Reliability and Power Quality Standards and Frameworks

Presented by Craig Savage
General Manager, Asset Management United Energy
Agenda

Broad Definitions

Snapshot of Global Standards

Detailed Definitions

International Examples

Performance Based Rates

Australian Framework

• Background (Victorian development)
• AER service target performance incentive scheme (STPIS)
• The future?
“power quality” event

“reliability” event

Quality, or Reliability?

what about this??

How deep or wide can a “dip” be before it is perceived as an “Interruption”?

How does the customer’s equipment react?

Could an extremely short “interruption” be seen as a form of distortion?
Power Quality or Reliability

So, to resolve these uncertainties, where customers’ equipment could react as if they’d experienced either an interruption or a disturbance, there is a generally accepted definition:

Power quality:
• There is supply *(includes interruptions of less than 1 minute)*
• How “pure” is the shape of the voltage waveform?
• Concept of “Waveform Distortion”

Supply reliability:
• There is no supply *(for a period of at least 1 minute)*
• No voltage waveform
• Concept of “interruption”
Power Quality or Reliability

Power quality in its simplest form
• There is supply
• How “pure” is the shape of the voltage waveform?
• Concept of “waveform distortion”
Power Quality or Reliability

Reliability in its simplest form
- There is **no** supply
- No voltage waveform
- Concept of “interruption”
Typical Graphical Example

- **Instantaneous Swell**
- **Momentary Swell**
- **Temporary Swell**
- **Overvoltage**
- **Normal Operating Voltage**
- **Instantaneous Sag**
- **Momentary Sag**
- **Temporary Sag**
- **Undervoltage**
- **Impulsive & Oscillatory Transients**

**Typical Duration**
- 0.5 Cycles
- 30 Cycles
- 3 sec
- 1 min
- Sustained Interruption
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International Standards

1159-2009, IEEE Recommended Practice for Monitoring Electric Power Quality

1250-2011, IEEE Guide for Identifying and Improving Voltage Quality in Power Systems

519-2014, IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems


1409-2012, IEEE Guide for Application of Power Electronics for Power Quality Improvement on Distribution Systems Rated 1 kV Through 38 kV

C63.14-2014, American National Standard Dictionary of Electromagnetic Compatibility (EMC) including Electromagnetic Environmental Effects (E3)

1453-2011, IEEE Recommended Practice – Adoption of IEC 61000-4-15:2010, Electromagnetic compatibility (EMC) – Testing and measurement techniques – Flickermeter – Functional and design specifications

1453.1-2012, IEEE Guide – Adoption of IEC/TR 61000-3-7:2008, Electromagnetic compatibility (EMC) – Limits – Assessment of emission limits for the connection of fluctuating installations to MV, HV and EHV power systems
Even More International Standards


3006.7-2013, IEEE Recommended Practice for Determining the Reliability of 7x24 Continuous Power Systems in Industrial and Commercial Facilities

3006.9-2013, IEEE Recommended Practice for Collecting Data for Use in Reliability, Availability, and Maintainability Assessments of Industrial and Commercial Power Systems

EN50160 Voltage Characteristics of Electricity supplied in Public Distribution Systems

NRS 048 Series, Electricity Supply – Quality of Supply

IEC 61000 Series, Electromagnetic Compatibility (EMC)

ITIC (CBEMA) Curve

AS/NZS 61000 Series, Electromagnetic Compatibility (EMC)

AS 4777 Series, Grid Connection of Energy Systems via Inverters
International Standards

Many varied and differing definitions
• How many cycles for power quality
  – 0.5 cycle to 30 cycles to 3 seconds
• Depth of voltage reduction
  – 0.01 pu to 0.05 pu 0.1 pu
• Timeframe boundary between Momentary and Sustained
  – 1, 3, 5 minutes
• Language differences
  – Instantaneous, momentary, temporary, short
Steady State Voltage – The Issue

There is no national consistency in defining the steady state voltage delivered to customers
• 240V ± 6%
• 230V + 10% / -2%
• 230V + 10% / -6%

