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Reliability & Safety Working Group

24 July 2012

Safety outputs

- Actions from 31 May meeting:
  - Views on financial incentives based on some measure of safety performance
  - Appropriate level of reward for such an incentive (SSE)
  - Details of safety data currently recorded / reported

Safety outputs

- Majority view that a financial incentive mechanism would not be appropriate for RIIO-ED1:
  - Concerns over the basic principle.
  - Concerns over role of Ofgem in safety regulation.
  - Concerns that an incentive would encourage underreporting of incidents.
- Majority view that a reputational incentive (e.g. a metric published the ED annual report) would not be appropriate for RIIO-ED1.

Safety outputs

SSE suggestion 1

- Safety performance measured against existing metric such as Total Reportable Incident Rate (TRIR)
- Reward available to companies which outperform target level
- ~1% of allowed revenue

SSE Suggestion 2

- Discretionary reward – similar format to customer service reward scheme, covering safety initiatives.
- Expert panel assess DNO submissions

Safety outputs

- Feedback from internal discussions.
- Sensitivities around incentivising safety performance, particularly if financial.
- Ofgem cannot enforce for safety performance.
- Arrangements need to properly reflect Ofgem's role in this area.
- Appropriate for the industry to publish comparable safety data?

WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales

The Need For Consequence When Relating Risk And Asset Health

24th July 2012

Bob Parker– Planning & Regulation

WESTERN POWER DISTRIBUTION
Serving the Midlands, South West and Wales

Extending HIs To Cover Risk

- The risk associated with asset failure is:-

  probability of failure (POF) x consequence of failure (COF)

- Asset health (represented by HIs) can be used as a proxy measure for probability of failure
- RSWG has discussed use of asset criticality as a representation of consequence of failure. The suitability of this approach requires consideration.

Determining Risk

- A number of consequences may be associated failure of a particular asset, such as:-
  - network performance;
  - environmental
  - safety etc.
- The total consequence of failure for a particular asset is the cumulative total of these individual consequences.

Determining Risk (2)

- Only by evaluating each individual consequence on a common basis (e.g. cost in £) can these be combined to determine the total consequence of failure for a particular asset.

  e.g.

Consequence of Failure (£)			
Network Performance	Environmental	Safety	**Total**
50,000	10,000	100	**60,100**

Determining Risk (3)

- The risk associated with failure of an asset is determined by applying the probability of failure to the total consequence of failure.
- The risks associated with multiple assets can be summated to give the total risk carried by these assets.

e.g:- consider three LV link disconnecting boxes:-

	POF	COF (£)	Risk (£)
LV UGB 1	0.04	1,000	40
LV UGB 2	0.03	2,000	60
LV UGB 3	0.1	3,000	300
Total			**£400**

Representing Risk

- Risk could be represented, within a ‘risk matrix’, by using HI and a ‘banding’ of consequence.
- Using the previous example, the three link disconnecting boxes could be represented in a risk matrix similar to below:-

Consequence Of Failure	Health Index				
	HI 1	HI 2	HI 3	HI 4	HI 5
£0 - £999					
£1,000 - £1,999			LV UGB 1		
£2,000 - £2,999			LV UGB 2		
£3,000 - £3,999					LV UGB 3

- In this example, the banding of consequence enables differentiation of the risk associated with each link disconnecting box.

Representing Risk (2)

- Risks can be summated across all assets, to determine the risk carried by the overall asset base, e.g.:-

	POF	COF (£)	Risk (£)
LV UGB 1	0.04	1,000	40
LV UGB 2	0.03	2,000	60
LV UGB 3	0.1	3,000	300
132kV Transformer 1	0.02	500,000	10,000
132kV Transformer 2	0.003	400,000	1,200
132kV Transformer 3	0.1	400,000	40,000
Total			**£51,600**

- By stating consequence on a common basis (£), risk can be compared between assets, irrespective of asset type.

Suitability Of Criticality

- Criticality does not equate to consequence.
- Combining individual criticalities, for an asset, without considering the relativity of the consequences that they represent, will result in misrepresentation of the overall consequences associated with failure of the asset.

	Consequence of Failure (£)				**Criticality**			
	Network Performance	Environmental	Safety	**Total**	Network Performance	Environmental	Safety	**Combined***
33kV Transformer 1	150,000	5,000	1,000	**156,000**	High	Med	Med	**High**
33kV Transformer 2	40,000	6,000	1,000	**47,000**	Med	Med	Med	**Med**
33kV Transformer 3	10,000	20,000	500	**30,500**	Low	High	Low	**High**

* - using the highest criticality

Average Consequences For Asset Type	40,000	5,000	1,000	**46,000**

Suitability Of Criticality (2)

- The relative consequences of failure associated with different asset types need to be known for comparison across asset types.
- For example, consider two assets:-
  - a link disconnecting box, with criticality of ‘very high’; and
  - a 33kV transformer 1, with criticality of ‘low’
- The above provides insufficient information to enable the consequences (and therefore ultimately the risk) associated with each asset to be compared.

Using Bandings Of Consequence

- Bandings of consequence of failure in terms of ‘low’, ‘medium’, ‘high’ etc. can be used in a way that enables comparison between different asset types, provided that:-
  - the average consequences of failure associated with each asset type; and
  - the relativity of the consequences associated with the bandings

  are known.

Using Bandings Of Consequence (2)

- For example:-

  If:-

  – the average consequence of failure associated with a link disconnecting boxes is £1,500; and

  – a ‘very high’ consequence for a link disconnecting box represents typically twice the average consequence.

