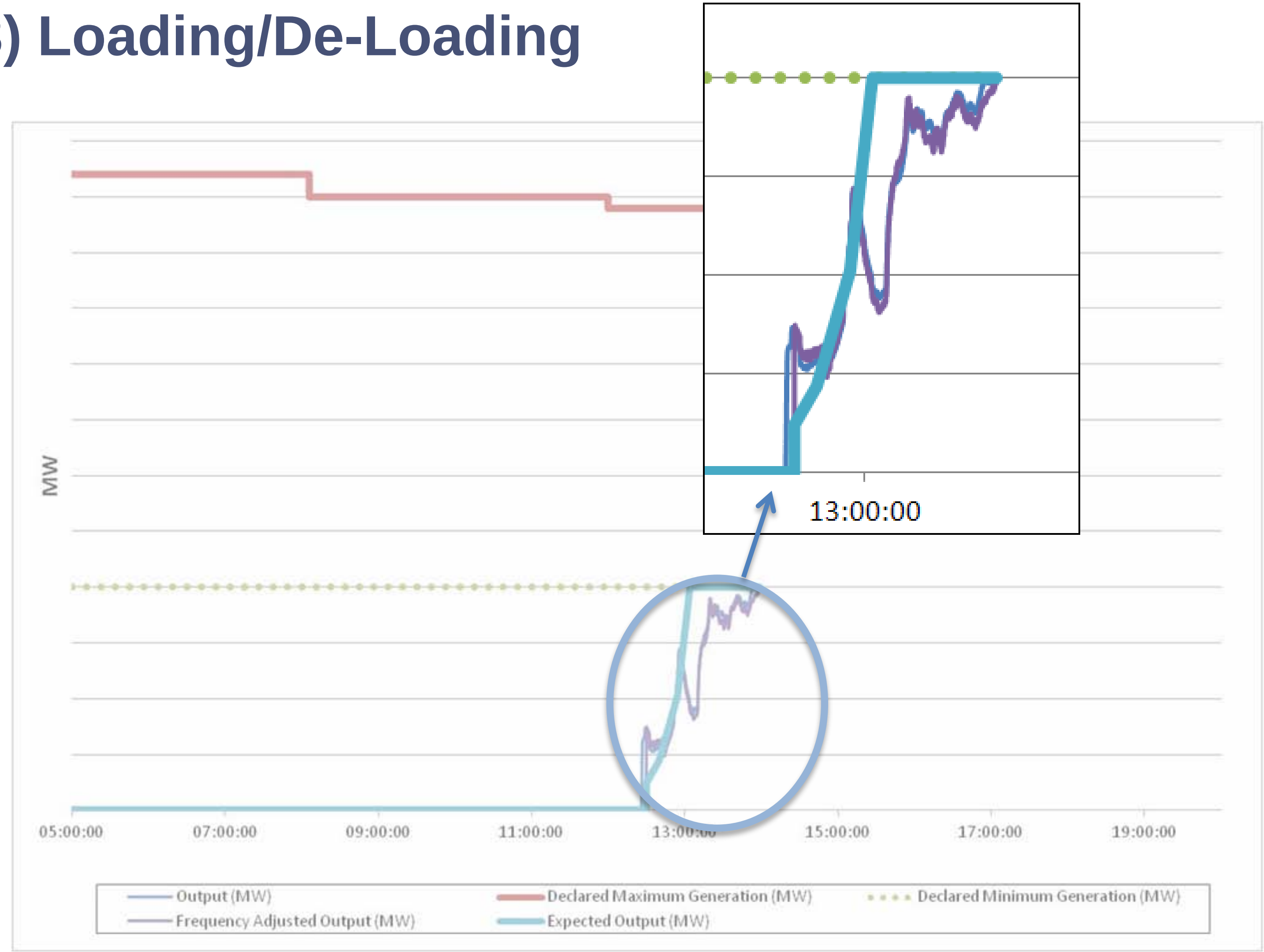
- Use SCADA to determine initial MW output
- Is this Grid Code compliant
- Does this align with the TOD for various heat states

(3) Loading/De-Loading



ACTIVE POWER

(3) Loading/De-Loading



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ACTIVE POWER

(3) Loading/De-Loading - DATA

- EDIL – Minimum generation, dispatched MW setpoint, target frequency
- TOD – Loading/De-Loading rates, break points, soak times
- 5 second MW SCADA

(3) Loading/De-Loading - ANALYSIS

- Is TOD Grid Code compliant
- Determine heat state
- Determine actual loading/de-loading performance
  - The actual MW per minute rate for each loading rate
  - Does unit provide frequency regulation

(3) Loading/De-Loading - REPORTING

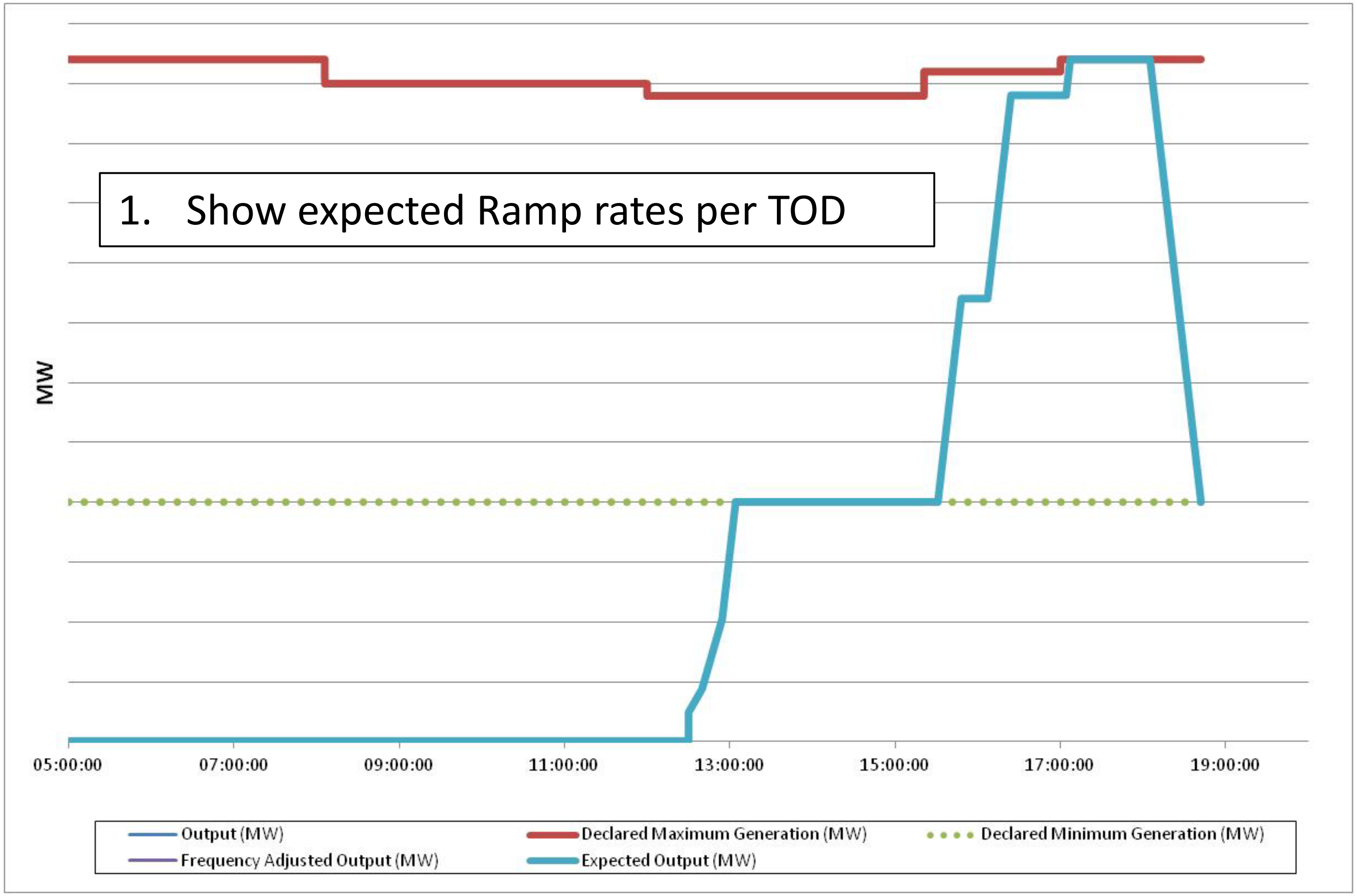
Detailed Report for each event:

