Manual 03A, Rev. 24
Energy Management System (EMS) Model Updates and Quality Assurance (QA)

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Power System Modeling Department

Reliability Standards & Compliance Subcommittee

Jan 11, 2024

First Read Summary

- Quick Fix
- Section 2.2.2, 2.3.1
  - Remove all Compliance Bulletin 14 references
- Appendix C
  - Reference NERC-approved BES definitions
  - Remove Compliance Bulletin 14 obsolete references and provide further clarity relating to BES equipment

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Compliance Bulletin 14

- Purpose: The purpose of this Compliance Bulletin (CB) is to describe the process PJM members are to use to notify PJM of any change in the status of PJM Member Bulk Electric System (BES) elements as a result of the application of the NERC-approved BES definition effective July 1, 2014.

- Recommendation: Retire the Compliance bulletin.

Section 2.2.1, and 2.3.1

2.3.1 Prepare Initial BES Data to Denote BES Elements of the System

- TOs staff perform an initial review of existing systems to assess what is to be included or excluded to the current list of BES elements and provide necessary documentation to NERC.[3]
- TOs review existing systems to identify areas of existing systems operated between 50 and 100 kV. Facilities under 50 KV are deemed to not warrant modeling[4].
- If facilities between 50 kV and 100 kV are 'networked', providing alternate flow paths to higher voltage equipment, TOs are to provide modeling and analysis details to PJM for joint assessment to determine if the system should be in the PJM EMS model. Assessment includes analysis provided by TO staff.

2.4 PJM Congestion Management Facilities

Facilities under PJM Congestion Management (or Reliability & Markets) Control

Note:
In this manual, the terms Congestion Management and Reliability & Markets will be used interchangeably.

PJM has developed standards that TOs must follow in order for PJM to operate generation to control loading or voltage on transmission facilities. See M-03, Transmission Operations, Section 1.

After all of the updates are made in eDART, the spreadsheets on PJM.com will reflect updated changes. To access the Transmission Facilities page, login to PJM.com and click Markets & Operations > Systems Operations. Under the Transmission section, click link for 'Transmission

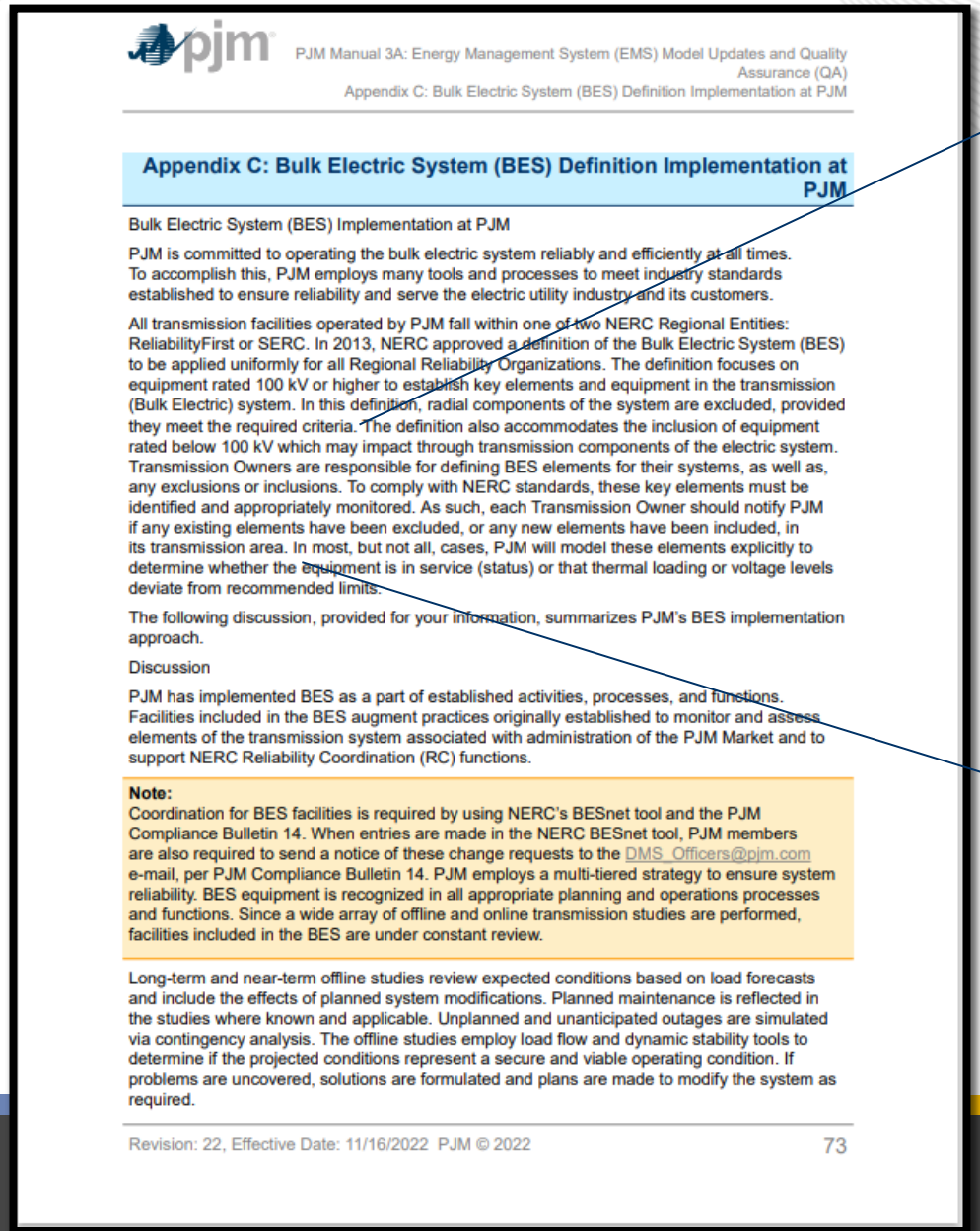
[3] Refer to **Compliance Bulletin 14: Definition of Bulk Electric System (BES) – PJM Member Requirements at** https://pjm.com/-/media/library/whitepapers/compliance/cb014-bulk-electric-system-definition-pjm-member-requirements.ashx?la=en