Long-term National Power Quality Survey conducted by the University of Wollongong indicates that some 30% of low voltage sites are delivered with voltages higher than 230V +10% some of the time

Most electrical appliances are now manufactured for nominal voltage of 230V, but Australian networks are still delivering a voltage in the order of 250V most of the time
• Sub-optimal appliance performance e.g. efficiency
• Potentially shorten equipment design life
AS61000.3.100 Voltage Standard

- 10-minutes rms values to smooth out momentary changes
- Minimum one-week recording for compliance purpose
- Statistical measure preferred to take account of extreme events and inaccuracy of raw data
- Supply voltage range (230V+10%/-6%) for 98% of the time (V1% and V99%)
  - This supply voltage range aligns with that stipulated in AS/NZS 60038
- In the longer term, DNSP should aim to deliver a lower average voltage. A V50% is defined with a target range of 230V +6%/-2%.
  - allows a head room of +4% for the connection of embedded generators (such as PV systems), and
  - -4% to allow for voltage drop during peak load conditions
Proposed 230V Voltage Standard

<table>
<thead>
<tr>
<th>Steady State Voltage Measure</th>
<th>Phase to Neutral Voltage Limit</th>
<th>Phase to Phase Voltage Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>(10 minute RMS)</td>
<td>Maximum</td>
<td>Minimum</td>
</tr>
<tr>
<td>$V_{1%}$</td>
<td>no limit</td>
<td>216V</td>
</tr>
<tr>
<td>$V_{99%}$</td>
<td>253V</td>
<td>no limit</td>
</tr>
<tr>
<td>$V_{50%}$</td>
<td>244V</td>
<td>225V</td>
</tr>
</tbody>
</table>
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3.14 **momentary interruption**: A single operation of an interrupting device that results in a voltage zero. For example, two circuit breaker or recloser operations (each operation being an open followed by a close) that momentarily interrupts service to one or more customers is defined as two momentary interruptions.

3.15 **momentary interruption event**: An interruption of duration limited to the period required to restore service by an interrupting device.

NOTE—Such switching operations must be completed within a specified time of 5 min or less. This definition includes all reclosing operations that occur within five minutes of the first interruption. For example, if a recloser or circuit breaker operates two, three, or four times and then holds (*within 5 min of the first operation*), those momentary interruptions shall be considered one momentary interruption event.

3.21 **sustained interruption**: Any interruption not classified as a part of a momentary event. That is, any interruption that lasts *more than 5 minutes*. 
4.2.1 System average interruption frequency index (SAIFI)
- The system average interruption frequency index indicates how often the average customer experiences a sustained interruption over a predefined period of time.

4.2.2 System average interruption duration index (SAIDI)
- This index indicates the total duration of interruption for the average customer during a predefined period of time. It is commonly measured in customer minutes or customer hours of interruption.

4.2.3 Customer average interruption duration index (CAIDI)
- CAIDI represents the average time required to restore service.

4.4.1 Momentary average interruption frequency index (MAIFI)
- This index indicates the average frequency of momentary interruptions.

4.4.2 Momentary average interruption event frequency index (MAIFle)
- This index indicates the average frequency of momentary interruption events. This index does not include the events immediately preceding a lockout.

4.2.6 Average service availability index (ASAI)
- The average service availability index represents the fraction of time (often in percentage) that a customer has received power during the defined reporting period.
Customer Guidelines

• blackouts, glitches, flicker & hum (common problems and how to deal with them)
• blackouts, glitches, flicker & hum (problem solver)
Ena Customer Guideline

Provides information on how electricity is supplied, the quality and reliability of electricity supply that can be expected from an electricity network, and steps that customers should take when they lose supply or believe that the quality of their supply is below an acceptable level.

PART 1 – Electricity Supply
• describes the way in which electricity is supplied to customers and the roles of generators, transmission companies, distribution companies and retailers.

PART 2 – Understanding your Load and Needs
• describes the key items that customers need to understand about their load when negotiating a new or upgraded connection to a Network Service Provider (NSP).

