System Reliability Regulation: A Jurisdictional Survey

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Introduction

System reliability for electricity distributors regulated relatively informally in Ontario

Since “First Generation” Incentive Regulation plan approved in 2000, distributors required to monitor and report certain reliability metrics to OEB

- System average interruption frequency index (SAIFI)
- System average interruption duration index (SAIDI)
- Customer average interruption duration index (CAIDI)

Introduction (Con't)

Each distributor with three years of reliability data required to keep reliability measures "within the range of its historical performance"

This "range" not precisely defined, nor were regulatory responses if reliability measures were outside historical norms

Board can also ask distributors to provide information on causes of interruptions

Introduction (Con't)

OEB Staff has prepared two discussion papers on service quality regulation in Ontario

- September 2003
- January 2008

Some changes to customer service regulation following 2008 Discussion Paper

However, no substantive changes to system reliability regulation from approach adopted in 2000

Introduction (Con't)

Current OEB initiative to develop a distribution system reliability standards regime

Pacific Economics Group Research (PEG) hired to advise OEB Staff during this consultation

One of PEG's main tasks was to prepare a jurisdictional survey on system reliability regulation

Our report *System Reliability Regulation: A Jurisdictional Survey* was released to the public on August 23, 2010

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Introduction (Con't)

Main purpose of report is to provide information on system reliability regimes used by regulators in:

- Canada
- The US
- Europe
- Australia and New Zealand

Also discusses framework of service reliability regulation

- Basics of service quality economics
- Approaches to service quality regulation
- Some principles for developing service reliability regulatory regimes
- "Case studies" of utility responses to reliability regulation (Rich Consulting)

>>> intended as a reference document

Introduction (Con't)

Today's presentation will review PEG's main findings

Basic questions:

- What approaches are generally used to regulate reliability?
- What reliability indicators are used?
- Are reliability measures "normalized" and, if so, how?
- How are reliability benchmarks established?
- What are the regulatory responses when reliability performance is substandard?

Introduction (Con't)

Broader questions:

- How does reliability regulation regime in Ontario compare with others in:
  - Canada
  - US
  - Elsewhere

- What regulatory approaches in other jurisdictions may be worth considering/adapting in Ontario?

General Regulatory Approaches

Three broad approaches can be taken towards service quality, and system reliability, regulation

1. Service quality monitoring
2. Service quality targets
3. Service quality penalty/reward mechanisms

A. Quality Monitoring

Company reports performance on selected service reliability metrics

If quality on reported metric deemed substandard, regulator can compel company to fix the problem

Quality/reliability monitoring may be appropriate when there is little history on a company's service quality performance

Main difficulty: What is acceptable quality?

May invite discretion and create uncertainty

B. Quality Targets

Utilities expected achieve

- Established, targeted performance levels on
- Identified service reliability indicators

Requires establishing targets or benchmarks for acceptable performance

If utilities fail to satisfy targets, they are often compelled to present action plans on how they plan to raise performance to the targeted or benchmark level

C. Penalty/Reward Mechanisms

Penalty/reward mechanisms make direct comparisons between

- Measured performance on selected reliability indicators; and
- Benchmark levels of performance on the same indicators

>>> benchmarks may also contain "deadbands"

If measured reliability falls below the benchmark (+/- deadband), there will be an automatic, rule-based penalty

Penalty/reward mechanisms can also allow for rewards if measured reliability exceeds the benchmark (+/- deadband)

Summary of Regulatory Approaches

	US	Canada	Europe	ANZ
Monitoring	17	3	12	3
Targets	9	2	0	2
Pen/Reward	12	2	9	4
Total	38	7	21	9

Reliability Indicators

In regulatory regimes, reliability can be measured at different levels of aggregation, and for different types of events

System reliability indicators measure reliability for the entire (distribution or transmission) system

Examples: SAIDI, SAIFI, CAIDI for *sustained* outages
MAIFI for *momentary* outages ("blinks")

Measured system reliability for sustained outages is often 'normalized' to exclude severe and unrepresentative events (primarily due to severe weather)

Reliability Indicators (Con't)

Severe storm/restoration indicators measure how quickly utilities restore power to customers during these severe (weather) events

Circuit indicators measure reliability performance for subsets of the overall distribution system (*e.g.* for individual network circuits)

Severe storm/restoration and circuit indicators are included in some regulatory plans to encourage appropriate reliability

- During events that are 'normalized' out of system reliability measures
- For "pockets" of the system, where ongoing reliability problems may be masked by system average measures

System Reliability Indicators

Most common system reliability indicators are SAIFI and SAIDI

Most jurisdictions measure both

A significant number of US plans measure SAIFI, SAIDI, and CAIDI, although this is redundant (since SAIDI = SAIFI * CAIDI)

Several European plans use Energy Not Supplied (ENS), which is a measure of the energy consumption that would have taken place during the interruption rather than the minutes of time that power was not available

