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December 12, 2018

*To: NPCC Member Representatives and Alternates*  
*Subject: Strategic Review of the NPCC Regional Reliability Criteria*

Ladies and Gentlemen:

The final report on a high level Strategic Review of the NPCC Regional Reliability Criteria was accepted by the Reliability Coordinating Committee on December 4<sup>th</sup> and the Regional Standards Committee on December 6<sup>th</sup>. As an attachment to this letter, the report is being distributed to the NPCC Membership for their information and reference as future revisions to NPCC Criteria are considered.

This Strategic Review was conducted in response to a request by the NPCC Board of Directors to determine if there is still a need for NPCC's Regionally-specific, more stringent Criteria given the overall enhancements and strengthening of the NERC Reliability Standards.

The report is organized according to broad reliability functions and provides an assessment of the NPCC Criteria in the areas of Planning, Operations and Protection. The NPCC Task Forces on Coordination of Planning, Coordination of Operation, System Protection and System Studies provided comments and were engaged in the report's development, as well as responses to several comments submitted by various entities.

The Strategic Review report concludes that the NPCC Criteria clearly contribute to the reliable design, operation, and resilience of the international, interconnected Northeastern North American Bulk Power System within NPCC. Additionally, the report recommends that during the Task Forces' regular reviews of each Directory, an additional evaluation that considers the incremental reliability benefit of the Criteria, should be undertaken and the results of such a review should be documented. Such reviews should also consider whether the specific Criteria requirements add value to reliability and if so, is this the most cost effective means of achieving the reliability benefit?

The final report will also be posted on the NPCC website for information. Additionally, the RCC will be accepting any comments on the Strategic Review and will incorporate identified reliability concerns in its future work plans as appropriate.

Thank you,

*Edward A. Schwerdt*

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NPCC President and CEO



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## Strategic Review of the NPCC Regional Reliability Criteria



Presented to the Reliability Coordinating Committee – December 4, 2018

Presented to the Regional Standards Committee – December 6, 2018



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# Strategic Review of the Northeast Power Coordinating Council, Inc.

## Regional Reliability Criteria<sup>1</sup>

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<sup>1</sup> “Criteria” as the term is used in this report include the criteria specifically identified and listed as criteria in each NPCC Directory, including those Directories, which have had their criteria converted into a Requirements format. The Requirements in those converted Directories are considered part of the discussions of “Criteria” in this report. Criteria will be the plural form used in the report.

## Executive Summary

This review was initiated by the NPCC Board of Directors to determine if, with the continuous enhancement and strengthening of the NERC standards, there is still a need for the Regional Criteria or is the criteria necessary to close any existing or potential reliability gaps in the NERC Reliability Standards. NPCC Staff developed this report as an initial strategic high-level review arranged by focus area (e.g. Operations, Planning, and System Protection), rather than a Directory specific or requirement-by-requirement assessment. The evaluation identifies the overarching reliability benefits of the Criteria and recommends whether NPCC should retain the Criteria within that focus area.

This report is prepared in response to the project scope (see page 22) issued by the NPCC Task Force on Coordination of Planning (TFCP) on April 30, 2018. This version of the report reflects changes to an initial draft issued for comment on June 13, 2018. Comments were received from the Task Force on Coordination of Planning (TFCP), the Task Force on Coordination of Operation (TFCO), the Task Force on System Protection (TFSP), and the Task Force on System Studies (TFSS). In summary, the Task Force responses supported the assessment that the NPCC Criteria clearly contribute to the reliable design, operation, and resilience of the NPCC Bulk Power System beyond what the NERC reliability standards require. Those responses also expressed a strong sentiment for a detailed ‘criteria by criteria’ analysis of NPCC Directories, which is beyond the scope of this report. Such an analysis should only be performed by the NPCC subject matter experts on each Task Force having jurisdiction over the respective Directories. However, during the periodic Task Force review of each Directory an additional evaluation that considers the incremental reliability benefit of the criteria should be undertaken by the Task Force having jurisdiction and the results of such a review should be documented.

This version of the report also contains proposed changes in response to comments received during the RCC and RSC comment period ending October 5, 2018 and final TFCP comments received on November 13, 2018.

The portion of the scope dealing with specific reporting requirements 1-7 for each Directory is contained in an Appendix, which provides a high-level assessment and recommendation for each Directory. Currently a number of Directories are open for review or scheduled for Task Force review in the near future under the NPCC Directory Development and Revision Manual process. If Directories are currently under review, advantage should be taken of that circumstance and the questions posed regarding relative stringency and need for criteria should be considered coincident with the currently open reviews.

Recommendations for next steps for each NPCC Directory are provided in the Conclusions and Recommendations section along with the Directory specific table in the Appendix.

Subsequent reviews of the NPCC Directories will involve the application of the revised NPCC Directory Development and Revision Manual, which will include a cost effectiveness assessment component as called for in the project scope.

## Introduction and Objective

The Northeast Power Coordinating Council, Inc. (NPCC) promotes and enhances the reliability of the international, interconnected bulk power system in Northeastern North America through its processes for governance of utility design and operation related decisions. The NPCC Criteria have been developed and supported to achieve adequate reliability performance of the NPCC Bulk Power System in the NPCC Region. This was particularly relevant and important during the period in which there were no mandatory North American reliability requirements.

This review was initiated by the NPCC Board of Directors to determine if, with the continuous enhancement and strengthening of the NERC standards, there is still a need for the Regional Criteria or whether the NPCC Criteria are necessary to close potential reliability gaps in the NERC Reliability Standards. Pursuant to the request of NPCC, the report also provides a high-level strategic review intended to identify the overarching reliability benefits of imposing the more-stringent requirements of the NPCC Criteria. The NPCC Criteria are cataloged in its Reference Directories<sup>2</sup>.

