WA MARKET REFORM PROGRAM

POWER SYSTEM OPERATIONS – STAKEHOLDER FORUM 2

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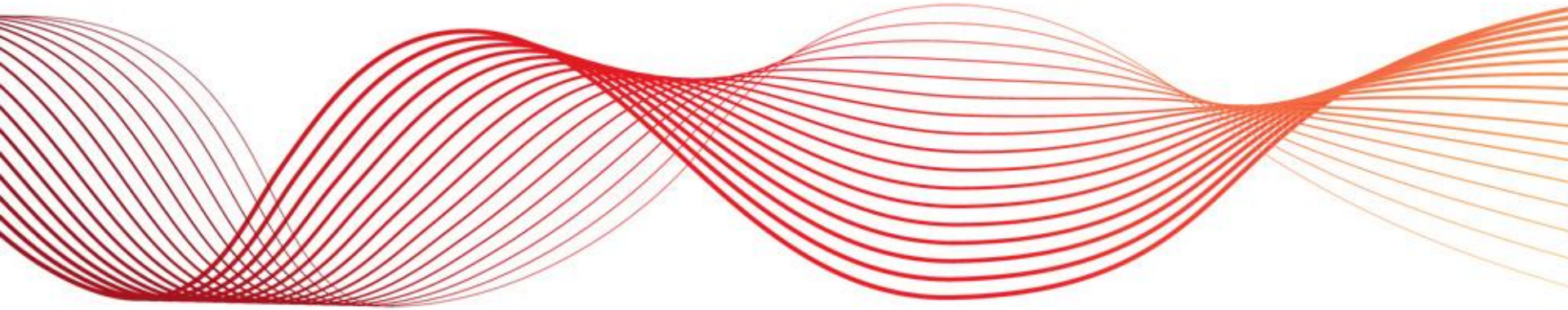
13 December 2016

