Normal frequency asset owner performance obligations

Consultation Paper

Submissions close: 5pm 22 July 2014

June 2014

Executive summary

The Electricity Authority (Authority) is proposing an amendment to the Electricity Industry Participation Code 2010 (Code) to clarify the obligations on generators relating to their contributions to maintain frequency in the normal band (49.8 Hertz [Hz] – 50.2 Hz)[1] (proposed Code amendment). The purpose of this paper is to consult with affected parties.

Why clarify the Code requirements – what is the current 'problem'?

Improving the efficiency of frequency keeping services, and frequency management more generally, promotes the efficiency limb of the Authority's statutory objective. [2]. Frequency keeping is an ancillary service procured and co-ordinated by the system operator to help maintain system frequency quality under normal circumstances. Total frequency keeping costs for 2013 were approximately $41m.

The Authority has an on-going programme of work intended to make the frequency keeping service more efficient and subject to greater competition, which in turn is expected to lower costs. Key initiatives include:

- enabling multiple frequency keepers (current)
- removing in-band constrained off payments to frequency keepers (current)
- establishing a national market for frequency keeping (current)
- reviewing the normal frequency asset owner performance obligations (current - the subject of this paper)
- reviewing frequency keeping cost allocation (future)
- reviewing the system operator's normal frequency objectives (future).

As part of developing this work programme, the Authority and the system operator have identified that aspects of the normal frequency management arrangements are ambiguous. They are open to interpretation. These aspects relate to generator asset owner performance obligations (AOPOs) in Part 8 of the Code to contribute to maintenance of frequency in the normal band.

The Authority considers that the current lack of clarity adversely affects generator compliance outcomes and creates unnecessary costs due to regulatory uncertainty for generators, the system operator and the Authority for the reasons set out below.

- Participants are making generator investment and operational decisions regarding normal frequency obligations using inconsistent assumptions regarding their obligations. The requirements are not specified clearly enough to result in efficient outcomes. There is no incentive for investors to make a trade-off between the cost of compliance or paying the cost of non-compliance.

[1] Referred to as normal frequency in this paper.

[2] The objective of the Authority is to promote competition in, reliable supply by, and the efficient operation of, the electricity industry for the long-term benefit of consumers(s 15 Electricity Industry Act 2010)

- The system operator does not have the information it requires to develop a complete and accurate assessment of overall generator contribution to normal frequency management. With a complete assessment of contribution, the system operator could:
  - more accurately calculate system reserve requirements
  - better assess the extent of generator non-compliances and any identifiable costs associated with those non-compliances
  - better assess system performance and security risks.

Fundamentally, the lack of information on overall contribution to maintaining frequency in the normal band has the potential to hinder the Authority's progress towards achieving enhanced efficiency and competition in the frequency keeping market for the long-term benefit of consumers.

What amendments does the Authority propose making to the Code?

The Authority has drawn on several key reports and earlier consultations in identifying proposed Code amendments to address the ambiguous requirements of the generator AOPOs described in the section above. The main reports and consultations are:

- the Electricity Commission's (Commission) consultation papers published in June 2010 on normal frequency AOPOs[3] (Commission's AOPOs consultation paper) and frequency keeping cost allocation[4] (Commission's cost allocation consultation paper), and submissions on those consultations
- the system operator's report entitled TASC-011: Normal Frequency Review, published in August 2011 following the system operator's major review of normal frequency arrangements (TASC-011 report).[5]

A summary of the key elements of the proposed Code amendment is as follows:

Part 8 clause 8.17	• amendments to clarify that generators must actively contribute to maintaining frequency when the frequency is within the normal band, and not just respond to frequency movements outside the normal band
Schedule 8.3 Technical Code A clause 5	• inclusion of a dead band of +/- 25 mHz around 50 Hz • amending the droop requirement to be set as low as is

[3] http://www.ea.govt.nz/development/work-programme/wholesale/normal-frequency-generator-asset-owner-performance-obligations/consultatins/#c7606

[4] http://www.ea.govt.nz/about-us/what-we-do/our-history/archive/dev-archive/consultations/power-systems-and-common-quality-consultations/2010/frequency-keeping-cost-allocation/

[5] The Commission initiated this review following its consideration of submissions on its earlier consultation. The Authority inherited responsibility for the review following the move to the new regulatory regime under the Electricity Industry Act 2010. The TASC-011 report can be found here: http://www.ea.govt.nz/development/work-programme/wholesale/normal-frequency-generator-asset-owner-performance-obligations/

	practical and no more than 7% • including a requirement that proportional gain and integral gain be set as high as practical • amendments to oblige generators to agree settings that can affect the performance of the governor (e.g. droop, gain) with the system operator
Part 1 Definitions	• including a definition of droop

The Authority proposes a transition period of eight months to allow generators a reasonable time to assess their compliance with amended Code obligations, and, to take actions as appropriate in light of their assessment (e.g. agree a new setting with the system operator or apply for a dispensation).

The system operator is responsible for considering dispensation applications. Following the proposed Code amendment, certain aspects of the dispensation regime could give rise to some adverse outcomes when applied to a mass (re-)application for dispensations from generators' normal frequency AOPOs. The Authority therefore intends to maintain a watching brief on dispensation applications, and only take further action (e.g. developing cost allocation guidelines for dispensations) if the nature and extent of the dispensations require intervention.

What costs and benefits does the Authority consider would result from the proposed Code amendment?

The key benefits of clarifying generators' normal frequency AOPOs through making the proposed Code amendment are as follows:

- provides the system operator with the information it requires to form a complete and accurate assessment of overall generator contribution to normal frequency management
- reduces generator compliance costs and improves compliance outcomes through reducing regulatory uncertainty for generators, the system operator and the Authority
- may bring some initial reductions in frequency keeping requirements and costs, as well as further reductions in the future once the Authority has progressed the remainder of its frequency keeping market development initiatives
- enhances competition amongst generators by preventing certain generators from avoiding costs under one interpretation of the Code while other generators bear increased costs under another interpretation (e.g. asset wear and tear if no dead band is applied)
- removes uncertainty, and possible distortions, for new generation investment decision-making.

The proposed Code amendments involve no significant trade-off between promoting efficiency, competition and reliable supply.

The Authority considers that these benefits enhance the efficiency and competitiveness of the electricity industry both now, and even more so over time, for the long-term benefit of consumers.

Clarifying the AOPOs may impose costs on some parties, including generators and the system operator. These may include assessing compliance with the amended Code requirements, agreeing governor settings with the system operator and applying for dispensations. There may also be increased on-going costs that some affected parties face. There is some uncertainty about the nature and extent of these costs, as they depend in part on:

- the interpretation each generator has made in relation to the existing Code; and
- the actions each generator would therefore need to take if the proposed Code amendment came into force.

The Authority's preliminary view is that the benefits identified are likely to significantly exceed the costs. However, it invites affected stakeholders to make submissions on the costs, including providing quantitative estimates, of the proposed Code amendment as part of this consultation process. It may be appropriate to revisit the assessment of the costs and benefits of the proposed Code amendment following consideration of submissions.

Contents

1. What you need to know to make a submission

1.1 What this consultation paper is about

1.1.1 The Authority proposes a Code amendment to clarify the obligations on generators relating to their contributions to the maintenance of normal frequency. The proposed Code amendment is attached as Appendix A.

1.1.2 The purpose of this paper is to consult with participants and persons that the Authority thinks are representative of the interests of those likely to be affected by the proposed Code amendment.

1.1.3 Section 39(1)(c) of the Electricity Industry Act 2010 (Act) requires the Authority to consult on any proposed amendment to the Code and corresponding regulatory statement. Section 39(2) of the Act provides that the regulatory statement must include a statement of the objectives of the proposed amendment, an evaluation of the costs and benefits of the proposed amendment, and an evaluation of alternative means of achieving the objectives of the proposed amendment. The regulatory statement for the proposed Code amendment is set out in part 3 of this paper.

