Review of Distribution Network Design Performance Criteria

Project Summary Presentation

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14 September 2007

Contents

Aims and objectives

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Review the strengths & limitations of network planning, design and performance criteria

Key Task Areas
1. Summarise the methodology and assumptions underpinning ER P2/6 2. Provide a detailed commentary on the methodology and data focusing on: • their appropriateness to today's distribution systems • the quantitative impact of any weaknesses identified • issues that may become material over the next 10-20 years 3. Comment on the strength of the case for and scope of a review of ER P2/6. 4. Propose options for a new planning standard and development paths

Are the existing arrangements appropriate for the future?

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ER P2/6 Table 1 requirements

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Table 1 concisely captures the minimum planning requirement

		Minimum Demand to be met after	
Class of Supply	Range of Group Demand	First Circuit Outage	Second Circuit Outage
A	Up to 1 MW	In repair time (Group Demand)	NIL
B	Over 1 MW to 12 MW	(a) Within 3 hours (Group Demand minus 1 MW) (b) In repair time (Group Demand)	NIL
C	Over 12 MW to 60 MW	(a) Within 15 minutes (Smaller of Group Demand minus 12 MW and 2/3 Group Demand) (b) Within 3 hours (Group Demand)	NIL
D	Over 60 to 300 MW	(a) Immediately (Group Demand minus up to 20 MW (Automatically disconnected)) (b) Within 3 hours (Group Demand)	(c) Within 3 hours (For Group Demands greater than 100 MW, smaller of Group Demand minus 100 MW and 1/3 Group Demand) (d) Within time to restore arranged outage (Group Demand)
E	Over 300 to 1500 MW	(a) Immediately (Group Demand)	(b) Immediately (All customers at 2/3 Group Demand) (c) Within time to restore arranged outage (Group Demand)
F	Over 1500 MW	CEGB Planning Memorandum PLM-SP2 Scottish Board Security Standard NSP 366	