PART 3 – Network Reliability
• describes how despite suppliers’ efforts to optimise the reliability of their power systems, customer interruptions to electricity supply are inevitable and customers need to identify and manage the associated risks.

PART 4 – Network Power Quality
• describes how the quality of the electricity provided to customers is not always suitable for use by all customer equipment. The major power quality disturbance types are identified and discussed and the importance of purchasing electrical equipment with sufficient levels of power quality immunity is highlighted.

ENA Power Quality Guidelines

ENA Doc 033-2014 Guideline for Power Quality: **Harmonics**
Recommendations for the application of the Joint Aus/NZ Technical Report TR IEC 61000.3.6:2012

- provide a coherent and practical guide to the application of TR IEC 61000.3.6:2012, for limiting harmonic voltages in medium voltage (MV) and high voltage (HV) distribution networks


- Guide to the application of TR IEC 61000.3.7:2012 for limiting voltage fluctuations in medium voltage (MV) and high voltage (HV) distribution networks, and to present a simplified approach that a particular DNSP may elect to adopt
ENA Power Quality Guidelines

ENA Doc 035-2014 Guideline for Power Quality: Inverter Energy Systems for Connection to Low Voltage Distribution Networks
• Provide a simplified approach to managing the connection of low voltage embedded generators

ENA Doc 037-2015 Guideline for Power Quality: Voltage Unbalance
Recommendations for the application of the Joint Australian / New Zealand Technical Report TR IEC 61000.3.13:2012
• Guide to the application of the joint Australian/New Zealand Technical Report, TR IEC 61000.3.13:2008 for limiting voltage unbalance in medium voltage (MV) and high voltage (HV) distribution networks and to present a simplified approach that a particular DNSP may elect to adopt
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Tracking the Reliability of the U.S. Electric Power System:

An Assessment of Publicly Available Information Reported to State Public Utility Commissions

Joseph H. Eto and Kristina Hamachi LaCommare

October 2008

The work described in this report was funded by the Office of Electricity Delivery and Energy Reliability of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.
USA framework - measures

Figure 3. State Reporting Requirements for Reliability Metrics

Figure 6. Utility Practices for Defining Sustained Interruptions
USA framework - benchmarking
United Kingdom framework

Ofgem administers a price control regime in UK

There are financial incentives in place on DNOs

Focus on delivering an improved level of performance in relation to the number and duration of power cuts and the quality of telephone response
United Kingdom framework – measures

SAIFI (Customer Interruptions) - 1.2% revenue
SAIDI (Customer Minutes Lost) – 1.8% revenue

Customer survey of telephone response

GSLs
• Supply (duration and multiple interruptions)
• Notice of supply interruptions
• Response to voltage complaint
• Response to charge query
• Appointments
• Payments
Other frameworks (Europe)

Greece – number of incidents per 100km of network

Estonia, Cyprus, Norway – interruption time at transmission level

Italy – MAIFI-transient (<1sec)

France – compensation payments of 20% fixed part of network tariff for very long interruptions (>6 hours)
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Performance Based Rate Structure with Dead Zone and Cap

Target = 90 minute SAIDI

-150%
-100%
-50%
0%
50%
100%
150%
200%
160%
180%
190%
200%

SAIDI/year

Maximum Bonus
Increasing Bonus
Dead Zone
Increasing Penalty
Maximum Penalty
Performance Based Rate Structure without Dead Zone

- Performance Based Rate Structure with Dead Zone

- Target = 90 minute SAIDI

Maximum Bonus
Increasing Bonus
Maximum Penalty
Increasing Penalty
Performance Based Rate Structure without Cap

Target = 90 minute SAIDI
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Australian Framework

Local jurisdictional

Nationally - Australian Energy Regulator

• Service Target Performance Incentive Scheme
  – reliability of supply
  – quality of supply
  – customer service
  – guaranteed service level (GSL)
ENA document on metrics

DISTRIBUTION RELIABILITY MEASURES
Response to the AEMC Draft Report
July 2014

ENA Service Standard Regulatory Policy & National Reliability Reporting Framework

ENA consulted heavily on the review
Service Target Performance Incentive Scheme (STPIS)

The beginning - How was it developed in Victoria?

