Appendix A Proposed Code amendment

Proposed Code changes to:

- move performance requirements for instantaneous reserve into the procurement plan. The procurement plan changes will be developed separately by the System Operator, and will be the subject of separate consultation (the drafting amendments to the procurement plan are included in this consultation paper in draft, and provided only as an aid for understanding the proposed amendments to the Code); and
- generalise the meaning of instantaneous reserve to refer to two forms of reserve (interruptible load and a new term "generation reserve") that would cover all forms of injectable reserve, including injection from battery energy storage systems.

battery energy storage system means all equipment functioning together as a single entity that is both able to store **electricity** from a **network** and provide **injection**

bona fide physical reason includes,—

(a) in relation to a **generator**, or a **purchaser**, or an **ancillary service agent** or a **grid owner**, a situation where personnel or plant safety is at risk; and

(b) in relation to a **generator** or an **ancillary service agent** providing ~~**partly loaded spinning reserve**~~, ~~**tail water depressed**~~ **generation reserve** or **frequency keeping**,—

(i) a reasonably unforeseeable change in generating capability, reserve capability, or **frequency keeping** capability (as the case may be) from an item of **generating plant** that is the subject of an existing **offer**, **reserve offer**, or offer to provide **frequency keeping** by that **generator** or **ancillary service agent**; or

(ii) a reasonably unforeseeable change in the level of expected uncontrollable water inflows into the head pond of a hydro station that is the subject of an existing **offer**, **reserve offer**, or offer to provide **frequency keeping** by that **generator** or **ancillary service agent**; or

(iii) a reasonably unforeseeable change in circumstances such that the **generator** or **ancillary service agent** will breach any consent held by it under the Resource Management Act 1991; or

(iv) a reasonably unforeseeable physical infeasibility that arises from a **price-responsive schedule**, a **non-response schedule**, or a **dispatch schedule**; and

(ba) in relation to an **intermittent generator**, a situation in which–

(i) variable resource conditions prevent the **intermittent generator** from generating at the level expected; or

(ii) the **intermittent generator** reduces the output of an **intermittent generating station**—

(A) to prevent an **un-modelled transmission asset** from exceeding its ratings; or

(B) in order to comply with an automated signal to maintain frequency; or

(C) in light of reasonably unforeseeable circumstances that require the output of the **intermittent generating station** to be reduced to enable

the **intermittent generator** to comply with the conditions of a resource consent or other law; or

(D) in anticipation of the expected onset of a weather event that would be likely to cause the **intermittent generating station's** asset protection systems to shut down assets forming part of the **intermittent generating station**; and

(c) in relation to a **purchaser**, or an **ancillary service agent** providing **interruptible load**,—

(i) a reasonably unforeseeable full or partial loss of demand or reserve capability (as the case may be) at a **grid exit point** that is the subject of an existing **bid** or **reserve offer** by the **purchaser** or the **ancillary service agent**; or

(ii) a reasonably unforeseeable change in circumstances such that the **purchaser** or **ancillary service agent** will breach any consent held by it under the Resource Management Act 1991; or

(iii) a reasonably unforeseeable full or partial loss of generating capability from an item of **generating plant** owned by, or the subject of a supply contract with, that **purchaser** during the relevant **trading periods**; and

(d) in relation to a **grid owner**, a reasonably unforeseeable loss of full or partial capacity on transmission plant forming part of the **grid**

The following definition is generalised to refer to all types of reserve. The performance requirements for the sub-categories of reserve are included in the procurement plan.

fast instantaneous reserve means—

~~(a) for providers of **partly loaded spinning reserve** and **tail water depressed reserve**, the additional capacity~~ the increase in generation or reduction in load (in **MW**) provided by **instantaneous reserve** no later than 6 seconds after the start of a "Contingent Event" (as defined in the **policy statement**) and that is sustained until at least 60 seconds after the start of the "Contingent Event" ~~for a period of at least 60 seconds; and~~

~~(b) for providers of **interruptible load**, the drop in load (in **MW**) that occurs within 1 second of the **grid** system frequency falling to or below 49.2 Hertz that is sustained for a period of at least 60 seconds~~

generation reserve means a form of **instantaneous reserve** (including **partly loaded spinning reserve**, **tail water depressed reserve** and that provided by **battery energy storage systems)** which comprises generating capacity that is able to provide **fast instantaneous reserve** or **sustained instantaneous reserve** in accordance with the **procurement plan**

The following definition of "instantaneous reserve" has been generalised to account for BESS.

