Union of Concerned Scientists

August 23, 2019

U.S. Department of Energy
Attn: Office of Electricity, Guidance for Enhancing Grid Resilience
1000 Independence Ave. SW
Mailstop OE-20
Washington, DC 20585

Re: DOE Request for Information – Codes, Standards, Specification, and Other Guidance for Enhancing the Resilience of Electric Infrastructure Systems Against Severe Weather Events.

On behalf of our 500,000 members and supporters and network of 26,000 scientists and experts, the Union of Concerned Scientists (UCS) submits these comments in response to the Department of Energy's (DOE) request for information related to the resilience of electric infrastructure systems. UCS has a long history and deep expertise working on the electric sector, particularly focused on opportunities to transition the electric system away from fossil fuels to renewable and other low-carbon energy options while enhancing electricity reliability, resiliency, and affordability.[i, ii] We also conduct research on the impacts of climate change, including accelerating sea level rise and worsening extreme heat events which present a significant threat to electricity infrastructure resilience and which are projected to become more severe over time, especially if we fail to make rapid and deep cuts in heat-trapping emissions.[iii, iv] We are encouraged to see DOE spearheading this important effort and look forward to continued opportunities to engage with the agency on these topics.

The issue of electricity sector resilience is not new; however, climate change is increasing the urgency of addressing growing risks. There is a wealth of existing research and analytics that should support and inform DOE's assessment and be included in the record of this request for information. Highlighting these important contributions to this discussion is the primary focus of our comments. We also emphasize several key conclusions that should be drawn from this body of work:

1. Any meaningful effort to strengthen the resilience of electricity infrastructure must be:
    a. Forward looking: Electric infrastructure investment decisions must be made in the context of their expected useful life – often 40 years or more. Because these investments tend to be expensive, ratepayer funded, and hard to relocate once installed, the intent must be to make cost-effective investments built to withstand the future expected challenges to resilience.[v, vi]
    b. Dynamic: Adaptive management processes must be in place at all levels of government to understand expected impacts and scenarios in advance and ensure lessons learned following extreme weather events and other ongoing climatic changes are integrated in an iterative fashion to further advance our preparation for and response to resilience challenges.[vii, viii]

2. Resilience codes, standards, specifications, and guidance for electric infrastructure must account for the expected extreme weather and climate change related impacts and scenarios over the long-term, including increased coastal and inland flooding, extreme heat events, extreme storm events, and wildfires, among other impacts, as informed by the best available science.[ix, x, xi]

3. Resiliency efforts must also focus on the need to decarbonize the U.S. electricity sector to limit the worst and most costly impacts of climate change to the resilience of electricity infrastructure.[xii, xiii]

4. Increasing resilience in electricity infrastructure starts with a focus on electricity transmission and distribution systems, where the vast majority of failures occur during extreme weather events and otherwise.[xiv, xv, xvi]

5. Enhancing the resilience of electricity infrastructure cannot be accomplished in isolation and must be responsive to the threats of co-occurring stresses and compounding impacts, cascading failures, the unique vulnerabilities of communities that are disproportionately impacted by climate change, and the need to maintain reliable electricity supply for critical infrastructure such as hospitals, transportation systems, and public facilities.[xvii, xviii, xix, xx, xxi] This requires additional interventions to support bottom-up electricity resilience to ensure reliable supply in the face of inevitable power grid failure.

6. The federal government has an important role to play by setting best practices and standards, providing technical assistance and information sharing, and better integrating actions across federal agencies, regions, states and territories. This work is already underway at DOE and the National Laboratories. This current effort should seek to complement and enhance rather than duplicate this work.[xxii, xxiii]

The Union of Concerned Scientists respectfully submits these references and guiding principles into the record of DOE's request for information regarding Codes, Standards, Specification, and Other Guidance for Enhancing the Resilience of Electric Infrastructure Systems Against Severe Weather Events. We look forward to continued engagement with the agency on this important issue.

On behalf of the Union of Concerned Scientists

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References to be entered into the record (all references accessed August 20, 2019):

[i] Baek, Y., S. Clemmer, J. Collingsworth, P. Garcia, J.C. Kibby, S. Sattler. 2018. *Soot to Solar*. Cambridge, MA: Union of Concerned Scientists. Online at https://www.ucsusa.org/sites/default/files/attach/2018/10/soot-solar-full-report.pdf.