- EDPR 2001-2005 (s-factor)
- Working Group with DNSPs, regulator, consultant
- Based on 2 years data for definitions of CBD, Urban, Short Rural, Long Rural
- Value based on PB Power report
  - $/MWh of DNSPs submissions on reliability improvement
  - Checked against Value of Lost Load (VoLL) of the time
  - Weightings between reliability indicators
How it operated

6 years of benefit for sustained improvement
Returned through DUOS in tariff submission 2 years post reliability results
GSLs for reliability (worst served 1%)

Exclusion criteria
No “dead band” or cap on performance
Split between customer feeder category
  • CBD, Urban, Short Rural, Long Rural
S bank to smooth year-on-year variability

2001 to 2005
  • SAIFI, CAIDI, planned SAIDI

2006 to 2010
  • SAIFI, SAIDI, MAIFI & call centre response
  • Rates increased by 2.5 to 4 times the first period rates
Definitions for customer segmentation

CBD, Urban, Short Rural, Long Rural
- SCNRRR definition by feeder
  - Based on 2 years Victorian data from 1997/8
- Tasmanian definition by load block
- Ena R+PQC work

Year end review of feeder categorisation
AER STPIS

First developed in June 2008
• AER requirement to do so under chapter 6 of the National Electricity Rules
Amended May 2009
• Amended s-factor calculation
• Amended cap from +/-3% to +/-5%
• Amended Major Event Day calculation
Current version November 2009
STPIS changes from Vic ESC to AER

Downside Caps (and upside)
S bank to smooth revenue fluctuations
Valuation of incentives (VCR)
SAIDI/SAIFI incentive ratio
  • Distributor specific to common ratio for all
Exclusions
  • Victoria SAIFI to SAIDI AER
Structure of the AER distribution service target performance incentive scheme

Scheme comprises of four components:

• reliability of supply
• quality of supply
• customer service
• guaranteed service level (GSL)

Exclusions to remove outlier performance

• AER considers the IEEE 1366 standard to be a robust method for determining exclusions
Reliability of supply component

- Unplanned SAIDI
- Unplanned SAIFI
- MAIFI (optional)

Divided into segments by network type

Performance targets and incentive rates applied for each parameter segment

Targets set on 5 year average performance

Adjustments made for funded improvements

Valuation of incentives (VCR)
  - AEMO review published Dec 2014
  - $39/kWh nationally, except CBD
  - Adjusted by CPI

Published: December 2014
### Value of service target performance incentive scheme

<table>
<thead>
<tr>
<th>NSH &amp; ACT</th>
<th>VIC</th>
<th>QLD</th>
<th>SA</th>
<th>WA</th>
<th>TAS</th>
<th>NT</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>66,309</td>
<td>43,441</td>
<td>43,690</td>
<td>12,849</td>
<td>18,717</td>
<td>10,099</td>
<td>1,883</td>
</tr>
<tr>
<td><strong>Energy delivery per minute (MWh)</strong></td>
<td>126.1</td>
<td>82.6</td>
<td>83.1</td>
<td>24.4</td>
<td>35.6</td>
<td>19.2</td>
<td>3.6</td>
</tr>
</tbody>
</table>

**Value of VCR per annum**

| $20000/MWh | $2,521,443 | $1,651,871 | $1,661,332 | $488,596 | $711,739 | $384,006 | $71,606 | $7,768,678 |
| $30000/MWh | $3,782,164 | $2,477,806 | $2,491,997 | $732,894 | $1,067,608 | $576,010 | $107,409 | $11,653,017 |
| $40000/MWh | $5,042,885 | $3,303,742 | $3,322,663 | $977,192 | $1,423,477 | $768,013 | $143,212 | $15,537,356 |
| $50000/MWh | $6,303,607 | $4,129,677 | $4,153,329 | $1,221,490 | $1,779,346 | $960,016 | $179,016 | $19,421,696 |

