

173 FERC ¶ 61,243  
UNITED STATES OF AMERICA  
FEDERAL ENERGY REGULATORY COMMISSION

Before Commissioners: James Danly, Chairman;  
Neil Chatterjee, and Richard Glick.

Virtualization and Cloud Computing Services

Docket No. RM20-8-000

ORDER DIRECTING INFORMATIONAL FILING

(Issued December 17, 2020)

1. On February 20, 2020, the Commission issued a Notice of Inquiry (NOI) seeking comments on the potential benefits and risks associated with the use of virtualization and cloud computing services in association with bulk electric system (BES) operations.<sup>1</sup> The Commission also sought comments on whether barriers exist in the Commission-approved Critical Infrastructure Protection (CIP) Reliability Standards that impede the voluntary adoption of virtualization or cloud computing services.

2. As discussed below, there is general agreement in the NOI comments that the voluntary use of virtualization and cloud computing could provide significant benefits to users, owners and operators of the Bulk-Power System so long as the risks associated with these technologies are carefully addressed. Without pre-judging their outcomes, we believe that the two North American Electric Reliability Corporation (NERC) standard drafting projects addressing virtualization and data storage (i.e., BES Cyber System Information (BCSI)) with third parties will facilitate the use of virtualization and cloud

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<sup>1</sup> *Virtualization and Cloud Computing Services*, 170 FERC ¶ 61,110 (2020) (Notice of Inquiry). Virtualization is the process of creating virtual, as opposed to physical, versions of computer hardware to minimize the amount of physical computer hardware resources required to perform various functions. *Id.* P 4. Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. *Id.* P 7.

computing by clarifying their compliance treatment in the CIP Reliability Standards.<sup>2</sup> We recognize, however, that some commenters advocate for even greater use of virtualization and cloud computing than what is currently being considered by the NERC standard drafting teams. Accordingly, as discussed below, we direct NERC to make an informational filing that considers the feasibility of modifying the CIP Reliability Standards to facilitate the voluntary use of virtualization and cloud computing for purposes beyond data storage (i.e., to perform BES reliability operating services), as well as the status and schedule for any plans to modify the standards by NERC.<sup>3</sup> We direct NERC to submit this informational filing by January 1, 2022.

## **I. Background**

### **A. Notice of Inquiry**

3. The NOI sought comment on four topics: (A) scope of potential use of virtualization and cloud computing services; (B) potential benefits and risks associated with virtualization and cloud computing services; (C) potential impediments to adopting virtualization and cloud computing services; and (D) potential use of new and emerging technologies in the current CIP Reliability Standards framework.<sup>4</sup> The NOI indicated that the Commission would use information in the comments to determine whether it would be appropriate, pursuant to section 215(d)(5) of the Federal Power Act, to direct NERC to develop modifications to the CIP Reliability Standards to facilitate the voluntary adoption of virtualization and cloud computing services by registered entities.<sup>5</sup>

4. Concurrently with the NOI, the Commission issued an order (Scheduling Order) directing NERC to submit a schedule and quarterly updates for NERC Project 2016-02 and Project 2019-02 (collectively, NERC Projects).<sup>6</sup>

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<sup>2</sup> NERC Project 2016-02 (Modifications to CIP Standards) and Project 2019-02 (BES Cyber System Information Access Management).

<sup>3</sup> See Notice of Inquiry, 170 FERC ¶ 61,110 at P 16 (identifying certain reliability operating services).

<sup>4</sup> *Id.* at P 14.

<sup>5</sup> *Id.* at P 3; 16 U.S.C. § 824o(d)(5).

<sup>6</sup> *North American Electric Reliability Corp.*, 170 FERC ¶ 61,109 (2020).

## **B. Comments and Reply Comments**

5. The Commission received 26 comments and three reply comments, generally supporting the voluntary use of virtualization and cloud computing services provided the risks associated with these technologies are mitigated.

6. NERC supports the use of virtualization, including to perform the BES reliability operating services identified in the NOI, if appropriate controls are implemented to mitigate the potential risks.<sup>7</sup> NERC cautions that virtualization may create risks to data security and increases the complexity of systems by adding layers of technology, which can make it more difficult to spot anomalies or unusual events happening on the network and the virtual machine. NERC states, however, that it has observed registered entities using virtualization and successfully mitigating known risks. In addition, NERC states that it supports the use of cloud computing for storage of BCSI. NERC identifies four risks related to cloud computing generally: (1) data security; (2) quality of service and resiliency; (3) ERO Enterprise oversight; and (4) infrastructure and operations. However, NERC contends that these risks can be appropriately mitigated in the context of third-party data storage. Moreover, NERC observes that some responsible entities already use cloud computing services for data storage, including BCSI storage.<sup>8</sup>

7. Other commenters generally agree with NERC's view that virtualization and data storage, including BCSI storage, with third parties can be implemented while addressing the risks associated with those technologies. The comments also support providing more clarity in the CIP Reliability Standards to mitigate compliance risk. MISO Transmission Owners state, for example, that there are no significant technical challenges to implementing virtualization, but there is compliance risk.<sup>9</sup> Public Power Trade Associations note that some of its members have encountered auditors who do not understand virtualization and therefore recommend against its use or are unwilling to confirm that virtualized configurations would be compliant with the CIP Reliability

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<sup>7</sup> BES reliability operating services include dynamic response to BES conditions, balancing load and generation, controlling frequency (real power), controlling voltage (reactive power), managing constraints, monitoring and control, restoration of BES, situational awareness, and inter-entity real-time coordination and communication. Notice of Inquiry, 170 FERC ¶ 61,110 at P 16.