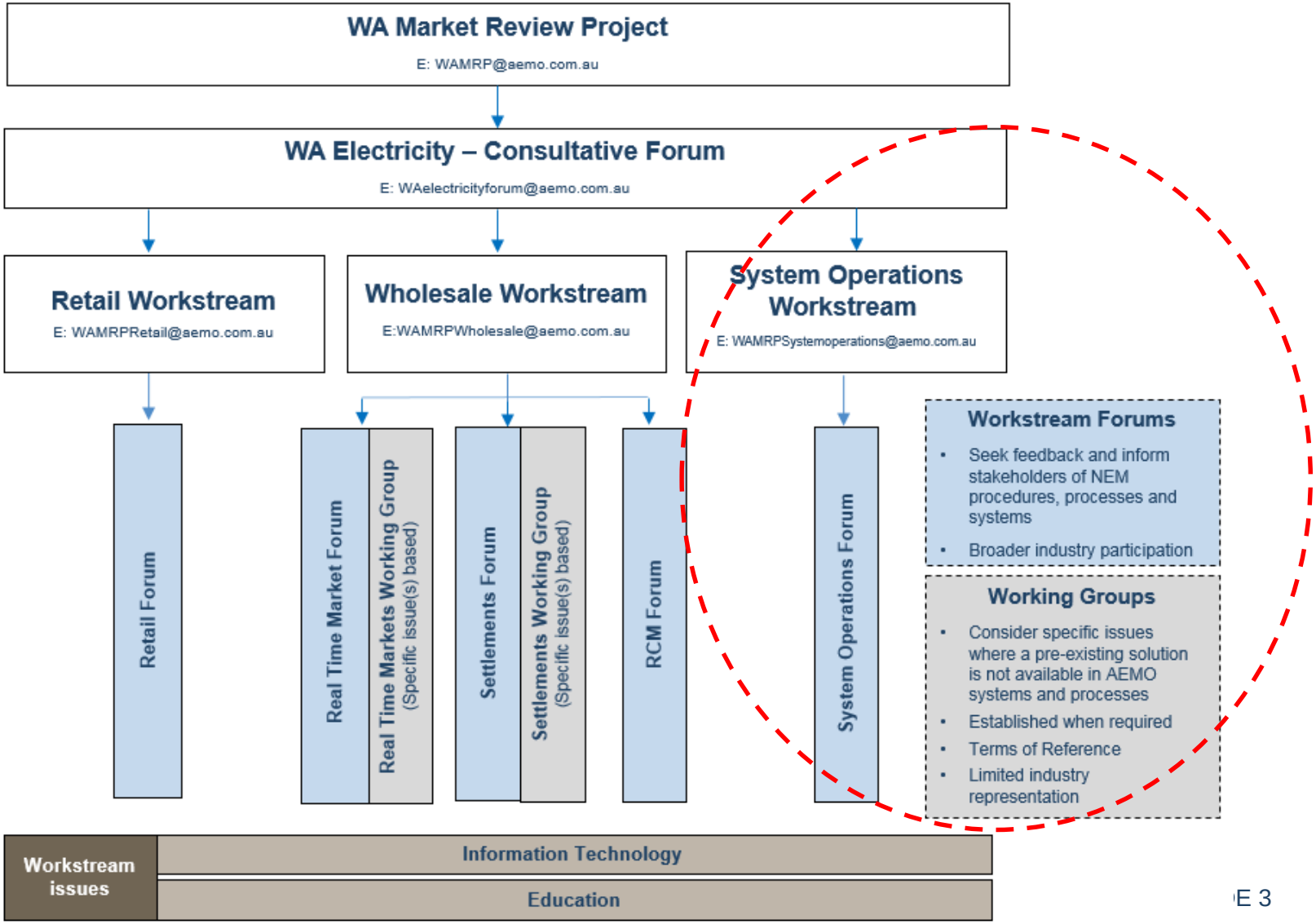


AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

AGENDA FOR TODAY

- Welcome
- Purposes of the System Operations Forum
- Proposed Implementation Approach
  - Workstream activities to be deferred
  - Workstream activities to continue
    - ICCP
    - e-terra
    - AGC
    - modelling
    - forecasting
- Discussion
- Q & A
- Next steps

ENGAGEMENT STRUCTURE



PURPOSE OF THIS FORUM (1)

- Consultation and provision of information between AEMO and participants on Workstream issues.
- Describe the proposed implementation approach of the Power System Operations workstream in light of legislative delays:
  - Workstream activities continuing to be implemented
  - Workstream activities to be deferred pending drafting of Rules
- Provide a high level overview of some of the key items being worked through in the Power System Operations stream, namely:
  - AGC interfacing – interim and final solutions
  - Generation modelling and performance standards
- At the conclusion of each section, we will seek feedback from stakeholders on the information presented and any other main items being sought
- This forum will also allow you to ask questions of some key AEMO subject matter experts who will be involved in delivering the workstream

PURPOSE OF THIS FORUM (2)

- Some things to keep in mind:
  - The rules are still under development by the PUO, however AEMO is continuing development works based on assumptions and discussions with the PUO to validate these assumptions where relevant. Ultimately the Western Australian Energy Minister will make the final decision on the rule changes.
  - As a result, some of the information in this presentation may change as the rules are developed and released
  - This presentation represents AEMO's current best understanding of what the rules will represent, where these are not developed fully this presentation will identify that there is additional work being conducted that is not yet finalised.

SYSTEM MANAGEMENT TRANSITION

- As part of the Electricity Market Review underway in Western Australia, accountability for the system management functions of the Wholesale Electricity Market (WEM) were transferred to AEMO on 1 July 2016.

- In order to provide continuity in the provision of system management functions, AEMO entered into a delegation agreement with Western Power as a System Operator allowing them to continue carrying out the day-to-day functions of System Management. This delegation expired on Monday, 31 October 2016, and AEMO is now accountable and responsible for the functions of System Management.

- As part of this transition, 32 new employees, contractors or Western Power secondees have been welcomed to the team. AEMO System Management personnel will be based at the existing East Perth Control Centre facilities until we amalgamate our control room and Perth office into one combined AEMO WA office – currently scheduled for September 2017.

- Western Power will continue to support the transition by providing a range of services to AEMO, such as; the facilities at East Perth, IT support for the current market dispatch systems, personnel to fulfil roles whilst AEMO recruits, and some limited transitional system operational services.

- For an updated list of System Operator delegations, please go to our website:

http://www.aemo.com.au/Electricity/Wholesale-Electricity-Market-WEM/Security-and-reliability/Current-Delegations

PROPOSED IMPLEMENTATION APPROACH OF THE POWER SYSTEM OPERATIONS WORKSTREAM – IN LIGHT OF LEGISLATIVE DELAYS

WORKSTREAM ACTIVITIES CONTINUING TO BE IMPLEMENTED

- Control system implementation - e-terra
  - ICCP link between AEMO and WP
  - AGC – frequency control via e-terra
  - Network models for state estimation, contingency analysis, fault level analysis and voltage stability analysis
  - Storing of network model save cases for offline analysis
- Generator models
- Generator Performance Standards (data collection)
- Demand forecasting
- Outage management – continuing to support the PUO in rule development (current PUO EMOP working group)

