Local Black System Procedures (LBSP) Information session

4 & 5 May 2020

Australian Energy Market Operator (AEMO)

Upcoming SRAS Guideline consultation

- SRAS Guideline update required following AEMC final rule determination on system restart services, standards and testing Rule change (2 April 2020).

- Updated Guideline will incorporate:
  - Description and requirements for new SRAS category – **restoration support service**
  - Guidance on criteria and reporting requirements for system restart tests.
  - Guidance on how AEMO expects to achieve the amended SRAS procurement objective.
  - Identification of inconsistencies between SRAS test and real event procedures
  - Other updates and improvements based on recent operational experience.

- First stage of consultation to commence in **May 2020**

Agenda

1. Background
    1. Purpose of Local Black System Procedures (LBSP)
    2. Why the LBSP guides have been updated
    3. Submission of updated LBSPs
2. Generator LBSP updates
    1. Asynchronous generators
    2. Synchronous generators
3. Q&A session for generators
4. NSP LBSP updates
    1. TNSPs and DNSPs
    2. FACTS
    3. Synchronous Condenser
    4. DC links
5. Major Loads
6. Q&A

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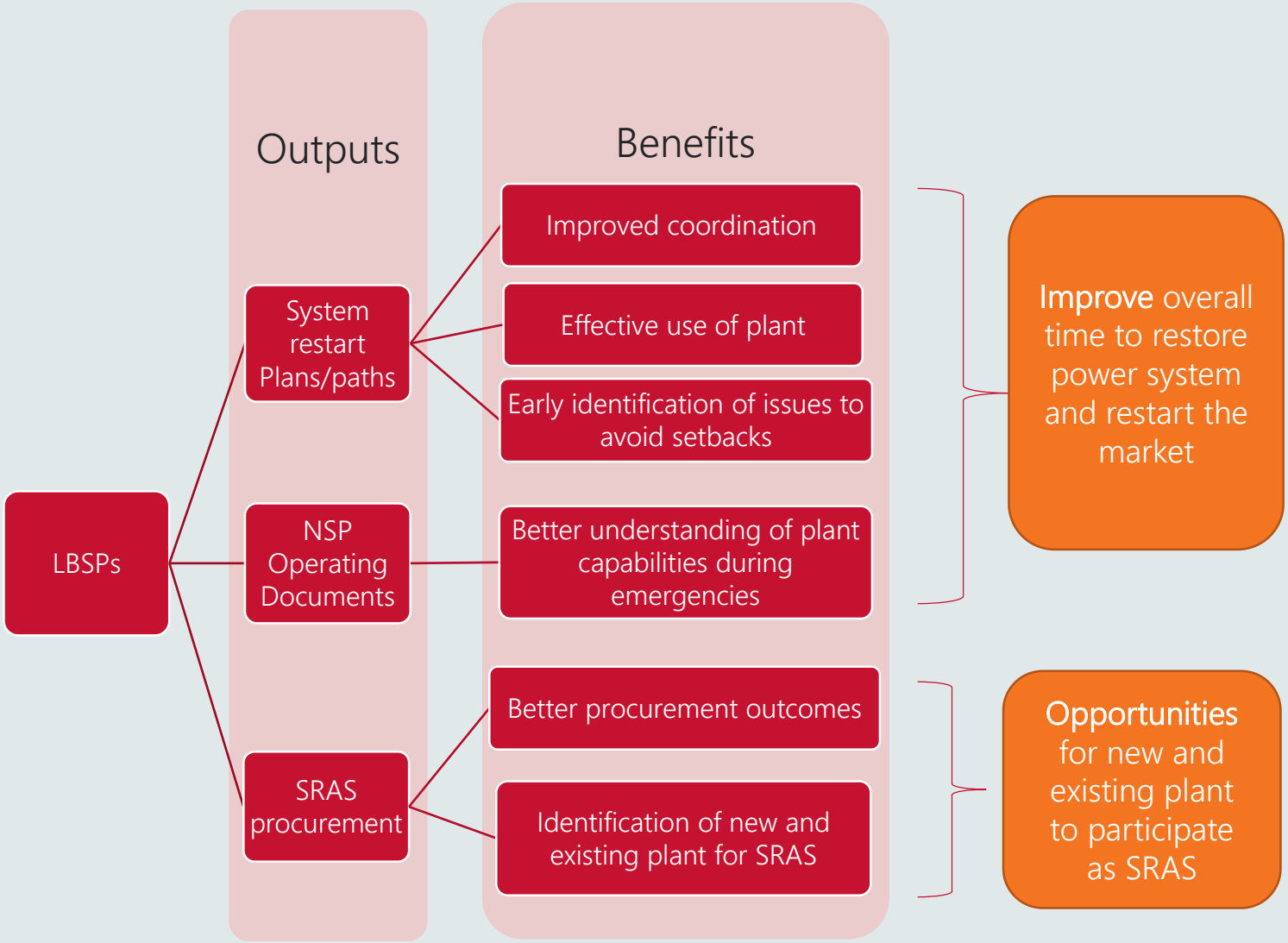
Use of Local Black System Procedures