- Actual loading/de-loading rate
- Broken down into various break points and heat state

Summary Report:

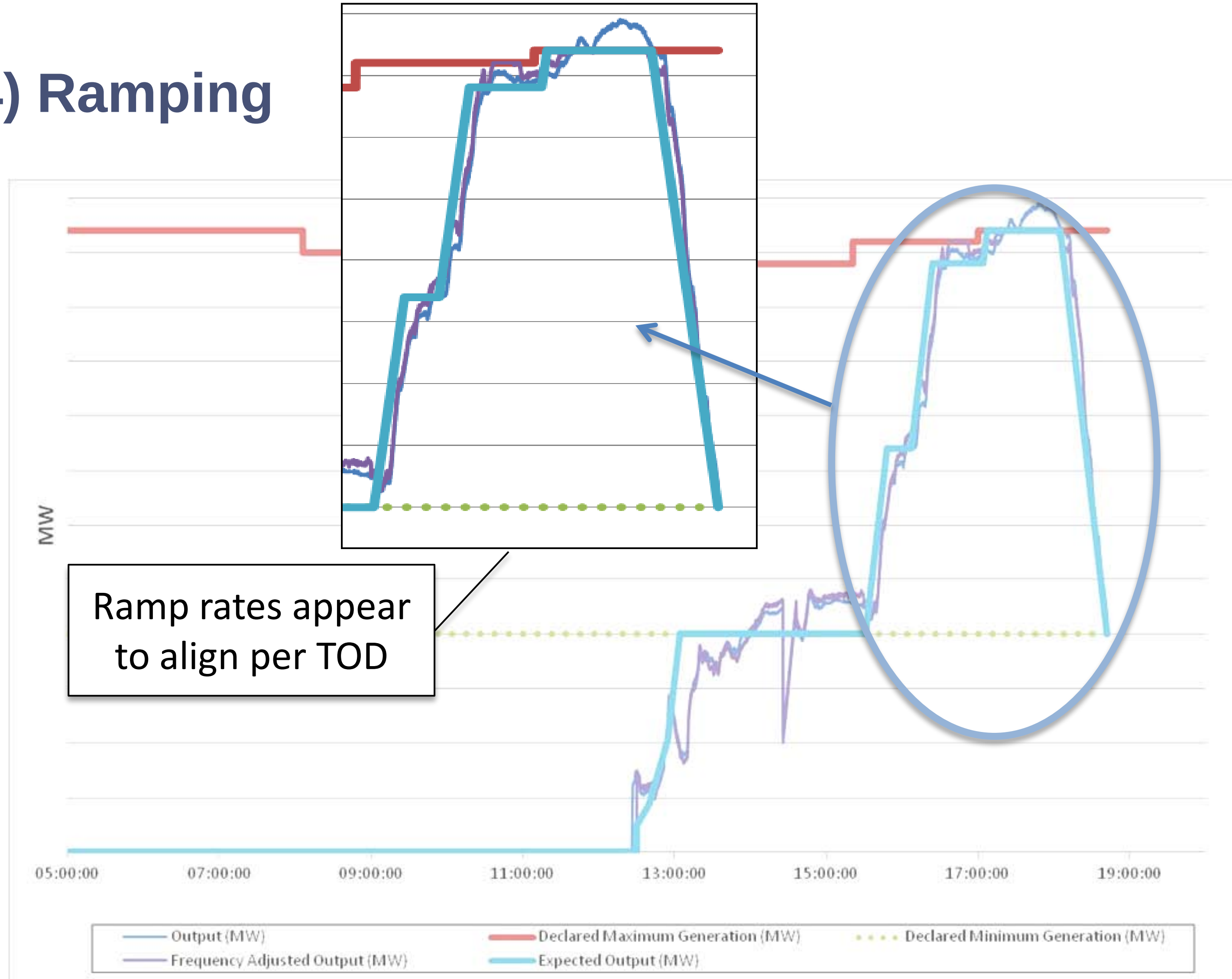
- Trend in compliance
- Grid Code compliance

(4) Ramping



ACTIVE POWER

(4) Ramping



ACTIVE POWER

(4) Ramping - DATA

- EDIL – Minimum generation, dispatched MW setpoint, target frequency, registered capacity, governor droop
- Contracts - TOR2, RRA, ramping under DS3
- TOD – Ramp up/down rates, break points, forbidden zones
- 5 second MW, Hz SCADA

(4) Ramping - ANALYSIS

- Is TOD Grid Code compliant
- Determine actual ramp up/down performance:
  - The actual MW per minute rate for each ramp rate
  - Does unit provide frequency regulation
- Does unit provide contracted/declared TOR2 & RRA
- Does unit provide contracted DS3 System Services

ACTIVE POWER

(4) Ramping - REPORTING

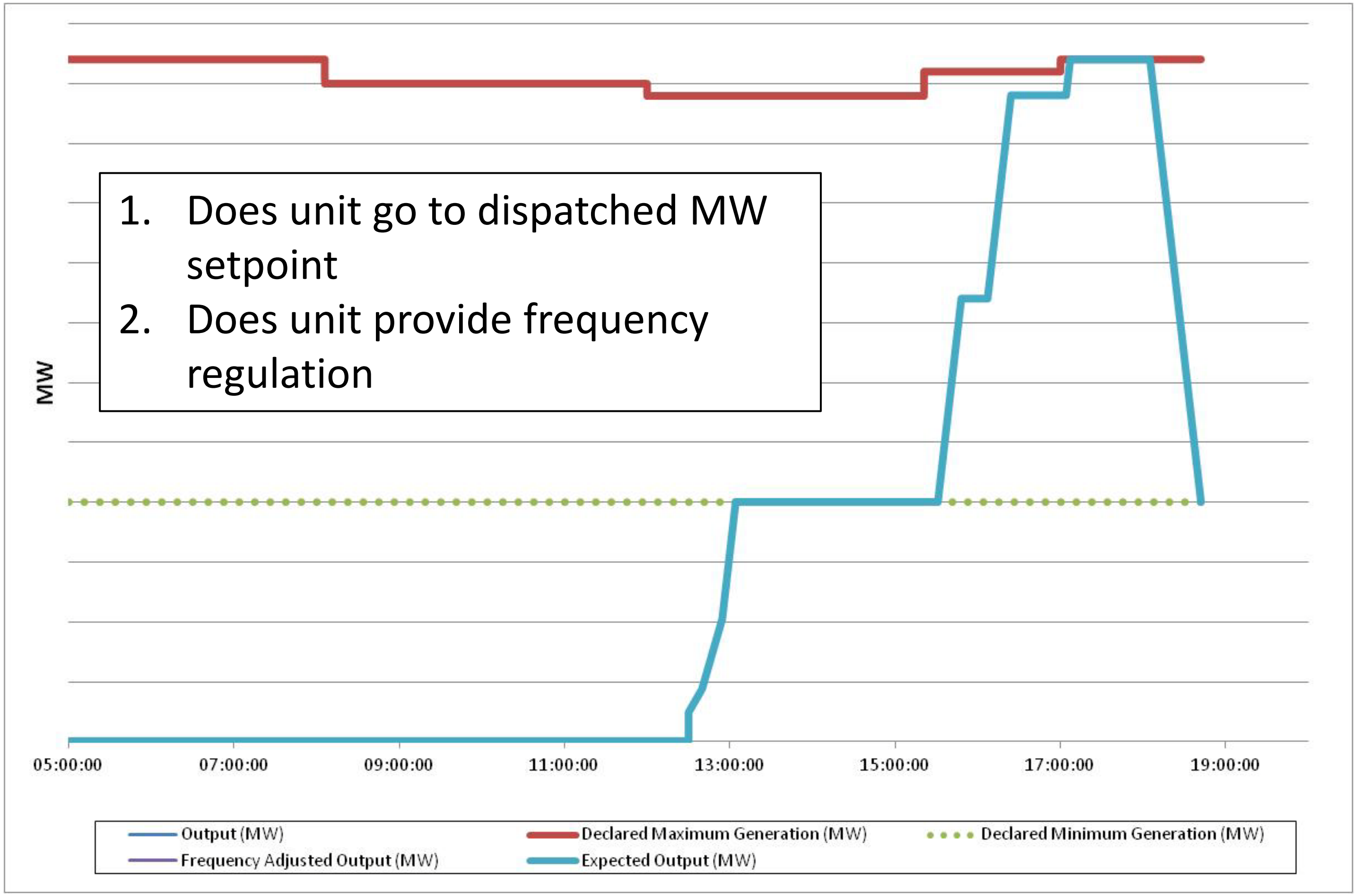
Detailed Report for each event:

- Actual ramp up/down rate
- Broken down into various break points and heat state
- Whether contracted values delivered

Summary Report:

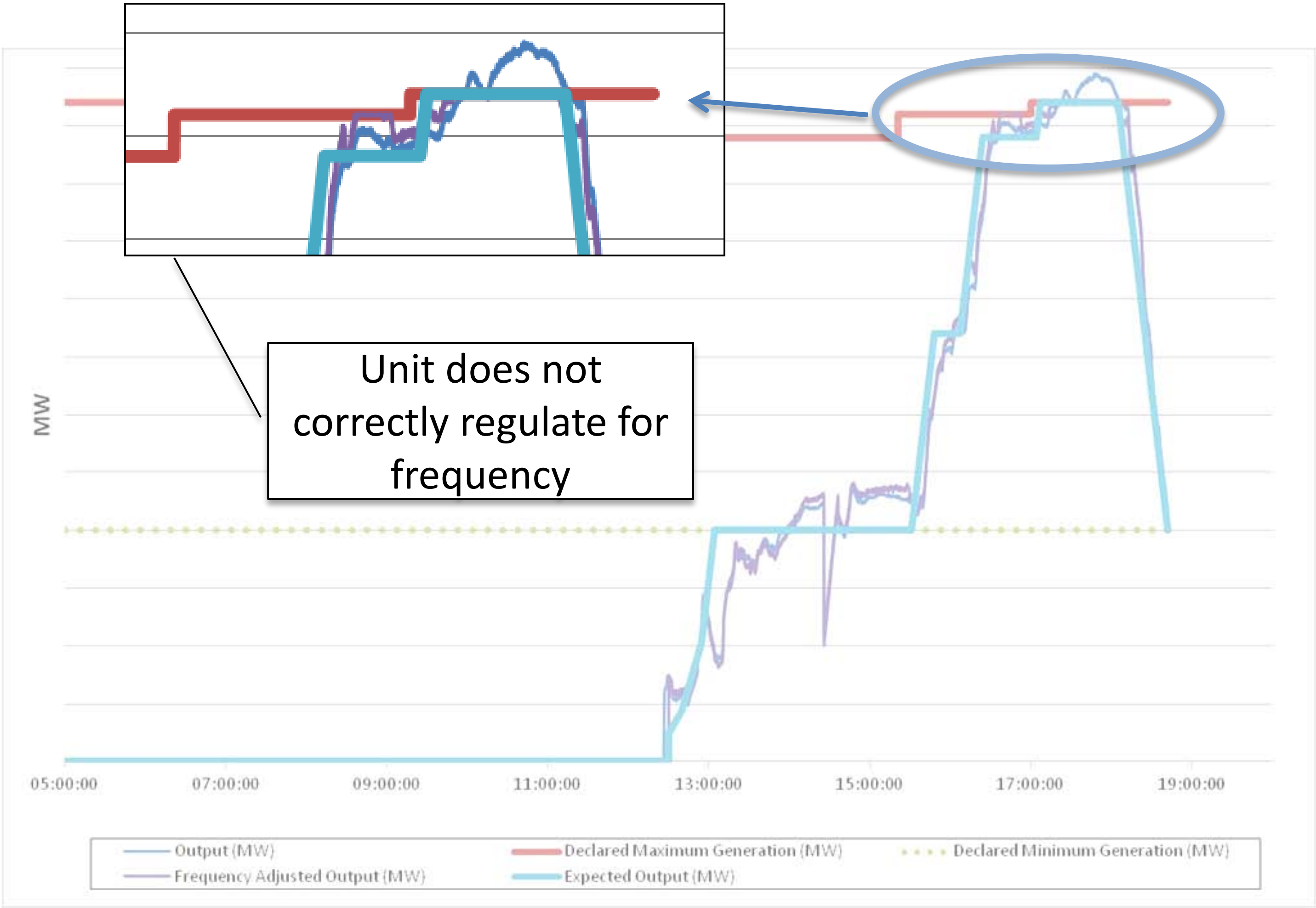
- Trend in compliance
- Grid Code compliance

(5) Compliance with Dispatch Instructions



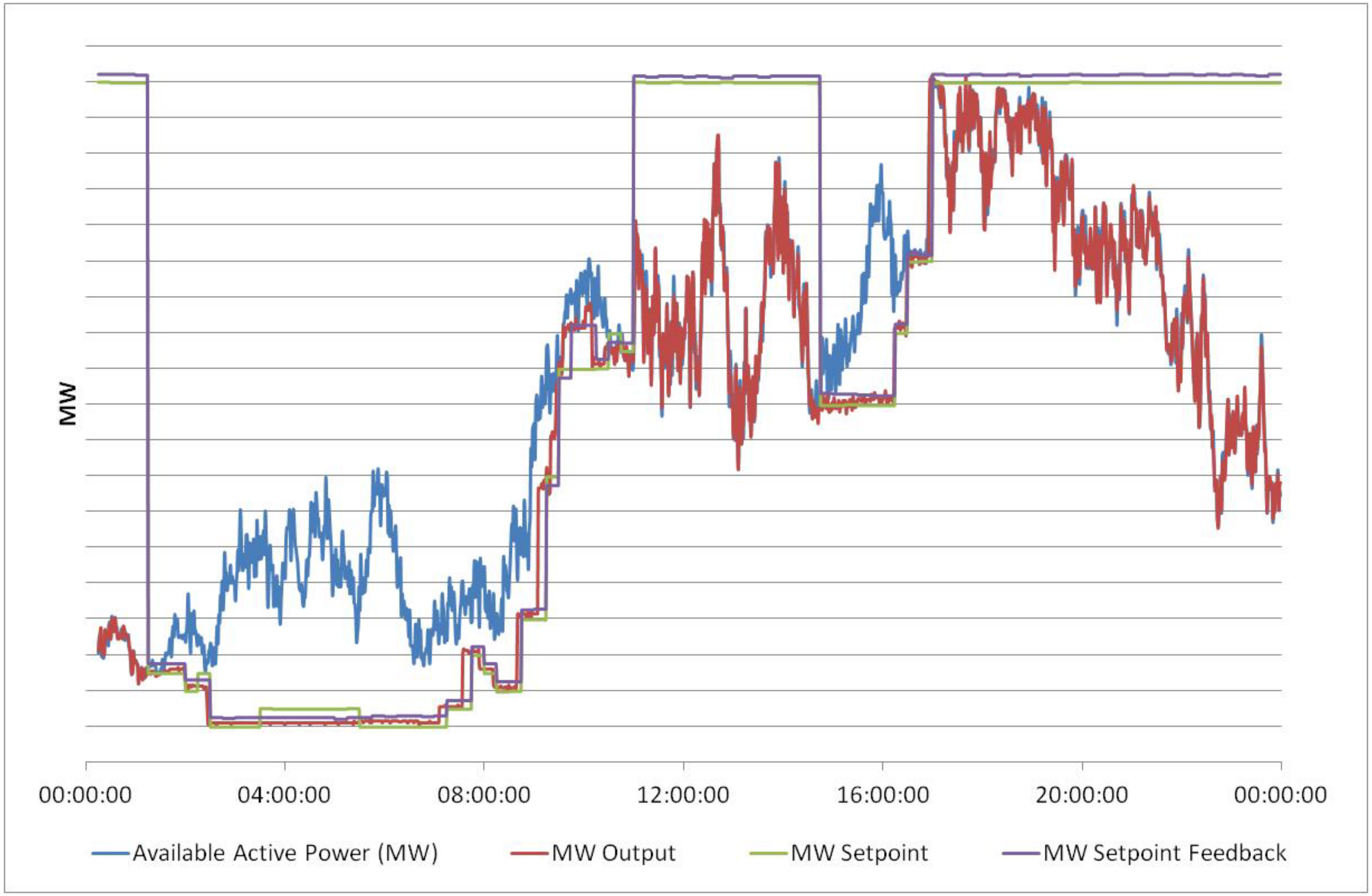
ACTIVE POWER

(5) Compliance with Dispatch Instructions



ACTIVE POWER

(5) Compliance with Dispatch Instructions



ACTIVE POWER

(5) Compliance with Dispatch Instructions - DATA

- EDIL – Minimum generation, dispatched MW setpoint, target frequency, registered capacity, governor droop, declared availability