1.1.4 The Authority invites you to make a submission on the regulatory statement and the proposed amendment.

1.2 How to make a submission

1.2.1 Your submission is likely to be made available to the general public on the Authority's website. If necessary, please indicate any documents attached in support of your submission and any information that is provided to the Authority on a confidential basis. However, you should be aware that all information provided to the Authority is subject to the Official Information Act 1982.

1.2.2 The Authority's preference is to receive submissions in electronic format (Microsoft Word) in the format shown in Appendix A. Submissions in electronic form should be emailed to submissions@ea.govt.nz with "Consultation Paper— Normal frequency asset owner performance obligations" in the subject line.

1.2.3 Do not send hard copies of submissions to the Authority unless it is not possible to do so electronically. If you cannot or do not wish to send your submission electronically, you should post one hard copy of the submission to either of the addresses provided below or you can fax it to 04 460 8879. You can call 04 460 8860 if you have any questions.

Postal address

Submissions
Electricity Authority
PO Box 10041
Wellington 6143

Physical address

Submissions
Electricity Authority
Level 7, ASB Bank Tower
2 Hunter Street
Wellington

1.3 Deadline for receiving a submission

1.3.1 Submissions should be received by **5pm** on **22 July 2014**. Please note that late submissions are unlikely to be considered.

1.3.2 The Authority will acknowledge receipt of all submissions electronically. Please contact the Submissions Administrator if you do not receive electronic acknowledgement of your submission within two business days.

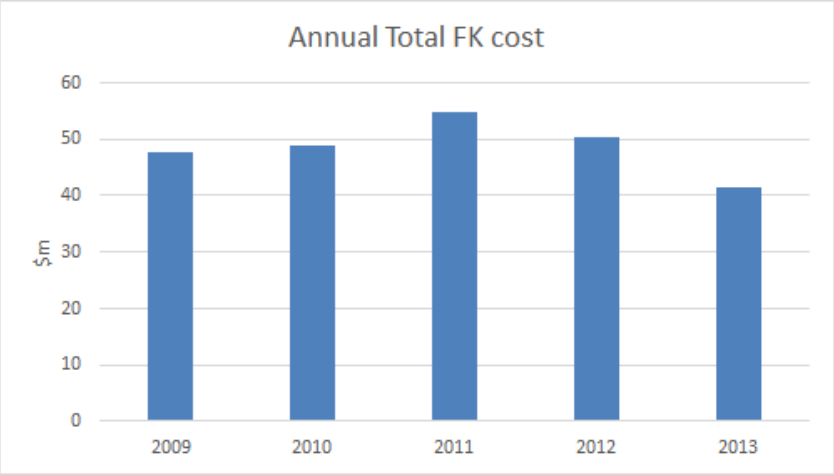
2. Improving the efficiency of frequency keeping services is a key initiative for the Authority

2.1 Frequency keeping costs are significant

2.1.1 Frequency keeping is an ancillary service procured and co-ordinated by the system operator to help maintain system frequency quality under normal circumstances. As the system frequency varies from 50 Hz, frequency keeping stations increase or decrease generation within a set band to help maintain real-time supply and demand balance between dispatch instructions.

2.1.2 Frequency keeping costs, which were approximately $41m in 2013, are recovered monthly from retailers and direct purchasers, according to their share of national energy purchases. Even a small percentage reduction in annual frequency keeping costs can have a material impact on the costs each of these parties face. In effect then, ongoing improvements to frequency keeping represent productive efficiency gains because electricity can be produced with less input costs.

Figure 1: Total annual frequency keeping costs



2.2 Improving the efficiency of normal frequency management

2.2.1 The Authority has been working with the system operator over recent years to enhance competition in the frequency keeping market and, more generally, to improve the efficiency of normal frequency management.

2.2.2 Figure 1 illustrates the decrease in costs since 2011, although there are several factors contributing to this, including an underlying energy cost component.

2.2.3 The Authority has an on-going programme of work intended to make the frequency keeping service more efficient and more competitive. The key initiatives in this programme are summarised in Table 1.

Table 1: Authority's frequency keeping initiatives

Initiative	Commentary	Status and Timeframe
National market for frequency keeping	This initiative, in conjunction with the system operator's project to operationalise the new HVDC bi-pole control functions, will seek to improve frequency keeping selection and achieve a reduction in the MW band of frequency keeping purchased nationally	In the design and implementation phase in 2014/15
Multiple frequency keeping	The objective of this initiative is to increase the competitiveness of the frequency keeping market by: • increasing the number of frequency keepers and frequency keeping stations that can provide frequency keeping, and • providing for alternative technologies such as demand response	Capital project scheduled for completion in August 2014
Removal of in-band constrained on and off payments to frequency keepers	An objective of this initiative is to make all costs associated with frequency keeping transparent on an ex-ante basis • It improves the efficiency of selection so that the lowest cost providers are more reliably selected • It prepares the frequency keeping arrangements for co-optimisation with energy and reserves	Consultation completed, with implementation in 2014/15
Reviewing the normal frequency asset owner performance obligations		The subject of this consultation paper

Initiative	Commentary	Status and Timeframe
Frequency keeping cost allocation review	Intended to improve the allocation of frequency keeping costs to provide better cost signals to parties that cause or contribute to frequency deviations, including the holders of generator AOPO dispensations	Future initiative, not yet scheduled
Normal frequency PPO review	Intended to define a quality standard for frequency in the normal band and align the normal frequency standard with the reserve management objective	Future initiative, not yet scheduled

2.3 Lack of clarity of generators' normal frequency obligations imposes costs and may hinder efficiency and competition benefits over time

2.3.1 As part of developing its work programme in relation to improving the efficiency of frequency keeping services, the Authority and the system operator have identified that aspects of the normal frequency management arrangements are ambiguous and hence open to interpretation. These aspects relate to generator asset owner performance obligations (AOPOs) in Part 8 of the Code to contribute to maintenance of frequency in the normal band. The detailed nature of the problems caused by the current Code arrangements are described in section 3.

2.3.2 The Authority considers that the current lack of clarity adversely affects generator compliance outcomes and is imposing costs due to regulatory uncertainty for generators, the system operator and the Authority for the reasons set out below.

(a) Participants are making generator investment and operational decisions regarding normal frequency obligations using inconsistent assumptions regarding their obligations. The requirements are not specified clearly enough to result in efficient outcomes. There is only a weak incentive for investors to make a trade-off between the cost of compliance or paying the cost of non-compliance.

(b) The system operator does not have the information it requires to develop a complete and accurate assessment of overall generator contribution to normal frequency management. With a complete assessment of contribution, the system operator could:

(i) more accurately calculate system instantaneous reserves requirements in its reserves management tool

(ii) better assess the extent of generator non-compliances and any identifiable costs associated with those non-compliances

(iii) better assess dynamic system performance and security risks.

2.3.3 The lack of clarity, in particular the lack of information on overall contribution, has the potential to hinder the Authority's progress towards achieving enhanced efficiency of normal frequency management and competition in the frequency keeping market for the long term benefit of consumers.

2.3.4 The Authority therefore proposes a Code amendment to clarify generators' normal frequency AOPOs. Clarifying the AOPOs may impose costs on some parties and there is uncertainty about the nature and extent of such costs. Accordingly, the Authority invites affected stakeholders to make submissions on the costs and benefits of the proposed amendment, and on the drafting of the amendment itself.