- **AEMO** prepares **system restart plans** to manage and co-ordinate system restoration for each NEM region.

- System restart plans supported by:
  - LBSPs
  - NSP Operating documents
  - System restart ancillary services (SRAS)

- LBSPs also a key input to:
  - SRAS procurement
  - AEMO system restart modelling/simulations



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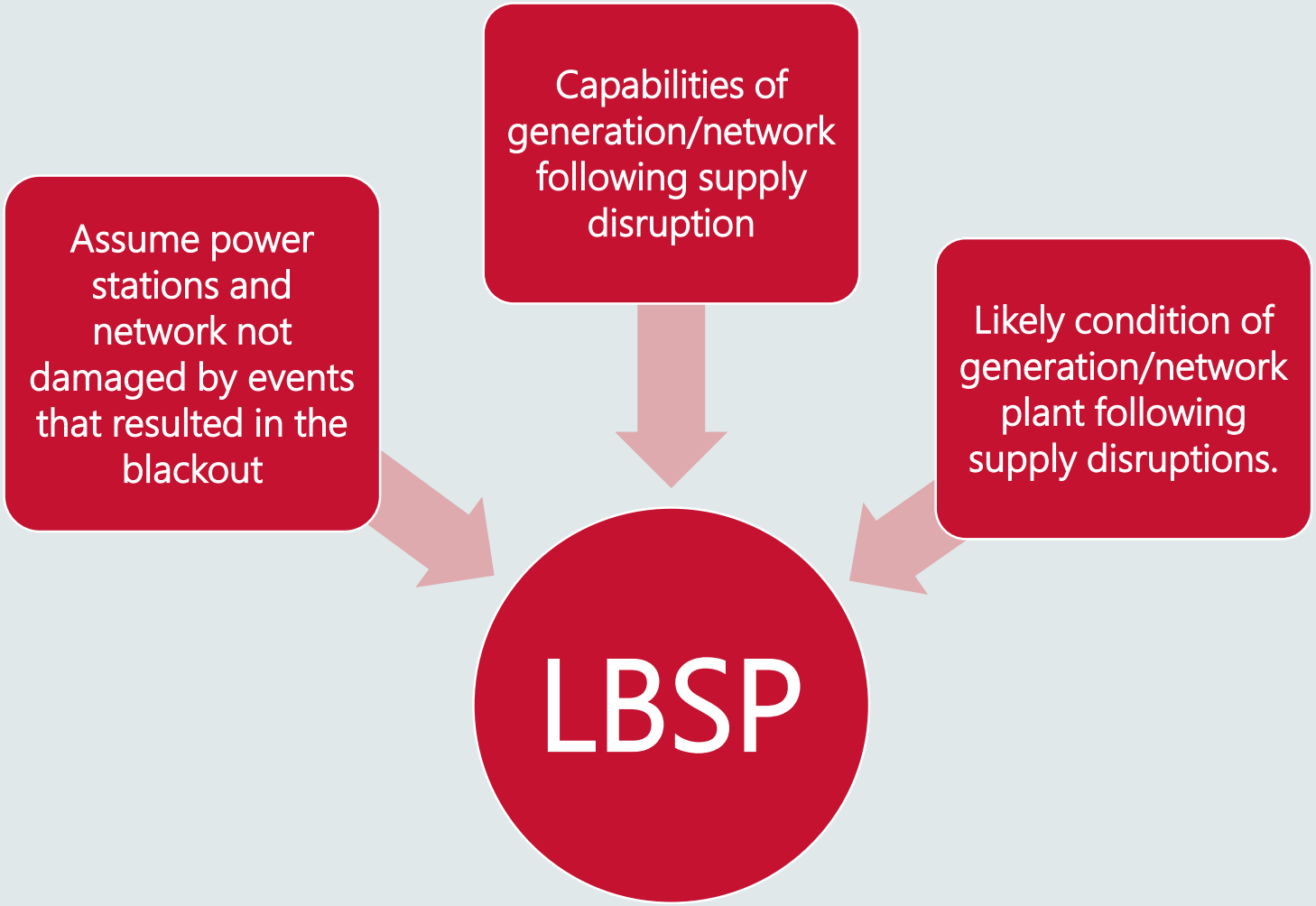
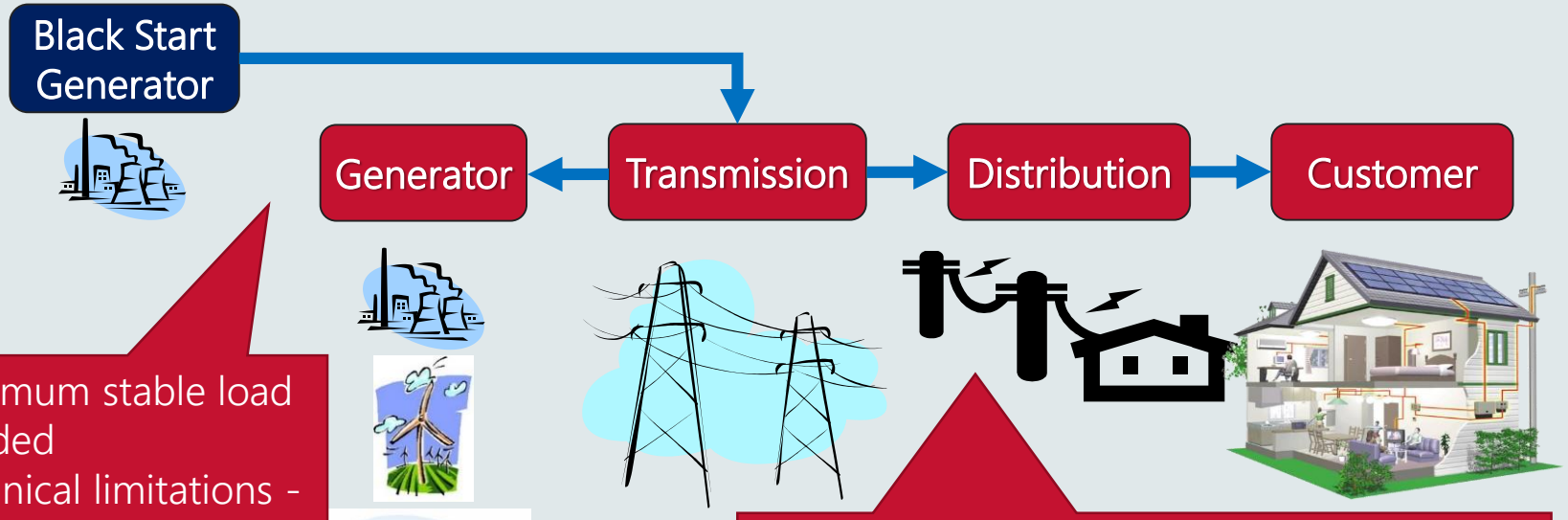
Purpose of LBSPs

- LBSPs should provide sufficient information to help effectively co-ordinate the safe implementation of a restart plan.

- LBSPs obtained from:
  - Generators
  - NSPs
  - DC links
  - Major loads (as needed)



How AEMO develops restart plans using LBSPs



- Minimum stable load needed
- Technical limitations - Rough running bands, ramp rates
- Staffing arrangements
- Safe shutdown
- Restart of generators

- Emergency supplies
- Availability of communication
- Operation of SCADA
- Synchronising points
- Time critical loads
- Strategy of preparing network to accept supply
- Operating arrangements between transmission and distribution operators

Why were updates to the LBSP required?