- Windfarms – Available Active Power signal, active power setpoints/feedback, active power control ON/OFF, frequency response ON/OFF, frequency response curve, DMOL

- DSU - Submitted energy profiles

- 5 second MW, Hz SCADA

- 15 min metered MW output

- Governor deadbands

(5) Compliance with Dispatch Instructions - ANALYSIS

- Is governor droop Grid Code compliant

- Actual Performance:
  - Last time unit was dispatched to min and max generation
  - Its frequency adjusted MW setpoint reached
  - Does unit respond correctly for changes in frequency
    - According to contracted governor droop
    - According to windfarm frequency response curve

(5) Compliance with Dispatch Instructions - REPORTING

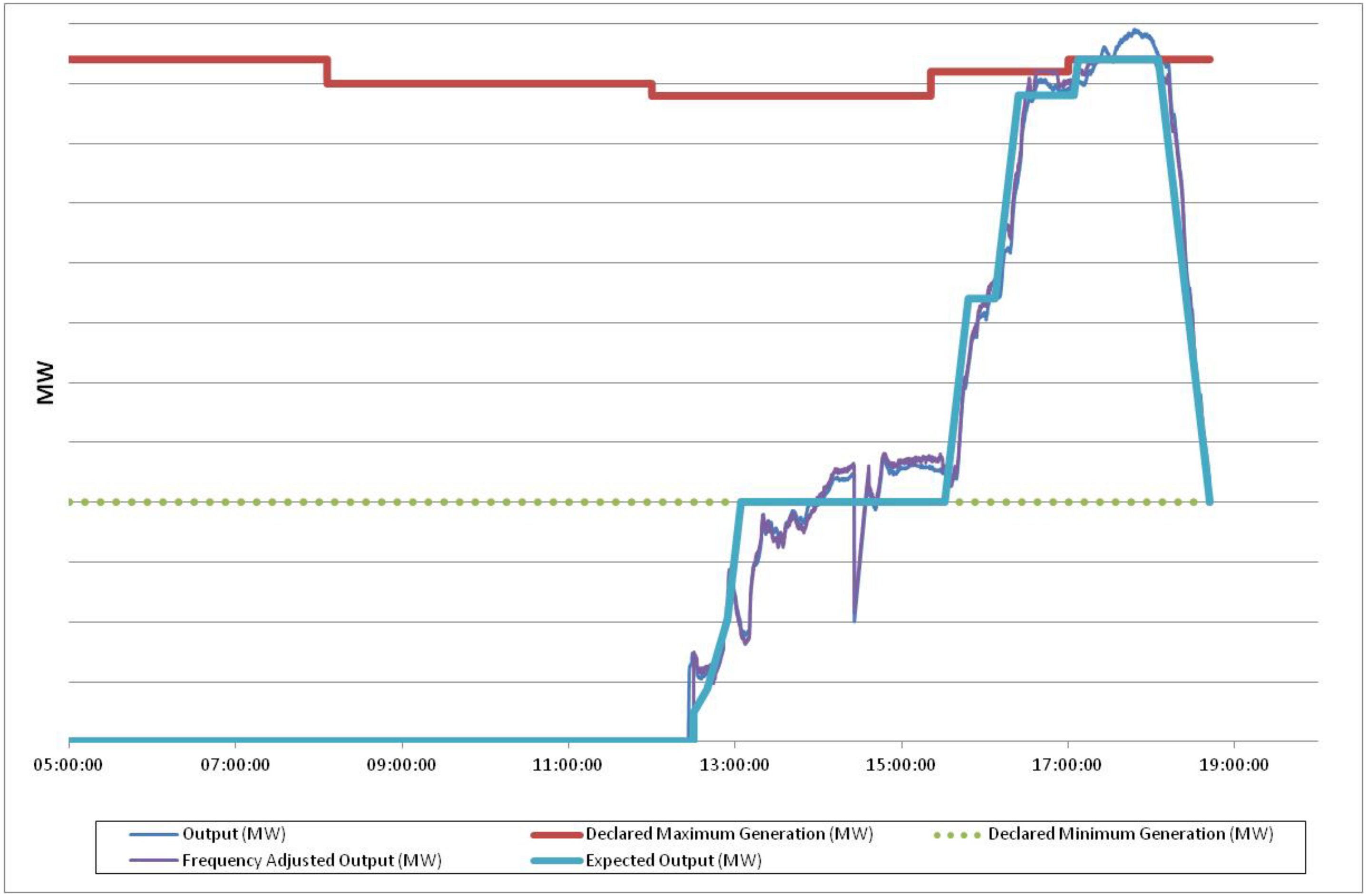
Detailed Report for each event:

- Whether declared min gen achieved
- Whether declared max gen achieved
- Whether unit went to dispatched MW setpoint
- Whether unit provided frequency regulation
- Wind – whether curtailment or constraint
- Wind – power curve for each windfarm

Summary Report:

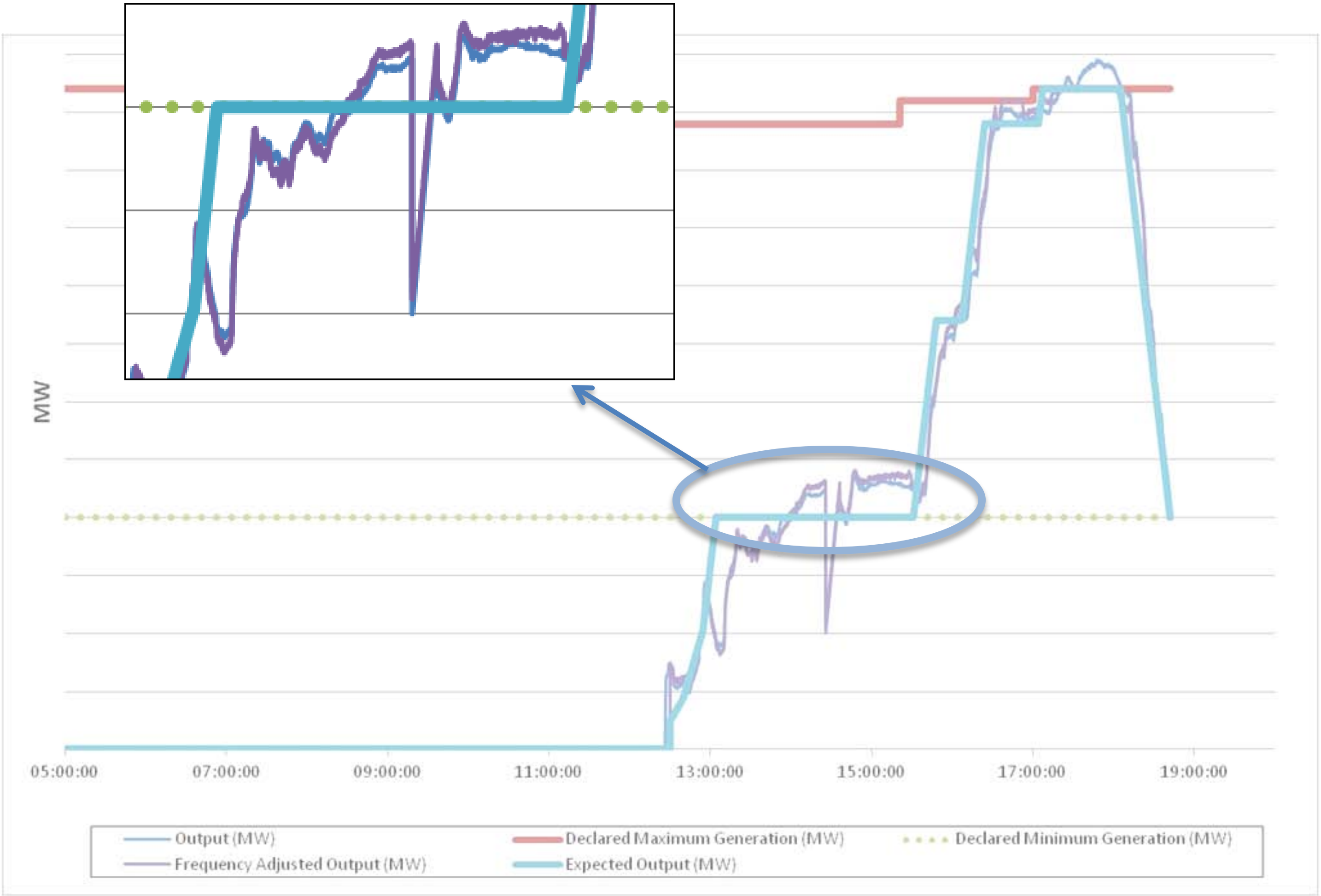
- Min/Max gen performance
- Last time dispatched to min and max gen
- Average governor droop