[ii] Jackson, S., J. Fisher, B. Fagan, W. Ong. 2016. *Beyond the Clean Power Plan: How the Eastern Interconnection Can Significantly Reduce CO_2 Emissions and Maintain Reliability.* Cambridge, MA: Prepared for the Union of Concerned

Scientists. Online at https://www.ucsusa.org/sites/default/files/attach/2016/02/beyond-the-clean-power-plan-full-report.pdf.

[iii] Dahl, K., R. Cleetus, E. Spanger-Siegfried, S. Udvardy, A. Caldas, P. Worth. 2018. *Underwater: Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate.* Cambridge, MA: Union of Concerned Scientists. Online at https://www.ucsusa.org/global-warming/global-warming-impacts/sea-level-rise-chronic-floods-and-us-coastal-real-estate-implications.

[iv] Dahl, K., E. Spanger-Siegfried, R. Licker, A. Caldas, J. Abatzoglou, N. Mailloux, R. Cleetus, S. Udvardy, J. Declet-Barreto, P. Worth. 2019. *Killer Heat in the United States: Climate Choices and the Future of Dangerously Hot Days.* Cambridge, MA: Union of Concerned Scientists. Online at https://www.ucsusa.org/sites/default/files/attach/2019/07/killer-heat-analysis-full-report.pdf.

[v] National Academies of Sciences, Engineering, and Medicine. 2017. *Enhancing the Resilience of the Nation's Electricity System.* Washington, DC: The National Academies Press. Online at http://doi.org/10/17226/24836.

[vi] Zamuda, C., D.E. Bilello, G. Conzelmann, E. Mecray, A. Satsangi, V. Tidwell, and B.J. Walker. 2018: Energy Supply, Delivery, and Demand. In *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 174-201. Online at https://nca2018.globalchange.gov/chapter/energy.

[vii] McNamara, J. 2017. *Commentary: How we could have prevented some of Puerto Rico's misery.* Reuters. September 29, 2017. Online at https://www.reuters.com/article/us-mcnamara-electricity-commentary/commentary-how-we-could-have-prevented-some-of-puerto-ricos-misery-idUSKCN1C42ER.

[viii] US Department of Energy. 2019. *Utility Investments in Resilience of Electricity Systems.* U.S. Department of Energy – Office of Electricity and Office of Energy Efficiency and Renewable Energy. Washington, DC. Online at http://eta-publications.lbl.gov/sites/default/files/feur_11_resilience_final_20190401v2.pdf.

[ix] McNamara, J., S. Clemmer, K. Dahl, E. Spanger-Siegfried. 2015. *Lights Out? Storm Surge, Blackouts, and How Clean Energy Can Help.* Cambridge, MA: Union of Concerned Scientists. Online at https://www.ucsusa.org/sites/default/files/attach/2015/10/lights-out-full-report.pdf.

[x] US Department of Energy. 2015. *Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Solutions.* U.S. Department of Energy, Washington, DC, pp. 4-1 to 4.68. Online at https://www.energy.gov/sites/prod/files/2015/10/f27/Regional_Climate_Vulnerabilities_and_Resilience_Solutions_0.pdf.

[xi] US Department of Energy. 2013. *U.S. Energy Sector Vulnerabilities to Climate Change and Extreme Weather.* Washington, DC: U.S. Department of Energy. Online at https://www.energy.gov/sites/prod/files/2013/07/f2/20130716-Energy%20Sector%20Vulnerabilities%20Report.pdf.

[xii] Davis, M., S. Clemmer. 2014. *Power Failure: How Climate Change Puts Our Electricity at Risk – and What We Can Do.* Cambridge, MA: Union of Concerned Scientists. Online at https://www.ucsusa.org/sites/default/files/legacy/assets/documents/Power-Failure-How-Climate-Change-Puts-Our-Electricity-at-Risk-and-What-We-Can-Do.pdf.