The approach of this Strategic Review is to:

1. Identify the high-level criteria attributes within each of the three focus areas<sup>3</sup> that provide a reliability benefit beyond the NERC standards.
2. Discuss the basic purpose of these Criteria within the three focus areas and indicate how they enhance reliability beyond the NERC standards<sup>4</sup>.

It is important to note that the current organization of the NPCC Directories does not strictly follow the three focus areas in terms of their content; for example, Directory #1 contains both planning and operations related Criteria.

Some NPCC Directories address operational system disturbance preparation, response and recovery directly related to resilience; an example of this is the requirement in Directory #8 regarding pressurization testing for high voltage oil filled cable systems and redundancy of support systems for control centers. Other Directories are administrative in nature, for example, Directory #6 which outlines the NPCC required components of Reserve Sharing Group Agreements, but nevertheless provides strong specific guidance for how reserve sharing is to be accomplished within NPCC.

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<sup>2</sup> Since the time of its creation in 1966, NPCC's role has evolved beyond its original purpose to provide a forum for "Coordination" between utilities. On behalf of electricity consumers, NPCC Members continue to support and develop stringent Regional Criteria for incremental reliability enhancements based on a "performance-based" analysis. NPCC traditionally gone beyond the NERC minimum "results-based" requirements through Criteria, which in the post ERO period has been permitted. In the ERO period, NPCC has adapted its Criteria to the evolving NERC mandatory standards where those standards have raised the bar toward where NPCC has stood with respect to reliability and resilience for many years.

<sup>3</sup> The three focus areas are System Protection, Planning and Operations.

<sup>4</sup> Covered in the body of the report and the Directory Appendix

## NPCC Reliability Principles

Using its membership structure and governance authority to create and apply Regional Criteria<sup>5</sup>, NPCC Members in many cases go beyond the ERO reliability “results-based” requirements approach used by NERC in standards development. For example, NPCC Criteria mandate specific design requirements for assets in NPCC Member facilities. NPCC’s approach to reliability and resilience can be summarized in Principles that guide NPCC Members in their effort to meet or exceed NERC requirements.

The NPCC reliability Principles include:

1. **Focus on the most important system components:** In order to focus resources to those portions of the power delivery system most important (critical) to overall reliability, NPCC Members employ and are updating the mechanism(s) for identifying those facilities that are most critical to the reliable planning and operation of the power delivery assets in the NPCC region<sup>6</sup>. These critical facilities collectively are identified as the NPCC Bulk Power System<sup>7</sup>.
2. **Application of Criteria beyond NERC requirements to identified critical facilities:** Where, in the opinion of NPCC’s Membership, the NERC standards do not adequately specify a necessary performance or design outcome in a given technical, operation or planning area, NPCC Criteria govern the design of their respective portions of the NPCC Bulk Power System planning and operation<sup>9</sup> activities.
3. **NPCC Members support the Criteria:** NPCC’s Full Members in accordance with the NPCC Bylaws are committed to designing and operating their systems to meet the NPCC Criteria under peer review of the NPCC Full Members.
4. **No conflict with NERC Requirements:** The NPCC Criteria supplement, improve upon where necessary, benefit, and do not conflict with or duplicate the results-based performance requirements of NERC standards where they apply to the NPCC Bulk Power System. NPCC

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<sup>5</sup> See NERC Rule of Procedure #313 on page 15 of the [NERC Rules of Procedure 3-9-2018](#).

<sup>6</sup> The method of identifying critical facilities is currently embodied in the [NPCC A-10 Classification of Bulk Power System Elements](#) document, currently under review by the CP-11 Working Group with a due date of October 31, 2018.

<sup>7</sup> The NPCC Bulk Power System is identified by a specific list of facilities in the NPCC region deemed critical by the NPCC A-10 classification process. This list is not determined based on the definition of the ERO Bulk Power System, which is defined in the US 2005 EPACT as:

“(A) facilities and control systems necessary for operating an interconnected electric energy transmission network (or any portion thereof); and

“(B) electric energy from generation facilities needed to maintain transmission system reliability.

The term does not include facilities used in the local distribution of electric energy.

<sup>8</sup> There are other documents which supplement the Directories, for instance the NPCC Compliance Guidance Statements. These documents usually refer to NERC standards applicability and can be found here: [NPCC CGS](#)

<sup>9</sup> NERC [Rule of Procedure](#) #313 (page 15) permits the following: “Regional Entities may develop Regional Criteria that are necessary to implement, to augment, or to comply with NERC Reliability Standards, but which are not Reliability Standards. Regional Criteria may also address issues not within the scope of Reliability Standards, such as resource adequacy. “

adjusts its regional Criteria to retire or adapt to any new NERC requirements as they come into effect as necessary.

5. **Include design specifications where needed:** The NPCC Criteria and related guidelines and procedures provide design criteria and practices to assure implementation. This is in contrast to NERC, which is limited through its standards requirements to only identifying a minimum “reliability result”. NPCC Directories go into greater detail regarding how to accomplish a given reliability result addressing the “how” of a given reliability result is to be achieved.
6. **Resilience has always been an element of NPCC Criteria:** Based on experience, resilience<sup>10 11</sup> is a necessary constituent component of reliability and it is important both to electricity consumers and regulatory authorities in NPCC’s footprint. NPCC Criteria provide substantial resilience benefits to the NPCC bulk power system by providing:
  - a. Robustness – The ability to withstand disturbances by supporting operations in a more secure state.
  - b. Resourcefulness – The ability to detect and manage a crisis as it unfolds.
  - c. Rapid recovery – The ability to get services back as quickly as possible in a coordinated and controlled manner.
  - d. Adaptability – The ability to absorb new lessons from events.