(6) Unexpected Load changes/Trips



ACTIVE POWER

(6) Unexpected Load changes/Trips



ACTIVE POWER

(6) Unexpected Load changes/Trips - DATA

- EDIL – Dispatched MW setpoint, declared availability (incl. reason Code), Trip DI, Failmin DI
- Windfarms – Available active power signal, active power setpoints/feedback, active power control ON/OFF, frequency response ON/OFF, frequency response curve
- 1 second MW, Hz SCADA
- Generator wind-down alarm, CB position indication

(6) Unexpected Load changes/Trips - ANALYSIS

- If output changes over a defined rate (MW/s) and range (MW) then calculate:
  - MW change
  - Rate of MW change (MW/s)
  - Pre-event frequency (Hz)
  - Frequency nadir/zenith (Hz)
  - Type of trip
  - Whether the unit recovers to dispatched setpoint and the time taken

(6) Unexpected Load changes/Trips - REPORTING

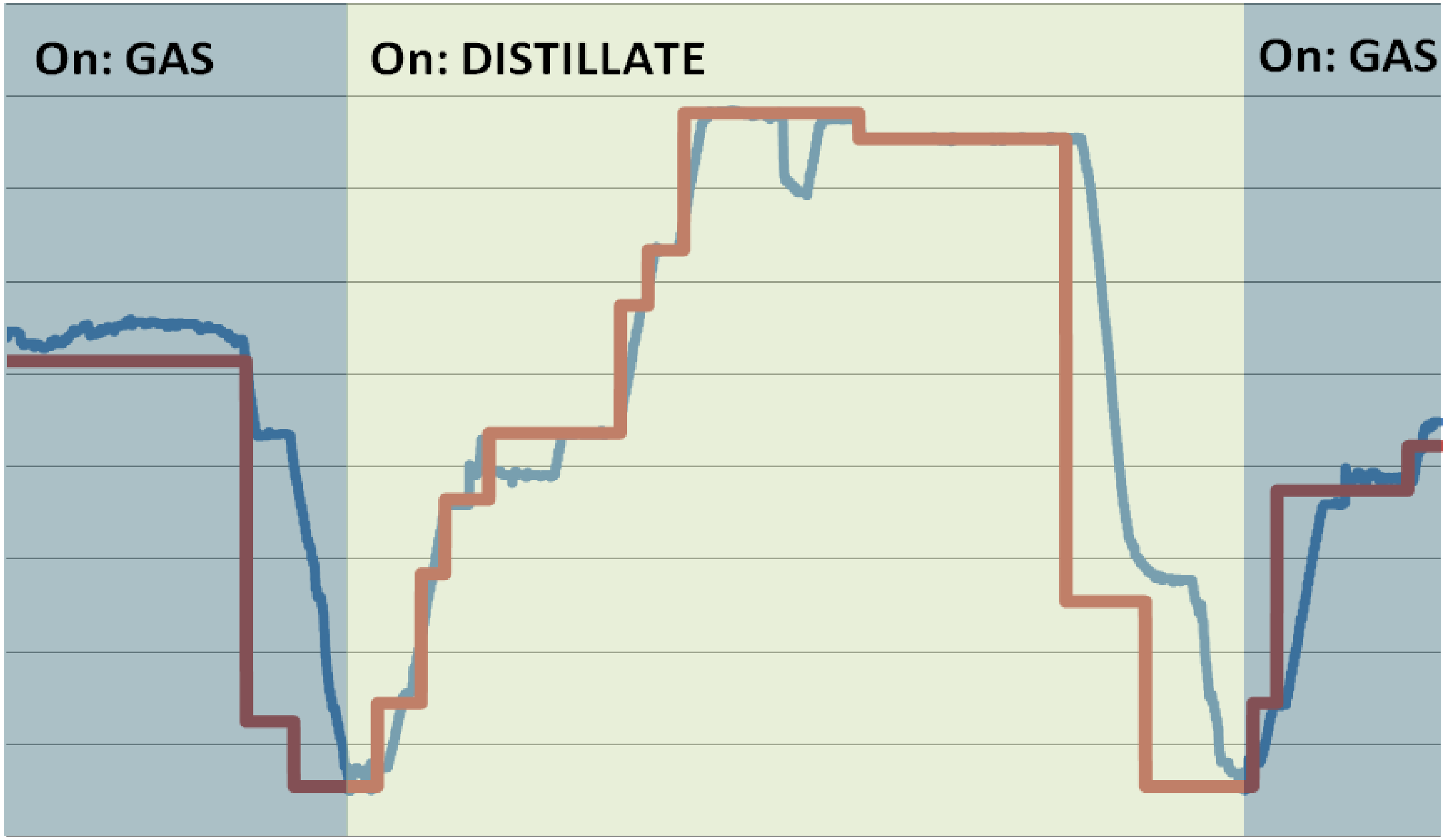
Detailed Report for each event:

- MW change
- Rate of MW change (MW/s)
- Pre-event frequency (Hz)
- Frequency nadir/zenith (Hz)
- Type of trip
- Whether the unit recovers to dispatched setpoint and the time taken

Summary Report:

- Numbers and type of load drops

(7) Secondary Fuel



ACTIVE POWER

(7) Secondary Fuel - DATA

- EDIL – FUCHP/FUCHS instruction, dispatch MW setpoint, declared availability
- Fuel indication
- Submitted fuel changeover curve
- 1 second MW, MVAr, Hz SCADA values
- Fuel stock levels

(7) Secondary Fuel - ANALYSIS

- Frequency adjust expected output

- Compare actual performance to expected performance

(7) Secondary Fuel - REPORTING

Detailed Report for each event:

- Instruction time to change fuel
- Actual performance compared to expected performance
- Fuel used
- Whether declared availability on secondary fuel is within limits
- Any oscillations during fuel changeover

Summary Report:

- Dates and result of testing
- Fuel stock levels

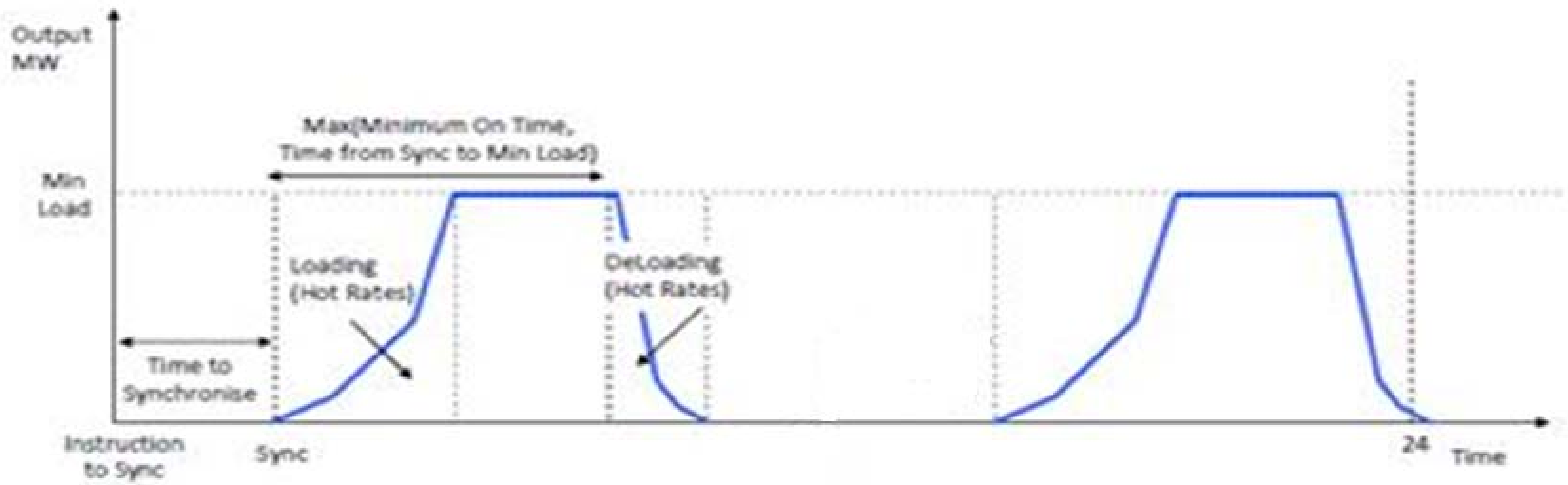
(8) Max Starts per 24 hours - DATA

- EDIL – Declared max starts in 24 hrs (MXST)

- TOD – Time to synchronise (hot), loading rates (hot), de-loading rates, minimum on time, minimum off time

(8) Max Starts per 24 hours - ANALYSIS

Note : Declarations for MXST made by Market Participants must be calculated based on the relevant unit in a hot state, as indicated in the following diagram. The declaration should take no account of the current warmth status of the unit.



