

---

## Project QC-2020-01

### TPL-007-3 – Transmission System Planned Performance for Geomagnetic Disturbance Events

---

#### 1. OVERVIEW OF THE STANDARDS

##### 1.1. Applicability

TPL-007-3 standard applies to the following set of functions and facilities:

**Functions covered:**

- Planning Coordinator (PC)
- Transmission Planner (TP)
- Transmission Owner (TO)
- Generator Owner (GO)

**Facilities covered:**

Facilities that include power transformer(s) with a high side, wye-grounded winding with terminal voltage greater than 200 kV.

- Requirements R5, R6, R9 and R10 refer to GO and TO that owns an applicable Main Transmission System (RTP) transformer.

##### 1.2. Purpose of the Reliability Standard

The purpose of proposed Reliability Standard TPL-007-3 – Transmission System Planned Performance for Geomagnetic Disturbance Events is to establish requirements for Transmission system planned performance during geomagnetic disturbance (GMD) events. The continent-wide Requirements remain unchanged from the prior version of the standard.

The proposed standard builds upon the revisions reflected in TPL-007-2 and further improves the standard by including a new Canadian variance for Canadian registered entities. This variance provides an option by which Canadian registered entities may leverage operating experience, observed GMD effects, and ongoing research to define alternative, technically justified benchmark GMD events or supplemental GMD planning event(s) for their GMD Vulnerability Assessments. The reliability benefits of such an approach are that it would allow an entity to develop a better understanding of the system impacts it is likely to experience as a result of such an event and the types of corrective actions that would best address them. This variance also recognizes the unique regulatory frameworks specific to Canadian jurisdictions, particularly with respect to provincial processes for approving investments identified in Corrective Action Plans (CAP).

Proposed standard TPL-007-3 requires responsible entities to complete a benchmark GMD Vulnerability Assessment and a supplemental GMD Vulnerability Assessment of the Near-Term Transmission Planning Horizon. It also requires responsible entities to conduct assessments of the potential impact of benchmark and supplemental GMD events on their systems.

The standard requires benchmark transformer thermal impact assessments to be performed on power transformers with high side, wye-grounded windings with terminal voltage greater than 200 kV, when the maximum effective geomagnetically-induced current (GIC) in the transformer is 75 A per phase or greater as determined by the benchmark GIC analysis of the system.

The standard further requires supplemental transformer thermal impact assessments to be performed on power transformers with high side, wye-grounded windings with terminal voltage greater than 200 kV, when the maximum effective geomagnetically-induced current (GIC) in the transformer is 85 A per phase or greater as determined by the supplemental GIC analysis of the system.

Transformers are exempt from the benchmark thermal impact assessment requirement if the maximum effective geomagnetically-induced current (GIC) in the transformer is less than 75 A per phase as determined by GIC analysis of the system. Similarly, transformers are exempt from the supplemental thermal impact assessment requirement if the maximum effective geomagnetically-induced current (GIC) in the transformer is less than 85 A per phase as determined by GIC analysis of the system.

Each responsible entity that concludes through their benchmark GMD Vulnerability Assessment that their System does not meet the performance requirements for the steady state planning benchmark GMD event shall develop a Corrective Action Plan (CAP) addressing how the performance requirements will be met.

### 1.3. Regulatory Context

This is the first regulatory filing to the Régie de l'énergie ( "the Régie") to approve Reliability Standard TPL-007-3 and its associated violation risk factors and violation severity levels, implementation plan, and effective dates. TPL-007-3 is an evolution of versions 1 and 2 with the addition of a variance for Canadian registered entities.

The proposed implementation plan of TPL-007-3 extends over a 5-year period, identical to the initial TPL-007-1 NERC implementation plan. Effective dates for each requirements have been adjusted to implement the Standard as soon as possible while harmonizing with the TPL-007-1 and TPL-007-2 NERC implementation plans.