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<sup>10</sup> Reference NERC’s recent [filing](#) with FERC regarding Resilience for a more complete discussion of the relationship between resilience, the NERC standards and the NAICS Resilience Framework. FERC is expected to define resilience in the course of its current examination of electric system resilience concepts.

<sup>11</sup>In the US, [Presidential Policy Directive – 21](#) defines resilience as “The ability to prepare for and adapt to changing conditions and withstand and recover rapidly from disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, or naturally occurring threats or incidents”.

## NERC RISC Proposed Model of Resilience

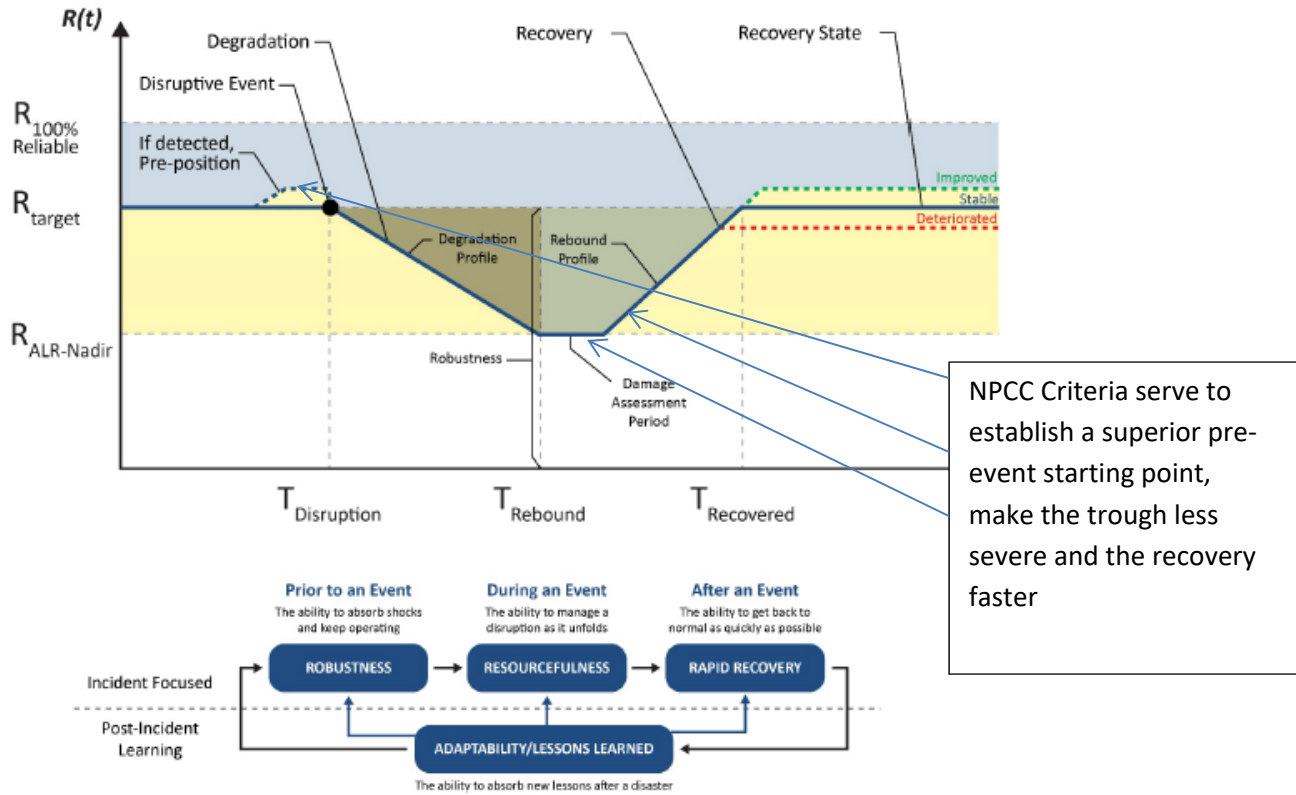


Figure 2.1

## Reliance on a Common Identification Process for Critical Facilities

A key feature of the NPCC approach to the management of its regional Criteria is that the NPCC Criteria in all three focus areas apply solely to the NPCC bulk power system<sup>12</sup>, which is largely a subset of the NERC Bulk Electric System (BES). The identification of critical facilities is conducted under a specific test method<sup>13</sup> with oversight through a peer review process using a performance-based approach. The key performance indicators are reviewed and agreed to by NPCC Members. Specific tests are designed to assess contingencies for their potential significant adverse impact outside of the local area and provide for an allowance of judgment by the Area under review for acceptable loss of load in the Area.

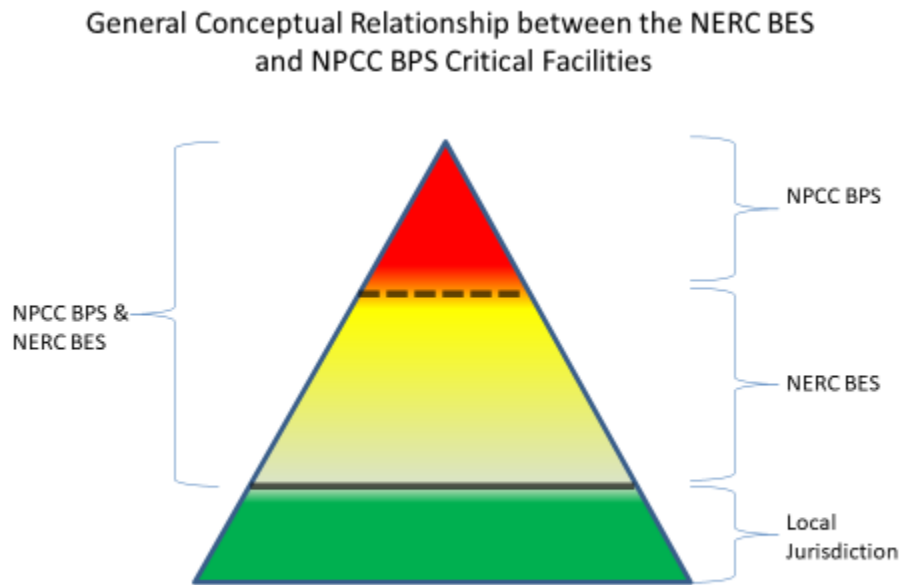
The NPCC approach relies on the successful identification of all facilities within the NPCC footprint that are “critical” to the reliable operation and planning of the power systems within the Region. This