WORKSTREAM ACTIVITIES TO BE DEFERRED

Broadly, the deferred activities are those that depend on the WEM3 Rules and are as follows:

- ST PASA
- MT PASA
- Centralised wind forecasting/solar forecasting
- AEMO due diligence/conversion of WP limit equations
- Network and FCAS Constraints
- New Outage Planning systems and processes
- Processes for the inclusion of WA in the NTNDP
- Development of forward looking marginal loss factors

NEM PARALLEL ACTIVITIES

- Market Ancillary Service Specification – Proposed NEM consultation
- MT PASA – Proposed NEM consultation
- Causer Pays Procedure – NEM consultation

These are consultations either proposed or currently underway with NEM participants that may result in changes to the NEM Rules prior to the introduction of new WEM Market Rules. The project team will continue to monitor developments with these consultation packages and work with the PUO on any resulting developments for consideration in the EMR process.

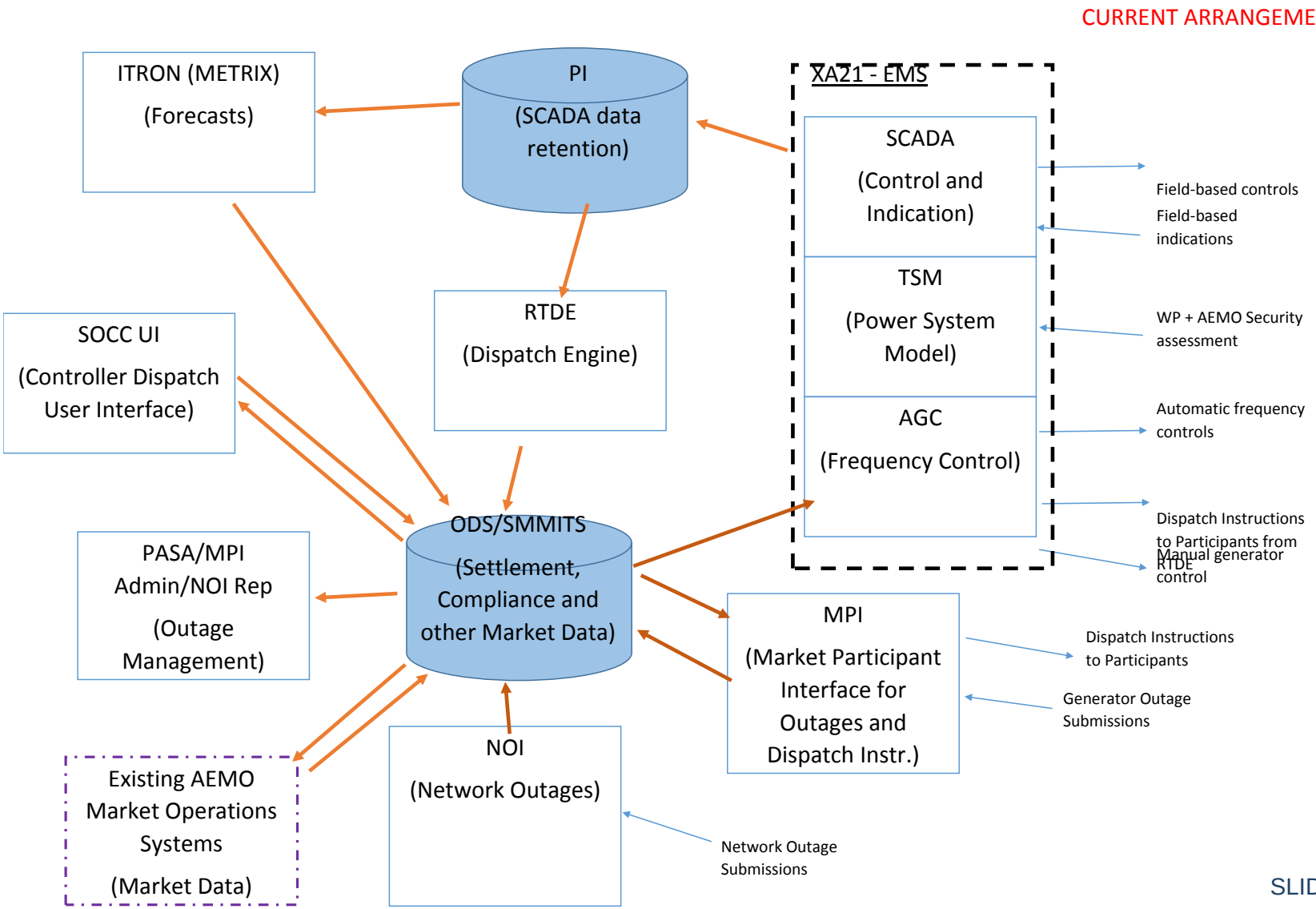
For information on these and other consultations currently underway in the NEM, please see our website:

http://www.aemo.com.au/Stakeholder-Consultation/Consultations

E-TERRA – ICCP, DISPATCH AND AGC

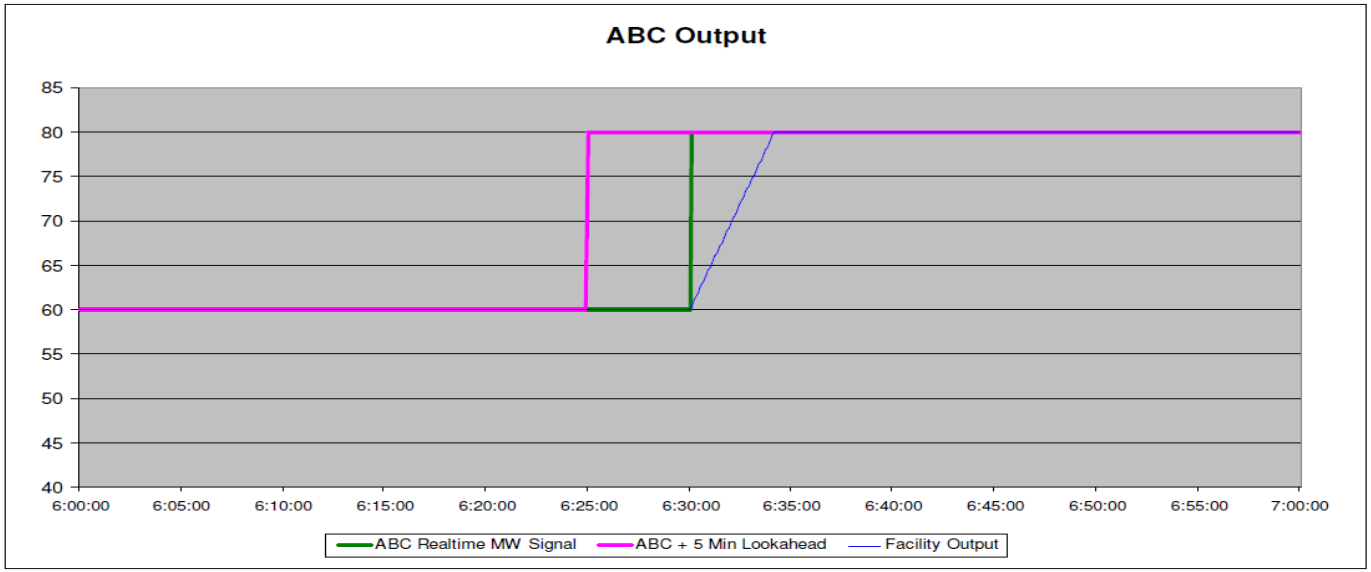
- The implementation of the AEMO e-terra system is not specifically tied to the market rules, there is benefit in progressing with the installation of this system to ensure sufficient time for bedding-in, training and commissioning activities.
- The intent is to integrate e-terra with the existing WEM market systems, gradually moving functionality to the new control system in a staged manner:
  - Stage 1A – basic functionality + network model
  - Stage 1B – frequency control
  - Stage 2 – dispatch instructions (timeframe dependent on reform)