Changing generation mix

- Certain LBSP questions were general and high level
- Section for wind, but not other asynchronous generation
- Not clear which sections apply for different generation.
  - Variability/insufficient information provided.

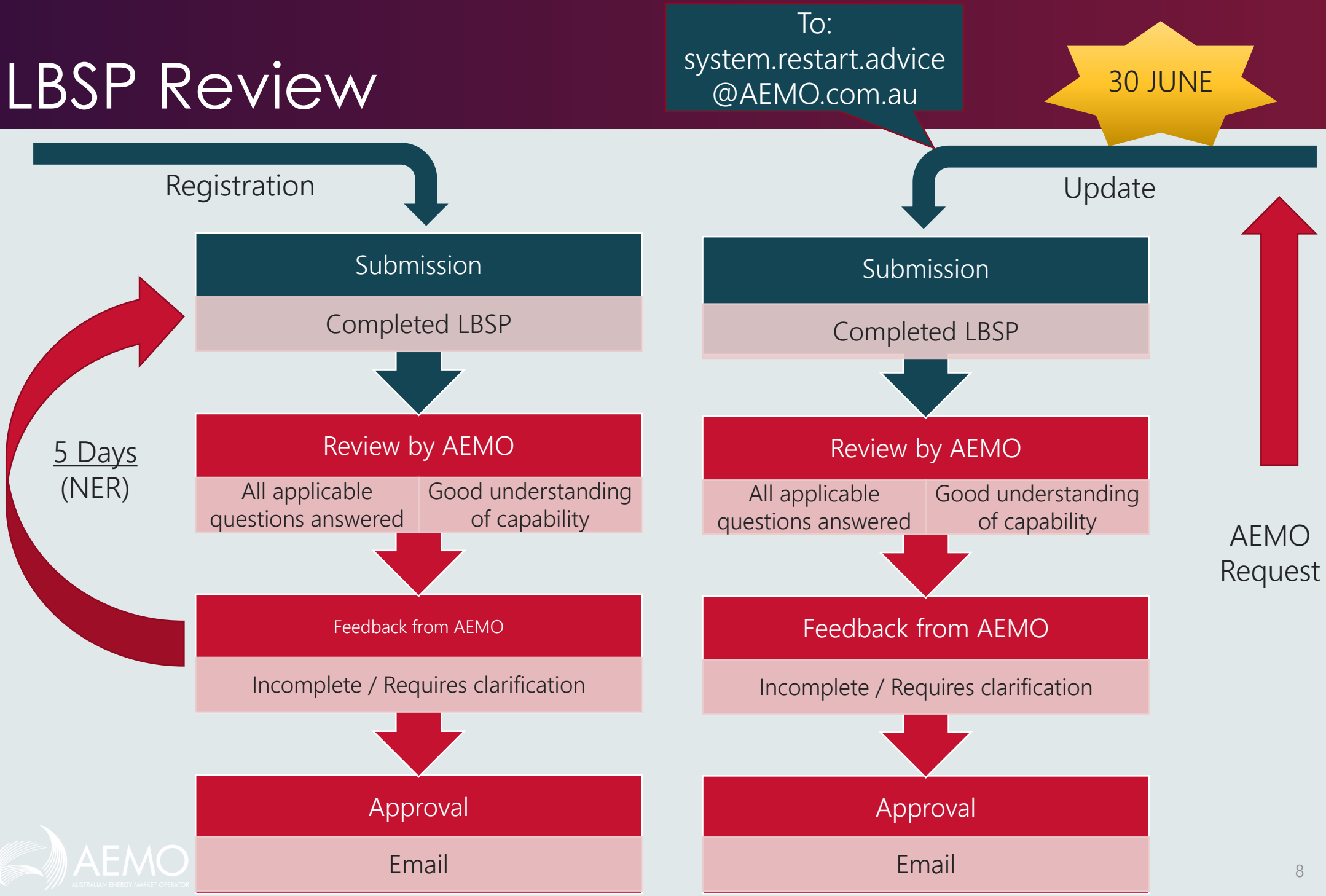
Existing generation

- Clarify existing LBSP questions
  - reduce variability (synchronous and asynchronous).