System Reliability Indicators (Con't)

	US	Canada	Europe	ANZ
SAIDI only	0	0	1	0
SAIFI only	0	0	1	0
SAIDI & SAIFI	11	3	13	7
CAIDI & SAIFI	5	1	0	0
SAIFI, SAIDI &CAIDI	22	3	2	2
Total	38	7	17	9

System Reliability Indicators (Con't)

MAIFI regulated much less frequently than sustained interruptions

- Eight US jursidictions
- Five European countries
- Four Australian jurisdictions
- No examples in Canada

Normalizing System Reliability Indicators

Sustained outage measures often normalized to exclude severe events

IEEE developed the IEEE 1366 standard for excluding “major event days” from SAIDI and SAIFI

IEEE standard increasingly used as basis for normalizing, at least in English-speaking world, although there is still a fair degree of heterogeneity

Normalizing System Reliability Indicators (Con't)

US	12 jurisdictions use IEEE standard 1366 16 jurisdictions exclude events where at least 10% of customers are interrupted
Canada	Enmax, Fortis, Quebec use IEE standard 1366 Maritime Electric excludes events where at least 10% of customers are interrupted
ANZ	Four Australian jurisdictions and all of NZ use IEEE 1366
Europe	Typically, force majeure events determined on a case by case basis

Severe Storm/Restoration Indicators and Benchmarks

Jurisdictions	Company	Standard
Arkansas	Statewide	End repair on all circuits within 24 hours
California	Statewide	System-wide CAIDI
Colorado	Public Service of Colorado	End repair in 24 hours
Delaware	Statewide	Begin repair within 2 hours
Idaho	Pacificorp	End repair in 24 hours
		End repair on 80% of circuits within 3 hours, all within 24 hours
Michigan	Statewide	End repair on 90% of circuits in 8 hours (normal), 60 hours (emergency), 36 hours (total)
		End repair in 16 hours, or 120 in case of emergency

Severe Storm/Restoration Indicators and Benchmarks (Con't)

Jurisdictions	Company	Standard
New York	Con Edison	Penalites for any outage lasting more than 3 hours
New Jersey	Atlantic City Electric	End repair in 24 hours
	Statewide	Begin repair within 2 hours
Utah	Pacificorp	End repair in 24 hours
		End repair on 80% of circuits within 3 hours, all within 24 hours
Washington	Pacificorp	End repair in 24 hours
		End repair on 80% of circuits within 3 hours, all within 24 hours
Wyoming	Cheyenne L&P	End repair on all circuits within 24 hours

Severe Storm/Restoration Indicators and Benchmarks (Con't)

European Jurisdiction	Companies Involved	Standard
Austria	132 Distribution System Operators (DSOs)	NA
Belgium	27 Distribution System Operators (DSOs)	NA
Czech Republic	3 Distribution System Operators (DSOs)	NA
Denmark	89 Distribution Network Companies	NA
Estonia	40 Distribution Network Operators	power restored within 3 days
Finland	88 Distribution Network Operators	power restored within 12 hours
France	EDF and 170 other Distribution System Operators	80% of affected customers within 24 hours, and 95% in 120 hours
Germany	256 Distribution Network Operators	NA
Hungary	6 Distribution Companies	power restored within 18 hours
Ireland	1 Distribution System Operator (DSO)	NA

Severe Storm/Restoration Indicators and Benchmarks (Con't)

European Jurisdiction	Companies Involved	Standard
Italy	more than 300 territorial districts served by the 24 major distribution companies	LV customers: power restored within 8-16 hours MV customers: power restored within 4-8 hours
Lithuania	7 Distribution Network Operators (DNOs) - 2 regional and 5 local	NA
The Netherlands	9 Regional Network Operators	NA
Norway	7 main Distribution System Operators (DSO's)	NA
Poland	14 Distribution System Operators (DSOs)	NA
Portugal	The main Distribution Distribution Operator & 10 other small DSOs	NA
Romania	35 Distribution Operators (8 of which are major)	NA
Slovenia	5 Distribution Companies (run by 1 distribution system operator)	NA
Spain	5 Distribution System Operators	NA
Sweden	174 Electricity Network Companies	power restored within 12 hours
United Kingdom	14 Distribution Network Operators (DNOs)	power restored within 24 hours (intermediate events) and within 48 to 141 hours (large/more severe events)