instantaneous reserve means an **ancillary service** provided to balance the injection of **electricity** into the **grid** with the offtake of **electricity** from the **grid** following a drop in system frequency to the level specified in the **procurement**

plan, comprising 1 or more of the following:

(a) **interruptible load**:

~~(b) **partly loaded spinning reserve**:~~

(~~c~~b) ~~**tail water depressed** **generation** **reserve**~~

The following definition is generalised to account for a battery energy storage system's ability to reduce load (as opposed to electrically disconnect it). The performance requirements for the sub-categories of interruptible load are included in the procurement plan.

interruptible load means a form of **instantaneous reserve** comprised of **demand** ~~energy being consumed~~ that is able to be ~~**electrically disconnected**~~ reduced to provide **fast instantaneous reserve** or **sustained instantaneous reserve** following a drop in system frequency, in accordance with the **procurement plan** ~~to balance the **injection** **supply** and the **offtake** of **electricity** following a drop in system frequency to a specified level below 50 Hz~~

The following definition is retained for the purpose of Form 5(1) of Schedule 13.1 and the references to this sub-category of generation reserve in the procurement plan.

partly loaded spinning reserve means a form of **generation** ~~**instantaneous**~~ **reserve** consisting of spare capacity, held in reserve on a **generating unit**, generating, but not operating at full output, but excludes the spare capacity provided by a **battery energy storage system** ~~which is able to provide **fast instantaneous reserve** or **sustained instantaneous** **reserve** following a drop in system frequency to a specified level below 50 Hz~~

The following definition is generalised to refer to all types of reserve. The performance requirements for the sub-categories of reserve are included in the procurement plan.

sustained instantaneous reserve means—

~~(a) for providers of **partly loaded spinning reserve** and **tail water depressed reserve**,~~ the average increase in generation or reduction in load ~~additional output~~ (in **MW**) provided by **instantaneous reserve** during the first 60 seconds after the start of a "Contingent Event" (as defined in the **policy statement**) and that is sustained for at least 15 minutes after the start of the "Contingent Event" (unless a new **dispatch instruction** is given before the expiry of that 15 minute period)~~; and~~

~~(b) for providers of **interruptible load**, the average drop in load (in **MW**) that occurs over the first 60 seconds after the **grid** system frequency falls to or below 49.2 Hz that is sustained until instructed by the **system operator**~~

The following definition is retained to clarify the use of Forms 5(1) and 5(2) at Schedule 13.1 and the references to this sub-category of generation reserve in the procurement plan.

tail water depressed reserve means a form of ~~**instantaneous**~~**generation reserve** comprising a generating capacity on a motoring hydro generation set with no water flowing through the turbine that is available following a drop in system frequency

We have specified in the clause below that Form 5(1) in Schedule 13.1 is to be used for partly loaded spinning reserve and Form 5(2) in Schedule 13.1 is to be used for all other categories of generation reserve.

13.38 Ancillary service agents to submit reserve offers to system operator

(1) Each **ancillary service agent** who has a contract described in clause 13.37 may submit **reserve offers** to the **system operator**.

(1A) An **ancillary service agent** who submits a **reserve offer** must ensure that the **system operator** receives the **reserve offer** at least 71 **trading periods** before the beginning of the **trading period** to which the **reserve offer** applies.

(2) Each **reserve offer** submitted by an **ancillary service agent** under subclause (1) may be for **fast instantaneous reserve**, **sustained instantaneous reserve** or both and must—

(a) contain all the information required by Form 5(1) in Schedule 13.1 for **partly loaded spinning reserve** or Form 5(2) in Schedule 13.1 for all other categories of ~~**tail water depressed generation**~~ **reserve**; and

(b) contain all the information required by Form 6 in Schedule 13.1 for **interruptible load**; and

(c) be a reasonable estimate of the quantity of **instantaneous reserve** available from the **ancillary service agent** at that **grid injection point**, **grid exit point** or **interruptible load group GXP**.

(3) Each **reserve offer** submitted under subclause (1), by an **ancillary service agent** that is a **generator**, must be made by reference to the same **generating unit** or **generating station** that is the subject of an **offer** under clauses 13.10 or 13.11.

13.40 Inter-relationship between reserve offers of interruptible load and bids

Bids and **reserve offers** of **interruptible load** are inter-related in that **demand electrically connected** in response to an **under-frequency event** and in accordance with a dispatched **reserve offer** may lower the quantity purchased at that **grid exit point**. Accordingly, a **purchaser** does not breach the reasonable estimate requirement in clauses 13.7(3), 13.7AA(2), and 13.8A(4) if the **purchaser** is acting as an **ancillary service agent** and ~~**electrically disconnects**~~reduces corresponding **demand** in response to an **under-frequency event** in accordance with a dispatched **reserve offer**.