CURRENT WEM ARRANGEMENT

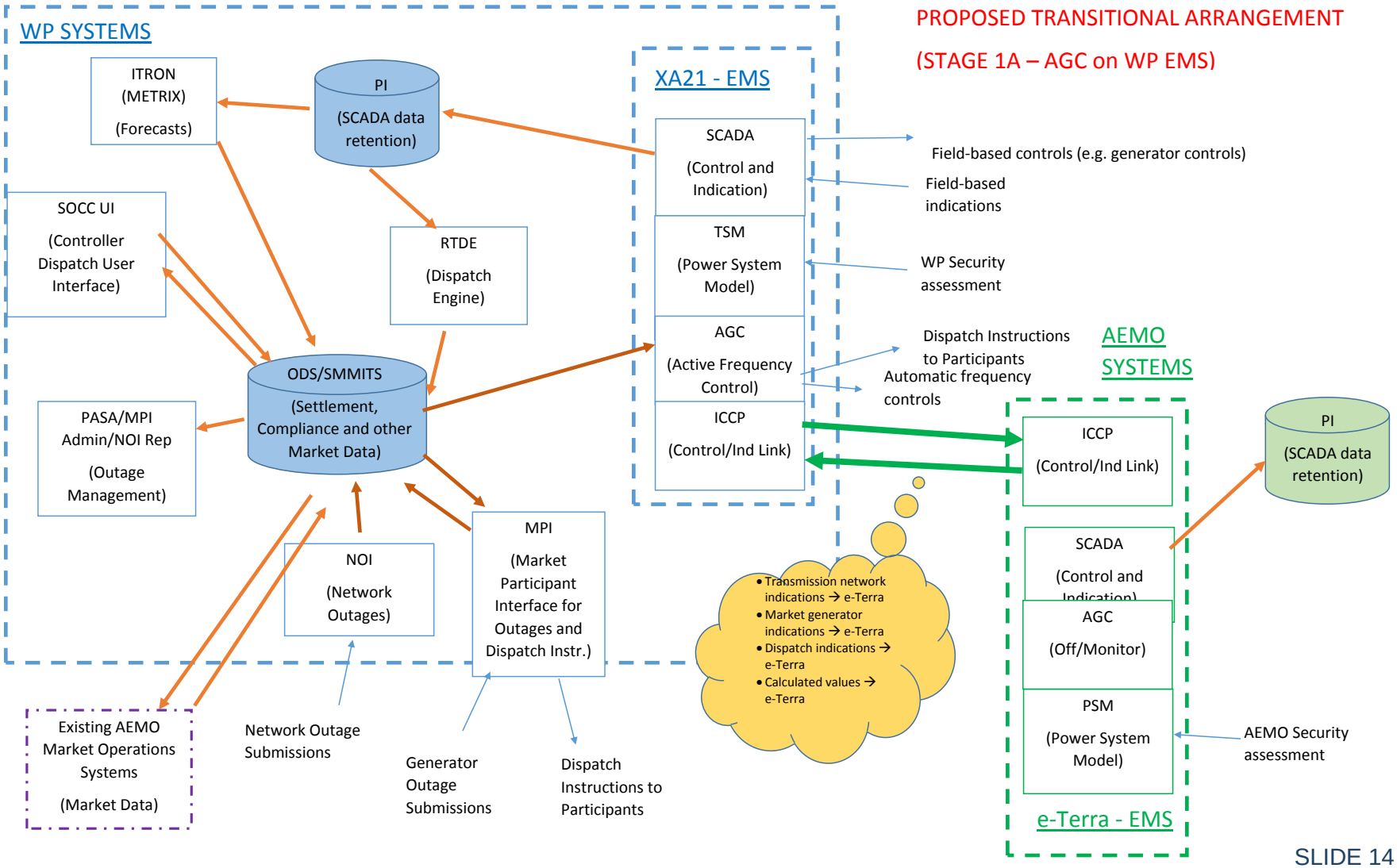


CURRENT WEM ARRANGEMENT

- All WP systems
- XA/21 TSM for security studies
- AGC for frequency control on XA/21
- AGC modes and limits set on XA/21 automatically for cleared LFAS quantities
- Dispatch Instructions issued via LFASC program on XA/21, using data from ODS
  - 4s setpoint indicating current dispatch target – TARGET DISPATCH MW (green line below)
  - 4s setpoint indicating 5-min lookahead dispatch instruction (end-of-interval target) – DISPATCH INSTRUCTION MW (magenta line)
  - 4s setpoint indicating x-min lookahead dispatch instruction (end-of-interval target) – LOOKAHEAD DI MW (not shown)