The following summarizes the regulatory context of Standard TPL-007. For more details, please refer to the complete TPL-007-3 NERC filing sent to the Régie on February 20, 2019.<sup>1,2</sup>

---

1. February 20, 2019, Notice of Filing of NERC Proposed Reliability Standard TPL-007-3 (Quebec) to the Régie, consulted online on January 29, 2020, at : <https://www.nerc.com/FilingsOrders/ca/Canadian%20Filings%20and%20Orders%20DL/Quebec%20TPL-007-3%20filing.pdf>

2. February 20, 2019, Appendix to Notice of Filing of NERC Proposed Reliability Standard TPL-007-3 (Quebec) to the Régie, consulted online on January 29, 2020, at <https://www.nerc.com/FilingsOrders/ca/Canadian%20Filings%20and%20Orders%20DL/Exhibits%20for%20TPL-007-3.pdf>

The Federal Energy Regulatory Commission (FERC) in Order No. 779<sup>3</sup>, directs NERC to implement the directive in two stages. In the first stage, NERC must submit one or more Reliability Standards that require owners and operators of the Bulk-Power System (BPS) to develop and implement operational procedures to mitigate the effects of GMDs consistent with the reliable operation of the Bulk-Power System. In the second stage, NERC must submit one or more Reliability Standards that require owners and operators of the Bulk-Power System to conduct initial and on-going assessments of the potential impact of benchmark GMD events on Bulk-Power System equipment and the Bulk-Power System as a whole.

Note that in this document and in NERC documents, BPS refers to Energy Policy Act section 215<sup>4</sup> and the NERC Glossary of Terms definition<sup>5</sup>

#### i. Reliability Standard TPL-007-1

On March 3, 2015, NERC submitted a filing to the Régie regarding Reliability Standard TPL-007-1.<sup>6,7</sup> On May 3, 2016, NERC submitted supplemental information<sup>8</sup> and on June 29, 2016, NERC also submitted supplemental information to the filing.<sup>9,10</sup>

Reliability standard TPL-007-1 requires applicable entities to conduct initial and ongoing assessments of the potential impact of a 1-in-100 year benchmark GMD event on Bulk Power System (“BPS”) equipment and the BPS as a whole. On September 22, 2016, the U.S. FERC approved Reliability Standard TPL-007-1 in Order No. 830<sup>11,12</sup>. In approving the standard, FERC stated that it “constitutes an important step in addressing the risks posed by GMD events to the BPS.”

3. Reliability Standards for Geomagnetic Disturbances, Order No. 779, 143 FERC 61,147, Reliability Standard for Transmission System Planned Performance for Geomagnetic Disturbance Events, Order No. 779, 143-FERC 61,147, consulted online on January 29, 2020, at <https://www.ferc.gov/whats-new/comm-meet/2013/051613/E-5.pdf>

4. FERC Bulk-power system (BPS) definition, section 215, page 349, consulted online on January 29, 2020, at <https://www.ferc.gov/enforcement/enforce-res/EPAct2005.pdf>

5. NERC Glossary of Terms Used in NERC Reliability Standards, Bulk-power system (BPS) definition, page 8, consulted online on January 29, 2020, at [https://www.nerc.com/files/glossary\\_of\\_terms.pdf](https://www.nerc.com/files/glossary_of_terms.pdf)

6. March 3, 2015, Notice of Filing of NERC of Proposed Reliability Standard TPL-007-1 Transmission System Planned Performance for Geomagnetic Disturbance Events (Quebec) to the Régie, consulted online on January 29, 2020, at <https://www.nerc.com/FilingsOrders/ca/Canadian%20Filings%20and%20Orders%20DL/Quebec%20GMD%20Supplemental%20Filing.pdf>

7. March 3, 2015, Attachments to TPL-007-1 Reliability Standard, consulted online on January 29, 2020, at [https://www.nerc.com/FilingsOrders/ca/Canadian%20Filings%20and%20Orders%20DL/TPL-007-1\\_exhibits.pdf](https://www.nerc.com/FilingsOrders/ca/Canadian%20Filings%20and%20Orders%20DL/TPL-007-1_exhibits.pdf)

8. May 3, 2016, Supplemental Information of NERC of Proposed Reliability Standard TPL-007-1 (Quebec) to the Régie, consulted online on January 29, 2020, at <https://www.nerc.com/FilingsOrders/ca/Canadian%20Filings%20and%20Orders%20DL/Quebec%20Letter%20Regarding%20GMD%20Standard.pdf>

9. June 29, 2016, Supplemental Information of NERC of Proposed Reliability Standard TPL-007-1 (Quebec) to the Régie, consulted online on January 29, 2020, at <https://www.nerc.com/FilingsOrders/ca/Canadian%20Filings%20and%20Orders%20DL/Quebec%20GMD%20Supplemental%20Filing.pdf>

10. June 29, 2016, Attachments to TPL-007-1 Filing, consulted online on January 29, 2020, at [https://www.nerc.com/FilingsOrders/ca/Canadian%20Filings%20and%20Orders%20DL/GMD%20Supplemental%20Filing\\_EXHIBITS.pdf](https://www.nerc.com/FilingsOrders/ca/Canadian%20Filings%20and%20Orders%20DL/GMD%20Supplemental%20Filing_EXHIBITS.pdf)