(8) Max Starts per 24 hours - REPORTING

- EDIL – Declared max starts in 24 hrs (MXST)

- TOD – Time to synchronise (hot), loading rates (hot), de-loading rates, minimum on time, minimum off time

DISCUSSION

Break

Available Active Power

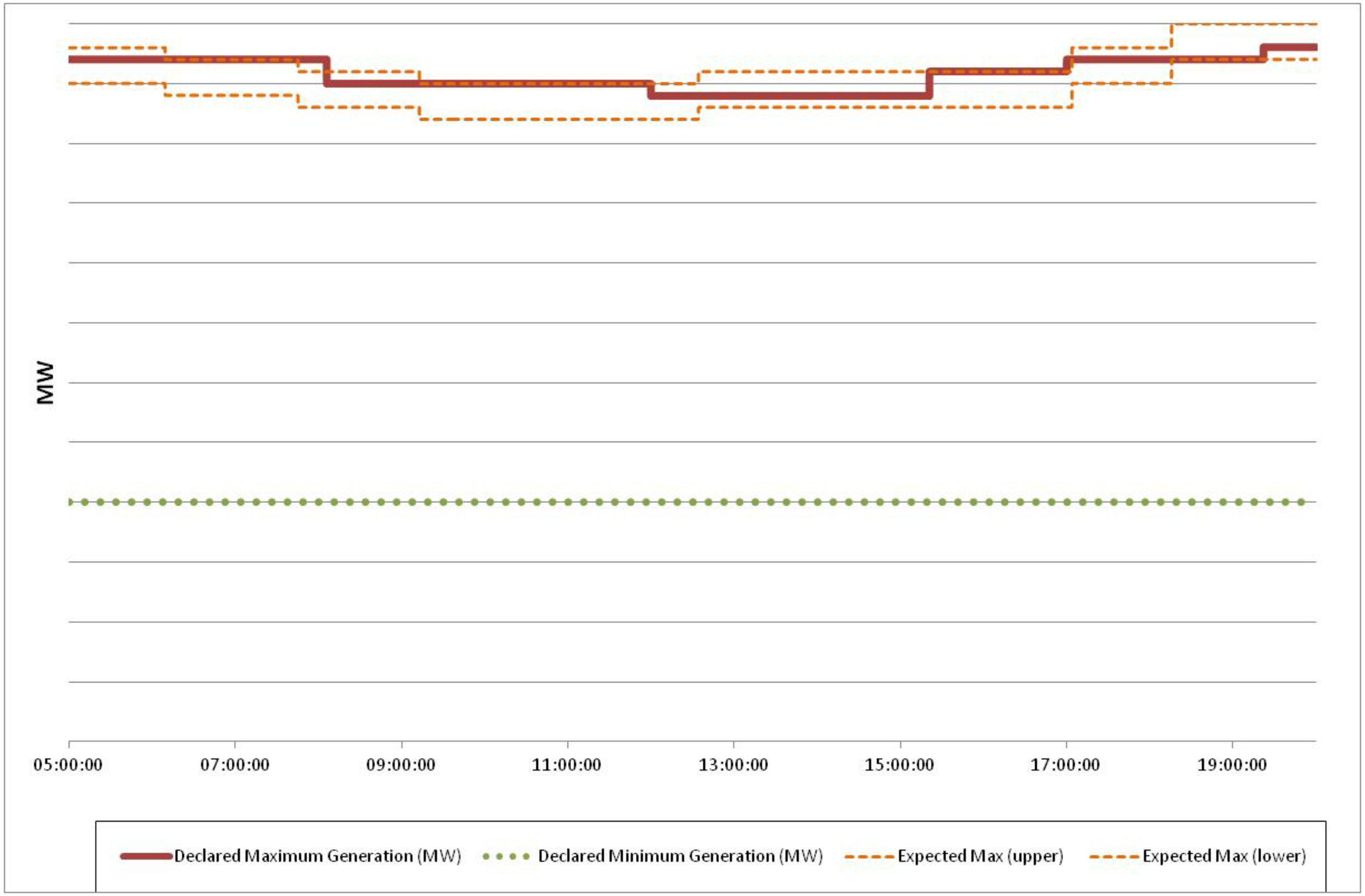
WHY? - Ensure capacity available

1. Minimum & Maximum Generation/Load

2. Wind Available Active Performance

3. DSU Energy Profile

(1) Minimum & Maximum Generation/Load



AVAILABLE ACTIVE POWER

(1) Minimum & Maximum Generation/Load - DATA

- EDIL – Declared min gen, contracted min load, declared maximum availability, registered capacity
- Ambient correction curves & degradation submitted as part of commissioning
- Ambient temperature, pressure, humidity