**3 year NPV, 10% DCF**

| $20000/MWh | $6,270,455 | $4,107,958 | $4,131,486 | $1,215,066 | $1,769,988 | $954,967 | $178,074 | $19,319,553 |
| $30000/MWh | $9,405,682 | $6,161,938 | $6,197,229 | $1,822,599 | $2,654,983 | $1,432,451 | $267,111 | $28,979,329 |
| $40000/MWh | $12,540,910 | $8,215,917 | $8,262,972 | $2,430,132 | $3,539,977 | $1,909,934 | $356,148 | $38,639,106 |
| $50000/MWh | $15,676,137 | $10,269,896 | $10,328,715 | $3,037,665 | $4,424,971 | $2,387,418 | $445,185 | $48,298,882 |
Quality of supply component

No quality of supply parameters are currently specified

- Victorian ESC currently looking to develop an obligation to measure and record quality of supply data
Customer service component

Telephone answering
Streetlight repair
New connections
Response to written enquiries

Performance targets and incentive rates applied for each parameter

Revenue at risk for all customer service parameters shall be +/-1%
Revenue at risk for an individual customer service parameters shall be +/-0.5%

Incentive rate of -0.040% per unit of ‘telephone answering’ parameter

May be proposed by a DNSP
Guaranteed service level component

Unless jurisdictional electricity legislation imposes an obligation on a DNSP

- Frequency of interruption
- Streetlight repair
- New connections
- Notice of planned interruption
- Duration of interruptions or total interruptions

However...

- Jurisdictional legislation exists in
  - Queensland
  - NSW
  - Victoria
  - South Australia

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency of interruptions</td>
<td>CBD and Urban feeders – 9 interruptions</td>
</tr>
<tr>
<td></td>
<td>Rural (short and long) feeders – 15 interruptions</td>
</tr>
<tr>
<td>Duration of interruptions</td>
<td>CBD and Urban feeders – 12 hours</td>
</tr>
<tr>
<td></td>
<td>Rural (short and long) feeders – 18 hours</td>
</tr>
<tr>
<td>Total duration of interruptions</td>
<td>Level 1 – 20 hours</td>
</tr>
<tr>
<td></td>
<td>Level 2 – 30 hours</td>
</tr>
<tr>
<td></td>
<td>Level 3 – 60 hours</td>
</tr>
<tr>
<td>Streetlight repair</td>
<td>5 days</td>
</tr>
<tr>
<td>New connections</td>
<td>Connection on or before the day agreed</td>
</tr>
<tr>
<td>Notice of planned interruptions</td>
<td>4 days, excluding Saturday, Sunday and any Public Holiday applicable to the customer’s location</td>
</tr>
</tbody>
</table>
How STPIS operates

<table>
<thead>
<tr>
<th>Year</th>
<th>Revenue Impact</th>
<th>Target Performance</th>
<th>Actual Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>$0.00</td>
<td>60.0</td>
<td>60.0</td>
</tr>
<tr>
<td>2017</td>
<td>$0.00</td>
<td>60.0</td>
<td>60.0</td>
</tr>
<tr>
<td>2018</td>
<td>$0.00</td>
<td>60.0</td>
<td>60.0</td>
</tr>
<tr>
<td>2019</td>
<td>$0.00</td>
<td>60.0</td>
<td>60.0</td>
</tr>
<tr>
<td>2020</td>
<td>$0.00</td>
<td>60.0</td>
<td>60.0</td>
</tr>
<tr>
<td>2021</td>
<td>$0.99</td>
<td>56.6</td>
<td>55.8</td>
</tr>
<tr>
<td>2022</td>
<td>$0.99</td>
<td>56.6</td>
<td>55.8</td>
</tr>
<tr>
<td>2023</td>
<td>$0.99</td>
<td>56.6</td>
<td>55.8</td>
</tr>
<tr>
<td>2024</td>
<td>$0.99</td>
<td>56.6</td>
<td>55.8</td>
</tr>
<tr>
<td>2025</td>
<td>$0.99</td>
<td>56.6</td>
<td>55.8</td>
</tr>
<tr>
<td>2026</td>
<td>$0.20</td>
<td>56.6</td>
<td>55.8</td>
</tr>
<tr>
<td>2027</td>
<td>$0.20</td>
<td>56.6</td>
<td>55.8</td>
</tr>
<tr>
<td>2028</td>
<td>$0.20</td>
<td>56.6</td>
<td>55.8</td>
</tr>
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<td>$0.20</td>
<td>56.6</td>
<td>55.8</td>
</tr>
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<td>2030</td>
<td>$0.20</td>
<td>56.6</td>
<td>55.8</td>
</tr>
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<td>2031</td>
<td>$0.00</td>
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<tr>
<td>2035</td>
<td>$0.00</td>
<td>55.8</td>
<td>55.8</td>
</tr>
</tbody>
</table>