Circuit Indicators

US Jurisdiction	Circuits Reported
Alabama	Worst 10
California	Any with SAIFI above 12
Colorado	Aquila reports 10 worst by SAIDI Reliability Warning Threshold (RWT) for SAIDI-ODI & 5 ODIs/year for each of PSCO's nine regions
Connecticut	Worst 100
Delaware	Worst 10
DC	Worst 3% by CAIDI
Florida	Worst 3% by SAIDI
Idaho	Pacificorp reports worst 5 by CPI (Circuit Perfomance Indicator): Weighted avg of SAIDI, SAIFI, MAIFI and cirucit breaker lockouts
Illinois	Worst by SAIDI, SAIFI, CAIDI. Targets for SAIFI of 6 and CAIDI of 18 set.
Kansas	Worst 10 by SAIDI, SAIFI
Louisiana	Worst 5% by SAIDI and SAIFI
Maryland	Worst 2%
Massachusetts	Worst 5% by SAIDI or SAIFI. Compare averages of worst circuits to rest.
Michigan	No more than 5% of circuits should have 5 outages/year. No circuits should have 8 or more outages/year.
Minnesota	Worst circuits
Nevada	Worst 25 by CAIDI, SAIDI, SAIFI

Circuit Indicators (Con't)

US Jurisdiction	Circuits Reported
New Jersey	Worst 5 by SAIFI or CAIDI
New York	Worst 5% by SAIFI or CAIDI
Ohio	Worst 8% for all utilities AEP reports SAIDI for all circuits.
Oklahoma	Worst by SAIDI, SAIFI
Oregon	Worst 5
Pennsylvania	Worst 5% by SAIFI, CAIDI
Rhode Island	Worst 5% by SAIFI
Texas	Worst 10% by SAIDI, SAIFI. Compare one year's "worst list" to next. Note if any are above 300% of sample average.
Utah	Pacificorp reports worst 5 by CPI: Weighted avg, SAIDI, SAIFI, MAIFI.
Vermont	Worst 10
Washington	Pacificorp reports worst 5 by CPI: Weighted avg, SAIDI, SAIFI, MAIFI.
Wisconsin	Worst by SAIDI, SAIFI, CAIDI

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Circuit Indicators (Con't)

All Other Jurisdictions	Circuit Reporting & Performance Standards
Alberta	3% worst performing circuits based on each distributor's formalized evaluation process
Ireland	worst 15 MV feeders
South Australia	Identify worst performing feeders in each region each year
Tasmania	No more than 5% of all feeders shall exceed total interruption time of 60 minutes in the Central Business District, 240 minutes for other urban feeders, and 720 minutes for rural feeders
	No more than 5% of all feeders shall experience more than 2 interruptions in the Central Business District, 4 interruptions for other urban feeders, and 9 interruptions for rural feeders
Victoria[1]	Worst 5% of feeders are reported, Targeted levels of SAIDI for worst served 15% of customers no more than 267 minutes.
	Worst 5% of feeders are reported, SAIDI of CBD feeders over 70 minutes (>1 interruption) SAIDI of Urban feeders over 270 minutes or a MAIFI over 5 SAIDI of short rural feeders over 600 minutes or MAIFI over 12 SAIDI of Long rural feeders over 850 muinutes or MAIFI over 25

[1] This number varies by company. We report here the values for Australia Gas Light.

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Reliability Benchmarks

In the US, Canada and ANZ, reliability benchmarks are based on the Company's own historical performance, or judgement

Examples:

Ontario	Three-year average
Enmax (AB)	Three-year average SAIDI
	Five-year average SAIFI
Fortis (BC)	Three-year average
Massachusetts	Ten-year average
New Zealand	Five-year average

Reliability Benchmarks (Con't)

In Europe, however, there are several examples of more purely "external" benchmarks that are not linked to the Company's own historical performance

- Netherlands: industry average SAIDI for all utilities
- Norway: benchmark level of ENS determined for each distributor using econometric methods
- Sweden: benchmarks determined using engineering, rather than econometric methods

Regulatory Responses

Basic approaches for regulatory responses previously summarized on “Summary of Regulatory Approaches” slide

Somewhat more complex in practice

- Can have different regulatory responses for system vs. restoration indicators
- Can also have different penalty levels for different types of indicators

Overall regulatory responses summarized in Table 4 in Report

Regulatory Responses (Con't)

Also important to note that estimates of customer valuations of reliability can be used to set penalty (or reward) rates in penalty/reward plans

Customer valuations of reliability rarely used in North American regulatory regimes

Somewhat more common overseas

- Victoria Australia
- South Australia
- Norway

Other Issues

Ontario currently monitors/targets CAIDI – retain or eliminate?

Previous Staff discussion papers have raised the possibility of adding MAIFI as an indicator

- Appropriate?
- Value to customers?
- Increasingly important, but would be first Canadian instance

Other Issues (Con't)

Some jurisdictions that could merit further attention

1. Massachusetts "Rule-based" but relatively simple reward/penalty regime

2. Victoria Similarly rule-based, but includes value-of service based penalties and rewards

3. Norway Complex, but has already been discussed as potential model for service reliability regulation in the Province

Conclusion

Some important issues in Consultation

1. Choice of indicators
   a. System reliability only
   b. Circuits? Restoration?

2. Normalization

3. How to determine benchmarks (and deadbands?)

4. Basic Regulatory Approach

5. If penalty/reward, how to set penalty (and reward?) rates