

RoCoF – GCRP Update

16th January 2013

Introduction

- Rate of Change of Frequency (RoCoF) risks have been managed actively by the industry for over a decade
 - Potential RoCoF events are reported in an annual update to the Panel
 - Issues are under active Working Group consideration

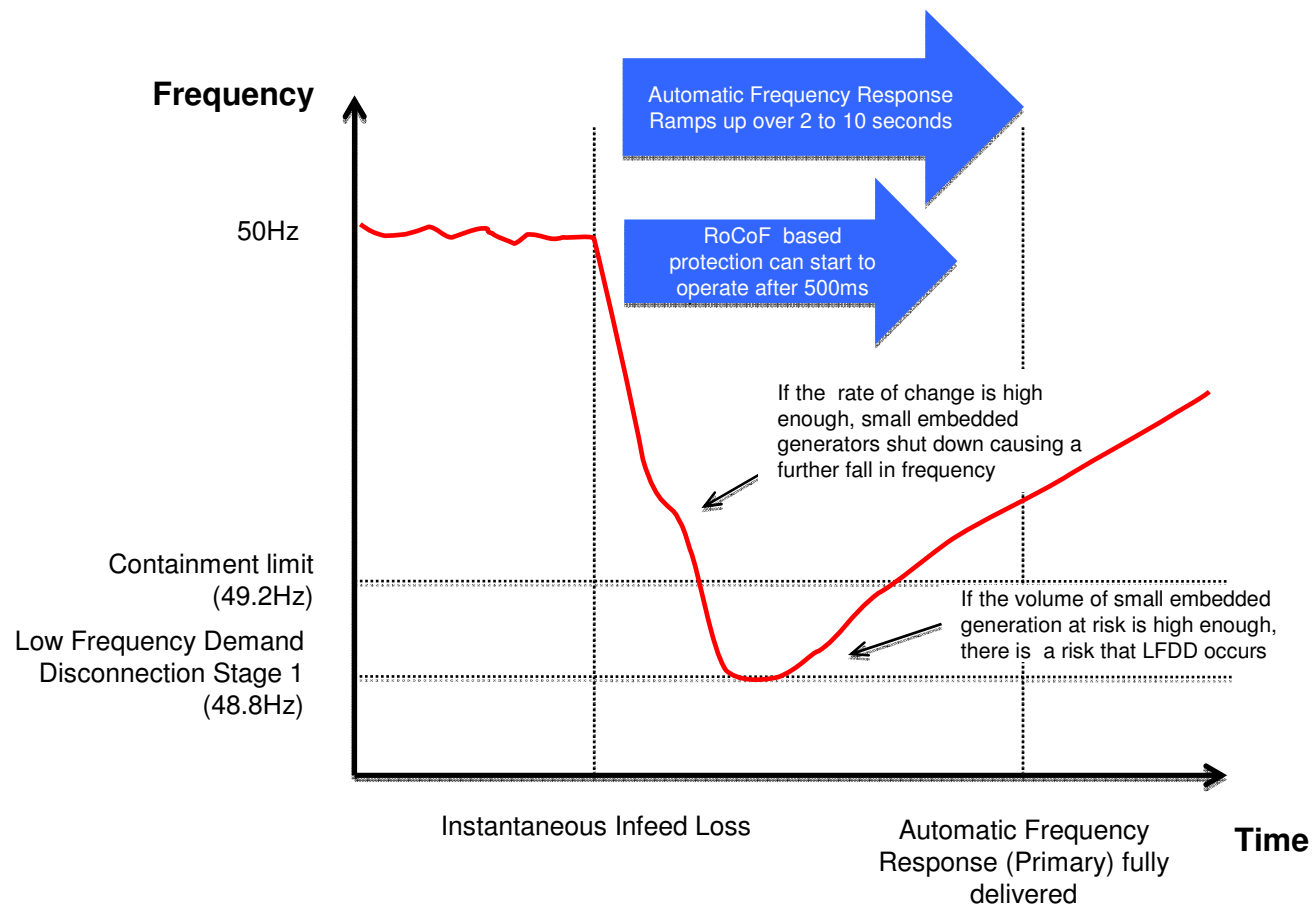
Working Group: Frequency Changes during Large System Disturbances

- National Grid has recently reviewed its methodology for assessing RoCoF related risks
- Panel Members have asked for additional information to be presented as part of the annual report
- These slides provide an update to the Panel and highlight the actions currently underway

Background to RoCoF

- The rate at which system frequency changes depends on
 - Size of the change in balance between supply and demand
 - Energy stored (predominantly in the form of rotating machines)
 - Natural response to frequency and control action taken in response to frequency
- In the event of a large instantaneous loss of generation or demand
 - If the rate of change of frequency is high enough, protection which is designed to prevent embedded generation operating in an island mode may operate
 - If the volume of embedded generation affected is high enough, there is a risk of involuntary demand control under Low Frequency Demand Disconnection (LFDD) as a result of cascading loss of generation
 - There have been no examples of this occurring on the GB networks to date
- 'Loss of Mains' protection is required to ensure safe operation of the distribution networks, as set out in Engineering Recommendations
 - A range of settings are prescribed, starting at 0.125Hz/s
 - Up to 8GW of generation capacity is estimated to be protected this way