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Network design philosophy

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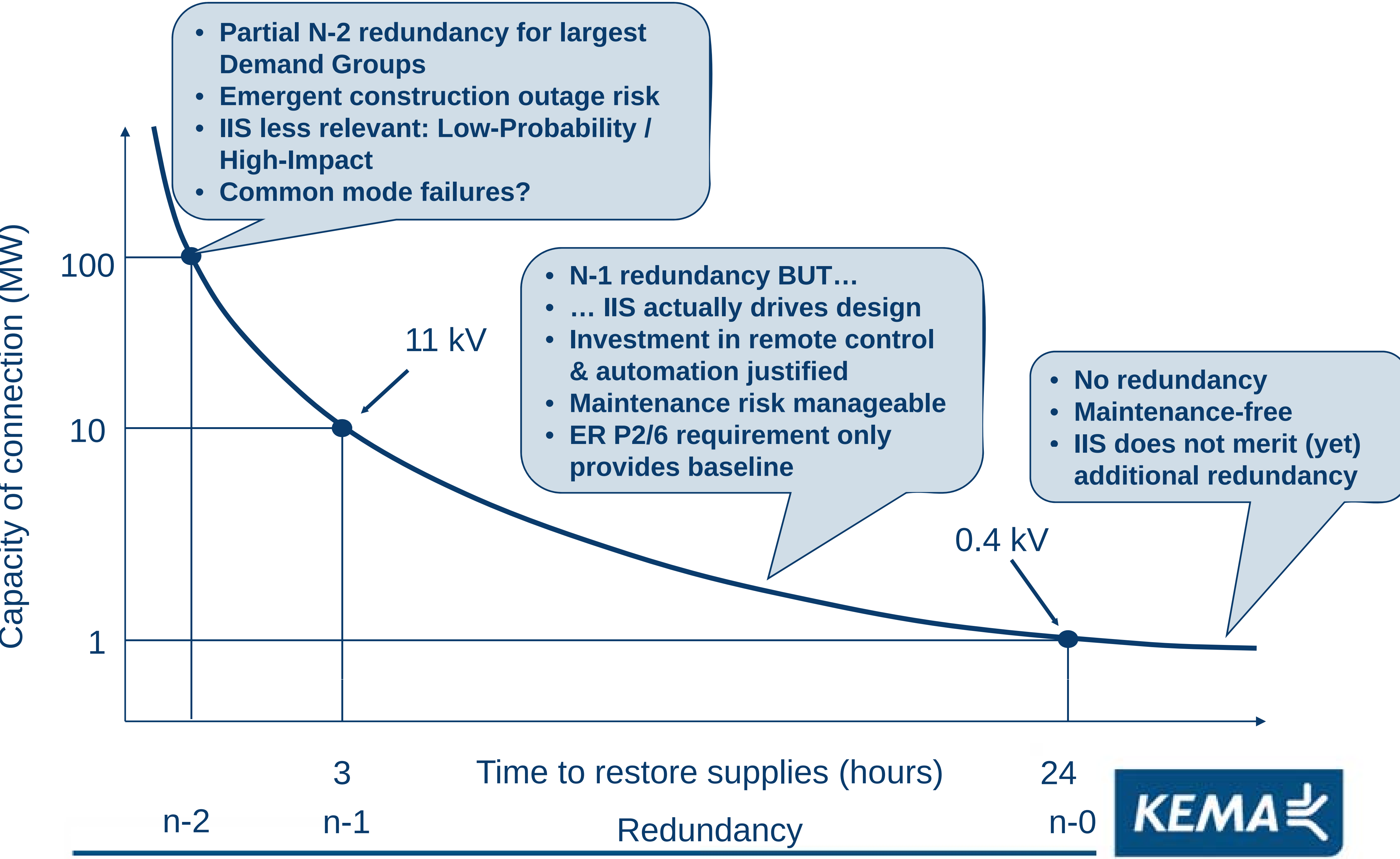

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Retaining a planning standard

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It is recommended that a planning standard be retained supplemented by incentives

Features of the planning standard	Incentive based approaches
• Provides a baseline planning reference for DNOs • Allows increased security provision where justifiable • Accommodates a variety of network designs. • Delivers adequate network security for the largest demand groups • Minimises the impact of low frequency/high impact events	• Useful for improving performance for the smaller demand groups • Well suited to high frequency/low impact network disturbances • Cost effective to date – implementation of quick wins but where next? • Driven investment in secondary infrastructure • Insufficient outage cost and failure distribution data to extend to EHV

Planning standard driving EHV design. IIS driving HV design

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Critical network loadings

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The timing of peak loadings is changing with convergence between seasonal demands

Peak loading considerations
• ER P2/5 originally based upon the notion of winter peaking • Summer load growth and peaking – air conditioning loads in urban environments • Reductions in network capacity with rising ambient temperature and loading • Outage scheduling assumptions rely on significant differences between seasonal demand • Summer/winter demand convergence can constrain circuit outage windows • The requirement to restore 2/3 demand following SCO perhaps less relevant now than in 1970s • Particularly true for extended (construction) circuit outages

Requirement for more sophistication during consideration of critical loading conditions

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Construction outage risks

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Extended EHV outages potentially increase network security risk for many customers

Risks associated with extended network outages
• ER P2/6 does not differentiate between maintenance and construction outages • Short 'maintenance' outages assumed with constant asset performance • Historically, reduced summer loading provided capacity headroom for outages • Outage scheduling becoming more challenging due to increased asset utilisation, convergence of seasonal load profile and reduced capacity headroom • Partial supply restoration criteria for Demand Groups >100 MW does not adequately protect customers – *"within time to restore planned outage"* • Mitigation at the discretion of the DNO and the risk awareness/attitude. Requirement to recognise the cost of mitigation • Dutch Grid Code specifies onerous mitigation criteria for EHV outages >6 hours