ARRANGEMENT: STAGE 1A – BASIC FUNCTIONALITY



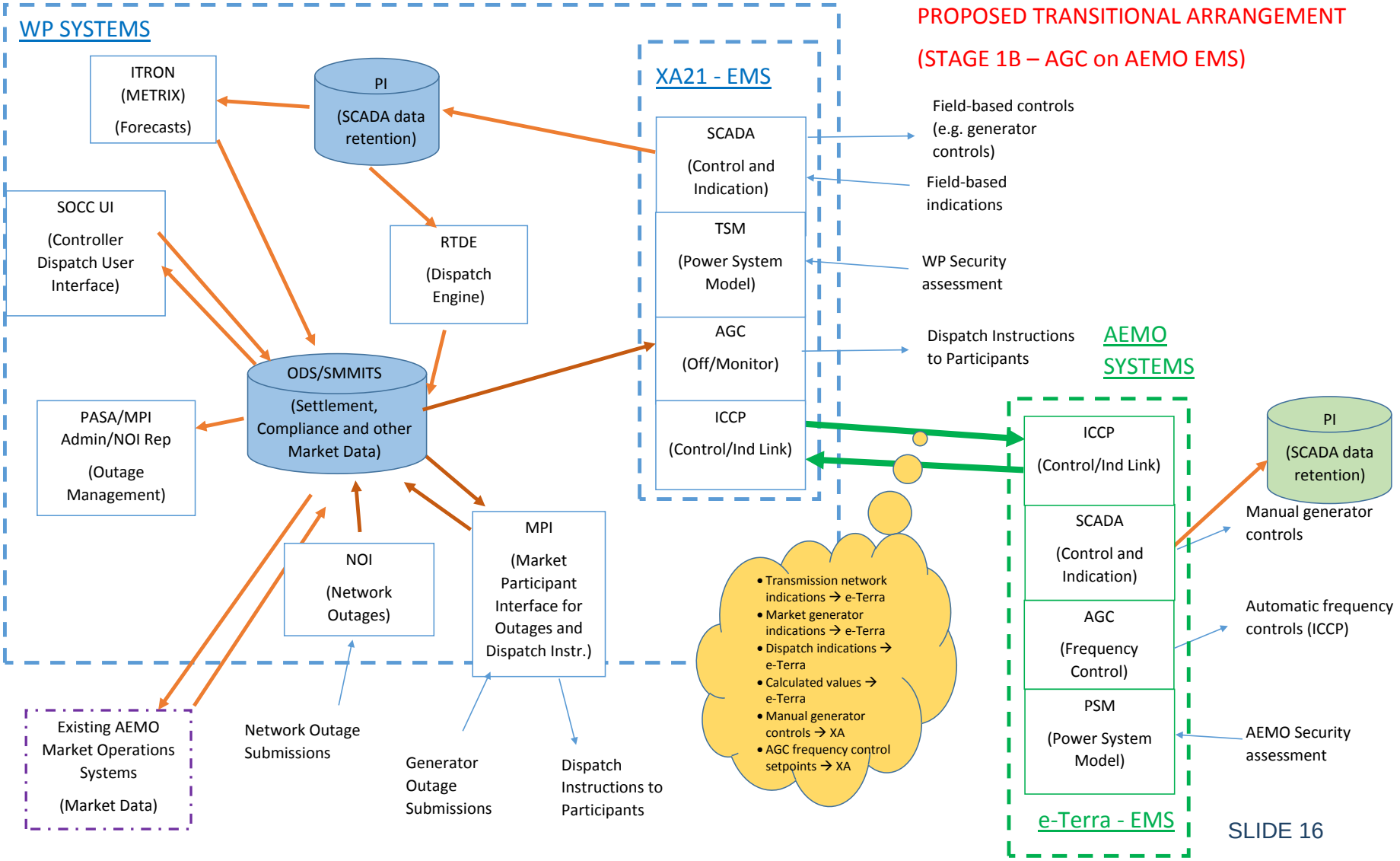
ARRANGEMENT: STAGE 1A – BASIC FUNCTIONALITY

Stage 1A – ICCP linked to e-terra

- All WP systems, but XA linked to e-terra
- ICCP indications to e-terra, logging realtime data to AEMO PI
- AEMO power system model converging and available for security studies
- AGC retained for frequency control on XA/21
- AGC modes and limits on XA/21 for cleared LFAS quantities set automatically via LFASC program for non-Synergy facilities
- Dispatch Instructions continue to be issued via LFASC program on XA/21, using data from ODS
- AGC modes mapped to ICCP statuspoints for e-terra AGC mode mapping custom logic development

AGC Control Mode	AGC Participation Mode			
	None	***Regulation***	***Assist***	***Full***
Base	Fixed dispatch, no frequency response. Used for ABC currently	Automatic response to frequency, within available generator limits, within frequency regulation range	Automatic response to frequency, within available generator limits, outside assist range	Automatic response to frequency, within available generator limits, at any frequency. Currently used for LFAS
Manual	Generator being controlled locally, not under AGC control (participation modes not used in this mode)			
Available	Generator ready to start, not under AGC control (participation modes not used in this mode)			
Unavailable	Generator not ready to start, not available for AGC control (participation modes not used in this mode)			
Econ	Not currently used			
Ramp	Not currently used			