[4] See NERC technical guide for low voltage facilities loop threshold at http://www.nerc.com/pa/RAPA/BES/BESExceptionEvaluationGuideline2-4-14REMGApp.pdfhttp://www.nerc.com/pa/RAPA/BES/BESExceptionEvaluationGuideline2-4-14REMGApp.pdf

- Remove Compliance Bulletin 14 reference and hyperlink from footers

~~Refer to Compliance Bulletin 14: Definition of Bulk Electric System (BES) – PJM Member Requirements at https://pjm.com/-/media/library/whitepapers/compliance/cb014-bulk-electricsystem-definition-pjm-member-requirements.ashx?la=en~~

Appendix C: Bulk Electric System (BES) Definition Implementation at PJM



PJM Manual 3A: Energy Management System (EMS) Model Updates and Quality Assurance (QA)
Appendix C: Bulk Electric System (BES) Definition Implementation at PJM

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Bulk Electric System (BES) Implementation at PJM

PJM is committed to operating the bulk electric system reliably and efficiently at all times. To accomplish this, PJM employs many tools and processes to meet industry standards established to ensure reliability and serve the electric utility industry and its customers.

All transmission facilities operated by PJM fall within one of two NERC Regional Entities: ReliabilityFirst or SERC. In 2013, NERC approved a definition of the Bulk Electric System (BES) to be applied uniformly for all Regional Reliability Organizations. The definition focuses on equipment rated 100 kV or higher to establish key elements and equipment in the transmission (Bulk Electric) system. In this definition, radial components of the system are excluded, provided they meet the required criteria. The definition also accommodates the inclusion of equipment rated below 100 kV which may impact through transmission components of the electric system. Transmission Owners are responsible for defining BES elements for their systems, as well as, any exclusions or inclusions. To comply with NERC standards, these key elements must be identified and appropriately monitored. As such, each Transmission Owner should notify PJM if any existing elements have been excluded, or any new elements have been included, in its transmission area. In most, but not all, cases, PJM will model these elements explicitly to determine whether the equipment is in service (status) or that thermal loading or voltage levels deviate from recommended limits.

The following discussion, provided for your information, summarizes PJM's BES implementation approach.

Discussion

PJM has implemented BES as a part of established activities, processes, and functions. Facilities included in the BES augment practices originally established to monitor and assess elements of the transmission system associated with administration of the PJM Market and to support NERC Reliability Coordination (RC) functions.