  Then a link disconnecting box with a ‘very high’ consequence banding therefore can be considered as having a consequence of failure of £3,000

Using Bandings Of Consequence (3)

- cont.

  If:-

  – the average consequence of failure associated with a 33kV transformer is £46,000; and

  – a ‘low’ criticality for a 33kV transformer represents typically a quarter of the average consequence

  Then a 33kV transformer with a ‘low’ consequence therefore can be considered as having a consequence of failure of £11,500

  The relative consequences (and by application of probability of failure, also risk) can be seen between the two assets

Proposal

- The consequences of failure should be evaluated and reported for each asset in ‘consequence bandings’
- The average (or typical) consequences of failure for each asset type (at the level of granularity used for output measures reporting e.g. ‘LV switchgear’ etc.) should be reported.
- The typical consequences of failure for each asset type are likely to be different for each DNOs.

Proposal (2)

- Common definitions for bandings of consequence of failure should be adopted for all asset types, for example:-

  - Low: consequence of failure less than 50% of the typical for the asset type;
  - Medium: consequence of failure between 50% and 200% of the typical for the asset type;
  - High: consequence of failure between 200% and 400% of the typical for the asset type;
  - Very High: consequence of failure above 400% of the typical for the asset type.

Proposal (3)

- The risk matrix for each asset type would therefore be:-

Consequence Of Failure	Health Index				
	HI 1	**HI 2**	**HI 3**	**HI 4**	**HI 5**
Low					
Medium					
High					
Very High					

Typical Consequence Of Failure (for asset type)	£

Proposal (4)

- By using suitable granularity of bandings of consequence, and definition, risk management can be compared:-
  - for assets within an asset type; and
  - across all asset types
- By using standard definitions for the bandings across all assets, this is likely to reveal that the differences in consequence of failure between assets in some asset types are not material to the overall management of risk. In these cases it may be inappropriate to calculate individual consequences of failure (as all assets may fall within a single banding for consequence of failure)

ARP

Criticality Index

Richard Wakelen

Criticality – Ofgem Definitions

Ofgem Definition: - RIIO-T1 Overview paper 17 December 2010

Criticality provides a measure of the **consequence** of failure of an asset. The criticality of an asset is based on system, safety and environmental considerations. These considerations are:

- **system** criticality is based on the impact of the transmission system not delivering services to customers and any impact on the smooth operation of the UK services and economy
- **safety** criticality is based upon the risk of direct harm to personnel or the public as a result of asset failure (for example conductor drop, asset fire or explosion)
- **environmental** criticality is based upon the environmental impact caused by asset unreliability or failure, taking into account the sensitivity of the geographical area local to the asset.

Criticality

UKPN Definition:

Building on Ofgem definition:

We are using four categories of criticality:

- **Network (or system) Criticality.**
- **Safety Criticality;**
- **Environmental Criticality**
- **Financial Criticality** (ability to quantify the financial implications).

Each category has specific consequences which are associated to a Monetary value with Severity of the CI being determine by contributing factors.

Criticality

Quantifying Criticality:

Absolute: Across all group assets

Pros
- Provides the bigger picture

Cons
- Future development
- (Transformer Example provided)