3. Problem Definition – the inefficiencies arising from generators' normal frequency obligations in the Code

3.1 Maintenance of normal frequency in the context of overall frequency management

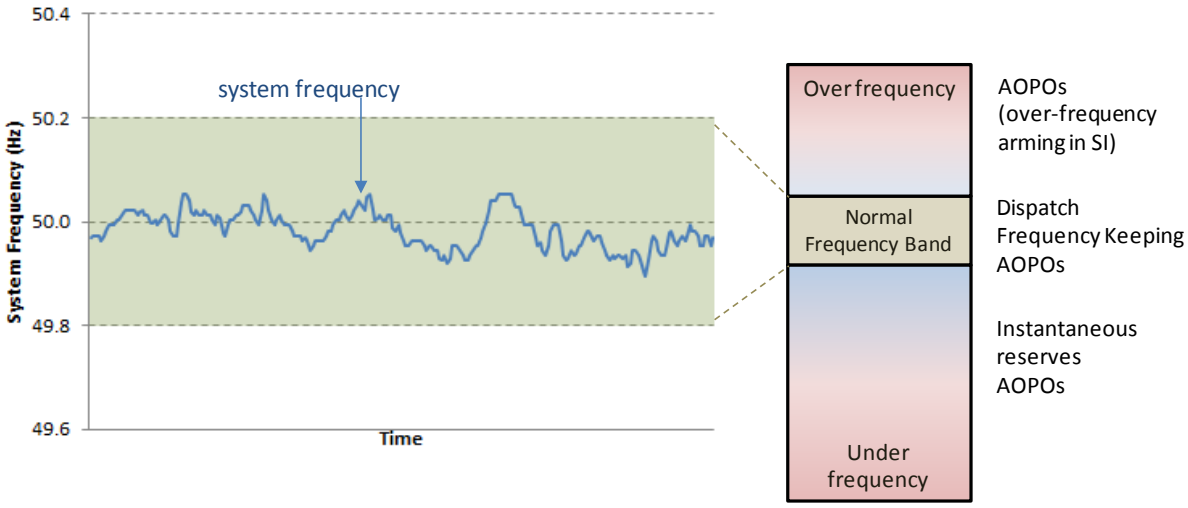
3.1.1 Short-term demand and supply imbalances occur continuously, and often unpredictably, affecting system frequency. As discussed in greater detail in the next section, under normal circumstances, the system operator relies on a combination of generator dispatch, generator AOPOs (particularly free governor action) and frequency keeping to manage these imbalances and maintain normal frequency quality.

3.1.2 When frequency drops below the normal band (e.g. due to the failure of large generating units or transmission elements), this automatically triggers instantaneous reserves. There are also AOPOs for generators and other classes of participants regarding the actions they take, the way their assets perform, and when frequency is above or below the normal band.

3.1.3 When frequency rises above the normal band (e.g. if there is a significant disconnection of demand), this automatically triggers over frequency reserves. The system operator only purchases these reserves to protect against the risk of sudden loss of HVDC power flow or sudden loss of large blocks of load.

3.1.4 These arrangements are illustrated in (Figure 2).

Figure 2: Frequency management overview



3.2 Framework for generator contributions to maintenance of normal frequency

3.2.1 Part 8 of the Code sets out the AOPOs that specify the contributions generators must make to maintaining frequency in the normal band. Clause 8.17 of the Code sets out the overarching requirement on generators to:

> "*make the maximum possible injection contribution to maintain frequency within the normal band (and to restore frequency to within the normal band)*."

3.2.2 Clause 8.17 also requires that such contributions be assessed against the technical codes in Schedule 8.3 of Part 8. Clause 5(1) of Technical Code A of Schedule 8.3 is particularly relevant. Amongst other things, it requires generators to:

(a) ensure their governor systems automatically respond to changes in system frequency

(b) agree governor settings with the system operator.

3.2.3 The collective response of generators operating under governor control is an essential aspect of normal frequency management. It acts in the first instance to limit system frequency changes due to imbalances between generation and demand. This action moves generators off their MW dispatch points and has implications for efficiency and wear and tear on plant. The greater the collective response, the less individual generators will move off their dispatch points. Decreasing movement in this context reduces governor wear and tear and associated maintenance costs.

3.2.4 Frequency keeping providers also help to mitigate these impacts by responding to return frequency to 50 Hz and to minimise system frequency error over time. The frequency keepers ramp their MW set points up and down within a specified MW band, typically, +/- 50 MW in the North Island and +/- 25 MW in the South Island.

3.2.5 At regular intervals, usually five minutes, the system operator issues dispatch instructions to generators, in accordance with their offers, to rebalance generation and demand. Sometimes it is necessary for the system operator to issue additional dispatch instructions within an interval to keep frequency keeping providers within their specified operating band.

3.2.6 While the three processes summarised above (governor response, frequency keeping and dispatch instructions) occur over different timeframes, they are inter-related. For example:

- without frequency keeping, generators under governor control would move further from their dispatch levels or would need to be re-

dispatched more often to maintain generation in balance with demand

- similarly, generators that restrict their governors by applying dead bands,[6] or generators that do not have governors, can affect frequency keeping requirements and cause a greater workload for other generators that have unrestricted governors.

3.3 Mandated standards and the role of dispensations

3.3.1 Specifying technical performance obligations is a common feature of grid operating codes around the world, as it is a lower cost means of procuring such capabilities than through ancillary services markets.

3.3.2 Importantly, the equivalence and dispensation provisions in clauses 8.29 to 8.37 of the Code provide alternatives to full compliance where the cost is excessive or there is an opportunity for innovation in the means of achieving compliance.

- **Dispensations** – if the system operator has a reasonable expectation that it can continue to operate the existing system and meet its principal performance obligations (PPOs) under the Code, it must grant a request from an asset owner for a dispensation from full compliance. An asset owner must pay readily identifiable costs borne by others as a result of the dispensation[7]
- **Equivalence** – if an asset owner can satisfy the system operator that it will put in place a technical or commercial arrangement that has the same outcome as full compliance with the technical obligations, the system operator must approve the arrangement.

3.3.3 Mandating common technical requirements and allowing asset owners to trade-off the cost of full compliance with the cost of alternatives ensures a 'level playing field' if asset owners make investment and operational decisions while avoiding excessive compliance costs. This is particularly important where the nature of certain types of generation technology (e.g. wind generation) make it impractical to comply with some obligations.

3.3.4 There are currently no approved equivalence arrangements relating to generators' normal frequency AOPOs.

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[6] Applying a frequency dead band to a machine's governor halts the machine's frequency response within that band and reduces the generator's response to frequency deviations. A dead band decreases the wear and tear that occurs when a machine's output is constantly changing in response to frequency.

[7] In practice, it is difficult to reliably and accurately identify such costs, and, accordingly, the system operator typically does not include a cost allocation in such dispensations. A notable exception is dispensation from certain under-frequency generator AOPOs where the cost allocation formula for non-compliant generators is set out in the Code.

3.3.5 The system operator maintains a register of dispensation applications and decisions (e.g. granted, withdrawn, or declined). Since the introduction of the Electricity Governance Rules (EGRs) in 2004, the predecessor to the Code, there have been a significant number of applications from generators for dispensations from one or more of the generator obligations relating to normal frequency. On the basis of the applications received by the system operator, the Authority considers that:

(a) certain types of generation technology (e.g. wind, geothermal) that are not well-suited to aspects of generators' normal frequency AOPOs (e.g. governor action) have sought and received dispensations

(b) some generators have interpreted the Code in a manner that means that significant dead bands are allowable, or, that there is no requirement for a response within the normal band (addressed further in the next section).

3.4 Lack of clarity is producing adverse outcomes

3.4.1 The manner in which the Code expresses generators' normal frequency AOPOs means that some aspects of the requirements could be open to interpretation. This is evident in the different approaches to compliance that asset owners take and from consideration of dispensation applications (discussed above). It was also apparent in the Commission's analysis undertaken in 2010 as part of its review of normal frequency AOPOs[8] and frequency keeping cost allocation,[9] and from generators' submissions on those consultations.

3.4.2 In particular, some generators appear to make little if any contribution to the maintenance of frequency when it is within the normal frequency band. This imposes additional costs on other generators that make active contributions. It can also affect the amount of frequency keeping required.