Recognise construction outages, amend SCO criteria re-partial restorations, include mitigation obligations and cost

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ER P2/6 restoration requirements

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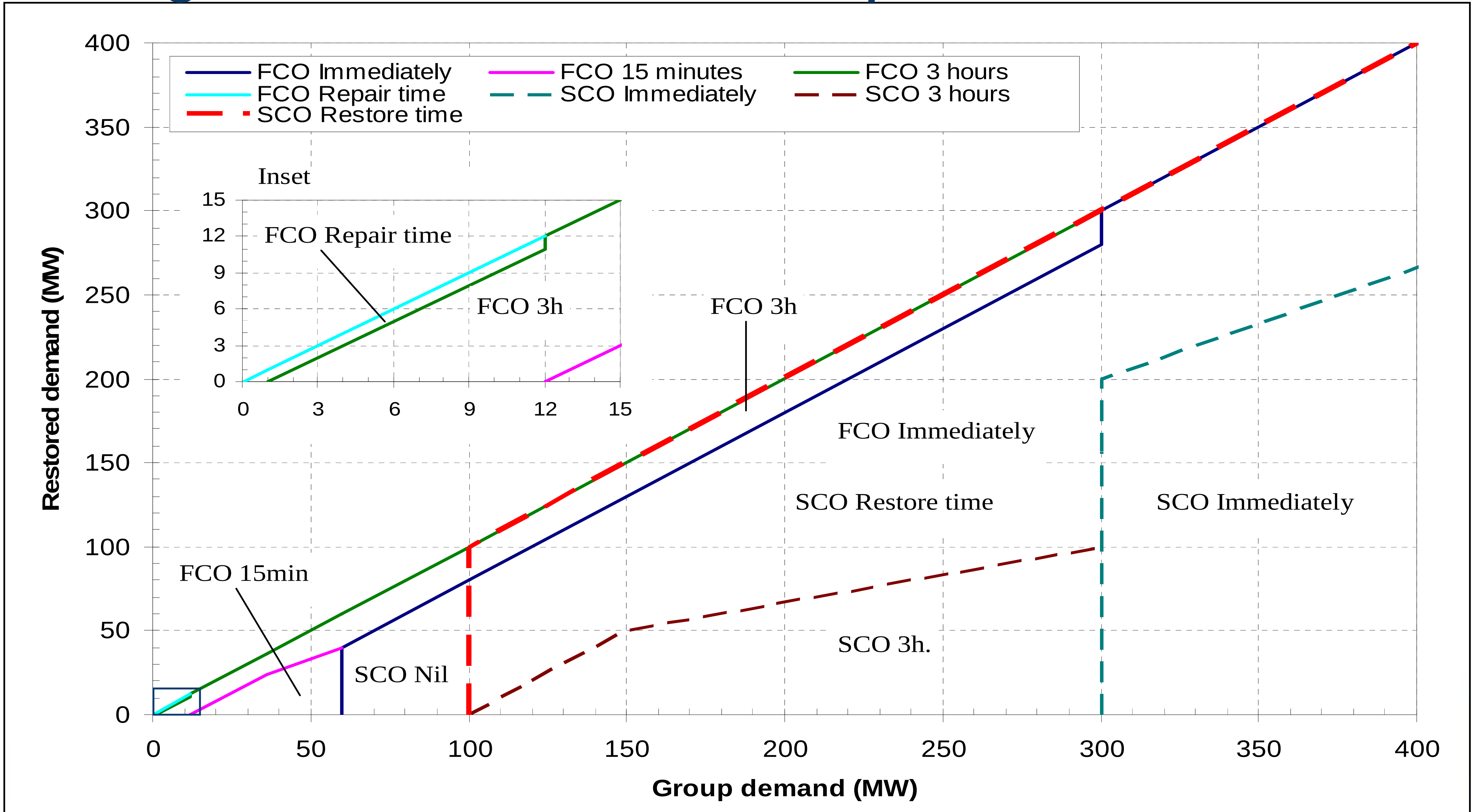
Significant customer risk associated with long outages for Demand Groups >100 MW



Distributed generation

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Security from DG limited. Connection criteria not essential. Bulk transfer capability missing!