Note:
Coordination for BES facilities is required by using NERC's BESnet tool and the PJM Compliance Bulletin 14. When entries are made in the NERC BESnet tool, PJM members are also required to send a notice of these change requests to the DMS_Officers@pjm.com e-mail, per PJM Compliance Bulletin 14. PJM employs a multi-tiered strategy to ensure system reliability. BES equipment is recognized in all appropriate planning and operations processes and functions. Since a wide array of offline and online transmission studies are performed, facilities included in the BES are under constant review.

Long-term and near-term offline studies review expected conditions based on load forecasts and include the effects of planned system modifications. Planned maintenance is reflected in the studies where known and applicable. Unplanned and unanticipated outages are simulated via contingency analysis. The offline studies employ load flow and dynamic stability tools to determine if the projected conditions represent a secure and viable operating condition. If problems are uncovered, solutions are formulated and plans are made to modify the system as required.

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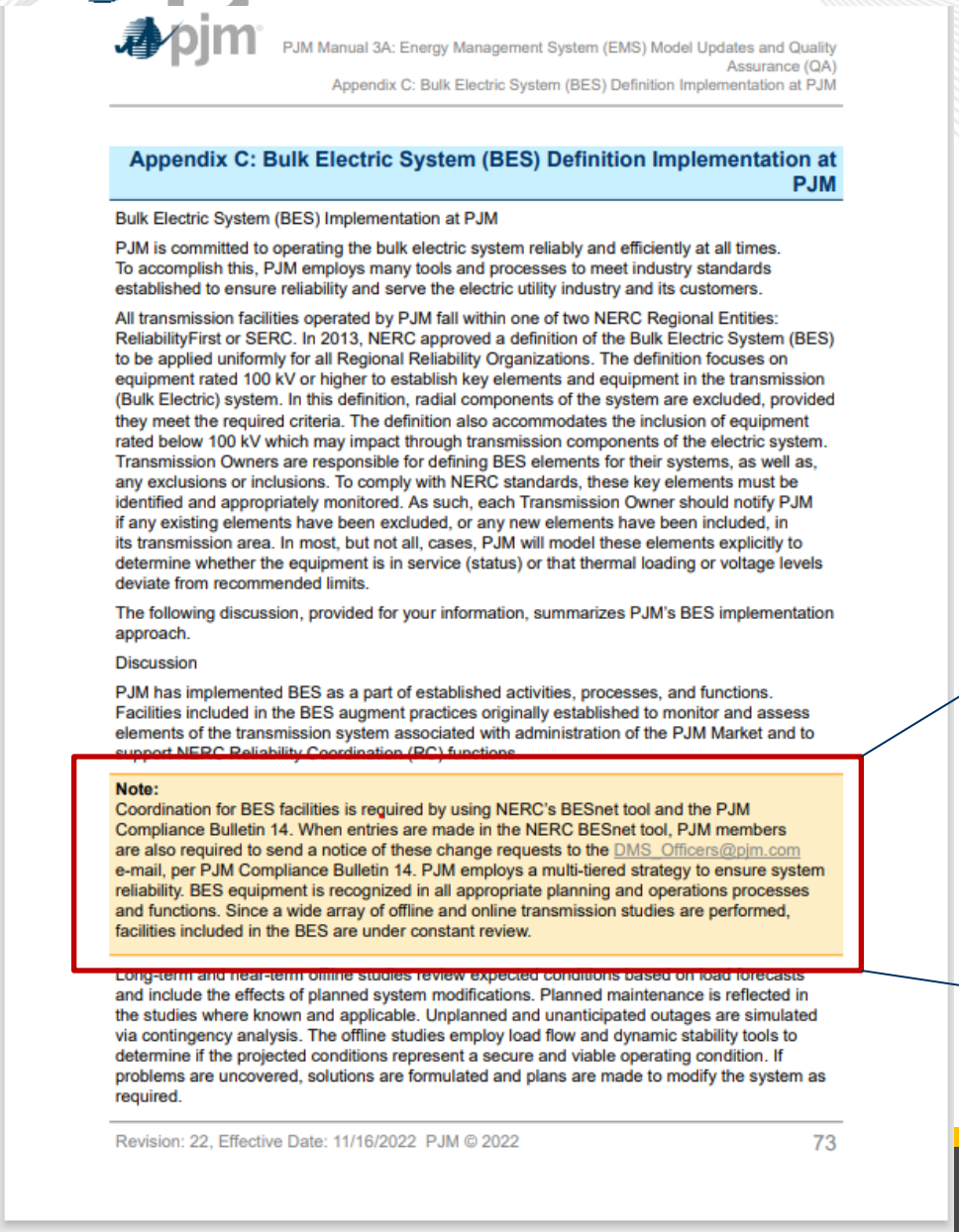
Appendix C: Bulk Electric System (BES) Definition Implementation at PJM