<sup>12</sup> TFSP noted in its first round comments that some Directories are not limited to NPCC BPS facilities noting that Directory 8 applies to “key facilities” which may or may not be BPS facilities. Also, that Directory 12 applies to distribution facilities. Directory 7 applies to SPS/RAS that may or may not be at BPS facilities.

<sup>13</sup> Currently the NPCC A10 Classification of Bulk Power System Elements is used to identify the critical facilities in the NPCC region.



approach has worked well because it focuses the enhanced reliability of NPCC Criteria on the most important portions of the transmission system.



## Focus Area Attribute Assessments

### Protection Focus Area: Basic Purpose and Identification of Protection<sup>14</sup> Related NPCC Criteria

The intent of the Protection Criteria established in NPCC Directory #4 is to ensure dependable<sup>15</sup> and secure operation of the protection systems for the NPCC Bulk Power System. The principle is that for those protective relays and related systems (e.g. control wiring and teleprotection systems) intended for removal of faults from the Bulk Power System, dependability is paramount. The NPCC Members have determined that the best way to achieve that assurance of dependability is to require the application of functional redundancy and separation<sup>16</sup> techniques as specified under the Criteria in section 5 of Directory #4<sup>17</sup>. There is a strong linkage to the planning focus areas through Directory #4 Criteria 5.5 where the timing of protection system operation is governed by planning studies in Directory #1.

For protective relays installed for reasons other than fault sensing, such as overload, etc., security is paramount, and the redundancy provisions of Directory #4 do not apply. The design Criteria in this area

<sup>14</sup> Directories #4, #7 and #11 are primarily System Protection focused. There is a strong linkage between Directory #1 and Directory #4

<sup>15</sup> Dependability can be defined as a combination of Reliability, Resilience, Maintainability and Facility Availability.

<sup>16</sup> TFSP noted in comments that merely duplicating systems to achieve redundancy is discouraged. Rather, independence by variation of equipment and protection choices is valued.

<sup>17</sup> See Directory #4 Requirements 5.2, 5.8, 5.11 and 5.12 as specific examples of design Criteria.

are intended to cause the asset-owning utility to weigh the relative effect on the NPCC Bulk Power System of a failure of a protection system to operate when desired versus unintended or misoperation of the protection system. Beyond Directory #4, detailed design parameters are offered in Directories #7 and #11 to provide a common platform for all NPCC Members to achieve the foregoing result for the NPCC Bulk Power System.

Among the early NPCC decision's regarding design criteria for critical facilities, was the decision to employ functional redundancy and specific separation requirements to be used in the design of protection systems. This was done, in order to assure reliable operation of those protection systems when called upon. For those protection systems intended for removal of faults from the Bulk Power System, dependability is paramount, and the functional redundancy provisions of the Criteria apply.

Redundancy of protection and related communication systems is the long-standing technology solution specified by NPCC for its critical facilities. It is important to note however that this design choice was made at a time when protection technology was very different than it is today. Today's technology employs extensive self-monitoring and reporting that was not available when the redundant design approach was first required by NPCC for the Bulk Power System. However, at the present time, the industry is not aware of any design approach that would provide an acceptable level of security and dependability without relying on redundancy<sup>18</sup>.

#### **An Area of Less Stringency in NPCC Criteria-Protection System Security**

An area of rough equivalence to NERC standards at first glance is in the area of Protection System security. NPCC (similar to NERC) defines the desired design outcome of Protection System Operation to limit actions to the removal of only the faulted Element(s). However, NPCC adds the qualifier that within a local area there is no concern regarding reliability impact. This qualifier makes the NPCC approach less stringent than NERC.

Protection Systems in the NPCC region are required to be designed to isolate only the faulted Element, except in those circumstances where additional Elements are tripped intentionally to preserve system integrity and will not have an unacceptable reliability impact outside a local area<sup>19</sup>. If the local area qualifier were not included in the NPCC Criteria, there would be a rough equivalency with NERC's approach<sup>20</sup>.

It is important to note that where NERC standards apply, those standards do not accept a result where a reliability impact within a local area (e.g. loss of non- consequential load) is an acceptable performance outcome. The NERC regulatory framework sees the BES as a single system. NPCC in a number of its

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<sup>18</sup> TFSP noted in its comments that the benefit of self-monitoring has been captured by the retirement of Directory 3 and the evolution of PRC-005. Through addition of allowance for increased maintenance, intervals in PRC-005 the industry and NERC have recognized the improved potential for early detection of protection system failure. These improvements led to the retirement of Directory #3.

<sup>19</sup> Reference Directory #4 Criteria 5.3. The design goal of "not impacting your neighbors" is long standing within NPCC.

Criteria qualifies that not impacting neighboring areas is the key consideration and that local impacts are an engineering judgment made by the local utility and regulatory authorities having jurisdiction. NPCC is not as stringent as NERC in that respect but since the BES and the NPCC Bulk Power System overlap, the NERC requirements where they are more stringent will prevail from a planning perspective.