The current version of the following clause does not appear to properly account for the tail water depressed reserve offer form, which is not offered as a proportion of electricity output. In addition to the clarifications at clause 13.38, we have redrafted this clause to clarify how the specifications stated in Form 5(1) and Form 5(2) apply to the various categories of generation reserve.

13.44 How quantity is to be specified in reserve offers

(1) For each price band, a **reserve offer** must specify the quantity of **instantaneous reserve** offered to respond as **fast instantaneous reserve** and/or **sustained instantaneous reserve**— ~~as a proportion of **electricity** output or consumption up to a specified maximum quantity or as a quantity available to be interrupted, and must be expressed in **MW** to not more than 3 decimal places. The minimum quantity that may be offered in a price band for a **trading period** is 0.000 **MW**.~~

(a) as the generation available to be injected as a proportion of **electricity** output up to a specified maximum quantity for **partly loaded spinning reserve**; or

(b) as the generation available to be injected for all other categories of **generation reserve**; or

(c) as a quantity of consumption available to be reduced for **interruptible load**.

(2) The quantity that may be offered in a price band for a **trading period** must be expressed in **MW** to not more than 3 decimal places and must not be less than 0.000 **MW**.

13.53 Additional information to be provided by participants

Despite clauses 13.22, 13.23, 13.51, and 13.52, if an **ancillary service agent** submits a **reserve offer** for ~~**partly loaded spinning reserve** or **tail water depressed generation**~~ **reserve** in accordance with clauses 13.37 to 13.54, the **ancillary service agent** must also provide the maximum quantity of fast response **generation reserve** expressed in **MW** and/or the maximum quantity of sustained response **generation reserve** expressed in **MW** ~~the following information in relation to the capability to provide **partly loaded spinning reserve** or **tail water depressed reserve**~~ to the **system operator** in a manner and at such times as are approved by the **system operator** (such approval not to be unreasonably withheld).~~:~~

~~(a) the maximum quantity of fast response **partly loaded spinning reserve** expressed in **MW** and the maximum quantity of sustained response **partly loaded spinning reserve** expressed in **MW**;~~

~~(b) the maximum quantity of fast response **tail water depressed reserve** expressed in **MW** and the maximum quantity of sustained response **tail water depressed reserve** expressed in **MW**.~~

Form 5
Generation Reserve Offer

(1) **Partly Loaded Spinning Reserve**

Band 1:

____% of electricity (**MW**), up to a maximum of ____ **MW** as Fast Instantaneous Reserve @ $ _____ per **MW**

____% of electricity (**MW**), up to a maximum of ____ **MW** as Sustained Instantaneous Reserve @ $ _____ per **MW**

Band 2:

____% of electricity (**MW**), up to a maximum of ____ **MW** as Fast Instantaneous Reserve @ $ _____ per **MW**

____% of electricity (**MW**), up to a maximum of ____ **MW** as Sustained Instantaneous Reserve @ $ _____ per **MW**

Band 3:

____% of electricity (**MW**), up to a maximum of ____ **MW** as Fast Instantaneous

Reserve @ $ _____ per **MW**

____% of electricity (**MW**), up to a maximum of ____ **MW** as Sustained Instantaneous Reserve @ $ _____ per **MW**

(2) ~~**Tail water depressed**~~ **All other forms of generation reserve**

Band 1:

Up to a maximum of_____ **MW** @ $_____ per **MW** as Fast Instantaneous Reserve

Up to a maximum of_____**MW** @ $_____per **MW** as Sustained Instantaneous Reserve

Band 2:

Up to a maximum of_____**MW** @ $_____per **MW** as Fast Instantaneous Reserve

Up to a maximum of_____**MW** @ $_____per **MW** as Sustained Instantaneous Reserve

Band 3:

Up to a maximum of_____**MW** @ $_____per **MW** as Fast Instantaneous Reserve

Up to a maximum of_____**MW** @ $_____per **MW** as Sustained Instantaneous Reserve

The objective function below has been generalised to account for all forms of "generation reserve". Deletions are shown in red strikethrough, and insertions are shown as green text.