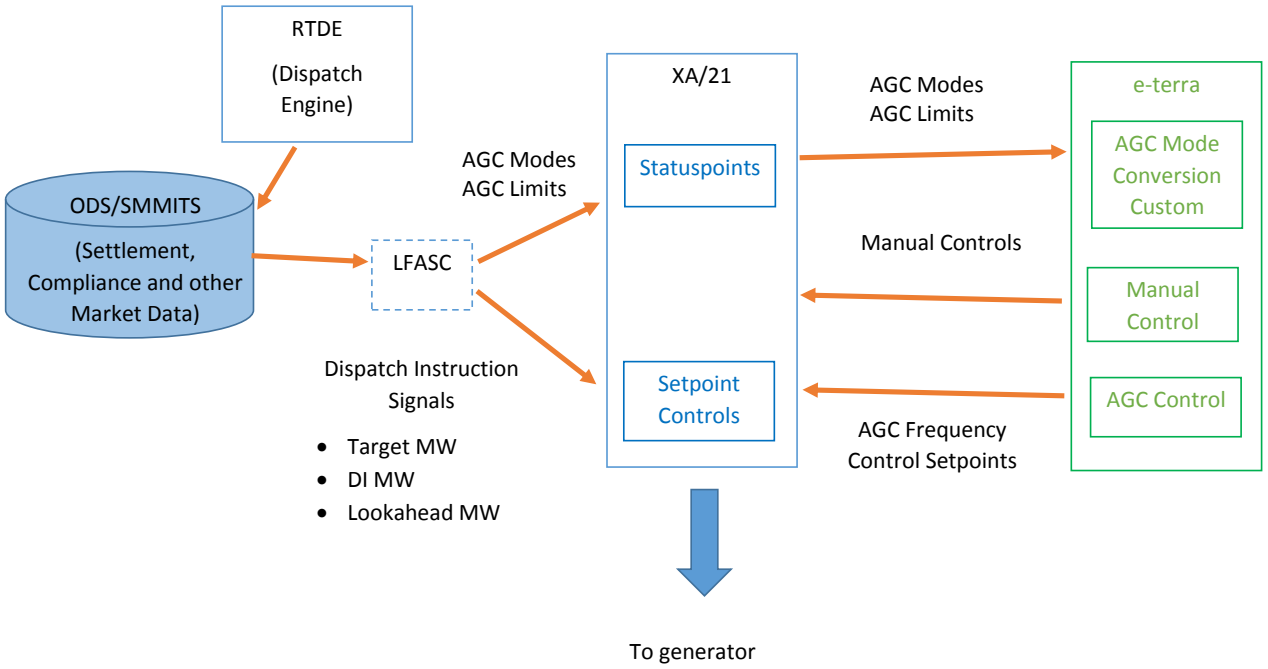
ARRANGEMENT: STAGE 1B – AGC ON AEMO EMS



ARRANGEMENT: STAGE 1B – AGC ON AEMO EMS

Stage 1B – AGC for frequency control from e-terra

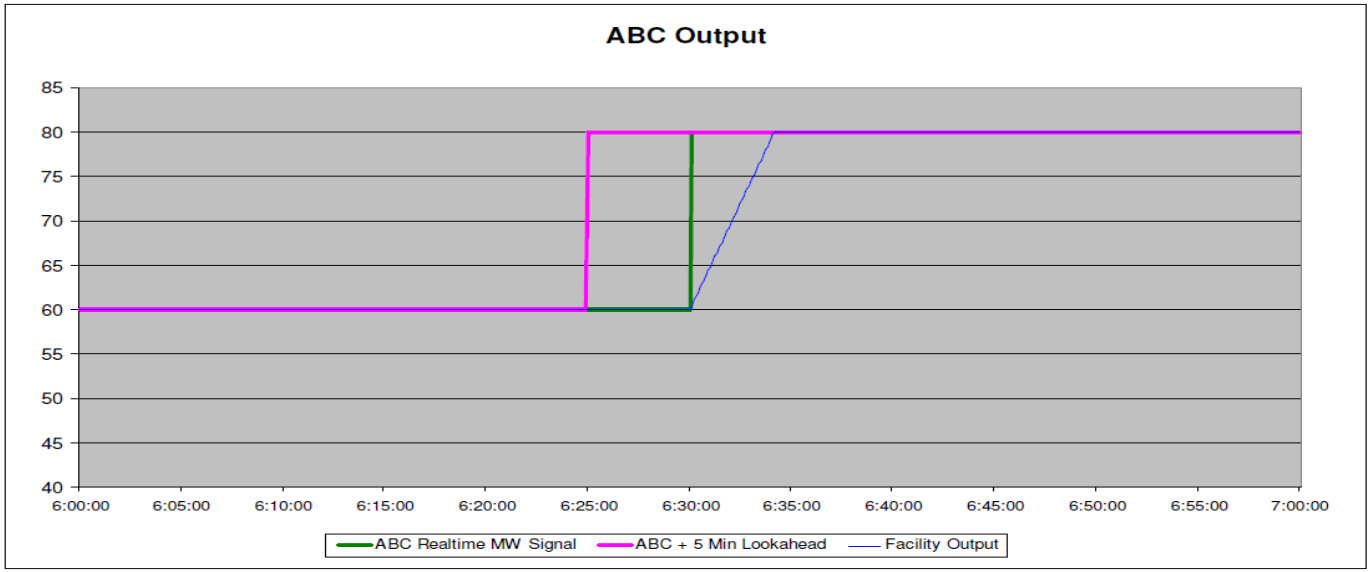
- E-terra fully active, but the rest of the market systems still on WP side (i.e. RTDE, databases, etc)
- ICCP indications to e-terra, logging realtime data to AEMO PI
- AEMO power system model converging and available for security studies
- AGC for frequency control on e-terra
- Dispatch Instructions continue to be issued via LFASC program on XA/21, using data from ODS
- AGC modes mapped to ICCP statuspoints for e-terra AGC mode mapping custom logic development, modes mapped via ICCP, e-terra custom to map AGC mode and limits