3.4.3 This situation also has potential implications for the system operator in meeting its PPOs. The system operator relies on asset owners complying with their obligations unless those asset owners have a dispensation approved by the system operator. However, if alternative interpretations of compliance are possible, then the system operator does not have the modelling information it would require to form a complete and accurate assessment of overall generator contribution to normal frequency management.

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8 http://www.ea.govt.nz/development/work-programme/wholesale/normal-frequency-generator-asset-owner-performance-obligations/consultatins/#c7606

9 http://www.ea.govt.nz/about-us/what-we-do/our-history/archive/dev-archive/consultations/power-systems-and-common-quality-consultations/2010/frequency-keeping-cost-allocation/

3.4.4 The system operator has advised the Authority that the modelling information it holds for generator governors is incomplete. For instance, the Code is silent on whether a generator can apply a dead band setting. As a consequence, the system operator cannot be sure of:

(a) how many generators may have applied a dead band

(b) the size of any such dead bands

(c) how generators might change any such dead band settings over time.

3.4.5 This uncertainty has the potential to hinder progress towards achieving enhanced efficiency and competition in the frequency keeping market. In particular:

(a) Enhancements to frequency keeping arrangements should in time enable a more dynamic approach to procurement. However, without accurate information about generator normal frequency capabilities, the system operator is not well-placed to be confident that it can reduce frequency keeping procurement quantities.

(b) The Authority intends reviewing frequency keeping cost allocation arrangements, including cost allocation associated with dispensations. This review may include consideration of more sophisticated regimes. Ambiguity in generator normal frequency obligations in this context may hinder the efficacy of any future cost allocation arrangements.

3.4.6 The uncertainty associated with alternative interpretations also increases regulatory costs; for instance, in monitoring compliance, applying for dispensations, and considering breach allegations. Generators, the system operator and the Authority bear these increased costs.

3.4.7 Additionally, the variety of possible interpretations creates uncertainty for asset owners' decision-making regarding generation investment:

(a) when deciding between investment in different types of generation technology

(b) when specifying the design of the new assets to meet Code obligations.

3.4.8 In summary, the current lack of clarity in generators' normal frequency AOPOs:

(a) results in the system operator not having the information it requires to form a complete and accurate assessment of overall generator contribution to normal frequency management

(b) adversely affects generator compliance costs and outcomes through regulatory uncertainty for generators, the system operator and the Authority

(c) may contribute to increased frequency keeping requirements and costs

(d) imposes costs on some generators (e.g. asset wear and tear) that other generators do not bear (thereby adversely affecting competition amongst generators)

(e) creates uncertainty, and possible distortions, for new generation investment decision-making

(f) has the potential to limit the gains from the Authority's progress towards achieving enhanced efficiency and competition in the frequency keeping market through its programme of normal frequency development initiatives.

4. Proposed Code amendment

4.1 The Authority has drawn on key source material

4.1.1 In considering the issues with generators' current normal frequency AOPO requirements in the Code and identifying options for addressing them, the Authority has drawn on a number of key documents, in particular:

(a) the Commission's AOPOs consultation paper and stakeholder submissions[10]

(b) the Commission's cost allocation consultation paper and stakeholder submissions[11]

(c) the TASC-011 report.[12]

4.1.2 The Authority has also engaged with the system operator recently, seeking input on a range of matters including:

(a) possible new information that could impact on the findings and recommendations in the TASC-011 report (including possible implications of operationalising the new HVDC bi-pole control functions)

(b) the current dispensation situation

(c) advice on Code amendment drafting.

4.2 The proposed Code amendment has three elements

4.2.1 There are three elements to the proposed Code amendment:

[10] http://www.ea.govt.nz/development/work-programme/wholesale/normal-frequency-generator-asset-owner-performance-obligations/consultatins/#c7606

[11] http://www.ea.govt.nz/about-us/what-we-do/our-history/archive/dev-archive/consultations/power-systems-and-common-quality-consultations/2010/frequency-keeping-cost-allocation/

[12] The Electricity Commission initiated this review following its consideration of submissions on its earlier consultation. The Authority inherited responsibility for the review following the move to the new regulatory regime under the Electricity Industry Act 2010. The TASC-011 report can be found here:

http://www.ea.govt.nz/development/work-programme/wholesale/normal-frequency-generator-asset-owner-performance-obligations/

Amendments to clause 8.17 of Part 8 – Contribution by injections to overall frequency management

Proposed drafting	Comments
Asset owner performance obligations and technical standards concerning frequency **8.17 Contribution by injections to overall frequency management** Each **generator** (while **synchronised**) and the **HVDC owner** must at all times ensure that its **assets**, other than any **generating units** within an **excluded generating station**, make the maximum possible **injection** contribution to correct ~~maintain~~ frequency while the frequency is within the **normal band** ~~(~~and, otherwise, to restore frequency to within the **normal band~~)~~. Any such contribution must be assessed against the **technical codes**.	The overarching requirement for generators (and the HVDC) to contribute to the maintenance of normal frequency could be wrongly interpreted to mean that any contribution is only required when the frequency is outside the normal frequency band of 49.8 to 50.2 Hz. Analysis suggests that some generators have adopted and applied this alternative interpretation. The Authority considers that this is inconsistent with the intent of the obligation. The Authority therefore proposes to amend 8.17 to clarify that generators and the HVDC owner must actively contribute to maintaining frequency when the frequency is within the normal frequency band, not just respond to frequency movements outside the normal band. Further notes: • *Injection contribution* has been retained as it is a more generic term than other options such as *unrestricted governor action* which is technology specific • the Authority proposes to retain the term *synchronised* as the Code now provides that asynchronous intermittent generating stations must be treated as being synchronised for the purposes of subpart 2 of Part 8 • with the proposed addition of a permissible dead band (see below), the Authority does not consider it necessary to split the overall obligation in 8.17 into two separate parts (operation within the normal band and operation outside of the normal band). Under this proposal, it is no longer open to generators to interpret the permissible dead band

Proposed drafting	Comments
	as +/- 0.2 Hz., A generator must now respond to frequency changes larger than the permitted dead band.

Amendments to Schedule 8.3 Technical Code A - Assets

Proposed drafting	Comments
Schedule 8.3 *Technical Code A – Assets* **5 Specific requirements for generators** (1) Each **generator** must ensure that— (a) each of its **generating units**, and its associated **control systems**,— (i) supports the **system operator** to plan to comply, and to comply, with the **principal performance obligations**; and (ii) is able to **synchronise** at a stable frequency within the frequency range stated in the **asset capability statement** for that **asset**; and (b) the rate of change in the output of any of its **generating units**— (i) does not adversely affect the **system operator's** ability to plan to comply, and to comply, with the **principal performance obligations**; and (ii) ~~The rate of change must be~~ is adjustable to allow for changes in **grid** conditions; and	The overarching obligation in clause 8.17 (refer above) includes the following for contributions to overall frequency management: *" Any such contribution must be assessed against the **technical codes**."* The Authority therefore proposes amendments to Technical Code A to further clarify generator frequency response requirements.