Network changes

- Proliferation of synchronous condensers
  - address system strength or inertia issues
  - potential to assist restoration
- Monitoring and control to incl both PMUs and SCADA
- Clarification of existing NSP LBSP questions

LBSP Review


To:
system.restart.advice
@AEMO.com.au
30 JUNE
Registration
Update
Submission
Completed LBSP
Review by AEMO
All applicable questions answered
Good understanding of capability
Feedback from AEMO
Incomplete / Requires clarification
Approval
Email
5 Days
(NER)
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Request

Generator LBSP

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Summary of information to be provided in Generator LBSP

Generator information & shutdown (all technologies)	• Site assessment and safe shut down of generating units • Normal staffing (day/night) & staffing for shutdown • External supply dependency • Emergency generation (diesel/gas) • Shutdown time & impacts on restart
Generator Restart (all technologies)	• Generator restart procedures, incl fuel supply • Switching required to receive supply from grid • Restart times incl different states (cold, warm, hot, during shutdown) • Loading requirements – minimum, steps, ramp rates • Islanding capabilities, energise a dead bus • Specific start-up capabilities - Trip to house load (TTHL)
Expansion for a changing generation mix	• Asynchronous generation section • Pumped hydro section • Multiple operating modes (generating and load /generation and synchronous condenser)
Technical information and communication	• Communication facilities to staff, AEMO and NSPs • Trip settings (voltage, frequency for abnormal conditions) • Other limitations (e.g. rough running bands, SCR etc)

Improved instructions for Generator LBSP

Information to be included in Generator LBSPs

Instructions for completion

Generators must complete relevant Parts of this template depending on all applicable technology and connection categories detailed in Table 1.

All fields in the applicable sections must be filled out. 'Not Applicable' can be used where an item is not relevant to the particular generation facility, however all fields in the applicable sections need to be considered.

Table 1

Section	Embedded Generators	Thermal/Gas Generators	Hydro	TTHL - capable Generators	Wind Generators	Solar Generators	Battery energy storage system	Hybrid Generators	Pumped Hydro
Part A – Information related to all Generators	✓✓	✓	✓✓	✓	✓	✓	✓✓	✓✓	✓✓
Part B – Information related to embedded Generators	✓	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)	(✓)
Part C - Information related to asynchronous Generators			(✓)		✓	✓	✓	✓	(✓)
Part D - Information related to TTHL generating units				✓					
Part E- Information related to pumped hydro									✓
Part F – Black start capability options	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional	Optional

✓ = *Required*

(✓) = *If applicable*

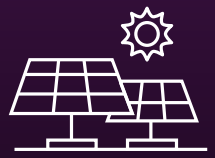
✓✓ = *Sections may need to be filled out multiple times for different modes of operation (e.g. generating, pumping, condenser, charging mode etc).*

(blank) = *unlikely to be required, but must be included if utilised within the plant*

Improved Generator LBSP for changing generation mix

Asynchronous generation

(e.g. wind, solar, battery, asynchronous pumped hydro)



- SCR withstand level (weaker conditions for restoration vs intact)
  Islanding Operation
- Reactive capability at lower SCRs
- Additional control loops required for restoration
  Switchover of control modes required – is this automatic?
- Voltage & frequency capability withstand during abnormal conditions

Improved Generator LBSP for changing generation mix

Clarified and refined questions to encourage more info (incl. examples)

* More info on capabilities incl. procedures for transformer (soft start, by-pass interlocks)
* Contingency plans if the generation fails during restoration
* Additional specific questions for TTHL capable units

Capabilities of:

* auxiliaries (e.g. Frequency withstand)
* operate and provide Mvar support at minimum load
* different modes of operation (e.g. islanding, black start mode, various stages of restart)

Examples tables: step-by-step restart procedures & impacts on restart depending on time without external supply