Relative: within a group asset

Pros
- Ability to compare across DNO's

Cons
- Data constrained

Criticality Factors

Network Performance

•Customer Numbers

Environmental

•Sensitive Location

Safety

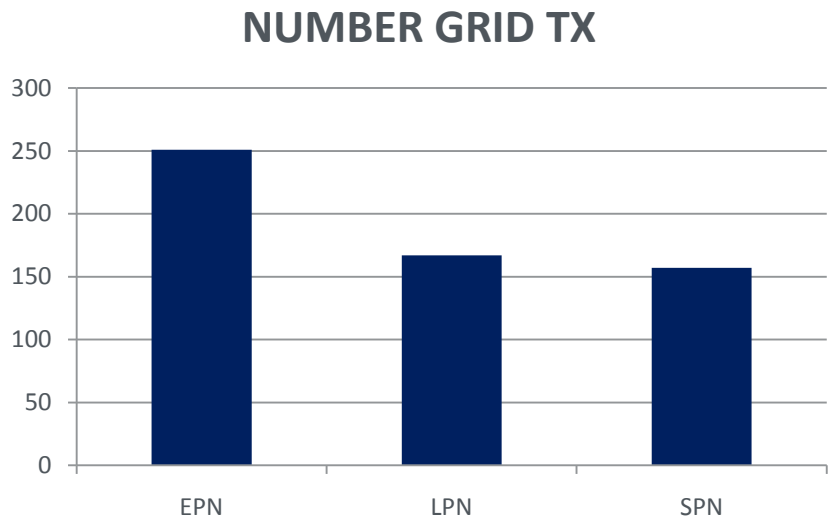
•ESQC

Opex / Capex

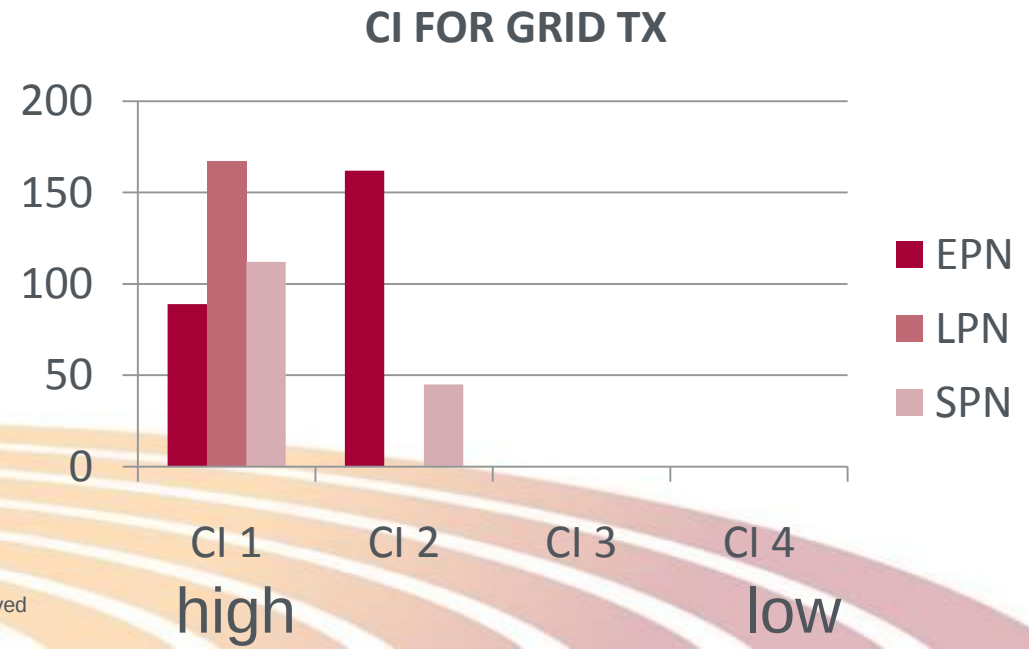
•Expenditure

Criticality

Representation of TX for Criticality

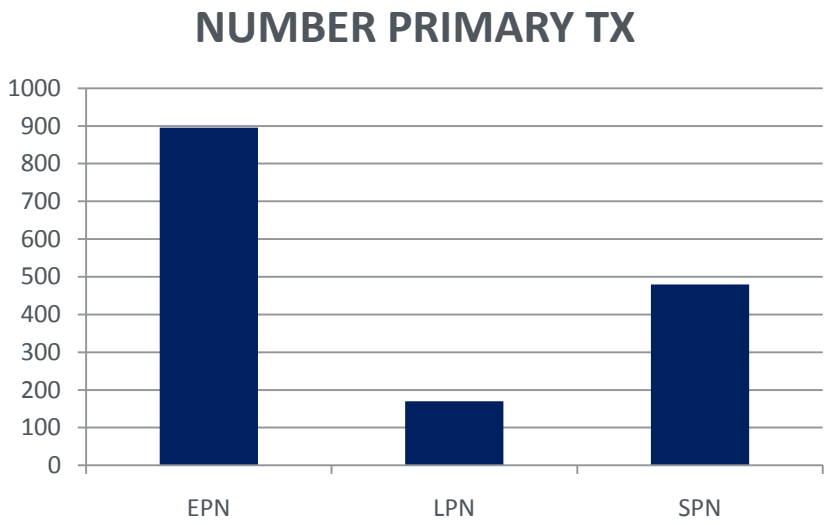


Grid TX generate high criticality factors



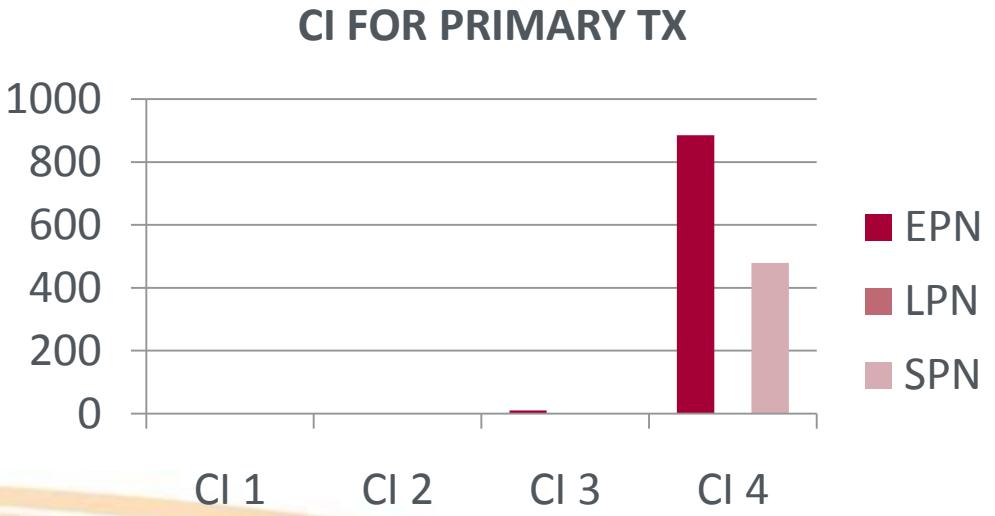
Criticality

Representation of TX for Criticality



Applying same approach to primary transformers gives them low criticality

This is not the profile that would be expected – different criticality approach needed?



Criticality

Example Replacement Priority (RP):

Index	HI 1	HI 2	HI 3	HI 4	HI 5
CI 1	90	188	62	17	11
CI 2	40	142	20	4	1
CI 3	20	232	37	12	3
CI 4	120	1008	163	57	16

RP1

RP2

RP4

RP3

Primary and Grid Transformers

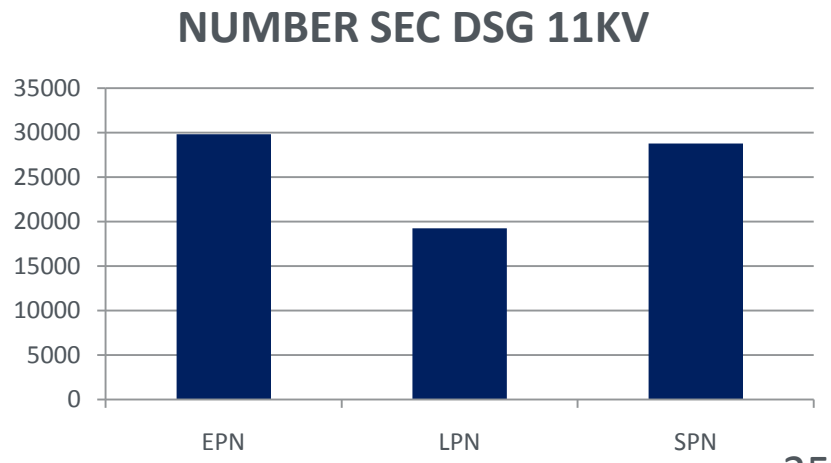
Over 8 year price period:

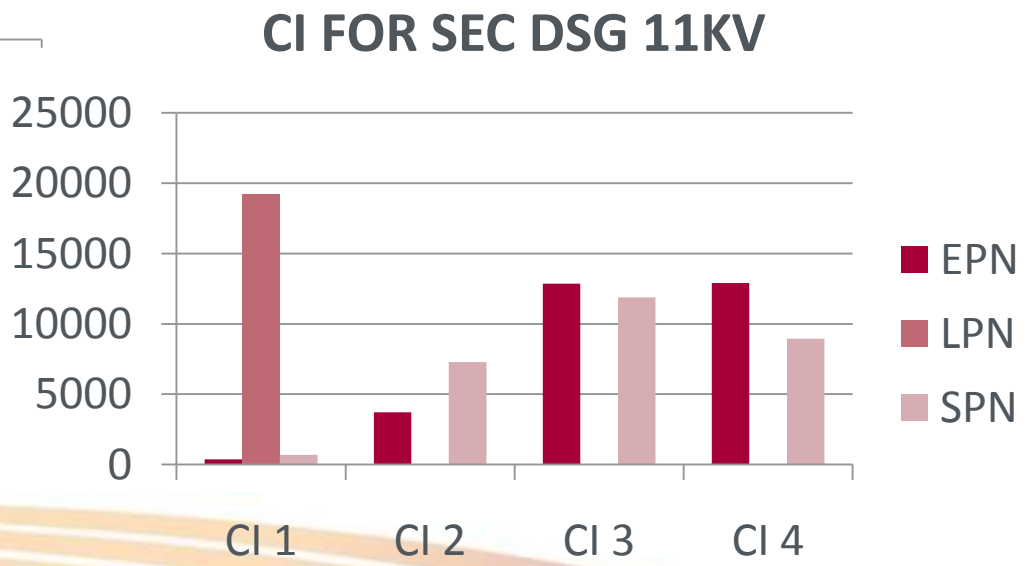
RP1 = Year 1-2
RP2 = Year 2-4
RP3 = Year 4-6
RP4 = Year 6-8

Some RP4 assets will move into HI4 and 5 later in the period

Criticality

Representation of Secondary Distribution Switchgear (DSG) 11KV for Criticality





Criticality

Example Replacement Priority (RP):

Index	HI 1	HI 2	HI 3	HI 4	HI 5
CI 1	9396	7760	2067	770	293
CI 2	464	3410	2262	2866	1980
CI 3	4619	10268	6602	3057	192
CI 4	14822	7015	1	5	0

RP1

RP2

RP4

RP3

11kv Secondary Distribution Switchgear

Over 8 year price period: RP1 = Year 1-2 RP3 = Year 4-6
RP2 = Year 2-4 RP4 = Year 6-8

On average RP1-3 will be prioritising on average 3000 assets per prioritisation year.

Conclusions

- We can apply the criticality methodology
- Consistent with our ARP approach
- Our APR is one of the most developed asset intervention models but two criticality challenges remain
  - Common standards for criticality in each asset class
  - Relative criticality between assets
    - Unit costs?
    - Relative MEAV?
    - Criticality or overall HCI score?
- Distribution assets more varied than transmission and therefore process more complex

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Proposed RIIO-T1 NOMs Assessment

24 July 2012

RIIO-T1 NOMs Assessment

- Introduction
  - Definitions of NOMs gap
  - Reconciliation of NOMs gap with NLR volumes
  - NOMs assessment
  - Revenue implications

NOMS (RP Definition)

	AH1 New or as new	**AH2** Good or serviceable condition	**AH3** Deterioration, requires assessment or monitoring	**AH4** Material deterioration, intervention requires consideration	**AH5** End of serviceable life, intervention required
C1 Very High	**RP4** 10 + Years	**RP3** 5 -10 Years	**RP2** 2- 5 Years	**RP1** 0-2 Years	**RP1** 0-2 Years
C2 High	**RP4** 10 + Years	**RP3** 5 -10 Years	**RP2** 2- 5 Years	**RP1** 0-2 Years	**RP1** 0-2 Years
C3 Medium	**RP4** 10 + Years	**RP3** 5 -10 Years	**RP2** 2- 5 Years	**RP2** 2- 5 Years	**RP1** 0-2 Years
C4 Low	**RP4** 10 + Years	**RP3** 5 -10 Years	RP2 2- 5 Years	RP2 2- 5 Years	**RP1** 0-2 Years

Information provided by the TOs

- A forecast of RP matrix was provided for all primary type assets (132kV, 275kV and 400kV).
  - Transformers
  - Switchgears
  - Overhead line conductors
  - Underground cables

- At
  - 2013 assuming business as usual
  - 2021 assuming no investment over the RIIO-T1 period
  - 2021 assuming LR only investments over the RIIO-T1 period
  - 2021 assuming LR & NLR investments