### Planning Focus Area: Basic Purpose and Identification of Planning<sup>21</sup> Related NPCC Criteria

Directory #1 is the cornerstone Directory for the Planning focus area. However, Directory #1 also includes a number of Operations related Criteria in conjunction with the Planning Criteria to facilitate operational planning. Since the NPCC Bulk Power System is generally a subset of the NERC BES, the NPCC Planning related Criteria are more stringent for that part of the system designated as the NPCC Bulk Power System and therefore enhances reliability.

NPCC considers the characteristics of a reliable Bulk Power System to include adequate generating resources and transmission delivery facilities to reliably meet projected customer electricity demand and energy requirements<sup>22</sup>. The objective of NPCC is to provide a “design-based approach” to design and operate the NPCC Bulk Power System to a level of reliability that will not result in the loss or unintentional separation of a major portion of the system from any of the contingencies referenced in Directory #1 (Table 1). The intent of this approach is similar to that of NERC to avoid instability, voltage collapse, and widespread cascading outages. However, a distinguishing feature of the NPCC objective, in contrast to NERC, is that with NPCC’s approach loss of small portions of a system may be tolerated provided these losses do not jeopardize the reliability of the remaining NPCC Bulk Power System. The notion of what is small is, is currently a judgment call.

NERC does have a similar but potentially more restrictive condition under TPL-001-4 footnote 12 to the performance results table that specifies planning solutions. In the US a planning solution which relies on non-consequential load loss above 75 MW is prohibited<sup>23</sup>.

### Resource Adequacy

An area where NPCC fills a reliability gap left unaddressed by NERC is the NPCC Criteria in Directory#1 R4 through R6 where NPCC has established expectations for the development of Area Resource Plans and the resource adequacy reliability performance outcome (maximum of one day in ten years, or .1 day in any year) measured as loss of load expectation due to a resource shortfall. While many utilities outside of NPCC use this industry design objective, NPCC administratively requires a comprehensive peer review every three years. This review is examined for each NPCC Area and NPCC in effect covers the resource requirements of the NERC BES also. In a sense, NPCC resource adequacy Criteria fills a reliability gap in

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<sup>21</sup> Directory #1 is the Directory containing planning related Criteria in addition to other Criteria

<sup>22</sup> Directory #1 Objective statement section 1.3.

<sup>23</sup> For example, TPL-001-4 requires corrective action plans for those protection systems that do not meet minimum redundancy criteria (which are loosely described in the standard) when, by failing to locally clear phase-to-ground faults, they have an impact outside of local area;

the NERC standards<sup>24</sup>. This is an area where NPCC has provided a basis for US state and Canadian provincial regulatory authorities with the necessary assurance that a common and reasoned approach to resource adequacy is implemented. The resource adequacy criteria serve as the vehicle through which US State and Provincial authorities fulfill their political mandates regarding resource adequacy<sup>25</sup>.

In Transmission Planning, the NPCC Transmission Reviews are intended to assure members in other neighboring Areas that the planning and operating activity of the Area under review will not negatively impact reliability performance in a neighboring Area.

The NERC planning paradigm is intended to assure industry stakeholders that the planning performance requirements in the NERC Standard TPL-001-4 (in Table 1) are being fulfilled and corrective action plans to achieve the reliability performance goals are actually put in place<sup>26</sup>.

In NPCC the technique for achieving this level of reliability is to require that the NPCC Bulk Power System is designed and operated to meet the performance requirements for the representative contingencies as specified in its Directory #1. Simulations are used to assess and analyze these contingencies. As a minimum, more stringent contingency events are applied on NPCC Bulk Power System elements and the resulting performance requirements are monitored on the NPCC Bulk Power System. This approach enhances reliability. Additionally, if a utility becomes aware of a contingency event outside of the NPCC Bulk Power System that results in a significant adverse impact outside of the local area, that utility must design and/or operate the system to respect that event.

### Operations Focus Area: Basic Purpose and Identification of Operations<sup>27</sup> Related NPCC Criteria

As mentioned earlier, Directory #1 contains a combination of operations and planning requirements.

The basic purpose from an operational aspect for Directory #1 is similar to planning in that the NPCC Bulk Power System is to be designed and operated to meet the performance requirements for the representative contingencies as specified in its Directory #1 Table 3. Operational planning simulations are used to assess and analyze these contingencies. As a minimum, contingency events are applied on NPCC Bulk Power System elements and the resulting performance requirements are monitored on the NPCC Bulk Power System.

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<sup>24</sup> NERC is precluded from mandating reliability outcomes through the ERO regulatory process in the resource adequacy portion of the planning function by statute under EPACT 2005. However, NERC, in conjunction with the other Regions and NPCC does perform resource adequacy assessments to alert regulatory authorities and stakeholders regarding potential resource shortfalls. NERC can cast a light on the issues, but not require remedies. NPCC Criteria set the design standard in this area.

<sup>25</sup> See NPCC BP&B at page 72

<sup>26</sup> Note that reliability assessments pursuant to TPL-001-4 are to be shared with adjacent Planning Coordinators and Transmission planners, and thus seems to achieve the same purpose as the Area Transmission Reviews required by Directory #1.

<sup>27</sup> Directories # 1, 2, 5, 6 and 8 contain operations related Criteria.

A summary of the key reliability objectives for Operators stated in the Directory #1 Criteria (R13-R19), are operating to normal transfer capabilities unless an emergency is identified, permitted pre-contingency disconnection of firm load, security-oriented evaluation of the post-contingency system adjustments and operating to the new secure state within the required time frames. Evaluation of the next contingency, related performance outcomes, allowed operator actions, and operational study conditions (notes: i through xi) is specified in Table #3 of the Directory #1.

Other Operations related Directories include Directory #2 – Emergency Operations, Directory #5- Reserve<sup>28</sup>, Directory #6- Reserve Sharing Groups, and Directory #8- System Restoration. Many of the Criteria in these Directories are resilience and recovery oriented.