11. Reliability Standard for Transmission System Planned Performance for Geomagnetic Disturbance Events, Order No. 830, 156 FERC ¶ 61,215, P 1 (2016), consulted online on January 29, 2020, at <https://www.ferc.gov/whats-new/comm-meet/2016/092216/E-4.pdf>

12. Reliability Standard for Transmission System Planned Performance for Geomagnetic Disturbance Events, rehearing denied, Order No. 830-A, 158 FERC ¶ 61,041 (2017), consulted online on January 29, 2020, at <https://www.ferc.gov/whats-new/comm-meet/2017/011917/E-14.pdf>

## ii. Reliability Standard TPL-007-2

In response to the U.S. FERC's directives in Order No. 830, NERC developed Reliability Standard TPL-007-2. As discussed in detail in NERC's February 27, 2018 filing to the Régie, Reliability Standard TPL-007-2<sup>13,14</sup> added new Requirements (R8, R9, R10, R11 and R12) for entities to assess their vulnerabilities to a second defined event, the supplemental GMD event. This supplemental GMD event was designed to account for the localized peak effects of severe GMD events on systems and equipment. The standard also contained new Requirements for the collection of geomagnetically-induced current ("GIC") and magnetometer data.

Lastly, the standard revised Requirement R7 to include deadlines for the development and completion of any necessary CAPs.

On November 15, 2018, the U.S. FERC issued Order No. 851<sup>15</sup> approving Reliability Standard TPL-007-2 and issuing directives for further standard modifications. In the order, the U.S. FERC also approved NERC's revised plan for conducting research into pertinent GMD-related topics.

## iii. Reliability Standard TPL-007-3

On February 27, 2018, staff from the Independent Electricity System Operator ("IESO") and Hydro One Networks Inc. ("Hydro One") submitted a Standard Authorization Request ("SAR") to NERC seeking to develop a Canada-specific Variance to Reliability Standard TPL-007-2<sup>16</sup>. In early 2018, NERC initiated Project 2018-01 Canadian-specific Revisions to TPL-007-2. The purpose of this project was to consider revisions to Reliability Standard TPL-007-2 that would:

- Allow entities from Canadian jurisdictions to define and implement alternative benchmark and supplemental GMD planning events for performing GMD vulnerability assessments, in lieu of the benchmark and supplemental GMD events defined in the standard; and
- Account for regulatory approval processes in place in some Canadian jurisdictions to implement capital improvements identified in CAPs.

NERC appointed a standard drafting team consisting of subject matter experts from several Canadian provinces to develop a variance to TPL-007-2.<sup>17</sup> The TPL-007-2 standard with the new variance was assigned standard version number TPL-007-3 achieved 100 percent approval rating with 80.43 percent quorum. The associated implementation plan achieved 100 percent approval rating with 79.1 percent quorum. The NERC Board of Trustees adopted the proposed standard on February 7, 2019. Requirements for U.S. Entities are unchanged from TPL-007-2, and TPL-007-3 superseded TPL-007-2 in U.S. jurisdictions in July 2019.

---

13. Notice of Filing of NERC of Proposed Reliability Standard TPL-007-2 (Quebec), consulted online on January 29, 2020, at <https://www.nerc.com/FilingsOrders/ca/Canadian%20Filings%20and%20Orders%20DL/Quebec%20TPL-007-2%20Filing.pdf>

14. Appendix to Notice of Filing of NERC of Proposed Reliability Standard TPL-007-2 (Quebec), consulted online on January 29, 2020, at [https://www.nerc.com/FilingsOrders/ca/Canadian%20Filings%20and%20Orders%20DL/TPL-007-2\\_exhibits.pdf](https://www.nerc.com/FilingsOrders/ca/Canadian%20Filings%20and%20Orders%20DL/TPL-007-2_exhibits.pdf)

15. Geomagnetic Disturbance Reliability Standard; Reliability Standard for Transmission System Planned Performance for Geomagnetic Disturbance Events <https://www.ferc.gov/whats-new/comm-meet/2018/111518/E-3.pdf>, Order No. 851, 165 FERC ¶ 61,124, (2018), consulted online on January 29, 2020, at <https://www.ferc.gov/whats-new/comm-meet/2018/111518/E-3.pdf>

16. TPL-007-2 - Standard Authorization Request (SAR), consulted online on January 29, 2020, at <https://www.nerc.com/pa/Stand/Project201801CanadianspecificRevisionstoTPL0072/TPL-007-2%20SAR%20from%20CEA.pdf>

