Stakeholder Comments Template

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The Union of Concerned Scientists (UCS) appreciates the opportunity to provide comments on the California Independent System Operator's (ISO) Frequency Response Phase 2 Issue Paper, which was released on December 15, 2016.

In Phase 2 of the ISO's frequency response stakeholder initiative, the ISO seeks to examine a market structure for primary frequency response (PFR) procurement and compensation. In previous comments in this stakeholder initiative, UCS has supported the development of a market product for PFR and maintains its support here.[1]

The ISO's current ancillary services paradigm does not position the system to be able to sufficiently respond to meet the state's dual reliability requirements and greenhouse gas emission reduction goals.

UCS does not believe the ISO's current ancillary services market adequately provides for primary frequency response. In addition, UCS believes that the lack of a market signal for non-conventional resources such as renewable generators, energy storage, and load-shedding technologies to provide PFR is a missed opportunity to provide an essential grid service in a way that will help the state reach its greenhouse gas (GHG) emission reduction requirements.

The ISO Frequency Response Phase 2 Issue Paper states that "For primary frequency response, the ISO and other organized markets have generally relied on the fact that

[1] See UCS's comments on the CAISO Frequency Response Issue Paper, submitted August 27, 2016 and on the CAISO Frequency Response Straw Proposal, submitted November 2, 2016.

conventional resources when interconnected are built with frequency response capability that provides automatic, autonomous, proportional response to frequency change."[2] Even if this is true in the California ISO today, the rapid shift towards renewable, intermittent, asynchronous generation resources supports the ISO's efforts to develop a market mechanism for procuring PFR.

Increased levels of asynchronous, renewable generation on the system will displace a significant portion of the conventional generation that has traditionally provided primary frequency response. California is making a rapid shift to relying on larger and larger amounts of renewable energy generation to serve electricity load, which means that without action by the ISO, California could lack sufficient PFR capability in the future.

The ISO's current ancillary service market, which ensures the provision of secondary and tertiary frequency response, will not necessarily also ensure there is enough primary frequency response: "Given the finite amount of primary frequency response by a resource, if the ISO only increases its operating reserve levels or awards reserves to a limited number of resources it would have increased headroom on the system but not increased the frequency response headroom."[3] In UCS's comments on the ISO's Frequency Response Phase 1 Staff Proposal, we made the case that spinning reserves and PFR should be separate market products because of the wide variation in the ability of different resources to respond on the one-minute timescale of PFR. Specifically, some resources that can provide spinning reserves on the ten- minute timescale will not be able to provide a large fraction of their response in the first one minute for PFR, whereas some resources could provide most or all of their spinning reserve capacity in one minute.

Finally, UCS believes that the absence of a market signal for PFR is a missed opportunity to encourage non-conventional technologies to provide PFR. In some cases, these non-conventional technologies could provide PFR in a much more responsive manner than conventional generators.[4,5] In addition, the procurement of non-conventional technologies to provide essential grid services, including PFR, will be increasingly necessary in order to significantly reduce GHG emissions in California's electric sector, as required by the passage of Senate Bill 32 in 2016. A key strategy for achieving these emission reductions will be significantly increasing the state's reliance on non-fossil technologies to supply both energy and grid reliability needs. Therefore, CAISO should put in place a PFR procurement strategy that enables the participation of a variety of resources, even if we anticipate that near-term needs can be met with natural gas generation.

The ISO's market design for primary frequency response should ensure that all technologies capable of providing the service can participate.

UCS supports the proposed market design principles listed in the Issue Paper, especially the one that would allow all technology types to participate in the procurement mechanism. The state will need to rely upon less natural gas generation to provide essential grid services, including PFR, in the future if it is to dramatically reduce GHG emissions in the electricity sector. The ISO Issue Paper acknowledges that renewable

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[2] California ISO Frequency Response Phase 2 Issue Paper, p.22.
[3] *Ibid*., P.24
[4] Miller, N. W.; Shao, M.; Venkataraman, S. 2011. California ISO (CAISO) Frequency Response Study. GE Energy. p.66---69. Online at http://www.uwig.org/report---frequencyresponsestudy.pdf
[5] California ISO Frequency Response Phase 2 Issue Paper, p.9.

energy resources and energy storage are technically able to provide PFR. In the case of storage, there could be significantly lower opportunity costs of providing the service, compared to conventional fossil resources. In addition, UCS appreciates the ISO including demand responsive technologies on the list of technologies that would provide PFR.[6] Load-shedding is especially valuable to mitigate under-frequency events, which the ISO points out are a "high grid reliability risk" since the persistence of such an event could result in cascading blackouts.[7]

Under frequency load shed (UFLS) – the disconnection of demand when frequency dips below a certain level – could be particularly effective in providing PFR and does not necessarily require new technology to implement. Electricity customers could be compensated for being voluntarily disconnected in the event of an under frequency event. For example, some customers could have their demand trip offline at 59.7 Hz instead of a lower value, perhaps 59.5 Hz.

A study by GE and the ISO[8] has shown this strategy to be very successful at arresting frequency decline. The study modeled the tripping of 1,379 MW of pumps and pumped storage hydro plants at 59.7 Hz, and found that in the case of a large decline in frequency, frequency response was comparable to 12 GW of headroom on conventional generation. In this case, UFLS was almost ten times more effective than conventional response.

Finally, UCS suggests that the ISO should seriously consider whether the PFR procurement process can be structured to facilitate the participation of aggregated residential and small commercial demand-side resources. An aggregation of small, frequency responsive loads could essentially mimic the full response curve of a governor. A study released by the Pacific Northwest National Laboratory illustrates that: "The loads shed by large substation relays represent large bulk load reductions; the curtailment of a vast number of loads controlled by GFA controllers could be intentionally staggered by imposing a distribution of frequency-response thresholds, resulting in a smoother abatement of system deceleration."[9]

UCS appreciates the chance to provide comments on the ISO's Issue Paper and looks forward to further opportunities to address these topics.

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[6] Ibid. p.31.

[7] California ISO Frequency Response Phase 2 Issue Paper, p.6.

[8] Miller, N. W.; Shao, M.; Venkataraman, S. California ISO (CAISO) Frequency Response Study. GE Energy. 09/11/2011. p. 71---73. Online at http://www.uwig.org/report---frequencyresponsestudy.pdf

[9] Hammerstrom, D. J., *et. al.*, 2007. Part II Grid Friendly Appliance Project, Pacific Northwest National Laboratory, p.vi. Online at: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-17079.pdf