NPV = $2.64
AER exclusion criteria

The 2.5 beta method described in the IEEE Standard 1366-2003 will be used to determine exclusion threshold for Major Events Days

- any day (midnight to midnight) where daily unplanned SAIDI exceeds the major event day threshold

In addition, impacts of specific events will be excluded
- load shedding directed by NEMMCO due to a generation shortfall
- load interruptions caused by a failure of the shared transmission network
- load interruptions caused by a failure of transmission connection assets except where the interruptions were due to inadequate planning of transmission connections and the DNSP is responsible for transmission connection planning
- load interruptions caused by the exercise of any obligation, right or discretion imposed upon or provided for under jurisdictional or national legislation
2.5 Beta Exclusion

The probability of exceeding $T_{MED}$ is a function of $k$, just as in the Gaussian example. Table B.2 gives these probabilities as well as the expected number of Major Event Days (MEDs) for various values of $k$.

<table>
<thead>
<tr>
<th>$k$</th>
<th>$p$</th>
<th>MEDs/yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.15866</td>
<td>57.9</td>
</tr>
<tr>
<td>2</td>
<td>0.02275</td>
<td>8.3</td>
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<td>2.4</td>
<td>0.00822</td>
<td>3.0</td>
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<td>2.5</td>
<td>0.00621</td>
<td>2.3</td>
</tr>
<tr>
<td>3</td>
<td>0.00135</td>
<td>0.3</td>
</tr>
<tr>
<td>6</td>
<td>9.9 x 10^{-10}</td>
<td>3.6E-07</td>
</tr>
</tbody>
</table>

Figure B.1—The area under the probability density function $pdf$ (SAIDI) above threshold ($T$) is the probability $p$ that a given day will have a SAIDI value greater than ($T$)

2.3 days per year excluded
Non-standard determinations

Endeavour: Box-Cox, not 2.5 Beta
Essential: targets based on trend, not average – 3% harder
Ausgrid: targets based on trend, not average – 8.8% - 18% harder

+/- 2% revenue at risk - Ergon, Energex
+/- 2.5% revenue at risk - Endeavour, Essential, Ausgrid
The future?

Inclusion of Power Quality measures
• Ena R+PQ Ref Group developing National PQ Indices

Tightening of Definitions
IEEE1366 developments
• 4.15 Beta for catastrophic events

OFGEM Incentive and Obligations project
Victorian f factor (fire starts)
• $25,000 per fire start currently

AEMC Review of electricity distribution reliability outcomes and standards
Ena Reliability and Power Quality Reference Group work
Catastrophic Days

- Experience with certain companies’ application of IEEE Std. 1366 found that unusually large events (“catastrophic”) lead to changes in $t_{med}$ which often impact the next 5 years of underlying SAIDI
- Distribution Reliability WG formed a Task Force to investigate
OFGEM direction

Link longer-term reliability benefits of healthier and less highly-loaded assets to a measurable deliverable within the price control.

• Load Index (LI) to maintain a specific average level of loading – 5 stage Significant spare capacity to fully utilise, mitigation required.
• Health Index (HI) to measure the probability of asset failure – 5 stage New to End of Service Life, intervention required.
• Risk Index (RI) to combine the impact of asset failure with HI.
• Network Resilience measure for use in scenarios such as during floods.