Section to request info on **modifications to enable black start**

Improved instructions for Generator LBSP

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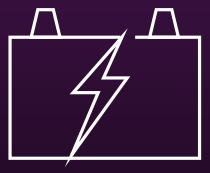
Improved Generator LBSP for changing generation mix

Storage and other modes of operation



- Explicit information **for different modes of operation** (e.g. charging/pumping and generation – applicable to BESS as well).
  Request **differences in shutdown or restart** for these different modes
- Technical **capabilities during restart** for charging/pumping
  – Frequency, voltage, reactive power, fault current etc.
- Addition of specific questions for pumped hydro capable units, including
  * Restart in pumped mode (process, challenges etc.)
  * Conditions for stable operation of pump mode
  * Voltage and frequency capabilities

Improved instructions for Generator LBSP

Information to be included in Generator LBSPs

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Questions?

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LBSP

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Summary of information to be provided in NSP LBSP

References to NSP operating documents can be included

Needs to be provided by TNSPs and DNSPs:

Capability of control centres & substations	• Operation after supply failure, durations w/o external supply • Control centres/substations emergency supplies • Substation capability without external supply (incl RTUs)
Communication systems & SCADA/PMU	• Voice communication systems (e.g. satellite phones) • Durations voice comms can be relied without external supply • Use of SCADA & PMU monitoring and control • Duration of SCADA & PMU without external supply
Restarting the network	• Assessing & preparing the network to accept supply • Manning critical substations incl. times for staff to arrive (on-call/other). • Tasks to ensure safety of equipment • Distribution operators approx. times to arrange stable load blocks • Synchronising facility locations & capabilities (check functions) • Limitations such as restart sequences to avoid (e.g. harmonics)
Technical information on network devices	• FACTs devices (e.g. installed SVC capability) • Synchronous condensers
Other technical capabilities	• Time critical major loads & characteristics to consider during restart • Arrangements between transmission, distribution operators and generators

Improved Network service provider LBSP

Communication/ monitoring and FACTS devices

- Increase in PMUs in the NEM (apparent in some regions)
- More questions for monitoring & control incl PMUs & SCADA
- Duplication of system and emergency supplies

- New FACTS device section and questions (e.g. SVCs)
- FACTS questions as per asynchronous generation (fault level, control strategy)

- Operating mode/control system differences for restoration
- Control mode switchover for emergencies (auto or manual)
- Any changes to static reactive filter switching during restoration?
- Parallel mode suspended?

Improved Network service provider LBSP

Proliferation of synchronous condensers, that can be installed by NSPs, in the NEM to address system strength issues

Synchronous condensers

Source: GE

- New section and questions to gather info on network synchronous condensers
- Some similar queries as generators (staffing arrangements, shutdown)

- Switching requirements to receive auxiliary from power system (e.g. protection requiring manual reset)
- Minimum Short circuit levels for start-up (starting method)
- Switchover of modes in emergency conditions

- Energy source to return condenser back to service without external supply?
- Restart without external supply, remote restart or on-site?
- How long the unit can operate without external supply (e.g. coasting)

Improved DC links LBSP information

Existing DC links

- 3 HVDC links (of different types) exist in the NEM
- Most cannot provide black start service or support early stages of restoration

Current LBSP

- Insufficient information requested on capabilities to support restoration
- Potentially new DC links in the NEM