(c) each of its **generating units** ~~has~~ is fitted with a speed governor or an equivalent mechanism that— (i) provides stable performance~~with adequate damping~~; and	Including the words "*or equivalent mechanism*" would provide some flexibility for generators in complying with this obligation. The Authority proposes removing the words "*adequate damping*" as this could be incorrectly interpreted. Provision of stable performance remains a paramount consideration. The Authority proposes clarifications to ensure that settings that can affect the performance of the governor have to be agreed with system operator (refer below).
(ii) has a dead band extending no more than 0.025 Hz above or 0.025 Hz below 50 Hz; and	The Code is currently silent on whether a dead band is permissible, and different generators have interpreted the Code in different ways. Analysis of generator performance and of stakeholder submissions on the earlier Commission consultation suggest that a significant number of generator governors operate with dead bands (reducing wear and tear on their own assets), and that some appear to respond little if at all to frequency movements within the normal range (suggesting a sizeable dead band). This places an extra burden, and cost, on those generators with governors that do respond within the normal band, and increases overall frequency keeping requirements. It also has the potential to distort investment decisions. Many machines have a small inherent dead band built in (around 10-25 mHz), making it impossible for the relevant asset owner to comply if the Code requires that there be no dead band. It is common in overseas jurisdictions to provide for a small dead band. The TASC-011 report (section 4.4) recommends a dead band of +/- 25 mHz. The studies in the report show that system response and governor stability would not be unduly affected by a small dead band. A dead band of around this size appeared to have a measure of support in stakeholder submissions on the earlier Commission consultation, however, other views were also expressed. The Authority has adopted the system operator's recommendation in this Code amendment proposal.

(iii) has its~~an adjustable~~ **droop** ~~over the range of 0% to 7%~~ set as low as is practical and at no more than 7%; and	The permanent droop of a governor system is a mechanism that changes the apparent output set point of a generator as a proportional response to frequency changes. Droop percentage refers to the percentage change in frequency that is necessary to cause the generator output to change from zero to full output (e.g. the set point of a generator with 7% droop will increase from no output to full output if the frequency decreases by 7%). The system operator has analysed the effects of droop on governor response and stability, with a view to determining the optimal droop response (Section 4.5 of TASC-011 report). The analysis was inconclusive: droop is not an isolated parameter, and to be most effective, a change in droop must be accompanied by changes in gain settings (refer below). In addition, each generator has many dynamic properties that affect frequency response. Clause 5(1)(c)(ii) of Technical Code A of Schedule 8.3 of the Code currently stipulates that governors must be capable of droop settings between 0 and 7%, but does not actually specify that the droop must be set within this range. The system operator therefore recommends: • tightening the language in the Code to mandate that the droop setting should be 7% or less • removing the word adjustable. The Authority has adopted these recommendations in this Code amendment proposal. The Authority also proposes including the words “set as low as is practical” reflecting the need to find the appropriate balance between responsiveness and stability (a lower setting means a more responsive machine but this could adversely affect stability). The Authority has also included the clarification that settings that can affect the performance of the governor have to be agreed with system operator (refer below).

(i~~i~~v) has proportional gain and integral gain set as high as practical; and	The Code currently contains requirements for droop settings but does not explicitly mention gain (although under clause 8.17, a generating unit's proportional response to frequency must not be unduly limited). The system operator's studies (TASC-011, section 4.6) confirm that gain is an important factor in maintaining system frequency. Both droop and gain collectively are necessary to improve dynamic performance of a machine: A machine can have a very low droop setting but still be unresponsive to changes in frequency if the gain setting is low. Accordingly, it is important to consider gain alongside droop in any consideration of Code amendments otherwise there may be unintended consequences if only the droop obligations are changed. There are two aspects of gain: proportional gain and integral gain. Section 4.6 of TASC-011 describes each of these aspects and presents the results of the system operator's studies. The system operator recommends an amendment to the Code to specify that proportional and integral gains be set as high as possible without making the respective governor unstable. The Authority has adopted that recommendation and also included the requirement that settings that can affect the performance of the governor have to be agreed with system operator (refer below).
(v) does not adversely affect the operation of the **grid** because of any of its non-linear characteristics; and	The Authority does not propose any amendments to this clause.
(d) ~~appropriate speed governor settings to be applied before commencing **system tests** for a **generating unit** are agreed between the **system operator** and the **generator**. The performance of the **generating unit** is then assessed by measurements from **system tests** and final settings are~~	The Authority considers that the proposed amendment to this clause: • clarifies that it is a generator's governor settings that could adversely affect the PPOs that must be agreed with the system operator • clarifies the circumstances when asset owners are required to obtain such system operator approval • provides enhanced information for the system operator regarding governor responsiveness, stability and settings

~~then applied to the **generating unit** before making it ready for service after those final settings are agreed between the **system operator** and the **generator**. An **asset owner** must not change speed governor settings without **system operator** approval.~~it obtains approval from the **system operator** for any settings to be applied to **generating unit** speed governors, or equivalent mechanisms, which could adversely affect the **system operator's** ability to plan to comply, and to comply, with the **principal performance obligations**, including but not limited to **droop**, proportional gain and integral gain, prior to: (i) conducting **system tests** on the **generating unit**; and (ii) commissioning the **generating unit** or making the **generating unit** ready for service following **system tests**; and (iii) changing the settings at any other time.	It is important to note that the obligations proposed above relating to low droop and high gain settings are not necessarily required for the system operator to meet its PPOs (e.g. even with low gains, the system operator could still meet its PPOs by procuring more frequency keeping). However, the Authority considers that the obligations are necessary to ensure generators contribute effectively to maintaining normal frequency.

Amendment to Part 1 of the Code – Definition of terms

Proposed drafting	Comments
Part 1, Preliminary provisions 1.1 **droop** means the ratio of the steady state change in **frequency**, expressed as a percentage of 50 Hz, to the steady state change in the power output of a **generating unit**, expressed as a percentage of the **generating unit's** nameplate **MW** capacity	The Authority proposes including a definition of **droop** in Part 1 of the Code to further clarify generators' normal frequency obligations. The proposed amendment expresses this definition in electrical terms rather than in generator speed droop terms.

4.3 Allowing time for transition

4.3.1 If the Authority adopted the proposed Code amendment it is likely that generators would need a period of transition before any amended Code obligations come into force.

4.3.2 There are a number of dispensations already in place relating to generators' normal frequency obligations. As these relate to specific Code obligations, most, if not all, will no longer be valid if the proposed Code amendment comes into force.[13]

4.3.3 The transition period would need to be sufficient to allow generators reasonable time to assess their compliance with the amended obligations under the proposed Code amendment and to take any appropriate actions in light of their assessment. This might include one of the following:

(a) no action, as the generating assets already comply with the amended Code obligations

(b) agreeing new settings with the system operator in order to comply with the amended Code obligations

(c) applying to the system operator for a dispensation from the amended Code obligations

(d) applying to the system operator for approval of an equivalence arrangement as an alternative means of complying with the amended obligations.

4.3.4 The transition would also involve significant system operator input, particularly if generators needed to agree new settings, or if the system operator needed to consider new dispensation applications.

4.3.5 The Authority proposes a transition period of eight months. The Authority considers that this strikes an appropriate balance between allowing a reasonable time for generators and the system operator to take the actions required, while not unreasonably delaying the benefits the Authority considers the Code amendment would deliver (discussed in the next section).

4.3.6 If, at the end of the transition period, an asset owner does not comply with the amended Code obligations, and does not have an approved dispensation or equivalence arrangement, the asset owner would need to self-breach and establish a compliance plan.

[13] The system operator has advised the Authority that it is now a standard condition of dispensations that they lapse if the underlying Code obligation is amended. Earlier dispensations may not have this condition, however, there is provision in the Code for the system operator to revoke a dispensation.

4.4 Authority intends maintaining a watching brief on dispensation outcomes

4.4.1 The consideration of dispensation applications is entirely a matter for the system operator, according to clauses 8.29 to 8.37 of the Code. If the system operator has a reasonable expectation that it can continue to operate the existing system and meet its PPOs, it must approve a dispensation, provided that the asset owner pays identifiable costs borne by others as a result of the dispensation.

4.4.2 However, following a Code amendment, some aspects of the dispensation regime, when applied to a mass (re-)application for dispensations from generators' normal frequency AOPOs, could give rise to some adverse outcomes. In particular, the Authority acknowledges that:

(a) the various aspects of generators' normal frequency AOPOs inter-relate closely (particularly the settings for droop and gain) and there is a risk that considering non-compliance of one aspect independently from the others could give rise to inefficient outcomes

(b) it is difficult to reliably and accurately identify the costs associated with such dispensations for normal frequency obligations.