Security contributions	Connection criteria	Bulk energy transfer
• GB experience limited • GB framework enables • DG deployment slow • DG not rewarded for security contributions • Regulatory & legislative barriers • Dutch pay generators for outage contribution (not wind)	• Stand alone DG unlikely to impact supply security • Risk diversified across large DG groups • Connection reliability less critical for security • Connection security a commercial issue for DG generators • Competition and DNO negotiations address	• Offshore wind transfer • DNO 'sandwich' • SQSS addresses on & offshore • ER P2/6 silent for DG • Not being developed in Offshore Codes • Significant omission from commercial framework

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Definitions and interfaces

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Requirement to clarify application to remove ambiguities and inconsistencies

Application clarifications	TSO interface
Group Demand & Transfer Capacity • ER P2/6 requirements dependent on different Group Demand levels • For radial networks, definitions are implicit • For meshed networks, Group Demands require local knowledge • Possibility that compliance assessments differ across DNOs	• TSO actions and requirements can impact network security for DNOs • Requirements to provide transfer capacity for TSO • GSP reconfiguration during asset replacement can impact CI/CML • Helpful to align transmission and distribution terminology • Benefits in agreeing interface procedures to mitigate risks to customers

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Supply interruption frequency

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Design and performance framework silent on interruption frequency to individual customers

Interruption frequency considerations
• ACE 51 contained guidance on interruption frequency – not transferred to ER P2/5 • CI/CMLs do not provide protection for individual customers as these are averaged system indices • Maximum individual customer interruption frequencies could be inserted in the network design and performance framework. • Does not necessarily need to be a feature in a future planning standard …. • …. could form part of an enhanced Guaranteed Standards framework or incentive arrangement • Further modelling required to determine appropriate values.

Inclusion of maximum interruption frequency guidance would enhance network planning and design for customers