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- Applicable changes are relatively rare.
- Process is covered in Manual 3A Appendix C (page 73):

"Coordination for BES facilities is required by using NERC's BESnet tool ~~and the PJM Compliance Bulletin 14~~. When entries are made in the NERC BESnet tool, PJM members are also required to send a notice of these change requests to the DMS_Officers@pjm.com."

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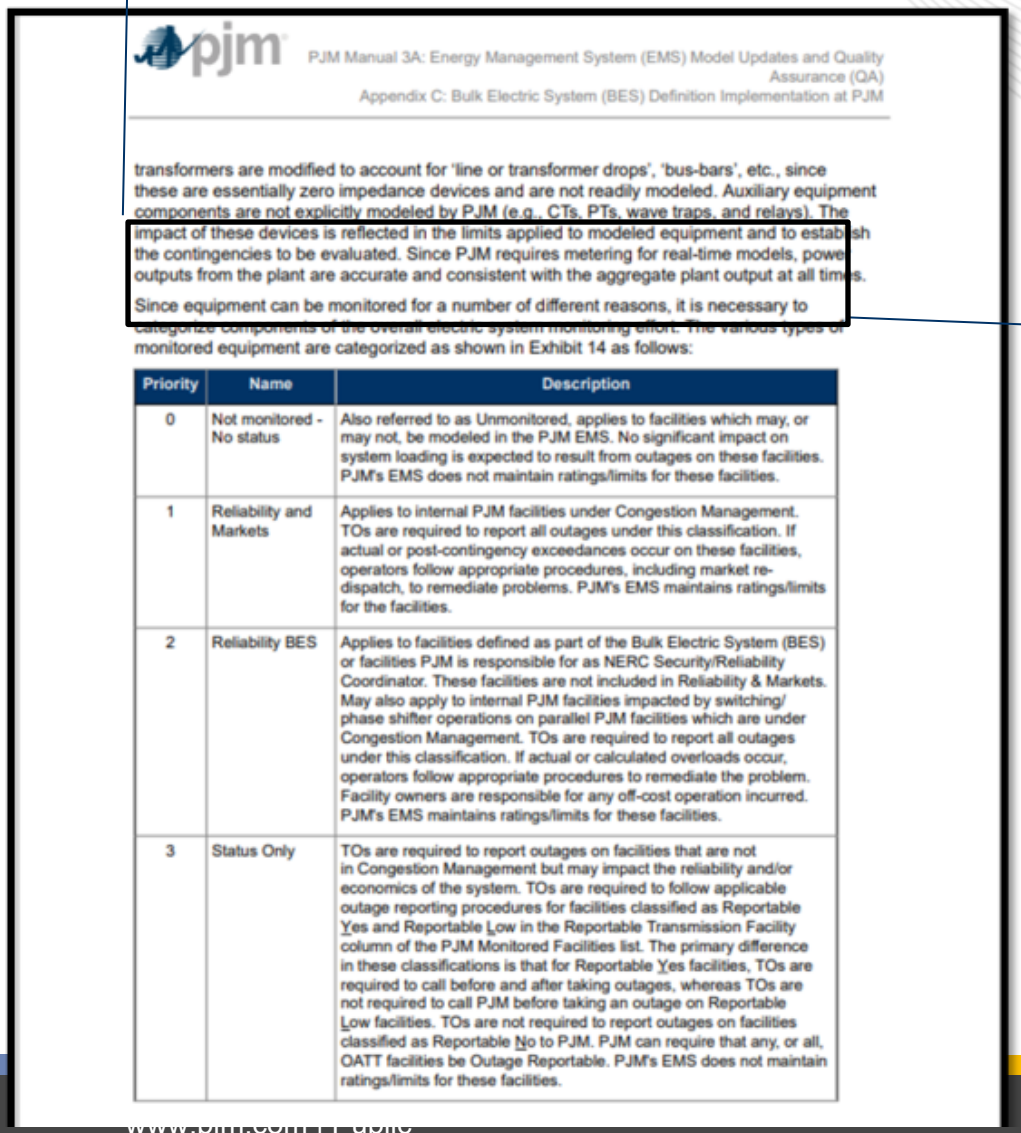