The operational requirements of Directory #1 and the related Table #3 performance outcomes focus on assuring that each Reliability Coordinator and associated Transmission Operator in the NPCC Region operates to normal transfer capabilities unless an emergency in accordance with NPCC Directory# 2, is identified. Each Reliability Coordinator and Transmission Operator must continuously assess the status of the NPCC Bulk Power System immediately after the occurrence of any contingency and prepare for the next contingency as specified in Table #3 of Directory #1. These fundamental operator principles have close parallels or even equivalents to various requirements in the NERC TOP, FAC and ERO families of standards.

## Promoting Reliability beyond the NERC Standards

The basic purpose of the NPCC Criteria in all focus areas is to promote and enhance the reliability of the NPCC Bulk Power System to assure reliable performance of the most critical facilities of the Member systems in NPCC. Some high-level examples showing where NPCC Criteria provide enhanced reliability performance beyond the NERC standards are discussed below. Note that reliability includes contributions of the NPCC Criteria to resilience as identified in the NPCC Principles.

### System Protection

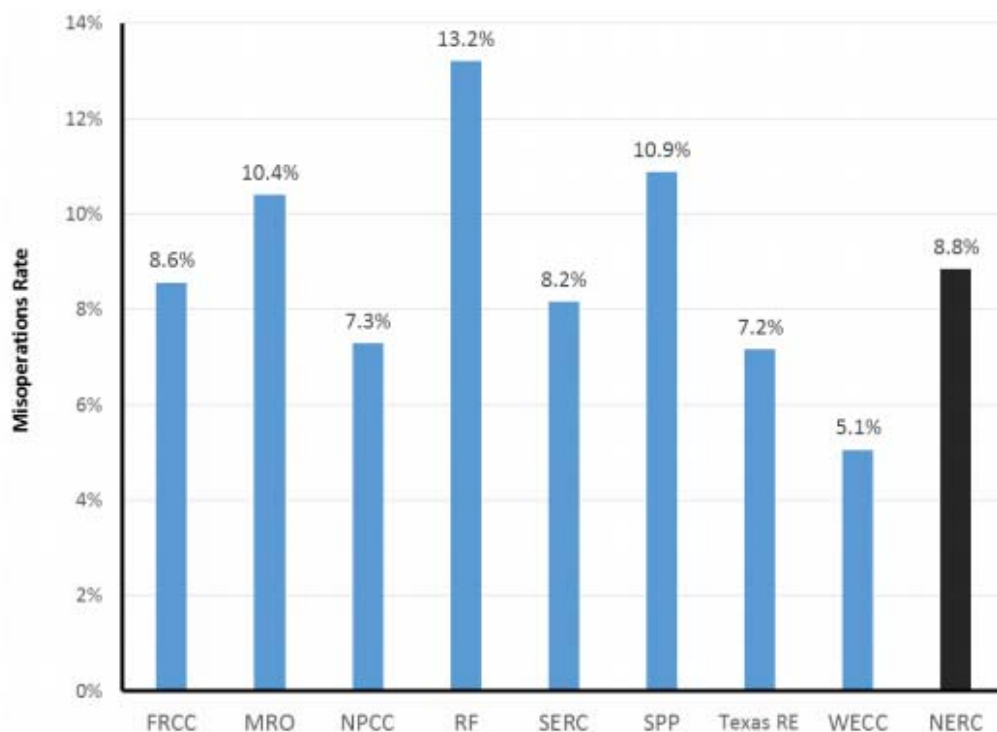
The very broad, multi-decade application of functional redundancy to the most critical portions of the system as a Protection System design requirement in NPCC enhances reliability. However, many utilities outside the NPCC region also apply functional redundancy based on their own engineering judgment, typically to their EHV systems. Outside of NPCC, this occurs on a utility by utility basis, where engineering design practice studies indicate a need for the additional dependability of protection systems.

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<sup>28</sup> Directory #5 is currently under NPCC review.

In the area of System protection, one potential performance indicator demonstrating that the NPCC protection Criteria enhances reliability beyond the NERC standards is the availability of records of misoperation performance of NPCC Protection Systems<sup>29</sup>.

Currently, based on NERC reporting of North America 2017 reliability performance, NPCC has among the lowest misoperation rates of the NERC regions<sup>30</sup>. One area to explore is to identify the contributing factors to misoperation performance in the NPCC region. Is it due to its critical facility identification process and related redundant protection system Criteria<sup>31</sup>? This may be a fruitful area for future investigation.



**Figure 3.5: Five-Year Misoperation Rate by Region (Q4 2012 through Q3 2017)**

NPCC continues its reliability enhancing practices for critical facility Protection Systems because it has not yet been shown that alternative approaches might be more reliable. NERC through its standards has

<sup>29</sup> TFSP suggest a way of investigating the correlation of Directory 4 criteria to misoperation data is to determine if there is a low number of “Failure to operate” as a result of protection system redundancy which is required in the Directory.

<sup>30</sup> See NERC 2018 State of Reliability Report for 2017, Figure 3.5 page 20: [LINK](#)

<sup>31</sup> At first glance, WECC’s 2016 misoperation performance seems to be better than NPCC’s, but it is the result of limited years of reporting at the time of the 2017 report. Also, the TRE reported results are for a very much smaller and very different island system as compared with NPCC.

not identified, nor fully implemented a better approach than NPCC, although progress is being proposed at the NERC level<sup>32</sup>.

NERC Standards do currently recognize Protection System performance as a key contributor to the reliable operation of the power system. For example, NERC's strong focus on Protection System Maintenance in PRC-005, its focus on Protection System Misoperation in PRC-004, several PRC standards focusing on relay loadability and other standards on the coordination of protection system operation between registered entities (including generator operators and owners) within the PRC family of NERC standards.