8 The objective function

(1) The objective function of the modelling system is described mathematically as:

$$\text{Maximise}\left\{\overbrace{\sum_{i,j} D_{i,j} \quad x \quad BP_{i,j}}^{\text{Gross Consumer Benefit}} \text{ minus } \overbrace{\sum_{i,j} G_{i,j} \quad x \quad OP_{i,j}}^{\text{Cost of Generation}} \text{ minus } \overbrace{\sum_{i,j} R_{i,j}^{\sout{PLSR}GR,f} \quad x \quad OP_{i,j}^{\sout{PLSR}GR,f} + \sout{\sum_{i,j} R_{i,j}^{TWD,f} \quad x \quad OP_{i,j}^{TWD,f}} + \sum_{i,j} R_{i,j}^{IL,f} \quad x \quad OP_{i,j}^{IL,f}}^{\text{Cost of Fast Instantaneous Reserves}} \text{ minus } \overbrace{\sum_{i,j} R_{i,j}^{\sout{PLSR}GR,s} \quad x \quad OP_{i,j}^{\sout{PLSR}GR,s} + \sout{\sum_{i,j} R_{i,j}^{TWD,s} \quad x \quad OP_{i,j}^{TWD,s}} + \sum_{i,j} R_{i,j}^{IL,s} \quad x \quad OP_{i,j}^{IL,s}}^{\text{Cost of Sustained Instantaneous Reserves}}\right\}$$

where

i is a price band of a **bid** / **offer** or a **reserve offer**

j is a **generating unit** / **generating station**, or a **purchaser**

$D_{i,j}$ is the scheduled demand corresponding to price band i of the **bid** for **purchaser** j or metered demand, whichever is relevant, and where the relevant **bids** used here are formed from a combination of the following, as appropriate to the schedule being calculated:

(a) nominated bids:

(b) the forecast prepared under clause 13.7A(1):

(c) difference bids (if difference bids are used, the quantities must be added or subtracted, as appropriate, from the forecast prepared under clause 13.7A(1)):

(d) the system operator's expectation of the profile of demand during the relevant period covered by the schedule being calculated:

(e) a measure of actual demand during the relevant period

$BP_{i,j}$ is the **bid** prices corresponding to price band i of the **bid** for **purchaser** j

$G_{i,j}$ is the scheduled generation corresponding to price band i of the **offer** for unit / station j

$OP_{i,j}$. is the **offer** price corresponding to price band i of the **offer** for unit / station j

$R_{i,j}^{GR,f}$ is the scheduled fast GR corresponding to price band i of the fast **reserve offer** for unit / station j

$R_{i,j}^{GR,s}$ is the scheduled sustained GR corresponding to price band i of the **reserve offer** for unit / station j

$OP_{i,j}^{GR,f}$ is the **reserve offer** price corresponding to price band i of the fast GR **reserve offer** for unit / station j

$OP_{i,j}^{GR,s}$ is the **offer** price corresponding to price band i of the sustained GR **reserve offer** for unit / station j

~~$R_{i,j}^{PLSR,f}$ is the scheduled fast PLSR corresponding to price band i of the fast **reserve offer** for unit / station j~~

~~$R_{i,j}^{PLSR,s}$ is the scheduled sustained PLSR corresponding to price band i of the **reserve offer** for unit / station j~~

~~$OP_{i,j}^{PLSR,f}$ is the **reserve offer** price corresponding to price band i of the fast PLSR **reserve offer** for unit / station j~~

~~$OP_{i,j}^{PLSR,s}$ is the **offer** price corresponding to price band i of the sustained PLSR **reserve offer** for unit / station j~~

~~$R_{i,j}^{TWD,f}$ is the scheduled fast TWD corresponding to price band i of the **reserve offer** for unit / station j~~

~~$R_{i,j}^{TWD,s}$ is the scheduled sustained TWD corresponding to price band i of the **reserve offer** for unit / station j~~

~~$OP_{i,j}^{TWD,f}$ is the **reserve offer** price corresponding to price band i of the fast TWD **reserve offer** for unit / station j~~

~~$OP_{i,j}^{TWD,s}$ is the **reserve offer** price corresponding to price band i of the sustained TWD **reserve offer** for unit / station j~~

$R_{i,j}^{IL,f}$ is the scheduled fast IL corresponding to price band i of the **reserve offer** for **purchaser** j

$R_{i,j}^{IL,s}$	is the scheduled sustained IL corresponding to price band i of the **reserve offer** for **purchaser** j
$OP_{i,j}^{IL,f}$	is the **reserve offer** price corresponding to price band i of the fast IL **reserve offer** for **purchaser** j
$OP_{i,j}^{IL,s}$	is the **reserve offer** price corresponding to price band i of the sustained IL **reserve offer** for **purchaser** j

and where

GR	is **generation reserve**
~~PLSR~~	~~is **partly loaded spinning reserve**~~
~~TWD~~	~~is **tail water depressed reserve**~~
IL	is **interruptible load**
fast	is **fast instantaneous reserve**
sustained	is **sustained instantaneous reserve**