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transformers are modified to account for 'line or transformer drops', 'bus-bars', etc., since these are essentially zero impedance devices and are not readily modeled. Auxiliary equipment components are not explicitly modeled by PJM (e.g., CTs, PTs, wave traps, and relays). The impact of these devices is reflected in the limits applied to modeled equipment and to establish the contingencies to be evaluated. Since PJM requires metering for real-time models, power outputs from the plant are accurate and consistent with the aggregate plant output at all times.

Since equipment can be monitored for a number of different reasons, it is necessary to categorize components of the overall electric system monitoring effort. The various types of monitored equipment are categorized as shown in Exhibit 14 as follows:

Priority	Name	Description
0	Not monitored - No status	Also referred to as Unmonitored, applies to facilities which may, or may not, be modeled in the PJM EMS. No significant impact on system loading is expected to result from outages on these facilities. PJM's EMS does not maintain ratings/limits for these facilities.
1	Reliability and Markets	Applies to internal PJM facilities under Congestion Management. TOs are required to report all outages under this classification. If actual or post-contingency exceedances occur on these facilities, operators follow appropriate procedures, including market re-dispatch, to remediate problems. PJM's EMS maintains ratings/limits for the facilities.
2	Reliability BES	Applies to facilities defined as part of the Bulk Electric System (BES) or facilities PJM is responsible for as NERC Security/Reliability Coordinator. These facilities are not included in Reliability & Markets. May also apply to internal PJM facilities impacted by switching/ phase shifter operations on parallel PJM facilities which are under Congestion Management. TOs are required to report all outages under this classification. If actual or calculated overloads occur, operators follow appropriate procedures to remediate the problem. Facility owners are responsible for any off-cost operation incurred. PJM's EMS maintains ratings/limits for these facilities.
3	Status Only	TOs are required to report outages on facilities that are not in Congestion Management but may impact the reliability and/or economics of the system. TOs are required to follow applicable outage reporting procedures for facilities classified as Reportable Yes and Reportable Low in the Reportable Transmission Facility column of the PJM Monitored Facilities list. The primary difference in these classifications is that for Reportable Yes facilities, TOs are required to call before and after taking outages, whereas TOs are not required to call PJM before taking an outage on Reportable Low facilities. TOs are not required to report outages on facilities classified as Reportable No to PJM. PJM can require that any, or all, OATT facilities be Outage Reportable. PJM's EMS does not maintain ratings/limits for these facilities.

The various types of monitored equipment are categorized as shown in Exhibit 14. Please note, overlap may exist between Monitored Priority 1 and Monitored Priority 2, in which case Monitored Priority 1 should be used. The list of priorities is as follows:

Appendix C: Bulk Electric System (BES) Definition Implementation at PJM

transformers are modified to account for 'line or transformer drops', 'bus-bars', etc., since these are essentially zero impedance devices and are not readily modeled. Auxiliary equipment components are not explicitly modeled by PJM (e.g., CTs, PTs, wave traps, and relays). The impact of these devices is reflected in the limits applied to modeled equipment and to establish the contingencies to be evaluated. Since PJM requires metering for real-time models, power outputs from the plant are accurate and consistent with the aggregate plant output at all times.