17. Project 2018-01 Canadian-specific Revisions to TPL-007-2 Team Roster, , consulted online on January 29, 2020, at [https://www.nerc.com/pa/Stand/Project201801CanadianspecificRevisionstoTPL0072Rel/Project%202018-01%20Roster\\_082018.pdf](https://www.nerc.com/pa/Stand/Project201801CanadianspecificRevisionstoTPL0072Rel/Project%202018-01%20Roster_082018.pdf)

**iv. NERC Project 2019-01 Modifications to TPL-007-3<sup>18</sup>**

In the Order No. 851, FERC directed NERC to file a revised standard by July 2020 (12 months following the TPL-007-3 effective date) to:

- Require CAPs to mitigate vulnerabilities from the TPL-007-2 supplemental GMD event; and
- Implement a process for authorizing case-by-case extensions of CAP mitigation deadlines.

Proposed Reliability Standard TPL-007-4 achieved a 78.95 percent approval rating with 94.52 percent quorum. The proposed Reliability Standard TPL-007-4 will be submitted for approval to NERC Board of Trustees (BOT) in February 2020. Filing with Regulators is planned for March 2020.

**1.4. Proposed Effective Dates**

The effective date for TPL-007-1 was July 1, 2017 in the United States.

The effective date for TPL-007-3 was July 1, 2019 in the United States. In the United States, TPL-007-2 came into effect simultaneously with TPL-007-3 and its Canadian variance. The FERC approved text is TPL-007-2.

The standard drafting team identified the need for a longer implementation period for compliance with the specific of the proposed Reliability Standard. This phased-in compliance is detailed in Table 1. The dates shown represent the dates by which entities must comply with each specific Requirement.

The proposed effective date adoption date for TPL-007-3 in Québec is October 1, 2020. The standard shall become effective on the first day of the first calendar quarter that is three (3) months after the adoption date by the Régie, thus January 1, 2021. The proposed implementation plan for TPL-007-3 in Québec is over a 60-month period, similar to TPL-007-1 implementation plan in the United States.

For neighbouring entities, the effective date for compliance with all requirements of TPL-007-3 is January 1, 2024. Since Québec must harmonize the standard with neighbouring entities, TPL-007-3 must be adopted in a timely manner.

---

18. NERC Project 2019-01 Modifications to TPL-007-3 web page, consulted online on January 29, 2020, at <https://www.nerc.com/pa/Stand/Pages/Project2019-01ModificationstoTPL-007-3.aspx>

**Table 1 – Compliance dates in the U.S. with proposed dates for Québec**

| Requirement             | Compliance Date in the United States | Proposed Compliance Date in Québec   | Rationale <sup>19</sup>   |
|-------------------------|--------------------------------------|--|---|
| TPL-007-1 - R1          | July 1, 2017 <sup>20</sup>           | NA   | Implement Standard as soon as possible.<br><br>In the Québec Interconnection there is only one PC and one TP<br>Three (3) months less than the six (6) months for neighbouring entities allowed (TPL-007-1) |
| TPL-007-3 - R1          | July 1, 2019                         | First day of the first calendar quarter that is three months after adoption by the Régie |   |
| TPL-007-1 - R2          | July 1, 2018 <sup>21</sup>           | NA   | Implement Standard as soon as possible.<br><br>Three (3) months less than the 18 months for neighbouring entities (TPL-007-1)   |
| TPL-007-3 - R2          | July 1, 2019                         | First day of the first calendar quarter that is 15 months after adoption by the Régie    |   |
| TPL-007-1 - R5          | January 1, 2019                      | NA   | Harmonize practices and implementation plan with neighbouring entities (TPL-007-1)  |
| TPL-007-3 - R5 and R9   | January 1, 2020                      | First day of the first calendar quarter that is 24 months after adoption by the Régie    |   |
| TPL-007-3 R11 and R12   | July 1, 2021                         | First day of the first calendar quarter that is 30 months after adoption by the Régie    | Harmonize practices and implementation plan with neighbouring entities (TPL-007-2)  |
| TPL-007-3 R6 and R10    | January 1, 2022                      | First day of the first calendar quarter that is 48 months after adoption by the Régie    | Harmonize practices and implementation plan with neighbouring entities (TPL-007-1)  |
| TPL-007-1 R3 and R4     | January 1, 2022                      | NA   | Harmonize practices and implementation plan with neighbouring entities (TPL-007-1), and that R8 is effective simultaneously with R3 and R4 (TPL-007-2)  |
| TPL-007-3 R3, R4 and R8 | January 1, 2023                      | First day of the first calendar quarter that is 60 months after adoption by the Régie    |   |
| TPL-007-1 - R7          | January 1, 2022                      | NA   | Implement Standard as soon as possible. Neighbouring entities effective date is 12 months after R4 and R8 (TPL-007-2). For TPL-007-1, R7 was effective simultaneously with R3 and R4                        |
| TPL-007-3 R7            | January 1, 2024                      | First day of the first calendar quarter that is 60 months after adoption by the Régie    |   |