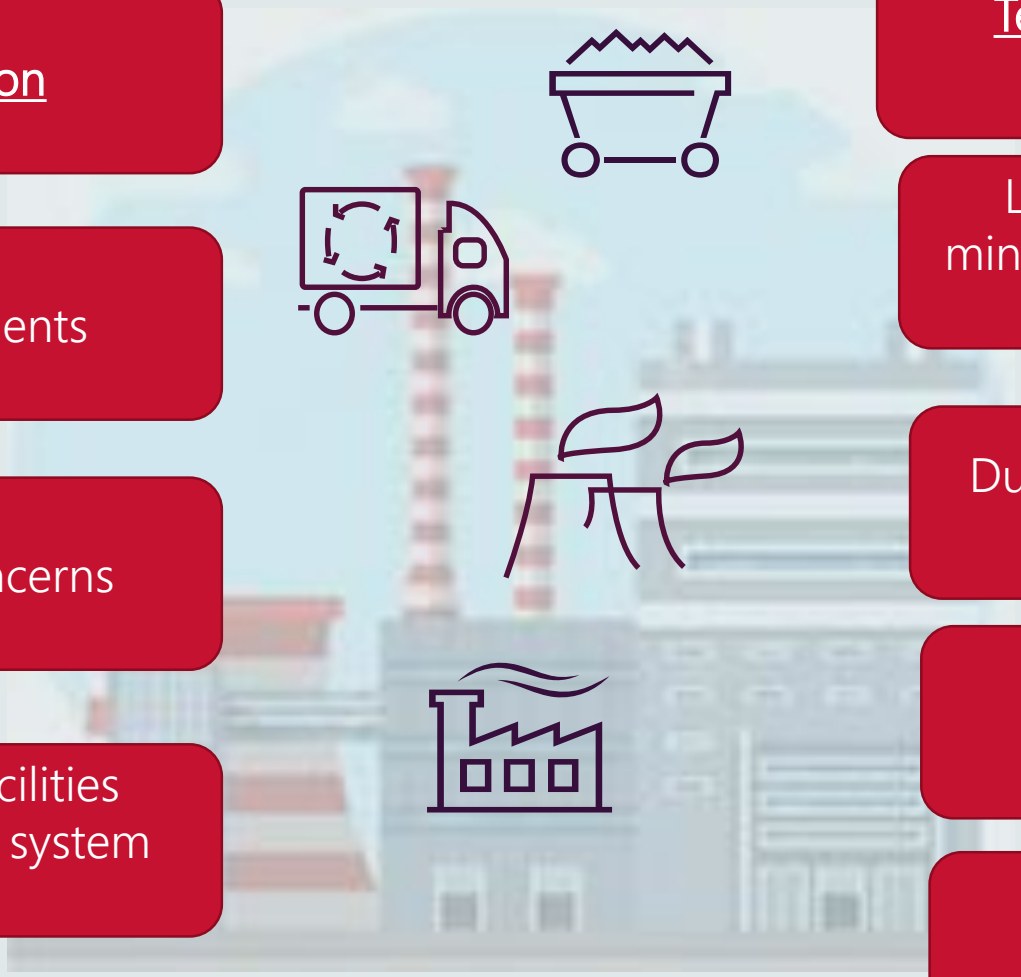
Updated LBSP – Similar to asynchronous generation

- SCR withstand level (weaker conditions during restoration than in system intact)
- Type of technology
- Reactive capability at lower SCR
- Additional control loops required for restoration
- Switchover of control modes required and whether this is automatic
- Black start capability (diesel, grid forming)

New LBSP template for major loads

Previously information obtained on case by case basis or through the Network Service provider.

- Plant information
- Staffing requirements
- Environmental concerns
- Communication facilities during major power system disturbance



- Technical capabilities & limitations
- Load block sizes and minimum load to maintain process
- Duration without supply (potlines)
- Auxiliary loads
- Emergency supplies

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Summary

Local Black System Procedures (LBSP) Background

- Obtained from Generators, TNSP/DNSP as input into system restart plans/SRAS procurement
- Including **timeframes, technical limitations and considerations** during restoration
- Helps **improve overall time** to restore power system and restart the market
- **Opportunities to identify** new/existing plant potential to **participate in SRAS**

The need to update Guidelines for Preparing LBSP

- **Insufficient information requested** from asynchronous generation on capabilities/limitations
- Improvements to info requested for all generation, **address variability in responses received**
- Improvements to info requested from **NSPs** for dynamic reactive plant, monitoring & control

Updated LBSPs - updates to existing LBSP by **30 June 2020**

- Generators – capabilities/limitation of **asynchronous and storage systems** following major supply disruptions
- NSPs – Includes specific questions for **FACTS & Synchronous condensers capabilities** & PMU info
- DC Links – More information on **capabilities/limitations** similar to asynchronous generation
- Major loads (as needed) – New LBSP template included for major loads (e.g. smelters)

- Link to new LBSP templates - https://aemo.com.au/en/consultations/current-and-closed-consultations/proposed-amendments-to-the-guidelines-for-preparing-local-black-system-procedures

Questions?

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