Reconciliation of NOMs with NLR investment volume

- Definition of the NOMs gap:
  - (RP with LR & NLR/2021) less (RP with LR Only/2021)
- NOMs gap compared with NLR volumes in BP.
- Results:
  - The Scottish TOs (use deterministic approach).
  - NGET (probabilistic model for forecasting their RP matrix)

Assessment of NOMs outturn

- RIIO-T1 NOMs opening position.
  - taken as forecasted
  - adjusted to reflect the 2013 outturn

- RIIO-T1 NOMs closing position (NOMs target)

- Using RIIO-T2 BPs or RRPs, access whether a TO's NOMs is
  - on target
  - above target or
  - below target

as a first tier assessment

Assessment of NOMs outturn continued

- RIIO-T2 funding decision will assume RIIO-T1 forecast NOMs/2021 as the RIIO-T2 NOMs opening position.
- If a TO's NOMs is assessed as on target, no financial adjustment will be made
- If a TO's NOMs is assessed as below/above target:
  - Identify the related asset vol. responsible for the variance
  - Determine the cost associated with the vol. variance using unit costs
  - Determine whether there justifiable reasons for this outcome
- Dead band and trade-off between assets categories & voltages.

Financial implications of RIIO-T1 assessment for RIIO-T2 funding

	Justified	Unjustified
Over delivery	The identified cost of the over delivery will be funded on a NPV neutral basis through the RIIO-T2 allowance. In addition, we will reward the company by adjusting its revenue upwards.	The identified cost of the over delivery will be funded on a NPV basis through the RIIO-T2 allowance. However, we will penalise the company by adjusting its revenue downwards.
Under delivery	The identified costs of under delivery will not be funded in the RIIO-T2 allowance and we will reward the company by adjusting its revenue upwards	The identified costs of under delivery will not be funded in the RIIO-T2 allowance and we will penalise the company by adjusting its revenue downwards

Update on Asset Criticality Measures for GD1

24 July 2012

Scottish and Southern Energy
Power Distribution

Overview

- General view is that Ofgem require better data for GDNs before setting asset criticality measures.
- GDN data is improving – but inconsistencies still remain between GDNs in terms of quality of data and consistency of reporting.
- Ofgem looking to publish GD1 IPs this Friday – clearer picture will emerge then regarding way forward.

Scottish and Southern Energy
Power Distribution

Next Steps

- **Ofgem likely to publish GDN data in IPs this Friday – but further work will be required to develop common output measure(s).**
- **Ofgem looking to develop criticality measures including:**
  - Environment
  - Security
  - Safety
- **Commonality of reporting is key issue and needs improvement.**
- **Significant further work is likely to be required between GDN's IP and FP.**

Scottish and Southern Energy
Power Distribution

SP ENERGY NETWORKS

Reliability and Safety Working Group

RIIO-T1 Health & Criticality

24th July 2012

RIIO-T1 current status

- December 2011 – Approach to RIIO-T1 Network Output measure assessment paper issued by Ofgem
- March 2012 – Update to NOMs assessment paper
- September 2012 – Workshop scheduled by Ofgem to discuss how NOMs will be assessed

As part of the annual RRP process the following is provided in order to assess NOMs performance:-

- Table 4.28.1 – Health & Criticality All investment – Health & Criticality Matrix table including the calculation for Replacement Priorities
- Table 4.28.2- Health & Criticality Load Investment Only
- Table 4.29 – Criticality table – list of criticality by substation & circuit

For SPT the outputs delta is primarily due to asset replacement activities however there is no reason that addressing criticality or refurbishment could be part of the delta for RIIO-ED1.

Key messages from NOMs assessment document

- Under/Over delivery will be carried forward into the next Price Control period. (Not funded)

  Different from D5

- Deviations from the agreed outputs during the RIIO-T1 period will have to be justified in terms efficient investment and that it is in the best interest of customers.

- Changing the mix of NOMs is acceptable if it can be demonstrated that it is at least equivalent to the agreed outputs

  As per D5

- 6 possible outcomes highlighted and the implications explained:-
  - exact delivery
  - equivalent delivery
  - unjustifiable under-delivery
  - justifiable under-delivery

  As per D5

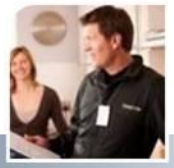
  - justifiable over-delivery
  - unjustifiable over-delivery

  Not explicit in D5

- Sample methodology included in March paper to evaluate the equivalence of outputs.

Commonality of HI assessments for RIIO-ED1

Reliability & Safety Working Group


Background

- DPCR5 assessment required companies to state impact of investment on Health Indices (HIs) of assets
- Only common elements to specification were asset type definitions (from RRP) and high-level HI classification;

	Specification
HI1	New or as New
HI2	Good or serviceable condition
HI3	Deterioration requires assessment and monitoring
HI4	Material deterioration, intervention requires consideration
HI5	End of serviceable life, intervention required