19. Based on TPL-007-1 and TPL-007-2 implementation plans for neighbouring entities as appropriate

20. TPL-007-1 effective date was January 1, 2017. Effective date for R1 was July 1, 2017

21. TPL-007-1 effective date was January 1, 2017. Effective date was for R2 was July 1, 2018

### 1.5. Standards or Requirements to withdraw

None

### 1.6. Modifications to the Glossary

New Glossary definitions are proposed to ensure consistent interpretation of the NERC standard.

| Term  | Acronym    | Definition  |
|---|------------|---|
| Geomagnetic Disturbance Vulnerability Assessment and GMD Vulnerability Assessment | <b>GMD</b> | Documented evaluation of potential susceptibility to voltage collapse, Cascading, or localized damage of equipment due to geomagnetic disturbances.<br><br><small>Source : Glossary of Terms Used in NERC Reliability Standards</small>   |
| Reactive Power  |            | The portion of electricity that establishes and sustains the electric and magnetic fields of alternating-current equipment. Reactive Power must be supplied to most types of magnetic equipment, such as motors and transformers. It also must supply the reactive losses on transmission facilities. Reactive Power is provided by generators, synchronous condensers, or electrostatic equipment such as capacitors and directly influences electric system voltage. It is usually expressed in kilovars (kvar) or megavars (Mvar).<br><br><small>Source : Glossary of Terms Used in NERC Reliability Standards</small> |
| Real Power  |            | The portion of electricity that supplies energy to the Load.<br><br><small>Source : Glossary of Terms Used in NERC Reliability Standards</small>  |

## 2. ASSESSMENT OF RELEVANCE

The proposed Reliability Standard TPL-007-3 satisfies the reliability standards criteria and is just, reasonable, not unduly discriminatory or preferential, and in the public interest. The proposed reliability standard builds upon the improvements reflected in the prior version of the TPL-007 standard and incorporates a new variance option for Canadian registered entities. This variance option maintains the rigour of the continent-wide requirements by continuing to require entities to assess their vulnerabilities to GMD planning events of a 1-in-100 year severity. The variance differs from the continent-wide approach in that it allows applicable Canadian entities to use regionally specific data to develop GMD planning events for their planning areas in lieu of the benchmark and supplemental GMD events defined in the standard. The variance also recognizes some differences in Canadian jurisdictions relating to regulatory approval for capital investments identified in CAPs. The purpose of proposed reliability standard TPL-007-3, is to establish requirements for transmission system planned performance during geomagnetic disturbance (GMD) events. The continent-wide requirements remain unchanged from the prior version of the standard. These modifications are as relevant in Québec as elsewhere in North America.

In accordance with the agreement signed in 2009 between the Régie, NERC and the NPCC and with the authorization of the Québec government,<sup>22</sup> this standard was developed and approved by external agencies in North America, including Québec. In the opinion of the Reliability Coordinator, this standard is relevant for system reliability in Québec and the standard contributes to harmonization with neighbouring systems.

### 3. PRELIMINARY IMPACT ASSESSMENT

This section presents the Reliability Coordinator's preliminary impact assessment.

| TPL-007-3                      | Low | Moderate | High |
|--------------------------------|-----|----------|------|
| Implementation of the standard |     | X        |      |
| Enforcement of the standard    |     |          | X    |
| Compliance monitoring          |     | X        |      |

**Legend:**

- Low:** Normal industry practice that only requires minor adjustments to existing processes or practices.
- Moderate:** Change that requires allocation of some physical, human or financial resources to implement the proposed standard, maintain it or monitor its compliance.
- High:** Change that requires allocation of significant physical, human or financial resources to plan and implement the proposed standard, maintain it or monitor its compliance.

### 4. FINAL IMPACT ASSESSMENT

This section shall be completed upon receipt of the impact assessment forms and at the conclusion of the consultation process prior to filing of reliability standards with the Régie.

---

22. Agreement entered into in accordance with Order-in-Council 443-2009 dated April 8, 2009.