(1) Minimum & Maximum Generation/Load - ANALYSIS

- Is Min Gen & Load Grid Code compliant

- Is unit declaring in line with ambient capability curve

(1) Minimum & Maximum Generation/Load - REPORTING

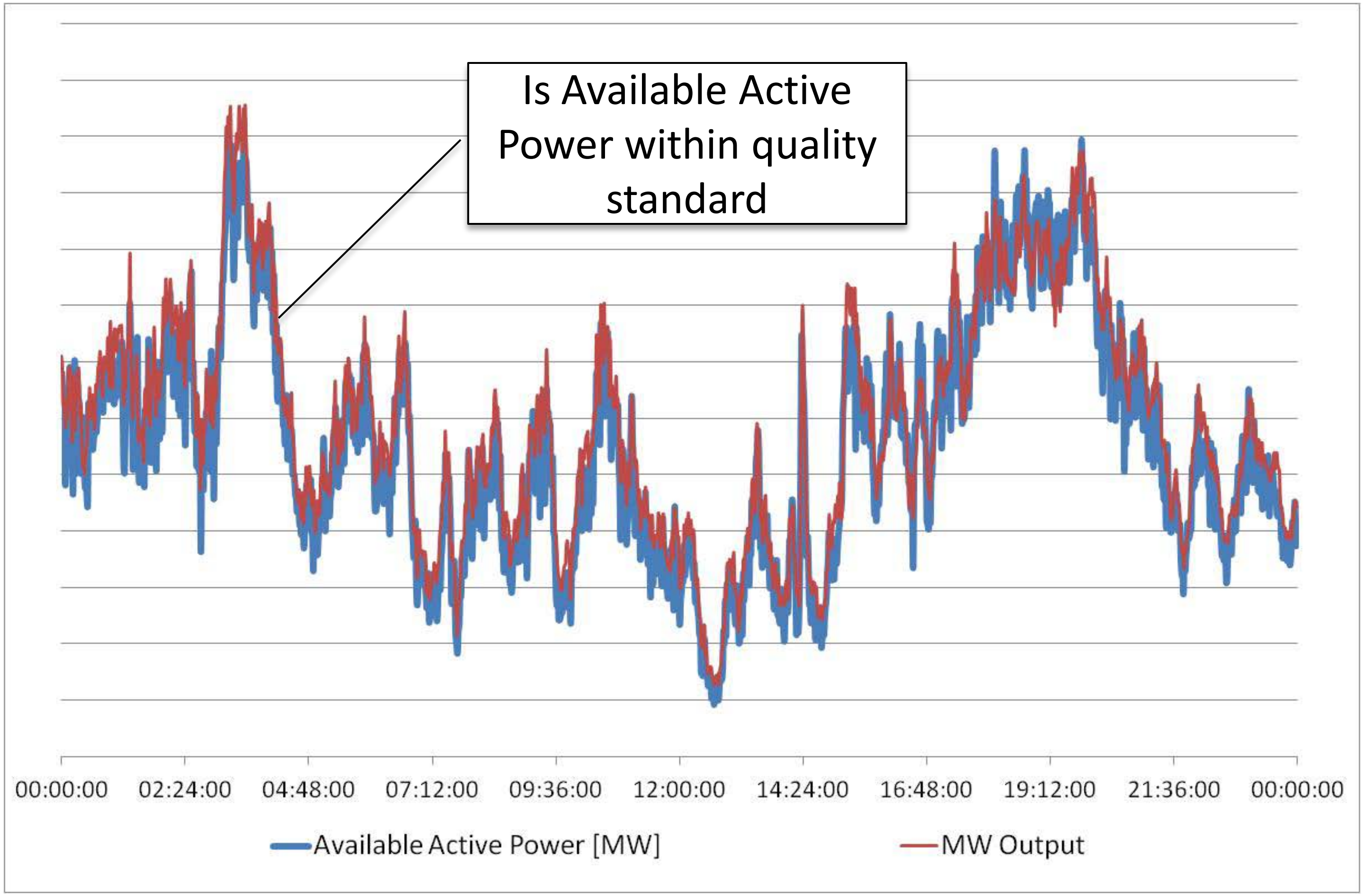
Detailed Report

- Expected minimum generation availability
- Expected maximum generation availability

Summary Report

- Trends in declarations

(2) Wind Available Active Power



AVAILABLE ACTIVE POWER

(2) Wind Available Active Power - DATA

- Active power setpoints, active power setpoint feedback, active power control ON/OFF, high/low wind speed shutdown, % availability, frequency response ON/OFF, frequency response curve select, DMOL, wind speed

- 1 minute available active power (MW), active power output (MW), frequency (Hz), CB position indication

- Windfarm controllability category

(2) Wind Available Active Power - ANALYSIS

- Normalised Root Mean Squared Deviation (NRMSD) analysis to ensure available active power tracks MW output when not curtailed/constrained

- If curtailed/constrained then is the available active power correct – base this on wind power curve

- Was there a wind speed shutdown event and was the expected response achieved

(2) Wind Available Active Power - REPORTING

Detailed Report:

- 14 day rolling NRMSD analysis
- High/low wind speed shutdown event analysis

Summary Report:

- Average NRMSD

(3) DSU Energy Profile - DATA

- DSU will upload their estimated energy profile up to 15 minutes before a trading period
- 15 minute meter readings

(3) DSU Energy Profile – ANALYSIS & REPORTING

- Is the estimated energy profile within the required standard

- The actual variance between DSU energy profile and the actual metered energy

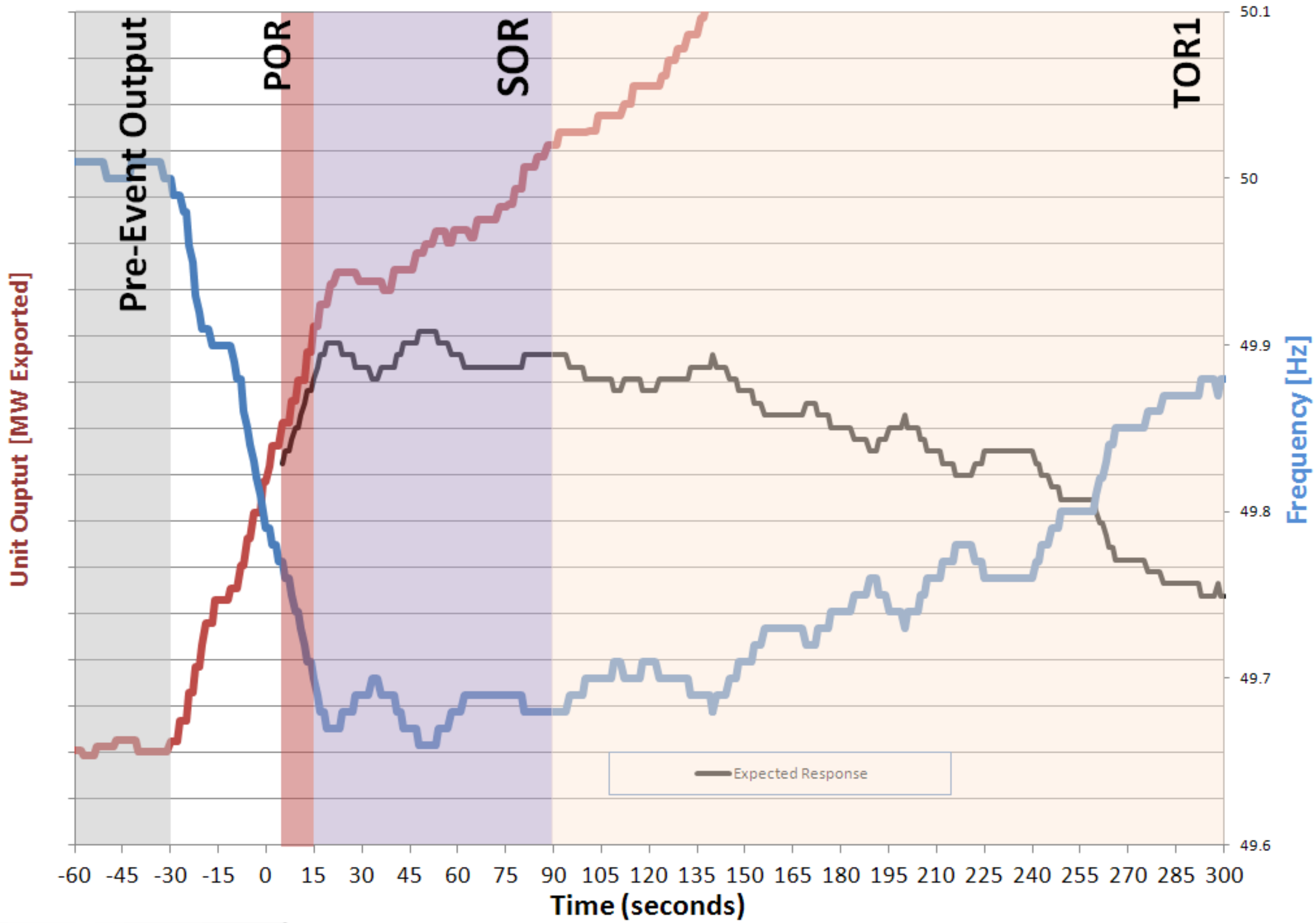
DISCUSSION

Frequency Response

WHY? - Restore frequency to nominal during events

1. Conventional
2. Wind
3. Frequency Relay Setting Activation
   - Interconnectors
   - Short Term Active Response (STAR) scheme
   - Special Protection Schemes

(1) Conventional



FREQUENCY RESPONSE

(1) Conventional – DATA

- EDIL – Declared POR – RRA, contracted POR – RRA, declared MW availability, declared fuel, active power setpoint, governor droop, target frequency

- 100 ms active power output, 100 ms frequency, actual POR – TOR1, required POR – TOR1, system demand, inertia, System Non-Synchronous Penetration (SNSP)

(1) Conventional – ANALYSIS

- Are contracted & declared values Grid Code compliant
- Carried out once frequency less than 49.8 Hz or greater than 50.2 Hz
- Pre-event output based on frequency adjusted dispatch instruction
- Maximum Rate of Change of Frequency (RoCoF)

(1) Conventional – REPORTING

Detailed Report:

- Actual vs. expected performance
- Maximum RoCoF

Summary Report:

- Maximum, Minimum, Average, 95th percentile performance
- Scatter plot of performance vs. pre-event output

(2) Wind – DATA

- Active power setpoints, active power setpoint feedback, active power control ON/OFF, frequency response ON/OFF, frequency response curve select, DMOL
- 1 minute available active power
- 100 ms active power output, 100 ms frequency, actual POR – TOR1, required POR – TOR1, system demand, inertia, SNSP
- Windfarm controllability category

(2) Wind – ANALYSIS

- Are contracted & declared values Grid Code compliant
- Primary frequency response of WFPS to under/over frequency event will be analysed
- Maximum Rate of Change of Frequency (RoCoF)
- Simulated inertia provided