<sup>8</sup> NERC Comments at 5, 6, 8-12.

<sup>9</sup> MISO Transmission Owners Comments at 17.

Standards.<sup>10</sup> ISO/RTO Council (IRC) states that many registered entities have not fully deployed virtualization technologies due to the potential compliance risks.<sup>11</sup> The National Rural Electric Cooperative Association (NRECA) maintains that a compliance challenge may arise from the need for a registered entity to provide evidence to show how it is meeting the CIP Reliability Standards.<sup>12</sup>

8. The NOI comments contain less consensus on performing BES reliability operating services in the cloud at this time. NERC indicates that it could support the use of cloud computing for purposes other than BCSI storage, such as BES reliability operating services, if appropriate protections are adopted to mitigate the risks and vulnerabilities.<sup>13</sup> While NERC contends that the same risks associated with BCSI storage also apply to the performance of BES reliability operating services in the cloud, NERC's comments suggest that these risks are more acute for BES reliability operating services. NERC also indicates that it has not seen registered entities use cloud computing for BES reliability operating services, but NERC acknowledges that "certain support services are increasingly being offered through cloud computing services."<sup>14</sup>

9. NRECA, Public Power Trade Associations, Edison Electric Institute (EEI), IRC and the Canadian Electricity Association (CEA), among others, identify benefits to adopting cloud computing technology for BES reliability operating services. Public Power Trade Associations state that potentially all BES reliability operating services that are system-based could be moved to the cloud and that cloud services offer technological advancements, sophistication and cost savings, including security features that may not otherwise be available to all utilities, particularly smaller entities.<sup>15</sup> EEI explains that cloud services could eliminate system downtime and improve patching and user administration.<sup>16</sup> NRECA states that cloud computing resources are more easily scalable to best fit the environment, allowing the entity to pay only for what is necessary

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<sup>10</sup> The American Public Power Association and the Large Public Power Council (collectively, Public Power Trade Associations) filed joint comments; Public Power Trade Associations Comments at 13.

<sup>11</sup> IRC Comments at 11.

<sup>12</sup> NRECA Comments at 15.

<sup>13</sup> NERC Comments at 8-12.

<sup>14</sup> *Id.* at 8.

<sup>15</sup> Public Power Trade Associations Comments at 5.

<sup>16</sup> EEI Comments at 13, 16.

and easily or rapidly expand capability based on changing demand. NRECA also states that the cloud potentially can provide improved security over what a smaller utility might be able to have in a non-cloud environment.<sup>17</sup>

10. MISO Transmission Owners and NRECA state that while BES reliability operating services could be implemented in a virtualized environment, the full range of services should not be implemented in the cloud.<sup>18</sup> CEA states that it prefers that real-time BES operations be kept within the registered entity's direct control. Among the risks, CEA raises concerns about the potential consequences of cloud unavailability.<sup>19</sup>

### **C. NERC's Reliability Standard Projects Schedule**

11. In response to the Scheduling Order, NERC filed an initial schedule on March 19, 2020 for the NERC Projects and three subsequent updates. In the most recent update filed on November 13, 2020, NERC indicates that it anticipates filing Reliability Standards resulting from the NERC Projects in December 2021.

12. NERC explains that the Project 2016-02 standard drafting team is considering modifications to five CIP Reliability Standards and their associated definitions,<sup>20</sup> as well as conforming changes to other Reliability Standards, to address permitted architecture and the security risks of virtualization technologies. In addition, NERC states that, because entities already use virtualized technologies on-premise or plan to implement them, NERC is preparing a Compliance Monitoring and Enforcement Program (CMEP) Practice Guide that addresses virtualization on-premise (Virtualization CMEP Practice Guide) to provide direction to CMEP staff, including auditors, on audit and compliance assessment approaches under the currently-effective CIP Reliability Standards. NERC maintains that the Virtualization CMEP Practice Guide will provide clarity on how CMEP staff will verify compliance in light of virtualized technologies and highlight the

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<sup>17</sup> NRECA Comments at 9.

<sup>18</sup> *Id.* at 5-6; MISO Transmission Owners at 13-14.

<sup>19</sup> CEA Comments at 3,7.