Since equipment can be monitored for a number of different reasons, it is necessary to categorize components of the overall electric system monitoring effort. The various types of monitored equipment are categorized as shown in Exhibit 14 as follows:

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1	Reliability and Markets	Applies to internal PJM facilities under Congestion Management. TOs are required to report all outages under this classification. If actual or post-contingency exceedances occur on these facilities, operators follow appropriate procedures, including market re-dispatch, to remediate problems. PJM's EMS maintains ratings/limits for the facilities.
2	Reliability BES	Applies to facilities defined as part of the Bulk Electric System (BES) or facilities PJM is responsible for as NERC Security/Reliability Coordinator. These facilities are not included in Reliability & Markets. May also apply to internal PJM facilities impacted by switching/ phase shifter operations on parallel PJM facilities which are under Congestion Management. TOs are required to report all outages under this classification. If actual or calculated overloads occur, operators follow appropriate procedures to remediate the problem. Facility owners are responsible for any off-cost operation incurred. PJM's EMS maintains ratings/limits for these facilities.
3	Status Only	TOs are required to report outages on facilities that are not in Congestion Management but may impact the reliability and/or economics of the system. TOs are required to follow applicable outage reporting procedures for facilities classified as Reportable Yes and Reportable Low in the Reportable Transmission Facility column of the PJM Monitored Facilities list. The primary difference in these classifications is that for Reportable Yes facilities, TOs are required to call before and after taking outages, whereas TOs are not required to call PJM before taking an outage on Reportable Low facilities. TOs are not required to report outages on facilities classified as Reportable No to PJM. PJM can require that any, or all, OATT facilities be Outage Reportable. PJM's EMS does not maintain ratings/limits for these facilities.

(Priority):1 (Name): Reliability and Markets

Applies to internal PJM facilities under Congestion Management, this includes both BES and non-BES facilities.

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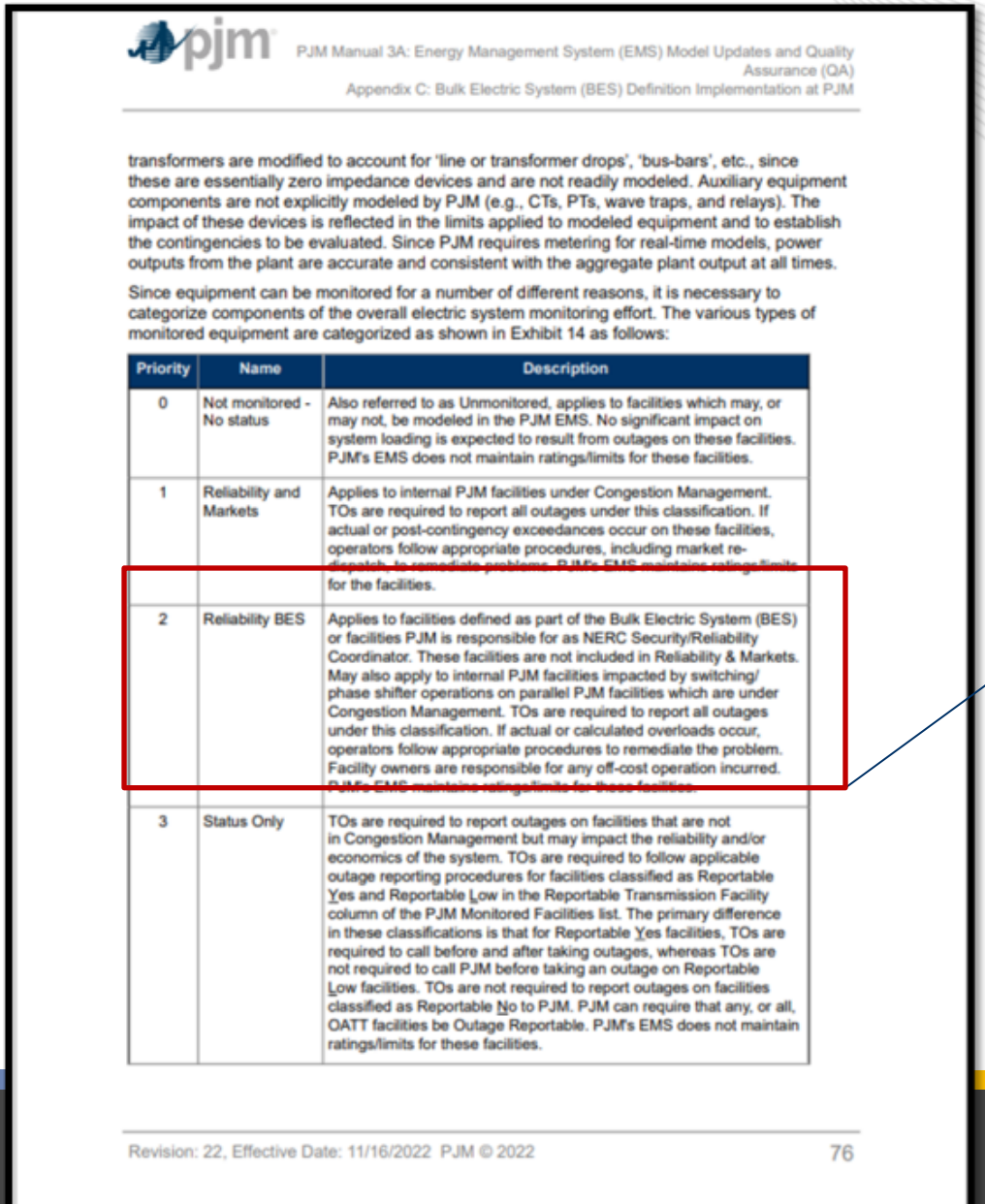