Background to RoCoF



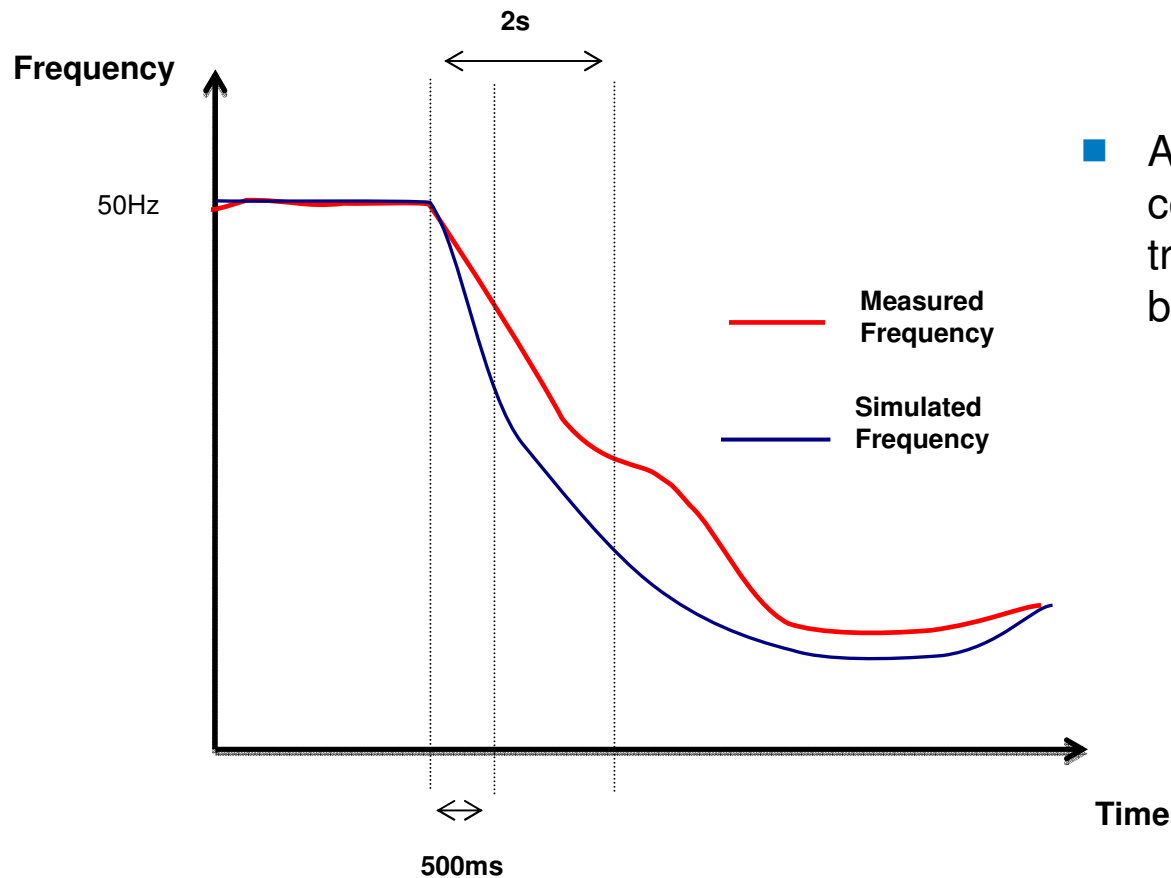
Background to RoCoF

- The maximum rate of change risk occurs when demand is low and there is a large instantaneous infeed or offtake risk to manage
- The maximum rate of change is rising because
 - Synchronous generation is being displaced by interconnectors and wind
 - Larger infeed losses in the future
 - There are trends within consumer demand which may exacerbate the problem (eg deployment of power electronics and decoupling motor loads directly connected to the system)
- The RoCoF risk has been re-evaluated as a consequence of work examining larger losses
 - Improved system monitoring and new analysis techniques have been used

Options for Managing the Risk

1. Limiting the largest loss limits the rate of change
2. Increasing inertia by synchronising additional plant reduces the rate of change
3. Limiting the rate of change by control action is not currently feasible
 - Generator governor action is not fast enough to limit the rate of change of frequency within the RoCoF protection operation time
 - Can help to contain the subsequent fall in frequency in some circumstances
 - An absolute frequency trigger (eg 49.7Hz), would also not be effective
 - frequency would have been falling for long enough for RoCoF protection to operate before it could trigger: at 0.125Hz/s, it would take 2.4s to reach 49.7Hz from 50Hz)
 - A rate of change trigger, operating sufficiently rapidly (less than half a second) could limit the frequency rate of change if applied to a large enough demand block
 - no providers of such a service at this time
4. Changing or removing RoCoF based protection
 - Requirement under joint GCRP/GCRP Working Group consideration
 - Subject to an ongoing requirement for reliable Loss of Mains protection to ensure networks are safe in an islanding situation

Proposed Reporting and Assessment Enhancements



- RoCoF Reports reference the change over 2 seconds
 - a 500ms period is closer to relay characteristic
- Actual frequency can be compared to a simulated trace to evaluate the background or residual inertia
 - simulation makes use of generator data submitted under the Grid Code
 - residual represents the contribution of demand and smaller generators

Challenges for Historic Analysis

- Relatively few large disturbances occur which provide good information
 - Losses need to be instantaneous eg by circuit breaker operation
 - Period of concern are light system loads
 - Combination of low demand, high winds and/or high interconnector imports
 - Data available from 2010 onwards
- High resolution frequency measurements vary with location and measurement technique
- Changes in consumer demand are happening on a continuous basis
 - Trends may not be visible due to the limited number of relevant incidents

Actions In Progress

- RoCoF Risks are now considered as part of National Grid's routine frequency control requirement assessment
 - Impacts will be reported through normal industry processes (eg Operational Forums)
- The Joint DCRP/GCRP Working Group is
 - Exploring the scope for changes to relay settings
 - Taking tactical actions to improve the current risk assessment
- The information presented in recent RoCoF reports is under review
 - An update will be provided to the Panel prior to the March meeting