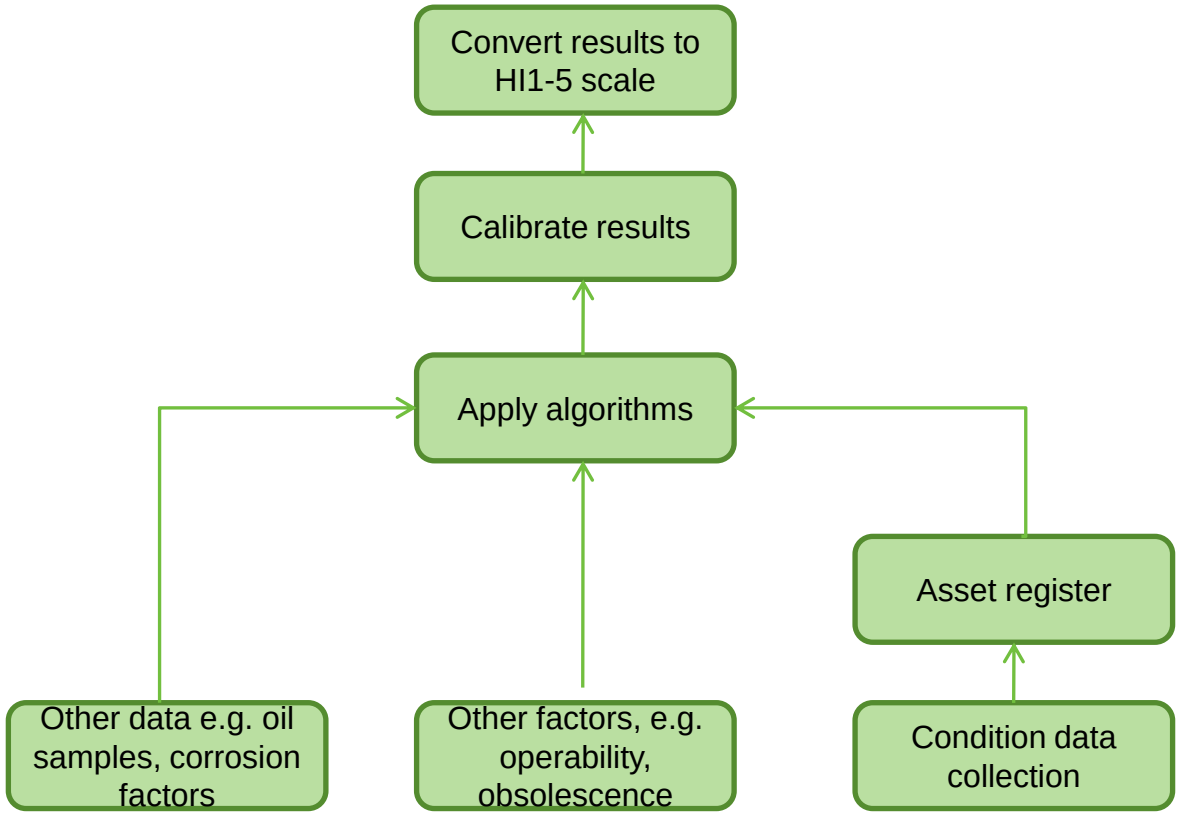
- Companies given complete discretion on population
- Consistency check between volume and output forecasts undertaken

Principles

- Company-specific methodologies allow company investment to be assessed against impact of that investment BUT do not allow inter-company comparisons
- Greater commonality;
  - PROS
    - Allows greater comparability across companies
    - Allows linking of output metrics to investment (e.g. unit cost of HI improvement)
  - CONS
    - Precludes best practice?
    - Does not allow companies to factor in bespoke considerations
    - Companies have to run dual approaches?
- Is it all-or-nothing (i.e. does a more but not totally comparable regime actually move us on?)?