“Unplanned interruptions and minutes lost targets set using a combination of DNO own and industry average.”

Ofgem priorities

<table>
<thead>
<tr>
<th>Arrangement</th>
<th>Proposed activity</th>
<th>Importance for Changes in ED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Index</td>
<td>Incorporation of asset criticality / consequence,</td>
<td>High</td>
</tr>
<tr>
<td>Load Index</td>
<td>Incorporation of criticality / consequence, DSM &amp; Investment ahead of need.</td>
<td>High</td>
</tr>
<tr>
<td>Safety</td>
<td>Develop and agree new primary output.</td>
<td>High</td>
</tr>
<tr>
<td>Interruption Incentive Scheme (IIS)</td>
<td>Incentive rates, confirm unplanned target setting methodology, pre-arranged interruptions, short interruptions?</td>
<td>Medium</td>
</tr>
<tr>
<td>Resilience</td>
<td>Review need for measure of network resilience</td>
<td>Medium</td>
</tr>
<tr>
<td>Guaranteed Standards (SI 698)</td>
<td>Review thresholds and payment levels – including 18hr standard</td>
<td>Medium</td>
</tr>
<tr>
<td>Worst Served Customers</td>
<td>Review allowance per customer and definition of WSC</td>
<td>Low</td>
</tr>
</tbody>
</table>
Productivity Commission Review Oct 2012

Recommend a bolstered STPIS

Remove input standards
- Deterministic planning standards
  - Jurisdiction - specific performance standards
- Input based reliability standards removed in QLD July 14
- Deterministic planning standards removed in NSW July 14

Establish a national framework

Targets based on a rolling 5-year average of past performance

More business-specific incentives based on VCR (ABS)
AEMC “Review of the national framework for distribution reliability” Sept 2013

Recommends a National framework for “setting, delivering and reporting on distribution reliability targets and outcomes”

Focus on consistent definitions (AEMC to develop)

Focus on customer/stakeholder consultation

No longer set reliability standards based on historical performance

Proposed VCR transfer from AEMO to AER, but start with AEMO’s 2014 VCR

Additional reliability measures (flexibility)

• Network assets that serve high load areas
• Areas of high economic or social importance
• Areas with history of poor reliability performance
AEMC “Review of Distribution Reliability Measures” Sept 2014

Definition changes:
- MAIFI over MAIFI
- Momentary as 3 minutes, not 1 minute
- 4.15 Beta for catastrophic events
- Feeder categorization using weather corrected MDs for load density assessment

Additional reliability measures (flexibility)
- Network assets that serve high load areas
- Areas of high economic or social importance
- Areas with history of poor reliability performance

UE and Powercor proposed adoption in Victorian 2016-2020 determination

AEMC determination
- Guideline published 30 June 2017,
- “…revision to STPIS likely to occur by 30 June 2017 to allow revisions to be incorporated into the NSW< ACT and Tasmanian
Ena Reliability and Power Quality Reference Group work

PQ **Voltage Unbalance** Draft Guideline with Standards Australia for publishing – promotes nationally consistent approach to connection assessment (companion to flicker and harmonics)

PQ Amendments to **NER** to align with Australian Standards

Australian Standard AS61000.3.100 Amd1:2015: draft amendment released for public comment closed October 2015 – provides a statistical sample approach to measure network compliance

Guidelines for the **Classification of Feeders** – scope Q1 2016 to improve reliability reporting consistency, better align with expectations and requirements of customers

**Reliability Performance Management Opportunities** – survey Q1 2016 as input into update of existing guidelines to promote continuing best practice

Guidelines for reporting poor reliability – discussion paper Q2 2016 to better align with the experience of customers
Ena Reliability and Power Quality Reference Group work

Aspects from the Electricity Network Transformation Roadmap:
- impacts of distributed energy resources
- two way power flows
- Improve host capacity to manage power quality efficiently

Summary Closing

Broad Definitions
Snapshot of Global Standards
Detailed Definitions
International Examples
Performance Based Rates
Australian Framework
• Background (Victorian development)
• AER service target performance incentive scheme (STPIS)
• The future