(2) Wind – REPORTING

Detailed Report:

- Actual vs. expected performance
- Maximum RoCoF

Summary Report:

- Maximum, Minimum, Average, 95th percentile performance
- Scatter plot of performance vs. pre-event output

(3) Frequency Relay Setting Activation – DATA

- EDIL – Declared POR – RRA, contracted POR – RRA, Declared MW availability, declared fuel, active power setpoint, governor droop, target frequency

- 100 ms active power output, 100 ms frequency, 100 ms reactive power output, actual POR – TOR1, required POR – TOR1, system demand, inertia, SNSP

- Frequency trigger points

(3) Frequency Relay Setting Activation – ANALYSIS

- Are contracted & declared values Grid Code compliant
- Carried out once frequency settings are triggered
- Pre-event output based on frequency adjusted dispatch instruction
- Maximum Rate of Change of Frequency (RoCoF)

(3) Frequency Relay Setting Activation – REPORTING

Detailed Report:

- Actual vs. expected performance
- Maximum RoCoF

Summary Report:

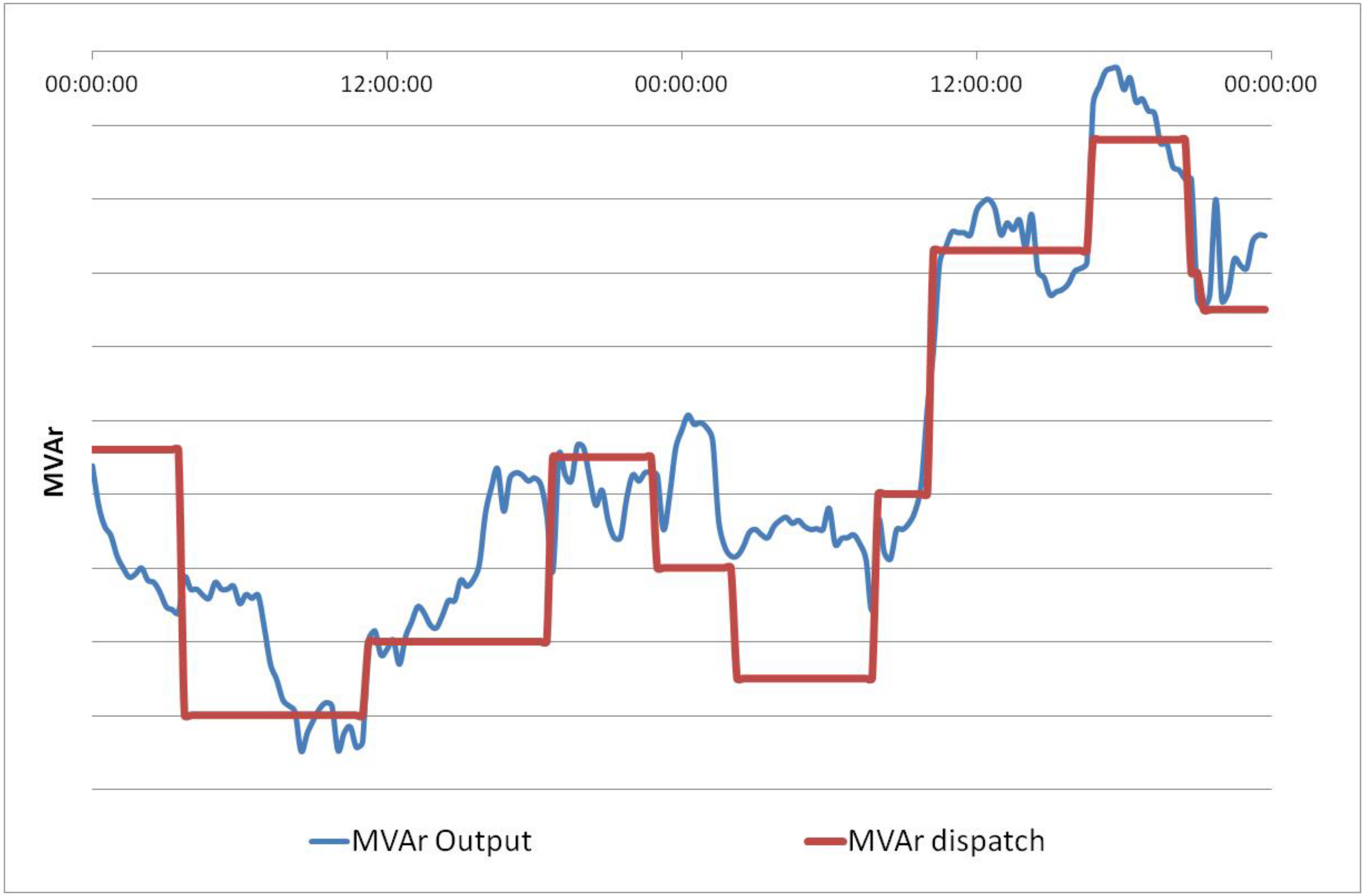
- Maximum, Minimum, Average, 95th percentile performance
- Scatter plot of performance vs. pre-event output

Reactive Power

WHY? - Voltage control

1. Conventional/Interconnector
2. Wind

(1) Conventional/Interconnector



REACTIVE POWER

(1) Conventional/Interconnector – DATA

- EDIL – Declared MVAr leading/lagging, contracted MVAr leading/lagging, declared AVR ON/OFF, MVAr setpoints
- 100 ms active power output, 100 ms frequency, 100 ms reactive power output, 100 ms HV voltage
- Fault Ride Through Requirements
- CB position indication

(1) Conventional/Interconnector – ANALYSIS

- Are contracted & declared values Grid Code compliant
- Determine last time unit dispatched to and achieves max leading and lagging at maximum active power output
- Determine whether the AVR responds correctly to changes in system voltage by adjusting the MVAr output
- For an under voltage event determine if the unit correctly rides through the fault

(1) Conventional/Interconnector – REPORTING

Detailed Report

- Are values Grid Code compliant
- Actual performance during under voltage event
- Is AVR responding correctly

Summary Report

- Scatter plot of reactive power vs. active power output
- Date unit last dispatch to max leading and lagging at full output

(2) Wind – DATA

- Active power setpoints, active power setpoint feedback, active power control ON/OFF, available active power, kV/MVAr/pf setpoint, kV/MVAr/pf setpoint feedback

- 100 ms active power output, 100 ms frequency, 100 ms reactive power output, 100 ms HV voltage

- Fault Ride Through Requirements

- CB position indication

(2) Wind – ANALYSIS

- Are contracted & declared values Grid Code compliant
- Determine last time unit dispatched to and achieves max leading and lagging at maximum active power output
- Determine whether the AVR responds correctly to changes in system voltage by adjusting the MVAr output
- For an under voltage event determine if the unit correctly rides through the fault

(2) Wind – REPORTING

Detailed Report

- Are values Grid Code compliant
- Actual performance during under voltage event
- Is AVR responding correctly

Summary Report

- Scatter plot of reactive power vs. active power output
- Date unit last dispatch to max leading and lagging at full output

Signals

- List of all signals required under Grid Code
- Traffic light display of signals with issues
- Would be automated as much as possible

DISCUSSION

Round Up of Proposed Enhanced Approach

Anne Trotter

Next Steps (1)

- Email any comments before end June to:
  DS3@EirGrid.com
  DS3@SONI.ltd.co.uk

- TSOs to summarise feedback and publish to industry by end July

- TSOs to consider proposals from Users when developing detailed Business Requirements Specification (BRS)

- BRS expected to be completed by Q4 2013

Next Steps (2)

- EirGrid will publish updated timelines for implementation of IT system in Q4 2013
- EirGrid to develop business processes for enhanced process and will present these in industry in late 2013/early 2014
- EirGrid are looking for expressions of interest from Users to test trial system: DS3@EirGrid.com; DS3@SONI.ltd.co.uk
- EirGrid to document and publish User guides and training to be provided

Next Steps - Operational Process

- Need to develop trigger for when trends become non-compliance issues
- Each trend would have an associated priority order
- Each priority order would have a required action and timeline in which the user must remedy the non-compliance
- If a required action is not completed by the user within the timeframe then this would result in the TSOs taking an action e.g. changing contract values, change in controllability category

DISCUSSION

THANK YOU FOR YOUR ATTENDANCE TODAY

EirGrid

semo
Single Electricity Market Operator

SONi
System Operator for Northern Ireland