4.4.3 Some generators who could comply with the amended Code obligations might nevertheless apply for a dispensation. Without a meaningful cost signal as a condition of the dispensation, they may bear little or no cost themselves, but may as a consequence, effectively impose costs on other parties. This has the potential to adversely affect efficiency and competition.

4.4.4 In practice, the costs resulting from a generator dispensation from normal frequency obligations arise for a number of reasons. It would be difficult under the current frequency keeping arrangements to establish an incremental quantity effect (and therefore incremental cost), as frequency keeping procurement quantities have typically been fixed.[14] Further, some of the costs relate to operating and maintenance requirements on compliant generators and, as such, are indirect as is the case for mandated standards generally.

4.4.5 The Authority considered establishing a modest administered cost allocation and including this in the Code amendment proposal or in published dispensation cost allocation guidelines for the system operator. This would provide clarity and certainty for generators and the system operator, but would also increase implementation costs and complexity and may lead to unintended outcomes. For instance, a generator might not be able to comply with the maximum droop setting but be able to

[14] although a significant increase in the amount of generation with unrestricted governor action could have a more immediate effect on frequency keeping quantity requirements.

contribute significantly through its gain settings beyond the minimum Code requirement. However, there may be no incentive for the generator to do so if it incurs penalties for its droop non-compliance.

4.4.6 On balance, the Authority has formed the view that it would be better to maintain a watching brief on dispensation outcomes, and only take further action (e.g. developing cost allocation guidelines in advance of the proposed cost allocation review) if the nature and extent of the dispensations shows that there is a need for such intervention.

4.4.7 The system operator has advised the Authority that, if a dispensation is granted without an associated cost allocation, the dispensation stipulates that a cost allocation may be imposed in the future if circumstances change or new information becomes available. Generators holding dispensations would therefore be aware that they may be subject to a cost allocation in the future.

4.4.8 The Authority considers it more appropriate to look at generator dispensation cost allocation as part of a wider review of the manner in which frequency keeping costs are recovered.

5. Regulatory Statement for the proposed amendment

5.1 Authority's proposal

5.1.1 The Authority proposes to amend Part 8 of the Code to clarify generator technical performance obligations regarding their contributions to the maintenance of normal frequency.

5.1.2 The Authority's proposed Code amendment is set out in Appendix A.

5.2 Statement of the objectives of the proposed amendment

5.2.1 The objective of the proposed amendment is to address uncertainty about generator normal frequency obligations. The benefits expected from the proposal include:

(a) ***Competition.*** The proposal would ensure a common understanding of generator performance obligations, consistent with establishing more "level playing field". This in turn would assist in delivering the anticipated benefits of the Authority's frequency keeping development initiatives over time, particularly those that seek to enhance competition in the frequency keeping market.

(b) ***Efficiency.*** The system operator would have better information regarding the capabilities and performance of generators within the normal band.

Removing uncertainty from the Code should reduce costs associated with monitoring compliance, considering dispensation applications and reviewing breach allegations.

There is potential for increased generator contributions to normal frequency leading to reductions in frequency keeping requirements, particularly in future if there is a move to more dynamic frequency keeping procurement.

5.3 The Authority has considered alternatives

Three possible options

5.3.1 In considering how best to meet the above objective, the Authority considered the following options:

(a) Option 1: A set of Code amendments to address all the identified issues with the lack of clarity in the existing Code, as presented in Section 4 of this paper. Option 1 is the Authority's preferred proposal.

(b) Option 2: Deferring Code amendments pending other developments relating to normal frequency, including the possibility of a national frequency keeping market and a review of how frequency keeping costs are allocated.

(c) Option 3: Just clarifying the permissible dead band pending other developments. Under this option, the Authority would amend clause 8.17, as in the proposal, to make it clear that generators must respond to frequency variations within the normal band with a permissible dead band of +/- 0.025 Hz specified in Technical Code A of Schedule 8.3.

Option 2 would not achieve the objective

5.3.2 Option 2 (deferring Code amendments) would not achieve the objective of the proposed amendment. It is possible that in time, developments such as a national frequency keeping market, an established basis for participation in such a market, or a more targeted cost allocation regime could influence the way the Code provides for generator normal frequency obligations.[15] However, these things are of themselves still uncertain at this time.

5.3.3 In the meantime, if the Authority deferred Code amendments, it could publish an interpretation of generator obligations to contribute to frequency maintenance within the normal band. However, that would merely confirm that the Code obligations are open to interpretation. It would also fail to address uncertainty about other aspects of the Code that are relevant to generator normal frequency obligations. For example, what level of dead band is permissible?

5.3.4 Accordingly, the Authority has excluded Option 2 from further consideration.

Option 1 would best achieve the objective

5.3.5 Option 3 (just clarifying the permissible dead band) would go some way to addressing the objective of the proposed amendment. It would clarify that generators must respond to frequency variations that occur within the normal band (i.e. that a dead band of +/- 0.2 Hz is not permissible) while specifying the level of dead band that is permissible. The inclusion of a permissible dead band is also consistent with international practice and supported by a number of generators in their submissions on the Commission's AOPOs consultation paper.[16] Further, under any future

[15] For example, in time it may be appropriate to specify a larger generator dead band and allow generators to opt-in to a more competitive frequency keeping market. Alternatively, it may be more appropriate to develop arrangements whereby generators that do not contribute to the maintenance of normal frequency within the normal band face a share of frequency keeping costs commensurate with their performance relative to the obligation.

[16] "Normal Frequency - Generator Asset Owner Performance Obligations", June 2010.

approach, the Authority would need to specify some level of permissible dead band.

5.3.6 However, there would remain uncertainty about the technical capabilities required of generators, and the response they must make, with respect to normal frequency variations. For example, it would be possible to meet the current requirement to have droop that is adjustable within a specified range,[17] but in practice, provide minimal response to normal frequency variations. That is because the contribution from a generator to normal frequency maintenance also depends on gain and other governor settings that can directly influence its response to normal frequency variations. Option 1 (the proposal) addresses this by clarifying the criteria against which generators must determine and apply settings to their governors, or equivalent devices, which are integral to normal frequency performance requirements. That would also ensure that the system operator has accurate information regarding the capabilities and contribution of generators to normal frequency maintenance.

5.3.7 The Authority has therefore reached the view that, subject to further consideration of the costs and benefits (discussed in the next section), Option 1 (the proposal) is the preferred means of achieving the objective.

5.4 Evaluation of costs and benefits

5.4.1 The proposed Code amendment would ensure that generators apply consistent assumptions when making investment and operational decisions. This would reduce the risk of distorting investment decisions, because all parties would have a common and clear understanding of their obligations. The Authority considers that the benefits of the proposal (Option 1) exceed those of Option 3 in this regard, as they provide greater clarity about requirements. The proposed review of the allocation of frequency keeping procurement costs and the prospect of dispensations incurring a cost allocation would reinforce this.

5.4.2 The proposed Code amendment would also ensure that the system operator is more confident about generator technical capabilities and contributions in relation to normal frequency maintenance. In this regard, the proposal (Option 1) would have greater benefits than Option 3 because of greater clarity regarding the performance criteria for governor settings. Absent such clarification, it could be possible to meet Code requirements while contributing minimally to normal frequency maintenance.[18] With frequency keeping market developments, the proposal is therefore more likely to reduce the amount of frequency

[17] Clause 5(1)(c) of Technical Code A of Schedule 8.3 of the Code.

[18] For example, a low droop setting of itself may support frequency very little if very low gain settings are applied.

keeping requirements and lessen the burden on those generators that currently comply with the proposed Code amendment.