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Since equipment can be monitored for a number of different reasons, it is necessary to categorize components of the overall electric system monitoring effort. The various types of monitored equipment are categorized as shown in Exhibit 14 as follows:

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1	Reliability and Markets	Applies to internal PJM facilities under Congestion Management. TOs are required to report all outages under this classification. If actual or post-contingency exceedances occur on these facilities, operators follow appropriate procedures, including market re-dispatch, to remediate problems. PJM's EMS maintains ratings/limits for the facilities.
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3	Status Only	TOs are required to report outages on facilities that are not in Congestion Management but may impact the reliability and/or economics of the system. TOs are required to follow applicable outage reporting procedures for facilities classified as Reportable Yes and Reportable Low in the Reportable Transmission Facility column of the PJM Monitored Facilities list. The primary difference in these classifications is that for Reportable Yes facilities, TOs are required to call before and after taking outages, whereas TOs are not required to call PJM before taking an outage on Reportable Low facilities. TOs are not required to report outages on facilities classified as Reportable No to PJM. PJM can require that any, or all, OATT facilities be Outage Reportable. PJM's EMS does not maintain ratings/limits for these facilities.

(Priority): 2 (Name): Reliability BES

Applies to facilities defined as part of the Bulk Electric System (BES) (i.e., 100 kV or above, or exclusions as allowed by NERC, as defined in the NERC Glossary of Terms) or facilities PJM is responsible for as NERC Security/Reliability Coordinator.

Appendix C: Bulk Electric System (BES) Definition Implementation at PJM

Priority	Name	Description
4	External Reliability	Similar to priority 2 but non-PJM facilities. These external facilities could impact the PJM system as part of Market-to-Market Congestion Management flow-gate coordination between adjacent RTOs. PJM's EMS maintains ratings/limits for these facilities.
5	External Status Only	Similar to priority 3 but applies to external, non-PJM facilities. PJM's EMS does not maintain ratings/limits for these facilities.
6	Reliability Non-BES	Similar to priority 2 but applies to facilities that may be monitored for loading by PJM but are not included as Markets & Reliability or BES facilities. Facilities are generally included in this category at the request of the transmission owner. TOs are required to follow applicable outage reporting procedures for facilities classified as Reportable Yes and Reportable Low in the Reportable Transmission Facility column of the PJM Monitored Facilities list. If actual or calculated overloads occur, operators develop remedial strategies in cooperation with the facility owner. Corrective strategies are implemented as approved by the owner. Owners assume responsibility for off-cost operation. PJM's EMS maintains ratings/ limits for these facilities.
7	Generation Equipment	Similar to priority 2, but applies to generation equipment. Facility owners are responsible for costs incurred to remediate problems. TOs are required to follow applicable outage reporting procedures for facilities classified as Reportable Yes and Reportable Low in the Reportable Transmission Facility column of the PJM Monitored Facilities list. PJM's EMS maintains ratings/limits for these facilities.
8	Pending	Applies to facilities that are candidates for, but not yet approved, inclusion in Reliability & Markets or facilities that are modeled but not yet in-service.
	General Notes: Doc #331840	For Security Analysis, PJM the EMS is typically set to monitor all facilities with priority 1 through 5. As required, these settings are changed to include the remaining facility categories. These facility classifications are utilized in PJM planning and operations.