[xiii] Rogers, J., K. Averyt, S. Clemmer, M. Davis, F. Flores-Lopez, P. Frumhoff, D. Kenney, J. Macknick, N. Madden, J. Meldrum, J. Overpeck, S. Sattler, E. Spanger-Siegfried, and D. Yates. 2013. *Water-smart power: Strengthening the U.S. electricity system in a warming world*. Cambridge, MA: Union of Concerned Scientists. Online at

https://www.ucsusa.org/sites/default/files/legacy/assets/documents/clean_energy/Water-Smart-Power-Full-Report.pdf.

[xiv] Silverstein, A., R. Gramlich, M Goggin. 2018. *A Customer-focused Framework for Electric System Resilience.* Grid Strategies, LLC. Online at https://gridprogress.files.wordpress.com/2018/05/customer-focused-resilience-final-050118.pdf.

[xv] Goggin, M. 2017. DOE study: *Markets and infrastructure key to electric reliability and resilience*. American Wind Energy Association. Online at https://www.awea.org/Awea/media/Resources/Publications%20and%20Reports/White%20Papers/AWEA-White-Paper-8-24-17.pdf.

[xvi] Houston, T., J. Larson, and P. Marsters. 2017. *The Real Electricity Reliability Crisis.* Boston, MA: Rhodium Group. Online at https://rhg.com/research/the-real-electricity-reliability-crisis-doe-nopr/.

[xvii] Clarke, L., L. Nichols, R. Vallario, M. Hejazi, J. Horing, A.C. Janetos, K. Mach, M. Mastrandrea, M. Orr, B.L. Preston, P. Reed, R.D. Sands, and D.D. White. 2018. *Sector Interactions, Multiple Stressors, and Complex Systems. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II* [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 638–668. Online at https://nca2018.globalchange.gov/chapter/complex-systems.

[xviii] Spanger-Siegfried, E., J. Funk, R. Cleetus, M. Deas, J. Christian-Smith. 2016. *Toward Climate Resilience: A Framework and Principles for Science-Based Adaptation.* Cambridge, MA: Union of Concerned Scientists. Online at https://www.ucsusa.org/sites/default/files/attach/2016/06/climate-resilience-framework-and-principles.pdf.

[xix] Rogers Gibson, J. 2017. *Built to Last: Challenges and Opportunities for Climate-Smart Infrastructure in California.* Cambridge, MA: Union of Concerned Scientists. Online at https://www.ucsusa.org/sites/default/files/attach/2017/11/gw-whitepaper-smart-infrastructure.pdf.

[xx] Sarhadi, A., M. C. Ausín, M. P. Wiper, D. Touma, N. S. Diffenbaugh. 2018. Multidimensional risk in a nonstationary climate: Joint probability of increasingly severe warm and dry conditions. Sci. Adv. 4, eaau3487 (2018). Online at https://advances.sciencemag.org/content/4/11/eaau3487/tab-pdf.

[xxi] Moftakhari, H., J.E. Schubert, A. AghaKouchak, R.A. Matthew, B.F. Sanders. 2019. Linking statistical and hydrodynamic modeling for compound flood hazard assessment in tidal channels and estuaries. Advances in Water Resources V. 128, p. 28-38 (June 2019). Online at https://doi.org/10.1016/j.advwatres.2019.04.009.

[xxii] US Department of Energy. 2017. *Ensuring Electricity System Reliability, Security, and Resilience: Quadrennial Energy Review: Transforming the Nation's Electricity System: The Second Installment of the QER, Chapter IV*. U.S. Department of Energy, Washington, DC, pp. 4-1 to 4.68. Online at https://www.energy.gov/sites/prod/files/2017/02/f34/Chapter%20IV--Ensuring%20Electricity%20System%20Reliability%2C%20Security%2C%20and%20Resilience.pdf.

[xxiii] See, for example: Argonne National Laboratory Resilient Infrastructure Initiative (online at https://www.gss.anl.gov/resilient-infrastructure-initiative/), the Grid Modernization Lab Consortium (online at https://www.energy.gov/grid-modernization-initiative-0/grid-modernization-lab-consortium), and the Office of Electricity's development of a resilience model for North America's energy sector infrastructure (online at https://www.energy.gov/oe/articles/developing-resilience-model-north-america-s-energy-sector-infrastructure).