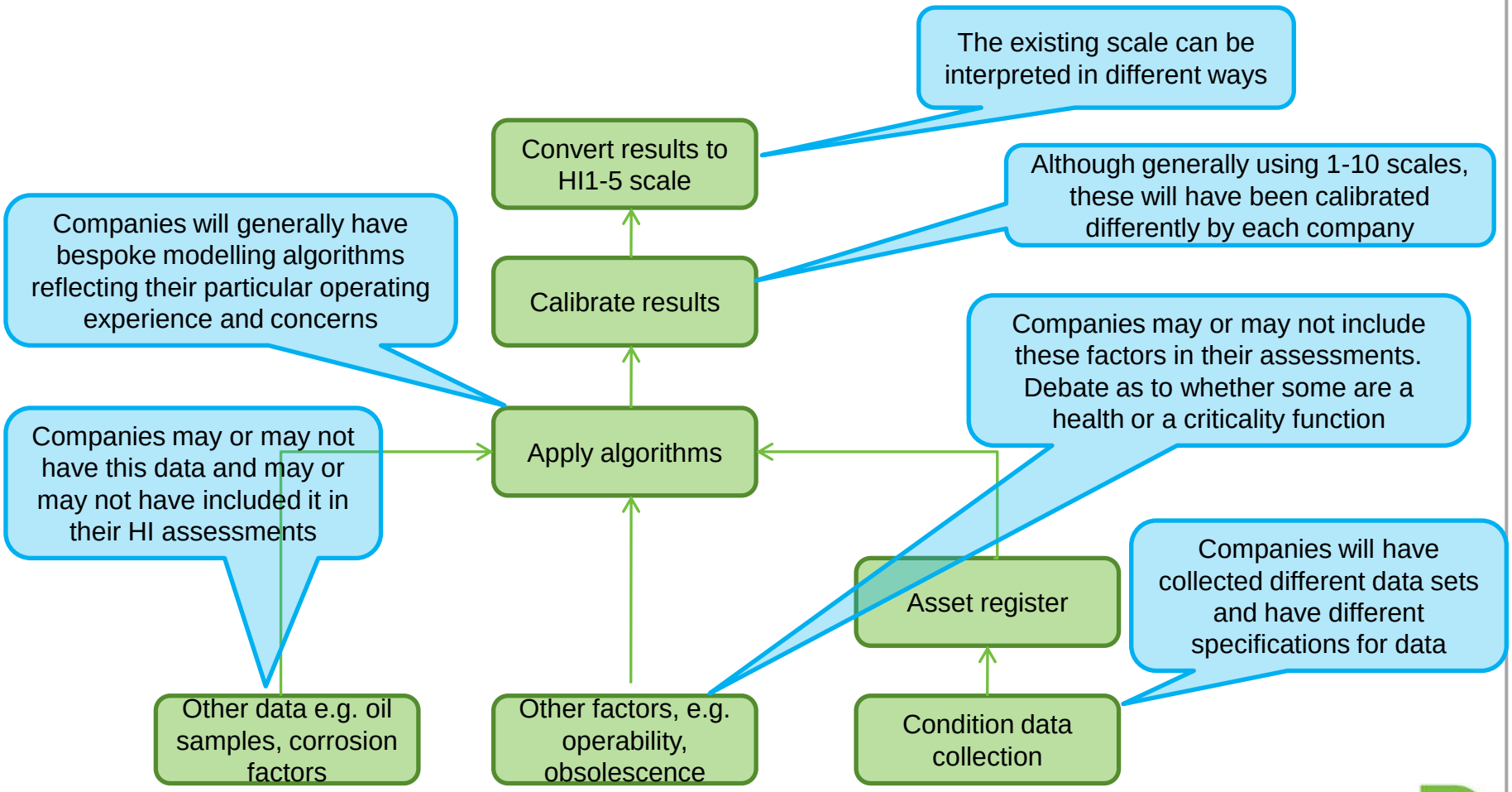
Simplified HI process

- Wide range of different practices in producing HIs
- Process shows typical logic



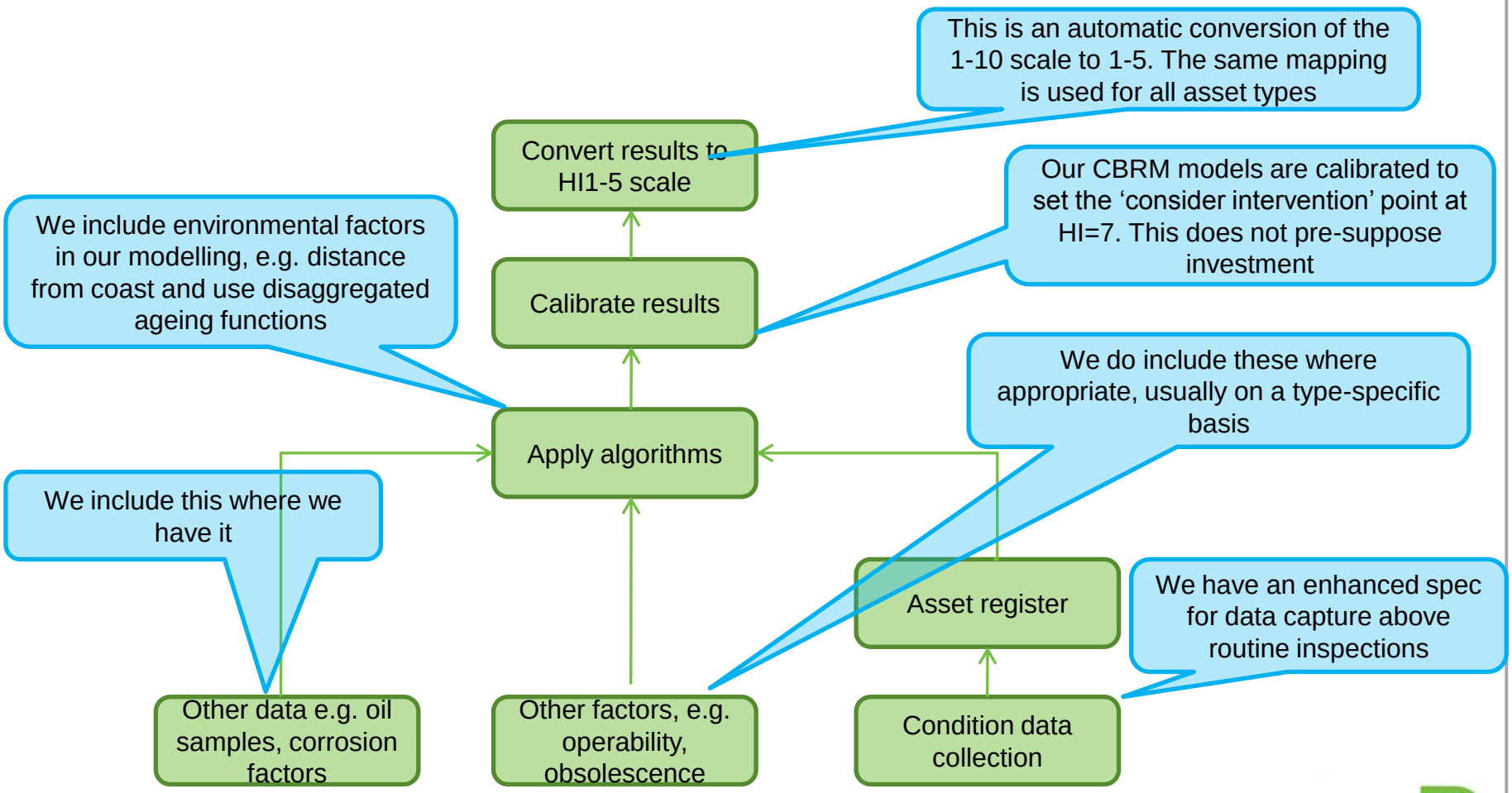
Simplified HI process

- Differences will appear at all parts in the process;



Simplified HI process

- For ENWL as an example;



Possible way forward?