<sup>20</sup> NERC November 13, 2020 Informational Filing at 3 (identifying Reliability Standards CIP-004-6 (Personnel & Training), CIP-005-6 (Electronic Security Perimeter(s)), CIP-006-6 (Physical Security of BES Cyber Systems), CIP-007-6 (System Security Management), and CIP-010-3 (Configuration Change Management and Vulnerability Assessments)).

types of information CMEP staff may review to assess compliance and reliability risk. NERC notes that it plans on issuing the Virtualization CMEP Practice Guide by February 2021.<sup>21</sup>

13. NERC maintains that Project 2019-02 includes proposed modifications to currently-enforceable Reliability Standards CIP-004-6 (Personnel and Training) and CIP-011-2 (Information Protection) and is intended to facilitate the use of third-party data storage and analysis systems by clarifying the minimum protections expected when a responsible entity utilizes these solutions.<sup>22</sup>

## II. Discussion

### A. NERC Reliability Standard Projects

14. We support NERC's effort to reassess the CIP Reliability Standards to facilitate the adoption of virtualization and cloud computing and relieving registered entities of compliance uncertainties. However, consistent with the precept that the Reliability Standards are technology-neutral, virtualization and cloud computing should continue to be voluntary to allow registered entities to consider the deployment of these new technologies, their system needs, and applicable security requirements.<sup>23</sup>

15. Based on these considerations, we support the completion of the NERC Projects based on the schedules provided in the November 13, 2020 Informational Filing, which target the filing of proposed Reliability Standards with the Commission in December 2021. We also support NERC's interim step to issue a Virtualization CMEP Practice Guide by February 2021. We believe that issuance of the Virtualization CMEP Practice Guide will provide more certainty to registered entities utilizing virtualization technologies on-premise and mitigate the compliance risk associated with their use. The anticipated proposed Reliability Standards coupled with NERC's Virtualization CMEP Practice Guide should provide a more comprehensive regulatory framework designed to ensure system reliability while facilitating the voluntary adoption of new technologies.

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<sup>21</sup> *Id.* at 4-5.

<sup>22</sup> *Id.* at 5-6.

<sup>23</sup> *See, e.g., Reliability Standards for Geomagnetic Disturbances*, Order No. 779, 143 FERC ¶ 61,147, at P 81, *reh'g denied*, 144 FERC ¶ 61,113 (2013) (acknowledging that Reliability Standards should be technology neutral).

**B. Virtualization and Cloud Computing for BES Reliability Operating Services and Other Uses**

16. The NOI comments suggest that the use of cloud computing could be expanded for purposes other than BCSI storage, such as for performing BES reliability operating services. However, NERC and other commenters express concern with moving such functions to the cloud at present.

17. As with BCSI storage, cloud utilization for BES reliability operating services or other uses may offer benefits, including cost savings and enhanced security and resiliency features that may be otherwise unavailable to some registered entities, particularly smaller entities.<sup>24</sup> Despite these benefits, we agree with NERC that facilitating BES operations in the cloud should be carefully evaluated prior to developing new, or modifying existing, Reliability Standards. To ensure that such evaluation occurs, we direct NERC to begin a formal process to assess the feasibility of voluntarily conducting BES operations in the cloud in a secure manner and to make an informational filing by January 1, 2022 that evaluates potential modifications to the CIP Reliability Standards to facilitate expanded use of the cloud, including to perform BES operations. The informational filing should report on any new or future NERC standard drafting projects, their status and schedule.

18. The NOI comments discuss various aspects of expanded cloud usage, including ensuring quality of service (e.g., reliable communication networks), resiliency (e.g., registered entity reliance on one major cloud provider creating a single point of failure and registered entities' having adequate on-site back-up capability), and compliance oversight (e.g., creating compliance processes that accommodate the use of third-party cloud service providers, such as the Federal Risk and Authorization Management Program).

19. In developing the informational filing, NERC should consider the NOI comments, including the security objectives to mitigate risks by entities voluntarily using virtualization implemented off-premises and cloud computing; potential for the use of BES reliability operating services data and the storage or use of BCSI outside the registered entity's country; evaluation criteria for the selection of cloud service providers for use by the electric industry; allowing registered entities to conduct their own reliability risk assessments to determine what BES reliability operating services and other services can be securely performed in the cloud; and establishing a clear dividing line between the security responsibilities of the cloud service provider and the registered entity. NERC's informational filing should also consider whether establishing a new audit process, which could provide auditors access to cloud service providers' facilities,

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<sup>24</sup> Public Power Trade Associations Comments at 5.

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is necessary to ensure that registered entities that elect to use cloud service providers are in compliance with all applicable CIP Reliability Standards.

The Commission orders:

NERC is directed to begin a formal process to assess the feasibility of voluntarily conducting BES operations in the cloud in a secure manner and to make an informational filing by January 1, 2022, as discussed in the body of this order.

By the Commission. Commissioner Clements is not participating.

( S E A L )

Kimberly D. Bose,  
Secretary.



Document Content(s)

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