5.4.3 Under the proposal (Option 1), generator contributions to normal frequency maintenance must be at least the same as at present, with the potential to be greater. It is possible that difficulties in attributing costs to dispensation holders could lead to generators seeking more dispensations than they otherwise would have. That could limit the potential for additional generator contributions to normal frequency maintenance (although it could also enable generators to legitimately avoid incurring excessive costs to achieve compliance). However, the Authority expects that generators that already comply with the proposed Code amendment, or can readily comply, would do so. Further, the Authority expects that any dispensations granted by the system operator would be subject to conditions about costs being imposed at some future point and the level of performance that the generator would provide (which could be better than at present[19]). The Authority therefore considers that the proposal could potentially improve overall generator contributions to normal frequency maintenance. As noted previously, Option 3 would be less likely to deliver such benefits because of lack of clarity about performance requirements.

5.4.4 Analysis of historical generator and system frequency data samples suggests that a significant amount of generation is either unresponsive to frequency variations within the normal band or operates with a significant dead band.[20] If at least some of this generation had a greater response to normal frequency variations, enhanced frequency keeping arrangements could lead to a reduction in frequency keepings requirements and offset any increase in intermittency on the system (for example due to wind farms). Estimating such benefits is very difficult,[21] but they could be significant. For example, a conservative reduction in frequency keeping requirements of 5% could plausibly represent a saving of the order of $1 to $1.5m per annum.[22] It is possible that some of the generators concerned

[19] For example, a generator that currently operates with a dead band of +/- 0.2 Hz might find it particularly onerous to operate with a dead band of +/- 0.025 Hz, but may operate effectively with a dead band significantly less than +/- 0.2 Hz.

[20] A study by the Commission in 2010 estimated that around 40% of generation makes free governor action capability available within the normal band with a combined system droop of around 20%, equating to an average droop performance of around 8% for plant that makes free governor action available. Further, droop is a steady-state concept, and, other factors such as governor gain and integral control settings may affect the rate at which a generator responds to frequency variations. A review of the data used in that study indicates that some generators are significantly more responsive than others with varying dead bands.

[21] The 2010 study by the Commission suggested that North Island frequency keeping requirements might be roughly halved to around ± 25 MW if the amount of generation contributing typical levels free governor action within the normal frequency range increased by around 50%. However, it was also noted that potential contributions vary by plant and technology and that it is difficult to estimate potential improvements in system performance.

[22] Assuming that an enhanced frequency keeping regime (with multiple providers, increased competition and greater use of HVDC) would potentially reduce procurement costs to $20m to $30m per annum. This amounts to a saving of $10m to $20m per annum compared to current frequency keeping procurement costs.

would incur additional costs in operating with more responsive governors within the normal band. Some generators currently operating with negligible dead bands might also reduce costs associated with free governor action.

5.4.5 Besides the relatively minor financial costs of making the proposed Code amendment, other costs are difficult to estimate. In particular, generators would need to assess whether they comply with the revised provisions under the proposed Code amendment and, if not, to agree new settings with the system operator to enable compliance. They would otherwise need to seek a dispensation from the system operator for any non-compliant plant, including any necessary conditions about the level of performance generators would provide. This would involve some effort by generators and the system operator. In this regard, the proposed eight-month transition period prior to the proposed Code amendment coming into effect would enable generators and the system operator to assess their plant against the Code, and either make changes to ensure compliance, or seek a dispensation. The Authority's preliminary view is that the benefits of the proposal outweigh such costs.

5.4.6 In this regard, the Authority is particularly interested in submitters' views regarding the likely effort, time and costs that might arise if the Authority ultimately adopted the proposed Code amendment.

5.5 Assessment under section 32(1)

5.5.1 Section 32(1) of the Act provides that Code provisions must be consistent with the Authority's objective and be necessary or desirable to promote any or all of the following:

(a) competition in the electricity industry

(b) the reliable supply of electricity to consumers

(c) the efficient operation of the electricity industry

(d) the performance by the Authority of its functions

(e) any other matters specifically referred to in the Act as a matter for inclusion in the Code.

5.5.2 The following table sets out an assessment of the proposed amendment against the requirements of section 32(1) of the Act

Section 32(1) requirements:	Response
The proposed amendment is consistent with the Authority's objective under section 15 of the Act, which is as follows:	
(a) to promote competition in, reliable supply by, and the efficient operation of, the electricity industry for the long-term benefit of consumers	The proposal would primarily improve efficiency for the long-term benefit of consumers by: • removing uncertainty (and associated transaction costs) regarding generators' normal frequency obligations in the Code • ensuring that the system operator has accurate information about generator contributions to normal frequency • potentially reducing frequency keeping requirements and procurement costs The proposal should also enhance competition and efficiency for the long-term benefit of consumers by ensuring that generators apply consistent assumptions about generators' normal frequency obligations when making investment and operating decisions.
The proposed amendment is necessary or desirable to promote any or all of the following:	
(a) competition in the electricity industry	The proposal would ensure a common understanding of generator performance obligations, consistent with establishing more "level playing field". This in turn would assist in delivering the anticipated benefits of the Authority's frequency keeping development initiatives over time, particularly those that seek to enhance competition in the frequency keeping market.
(b) the reliable supply of electricity to consumers	The proposal would provide benefits to the system operator because it would gain greater confidence about generator performance and compliance with their obligations regarding normal frequency.

(c) the efficient operation of the electricity industry	The system operator would have better information regarding the capabilities and performance of generators within the normal band. Removing uncertainty from the Code should reduce costs associated with monitoring compliance, considering dispensation applications and reviewing breach allegations. There is potential for increased generator contributions to normal frequency leading to reductions in frequency keeping requirements, particularly in future if there is a move to more dynamic frequency keeping procurement.
(d) the performance by the Authority of its functions	The Authority seeks to make the regulatory regime more effective by addressing a lack of clarity within the Code regarding generators' normal frequency obligations This would also provide a consistent basis for reviewing the allocation of frequency keeping costs.
(e) any other matter specifically referred to in this Act as a matter for inclusion in the Code.	n/a

5.5.3 The proposed Code amendments involve no significant trade-off between promoting efficiency, competition and reliable supply.

5.6 Assessment against the Code amendment principles

5.6.1 When considering amendments to the Code, the Authority's Consultation Charter obliges the Authority to have regard to the following Code amendment principles, to the extent that the Authority considers that they are applicable.

5.6.2 *Principle 1 – Lawfulness:* The Authority and its advisory groups will only consider amendments to the Code that are lawful and that are consistent with the Act (and therefore consistent with the Authority's statutory objective and its obligations under the Act).

5.6.3 The Authority considers that the proposed Code amendment is lawful and is consistent with the Act.

5.6.4 *Principle 2 – Clearly Identified Efficiency Gain or Market or Regulatory Failure:* Within the legal framework specified in Principle 1, the Authority and its advisory groups will only consider using the Code to regulate market activity when:

(a) it can be demonstrated that amendments to the Code will improve the efficiency[23] of the electricity industry for the long-term benefit of consumers;

(b) market failure is clearly identified, such as may arise from market power, externalities, asymmetric information and prohibitive transaction costs; or

(c) a problem is created by the existing Code, which either requires an amendment to the Code, or an amendment to the way in which the Code is applied.

5.6.5 The Authority considers that (c) is particularly relevant here: the proposed Code amendment would address a problem in the existing Code by removing uncertainty about generators' normal frequency performance requirements, ensuring that generators apply consistent assumptions in their decision-making and that the system operator has accurate information about generators' normal frequency capabilities and performance.

5.6.6 The Authority considers that (a) is also relevant because common and clear generator obligations are consistent with a more level playing field for investment in frequency keeping services, and because the proposal may lead to greater overall generator contributions to normal frequency, potentially reducing frequency keeping costs.

5.6.7 *Principle 3 – Quantitative Assessment:* When considering possible amendments to the Code, the Authority and its advisory groups will ensure disclosure of key assumptions and sensitivities, and use quantitative cost-benefit analysis to assess long-term benefits for consumers, although the Authority recognises that quantitative analysis will not always be possible. This approach means that competition and reliability are assessed solely in regard to their economic efficiency effects. Particular care will be taken to include dynamic efficiency effects in the assessment, and the assessment will include sensitivity analysis when there is uncertainty about key parameters.