Exhibit 14: List of Monitored Priorities

Note:
The specific requirements associated to Reportable Yes, Low, and No are detailed in Manual 03 Transmission Operations, Section 1.5.4 'Reportable Transmission Facility'.

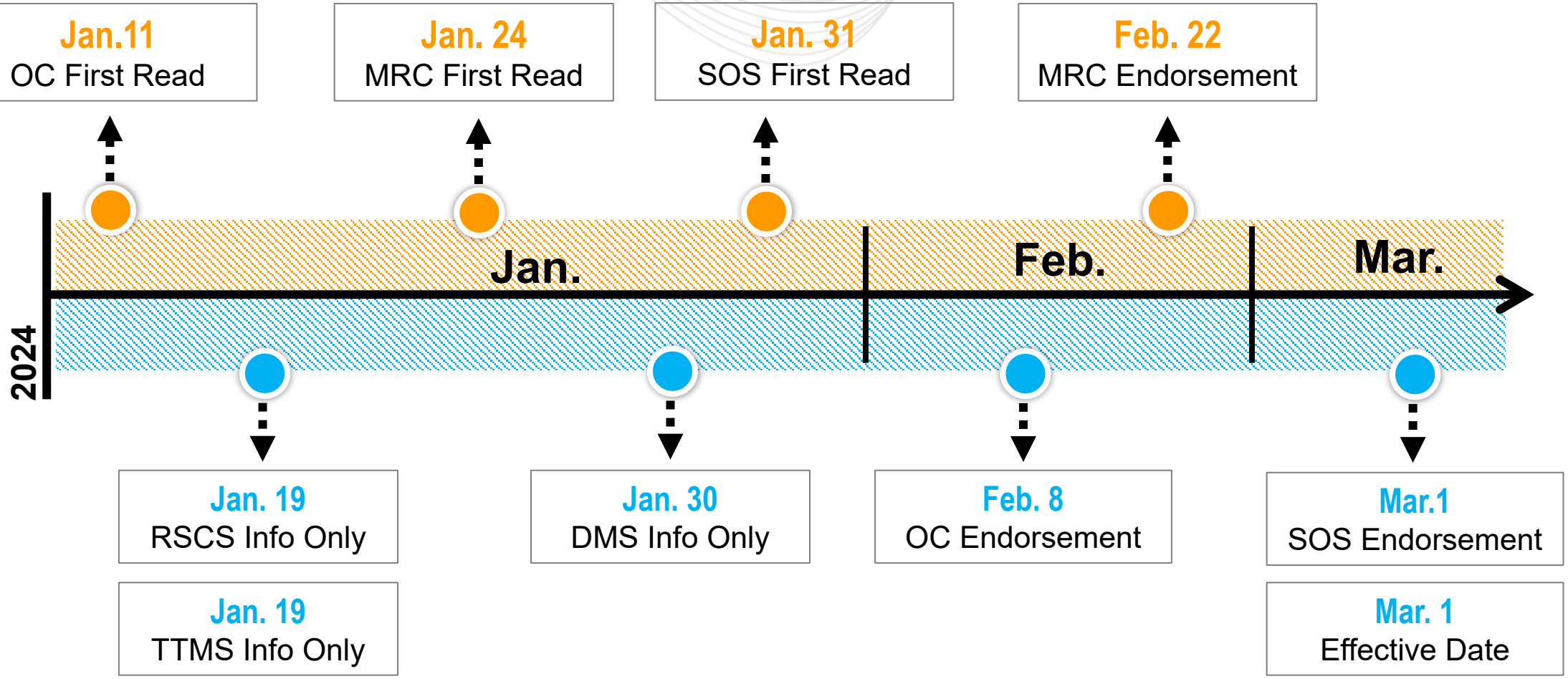
Any BES facility limitations which cannot be modeled or approximated readily by PJM can typically be monitored by adjusting major equipment limits. When this is not feasible, PJM works with TOs to develop appropriate mechanisms to avoid potential problems.

PJM's analysis of the electric system is not limited to equipment identified as part of the BES. In addition to fully integrating, qualifying BES electric system components into all analyses, PJM

(Priority): 6 (Name): Non-BES

~~Similar to priority 2 but a~~ Applies to facilities that may be monitored for loading by PJM but are not BES elements and are not included as priority 1 or BES facilities.

Manual 03A, Rev 24 Review / Approval Timeline



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