Redundancy, while not the only aspect of Protection System design, is perhaps the most contentious within the industry<sup>33</sup>. In particular, the cost of adding redundant systems to existing older substation facilities is very high, even if other work is being done.

NERC has not reached the point where its standards fully require redundancy in protection system design in order to assure reliable operation of protection systems. Utilities are currently free to use redundancy as a corrective action plan solution.

If an equally effective method of achieving a reliability result can be implemented, it is generally available for consideration under the NERC framework. NERC's practice and approach is to avoid specifying the "how" and only focus on the desired reliability result. NERC generally requires that corrective action plans be developed and implemented within its standards when the reliability performance results are not achieved. This has the benefit of leaving it to the industry to find solutions to reliability issues where they are proven to be needed and avoids regulatory over prescription of the design goals. Alternatively, it will take a very long time for the evolution of the delivery systems solely under the NERC paradigm to reach a point of equivalence in dependability of protection system performance within NPCC.

NPCC Directory #4 has a number of technical areas which delve into the "how" and are more prescriptive than NERC. These include separation of Protection Systems, multiple sources of station service, circuit breaker trip coil redundancy requirements, tele-protection separation requirements, ground grid requirements and IEC-61850 related design details. These are beneficially more stringent from a reliability perspective relative to the NERC standard requirements and reliability is enhanced as a result.

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<sup>32</sup> For example, TPL-001-4 incorporates in the P5 contingency analyses a review and corrective actions related to protection system failure. This type of failure is often remedied through the introduction of redundant protection system components. TPL-001-5 which is currently under development, is proposing to address the reliability risk of single points of protection system a step further.

<sup>33</sup> Examination of the record leading to the FERC Order #754 will show that when FERC proposed redundancy in all protection systems for the BES, the industry resisted this approach as uneconomic and unworkable. This in effect has moved NERC to a process where the need for protection system redundancy, as a reliability solution, is considered through the transmission planning process in the form of a corrective action plan under NERC TPL-001-4.

## Planning

The difference between the applicability of the NPCC Criteria to the NPCC Bulk Power System and the NERC requirements to the BES creates a difficult situation for direct comparison between the two regulatory paradigms in terms of an enhanced reliability assessment because the two sets of facilities are interdependent. There is no absolute, one to one correspondence for a comparison possible. In terms of contingency events, for the same facilities,<sup>34</sup> NPCC Criteria are generally more stringent for the NPCC Bulk Power System, enhancing reliability through more stringent planned performance outcomes.

NPCC Criteria fill an important gap in the NERC framework by supplying the resource adequacy design minimum Criteria. Additionally, NPCC has for a number of years required that such analysis is carried out using probability-based methods. In the NERC reliability assessment framework, probabilistic approaches have been implemented only in recent years<sup>35</sup>.

While NERC is currently modifying its TPL-001-4 standard<sup>36</sup> to address single points of Protection System failure as a planned contingency, even if it is successful in implementing the proposed changes, it will take many years to move systems outside of NPCC to the level of dependability currently implemented within NPCC as a result of the Directory #4 Criteria<sup>37,38</sup>. It is important to note that NPCC does not require protection system contingencies, in the sense of system design contingencies. It does require under design contingencies that the system perform acceptably regardless of which of the two required protection systems clears the fault. This is not to be interpreted as a protection system contingency, but rather it is a demonstration of acceptable system performance given the design requirement.

NPCC requires the NPCC Bulk Power System to be designed for the loss of double-circuit towers and the loss of multiple circuits resulting from the failure of a circuit breaker to operate (i.e., “stuck breaker” contingency). NERC TPL-001-4 has a similar requirement under first contingency. However, NPCC calls for meeting reliability performance requirements under a N-1-1 contingency and planning for these design contingencies helps provide for a system that is more reliable in the first instance and perhaps more resilient depending on the circumstances.

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<sup>34</sup> Where the NPCC bulk power system overlaps the NERC Bulk Electric System.

<sup>35</sup> TFCO in its comments suggests that a side by side analysis to identify similarities and differences between the methods employed by NERC and by NPCC may provide some guidance for a review of the resource adequacy criteria.

<sup>36</sup> TFSP notes that the NERC single point of failure effort is only moving to address single point of system protection failure in a limited way, sometimes using monitoring as a substitute for full redundancy.

<sup>37</sup> If the NERC TPL-001-5 results in the same level of single point of failure related reliability as the current NPCC standards, then the responsible Task force should focus on investigating if there is a need to continue to rely on NPCC criteria.

<sup>38</sup> An important historical point however is that not all NPCC BPS facilities have all the redundancies specified in Directory #4 if they were existing BPS facilities before Directory #4 was implemented.



## Operations

The difference between the applicability of the NPCC Criteria to the NPCC Bulk Power System and the NERC requirements to the BES creates a difficult situation for direct comparison between the two regulatory paradigms in terms of enhanced reliability assessment. There is no absolute, one to one correspondence for a comparison possible. In terms of operational contingency events, for the same facilities, NPCC Criteria are generally more stringent for the NPCC Bulk Power System<sup>39</sup>.

Reserve Criteria in Directory #5<sup>40</sup> provide additional requirements, which NPCC Members must meet to plan for and deploy adequate reserve. The Directory provides minimum requirements governing the amount, availability, distribution, and activation of reserve in addition to those specified in applicable NERC standards. Additionally, references to Frequency Response and Bias are being removed from Directory #5, due to the developing NERC standards.

An additional area focused on resilience and recovery is the NPCC Criteria related to Key Facilities in Directory #8. NERC standards do not specify an identification of Key Facilities. Within NPCC, this is considered essential to ensure that the Critical Components associated with Key Facilities are maintained and tested to assure their functionality when called upon during System Restoration.