5.6.8 The Authority has undertaken a high level qualitative cost-benefit assessment, which is set out in section 5.4. The evaluation of alternative means of achieving the objective is also relevant, and this is set out in section 5.3.

5.6.9 The Authority considers that its assessment of the costs and benefits of the proposed Code amendment and of the alternatives demonstrates that the proposed Code amendment is preferable to the alternative options, and thus the tie-breaker principles 4-8 need not be applied.

[23] Where efficiency refers to allocative, productive and dynamic efficiency, and improvements to efficiency include, for example, a reduction in transaction costs or a reduction in the scope for disputes between industry participants.

5.6.10 The Authority acknowledges, however, that its assessment is high-level in nature, and, importantly, that it may not be aware of the full costs that some affected parties may face if the proposed Code amendment was to proceed.

5.6.11 Accordingly, the Authority may revisit its assessment of the costs and benefits of the proposed Code amendment and of the alternatives, following consideration of submissions.

Q1. Do you agree that the problems identified with the current generator AOPOs are creating inefficiencies?

Q2. Do you have any comments relating to the drafting of the proposed Code amendment? Please provide comments and suggested drafting improvements with reference to specific parts, schedules and clauses of the draft proposed Code amendment set out in Appendix A.

Q3. What comments do you have on the Authority's proposal for an eight-month transition period?

Q4. What costs do you anticipate that affected parties, particularly generators, may face in transitioning to the new regime if the proposed Code amendment were to proceed?

Q5. What on-going costs, relative to the status quo, do you anticipate that that affected parties, particularly generators, might incur if the proposed Code amendment was to proceed?

Q6. What comment do you have on the Authority's evaluation of the alternatives and the cost-benefit assessment of the preferred Code amendment (the proposal) set out in sections 5.3 and 5.4?

Q7. What comment do you have on the Authority's assessment of the proposed Code amendment against the requirements of section 32(1) of the Act?

Q8. What comment do you have on the Authority's assessment of the proposed Code amendment against the Code amendment principles?

Glossary of abbreviations and terms

Act	Electricity Industry Act 2010
AOPOs	asset owner performance obligations set out in Part 8 of the Code
Authority	Electricity Authority, the regulatory body established under the Act
Code	Electricity Industry Participation Code 2010
Commission	Electricity Commission, the regulatory body established under the regulatory regime that operated prior to the current Act; the Authority's predecessor
dead band	a frequency range within which a generator's speed governor will not respond to frequency movements
droop	a mechanism which changes the apparent output set point of a generator as a proportional response to frequency changes
frequency keeping	an ancillary service the system operator contracts for to assist in managing frequency inside the normal band
governor	a device used to measure and regulate the speed of a machine
integral gain	In a closed-loop feedback control system, the constant (Ki) applied as a multiplier to the integral of instantaneous error with respect to time, to adjust output.
Hertz or Hz	Hertz, the unit of measure for frequency
IR	Instantaneous Reserve, an ancillary service the system operator contracts for to assist in managing frequency disturbances outside the normal band
normal band	the frequency band between 49.8 Hz and 50.2 Hz (also referred to as normal frequency)
normal frequency asset owner performance obligations	specific AOPOs that only apply to generators that contribute to the maintenance of frequency within the normal band, set out in clause 5 of Technical Code A of Schedule 8.3
proportional gain	In a closed-loop feedback control system, the constant (K_p) applied as a multiplier to the instantaneous error to adjust output.

PPOs	Principal Performance Obligations, the system operator obligations in Clause 7.2 of the Code
system operator	Transpower New Zealand Limited, in its role as the service provider under the Act and Code responsible for ensuring the real-time co-ordination of the electricity system

Appendix A **Proposed amendment**

A.1 Proposed Code drafting

Asset owner performance obligations and technical standards concerning frequency

8.17 Contribution by injections to overall frequency management

Each **generator** (while **synchronised**) and the **HVDC owner** must at all times ensure that its **assets**, other than any **generating units** within an **excluded generating station**, make the maximum possible **injection** contribution to correct ~~maintain~~ frequency while the frequency is within the **normal band** ~~(~~and, otherwise, to restore frequency to within the **normal band~~)~~. Any such contribution must be assessed against the **technical codes**.

Schedule 8.3 *Technical Code A – Assets*

5 Specific requirements for generators

(1) Each **generator** must ensure that—

(a) each of its **generating units**, and its associated **control systems**,—

(i) supports the **system operator** to plan to comply, and to comply, with the **principal performance obligations**; and

(ii) is able to **synchronise** at a stable frequency within the frequency range stated in the **asset capability statement** for that **asset**; and

(b) the rate of change in the output of any of its **generating units**—

(i) does not adversely affect the **system operator's** ability to plan to comply, and to comply, with the **principal performance obligations**; and

(ii) ~~The rate of change must be~~ is adjustable to allow for changes in **grid** conditions; and

(c) each of its **generating units** ~~has~~ is fitted with a speed governor or an equivalent mechanism that—

(i) provides stable performance~~with adequate damping~~; and

(ii) has a dead band extending no more than 0.025 Hz above or 0.025 Hz below 50 Hz; and

(iii) has its~~an adjustable~~ **droop** ~~over the range of 0% to 7%~~set as low as is practical and at no more than 7%; and

(iv) has proportional gain and integral gain set as high as practical; and

(v) does not adversely affect the operation of the **grid** because of any of its non-linear characteristics; and

(d) ~~appropriate speed governor settings to be applied before commencing **system tests** for a **generating unit** are agreed between the **system operator** and the **generator**. The performance of the **generating unit** is then assessed by measurements from **system tests** and final settings are then applied to the **generating unit** before making it ready for service after those final settings are agreed between the **system operator** and the **generator**. An **asset owner** must not change speed governor settings without **system operator** approval.~~ it obtains approval from the **system operator** for any settings to be applied to **generating unit** speed governors, or equivalent mechanisms, which could adversely affect the **system operator's** ability to plan to comply, and to comply, with the **principal performance obligations**, including but not limited to **droop**, proportional gain and integral gain, prior to:

(i) conducting **system tests** on the **generating unit;** and

(ii) commissioning the **generating unit** or making the **generating unit** ready for service following **system tests**; and
(iii) changing the settings at any other time.

Part 1, Preliminary provisions 1.1

droop means the ratio of the steady state change in **frequency**, expressed as a percentage of 50 Hz, to the steady state change in the power output of a **generating unit**, expressed as a percentage of the **generating unit's** nameplate **MW** capacity.

Appendix B **Format for submissions**

Question	Comment
Q1. Do you have any comments relating to the drafting of the proposed Code amendment? Please provide comments and suggested drafting improvements with reference to specific parts, schedules and clauses of the draft proposed Code amendment set out in Appendix A.	
Q2. What comments do you have on the Authority's proposal for an eight-month transition period?	
Q3. What costs do you anticipate that affected parties, particularly generators, may face in transitioning to the new regime if the proposed Code amendment was to proceed?	
Q4. What on-going costs, relative to the status quo, do you anticipate that that affected parties, particularly generators, might incur if the proposed Code amendment was to proceed?	
Q5. What comment do you have on the Authority's evaluation of the alternatives and the cost-benefit assessment of the preferred Code amendment (the proposal) set out in Sections 5.4 and 5.5?	
Q6. What comment do you have on the Authority's assessment of the proposed Code amendment against the requirements of section 32(1) of the Act?	
Q7. What comment do you have on the Authority's assessment of the proposed Code amendment against the Code amendment principles?	

Suggested format for providing drafting comments on the proposed Code amendment in Appendix A.

Clause reference	**Submitter's comment**	**Submitter's alternative drafting**