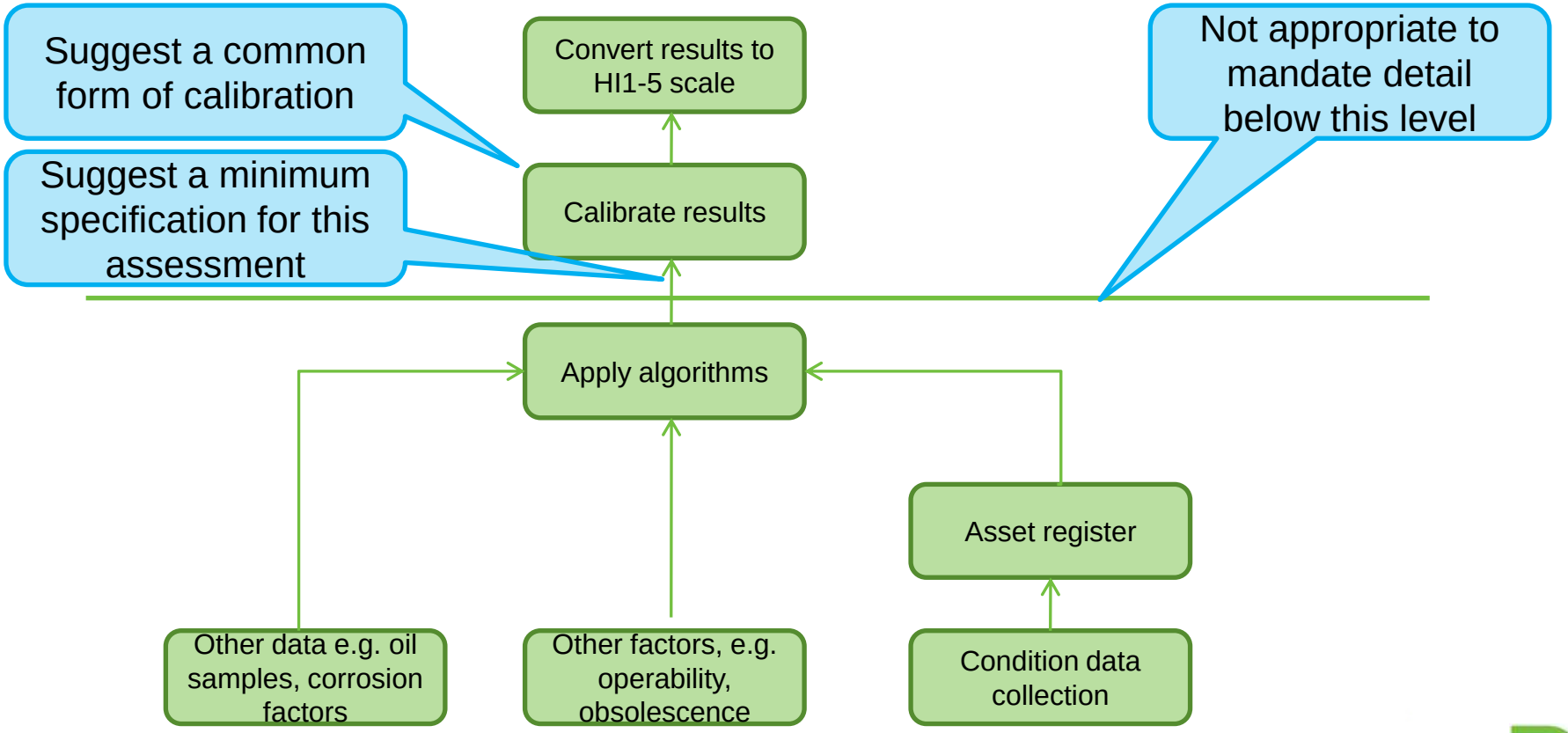
- Options;

	Option	Precedent
1	Completely common, industry-standard model including data sets, factors and algorithms	
2	Common framework with common definitions, e.g. mandating *how* an HI is produced by asset type	IIS?, ETR138 (Flooding)
3	Common overall principles, e.g. minimum level of assessment and greater specification of factors to be included/scoring	LIs?
4	Common high-level scale with significant scope for interpretation	DPCR5 HIs

- Realistically, it may be possible to move from level 4 to 3 for RIIO-ED1.

What does this mean

- What does this mean?



Further work

Minimum specification

- Current company assessments are based on very different bases;
  - Company A collects detailed condition data (at I&M expense), has extensive coverage of the asset base, integrates other factors and incorporates differentiated ageing factors. Different intervention options are assessed to judge best value
  - Company B ‘slices & dices’ an age profile and mechanistically links the results to an investment programme
- At the moment, both of these are given equal weighting and credibility
- Should a minimum specification for assessment be developed?
- Companies could go beyond this if they thought it worthwhile, but this would be discretionary

Further work

Common calibration

- At present, companies perform two assessments;
  - Calibration of raw models
  - Conversion to ‘Ofgem’ scales
- Both of these are subjective and bespoke
- Could these be collapsed into one (i.e. use company 1-10 scales)?
- In either case (collapse or not), apply a greater degree of specification to the HI assessment
- This means resolving the debate around the link to investment - currently not possible to reach common calibration when some companies base on asset condition and some on a prioritised investment plan

Commonality of assessment

Other responses:

- Common principles could be agreed by the DNOs, specifying the minimum standards that would have to be met, while allowing companies to develop own systems & capabilities further.
- Key point – no common methodology should limit further development by DNOs.
- Changing to a common methodology could be difficult where not consistent with current practice.
- Agreement on best practice could be difficult to achieve between licensees.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