Stage 2 – Dispatch Instructions generated from e-terra

(FUTURE ARRANGEMENTS – WEM3)

- 5-min Dispatch Targets issued via e-terra
- Rather than a step change issued 5-minutes in advance as per current arrangements, AGC will send 4s setpoints to ramp the facility to its desired setpoint based on bid ramp rate (blue line below)



Stage 2 – Dispatch Instructions generated from e-terra

(FUTURE ARRANGEMENTS – WEM3)

- Based on feedback from participants, we have investigated implementing Lookahead Dispatch Targets similar to the existing arrangements in ABC. Options currently being investigated include:
  - Utilising similar NEM functionality that allows “commitment” status signals to be issued to facilities via SCADA (likely to be the preferred solution if this is suitable, as the functionality exists). Modes are calculated based on dispatch point and fast-start inflexibility profiles and are sent to the facility in the form of an analogue setpoint, the modes include:
    - Off, Synchronising, Ramp-up, Min On, On
  - Using 5-min pre-dispatch data to drive additional lookahead dispatch target values at pre-defined intervals (there will be limitations in this approach as the 5-min pre-dispatch does not replicate the dispatch process exactly)
- Note that the full pre-dispatch data will also be available to participants via MarketNet

GENERATOR MODELS

- While the implementation of a fully automated constrained dispatch engine may be delayed, the development of the constraint equations themselves still takes time and requires AEMO to develop a fully functioning SWIS model that includes dynamic generator model parameters.

- In the previous System Operations stakeholder forum we advised that AEMO would be seeking to utilise the Western Power Powerfactory model which already contains the necessary dynamic model parameters provided to Western Power, in order to minimise impact to participants. This would have been possible through the introduction of some transitional WEM Rules.

- Unfortunately without the necessary heads of power in WEM Rules we need to look at alternative ways of collecting this data. Some options being investigated for this are:
  - Continuing to pursue transitional WEM Rules (this is considered unlikely in the short term)
  - Pursuing a change to the Technical Rules to allow AEMO to source the model from Western Power (also considered unlikely in the short term)
  - Requesting the data directly from Participants (time consuming exercise for Participants, and also for AEMO to re-build a Powerfactory model from scratch)
  - Requesting permission from Participants directly to access the data provided to Western Power in their Powerfactory model (likely to be the most expedient method)

GENERATOR MODELS

- The current requirements for generator modelling data are listed on the AEMO website below:

http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Network-connections/Modelling-requirements

- Also note that in the area of generator system modelling, AEMO has made a submission to the AEMC in relation to a Rule change and amendment to the generating system model guidelines. You can see the initiation paper here:

http://www.aemc.gov.au/Energy-Rules/Generating-System-Model-Guidelines

GENERATOR PERFORMANCE STANDARDS

- It is likely that AEMO will play a role in the future in monitoring generator performance standards (e.g. fault ride through capability, immunity to frequency disturbances, etc). Currently this role is performed by Western Power.
- Although AEMO is not likely to assume this role until the WEM rule changes have progressed, the collection of generator performance standard data may take some time. The proposal therefore is to commence collecting generator performance standard data as early as possible.
- Similar to generator modelling information, the project is proposing to seek endorsement from participants for AEMO to engage with Western Power in collecting this data.
- The present published NEM generator performance standards template is being reviewed and when finalised will be available from the AEMO website.

NEXT STEPS

- December
  - Continue ICCP development work with Western Power
  - Continue e-terra network model development
  - Continue work on developing WA demand forecasting models

- January
  - Work through generator modelling data collection options
  - Work through generator performance standard data collection options

QUESTIONS