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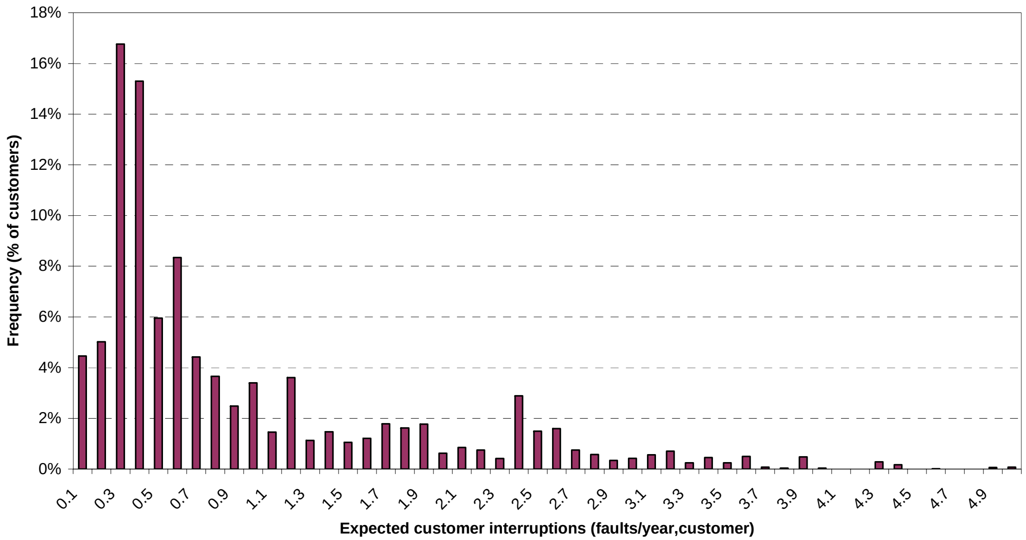
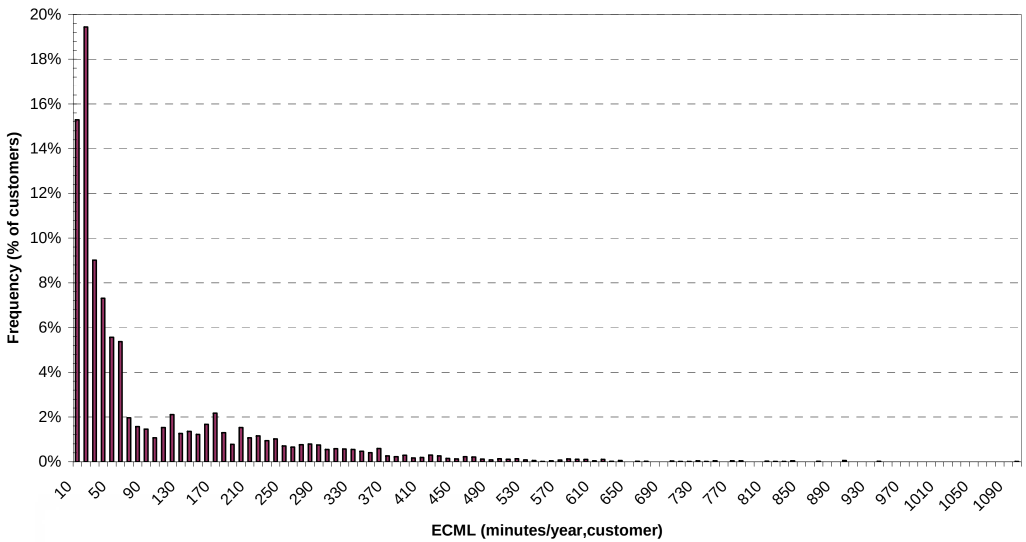
Variations in CI/CML performance

CI/CMLs provide System performance insights rather than customer Load Point views





CI/CML Analysis

- Sample size 100 feeder, expected average CI=95, CML=98. However…
- Large variations in individual customer interruptions 10<CI<500+
- Similarly, large variations in interruption duration, 10<CML<500+
- Average CI/CML statistics useful to drive average network performance
- CI/CML do not address maximum customer interruption frequency well

Lifecycle costing

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ER P2/6 provides no guidance regarding the costs of network design options

Linkages between network design, cost and performance

- Some DNOs have pursued low capital cost design solutions since privatisation
- Initial cost does not guarantee optimised lifecycle costing or operational flexibility
- Concern expressed regarding 3rd party operators installing assets to the minimum standard, exposing customers to reduced security and DNOs to IIS penalties
- GB distribution losses higher than Western European average
- Loss optimisation analysis reveals ‘over-sized’ assets can be advantageous to reduce lifecycle costs, particularly LV and HV cables
- Additional benefits for DG integration of ‘robust’ network specification and consistent with CO_2 reduction targets

Least cost designs seldom optimise security, losses and DG

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Recommendations

In absence of fundamental changes in system usage, an evolutionary approach is proposed

- Retain a planning framework with complementary incentive arrangements
- Evaluate further inclusion of interruption frequency guidance in planning standard
- Revise outage classification provisions: Differentiate construction outages
- Insert risk assessment and mitigation guidance regarding long-duration outages, consider Dutch approach, and amend Second Circuit Outage requirements
- Revise and update critical load provisions
- Clarify key definitions to assist compliance assessments
- Clarify transmission interface requirements to protect customer interests
- Encourage adoption of lifecycle costing techniques
- Insert guidance regarding common mode failure risk
- Insert provisions regarding requirements to transport energy from generation