### **NPCC Criteria address important reliability and resilience topics that go beyond NERC requirements**

In addition to resource adequacy, for many NPCC Criteria, there are no direct NERC standard equivalents. For each NPCC Criteria without a specific NERC standard companion listed below, a proposed characterization as to whether the NPCC Criteria contributes mostly to reliability (avoiding a loss of facility or load), mostly to resilience (recovery from an upset) or to both reliability and resilience. Opinions may vary regarding specific items, but it is clear the NPCC Criteria not covered by NERC provide a significant contribution to reliability by avoiding loss of facilities and resilience by assuring recovery from events.

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<sup>39</sup> TFCO in its comments suggests a more granular analysis as follows: Focusing on Operations aspect of Directory #1 (Table 3), it would be beneficial to develop evidentiary information to determine whether more stringent criteria results in better performance. For example, identification/explanation for the specific, incremental differences between Directory #1, Table 3 contingencies (breaker failure, double circuit tower, etc.) and pertinent NERC contingencies (e.g. FAC-011-3), supplemented by the actual historical numbers/occurrences of such contingencies. One way to carry out this analysis is for each NPCC RC and/or TOP to provide their 5 or 10-year historical data for the number of qualifying, more stringent contingencies vs. contingencies covered by NERC standards, to show the risk/probability of the stated contingency events to provide some assessable reliability performance result to evaluate.

<sup>40</sup> Directory #5-Reserve is currently under redevelopment to coordinate with revised NERC standards.

**NPCC Directory Criteria that go beyond NERC Standard Requirements**

<b>Directory #</b>	<b>Criteria</b>	<b>Topic</b>	<b>Contribution to:</b>
1	R4	Resource Adequacy Evaluation and Performance	Reliability & Resilience
1	R5	Resource Adequacy Coordination	Reliability & Resilience
1	R16	Voltage Reduction and Firm Load Shedding	Reliability
1	R19	Metering for reactive power	Reliability
2	C5	Manual load shedding	Reliability
4	C5.1	Protection System Redundancy	Reliability & Resilience
4	C5.2	Protection System Redundancy	Reliability & Resilience
4	C5.4	Protection system element thermal capability, protection control devices, use of LAN, short circuit modeling, power supply to protection components, contact outputs	Reliability
4	C5.5	Specification of protection operating time from planning studies	Reliability
4	C5.6	Current transformer criteria	Reliability
4	C5.7	Voltage Source criteria	Reliability
4	C5.8	Battery criteria	Reliability
4	C5.9	Duplicate station service for critical Substation loads	Reliability & Resilience
4	C5.10	Independent trip coils	Reliability
4	C5.11	Tele protection requirements	Reliability
4	C.12	Physical separation of protection groups	Reliability
4	C.13	Grounding	Reliability
4	C.15	Breaker failure requirements	Reliability & Resilience
4	C.16	Design to Facilitate Testing and Maintenance	Reliability
4	C.18	Commissioning testing	Reliability
4	C.20	Provide performance requirements for protection systems relying on LAN communications.	Reliability
5	C5.1	Ten-minute reserve requirement	Reliability
5	C5.2	Restoration of Ten-minute reserve	Resilience
5	C5.3	Thirty-minute reserve requirement	Reliability
5	C5.4	Restoration of Thirty-minute reserve	Resilience
5	5.11	Ace Diversity Interchange	Reliability
5	5.13	Operating reserve sustainability	Resilience
5	5.14	Resource-specific requirements for synchronized reserves	Reliability
6	R5.1- R5.19	Reserve Sharing Agreement specifications	Reliability
8	R1.1	Basic Minimum Power System-neighboring	Resilience
8	R1.2	Nuclear Plant off-site power	Reliability
8	R1.8	Fuel resources for supplemental generators	Reliability
8	R2	Basic Minimum Power System	Resilience
8	R3	Basic minimum Power System	Resilience
8	R4-6	Identification of Key Facilities	Resilience

8	R8	Key Facilities Testing	Resilience
8	R9	Cable back Pressurization testing	Resilience
8	R10	Battery testing	Resilience
8	R11	Control center support systems redundancy	Resilience
8	R12	Black Start Generators	Resilience
8	R13-14	Black Start Generating Testing	Resilience
8	R15-18	Reporting loss of Critical Components of Key Facilities	Resilience
12	C5.1-5.5	Under frequency Load Shedding Program Requirements	Resilience

A review of the foregoing topical areas reveals that many of the Criteria relate to system recovery and/or robustness. These are important components of maintaining the resilience of the NPCC bulk power system.

## Conclusion and Recommendations

While a comprehensive analysis of each NPCC Criteria against NERC standards requirements was not requested for this high-level review, based on this assessment the NPCC Criteria clearly contribute to the reliable design, operation, and resilience of the NPCC Bulk Power System beyond what the NERC reliability standards require. Additionally, to address Task Force comments received on the initial draft of this report, it is recommended that each Directory undergo a detailed ‘criteria by criteria’ review, to assess the incremental reliability benefit of the criteria in accordance with the scope of this review and the results of such an assessment should be documented. This review should be carried out by the subject matter experts on each Task Force as Directories are reviewed. As part of that review, each NPCC Task Force should identify relevant and currently effective NERC Standards, which may have crosscutting impact on the Criteria/Requirements in a given Directory. To the extent possible, the review should also include a cost effectiveness component as called for in the project scope.

Because a number of the NPCC Directories are currently under active review, the opportunity exists to perform this detailed review. For these Directories, it is recommended that the questions posed in the Project Scope be applied to those active Directory reviews before new Directory revisions are put forward for NPCC Member approval. The recommended plans for Directory review are shown below.

Note that in no case has there been a determination that a Directory lacks incremental benefits. Such a conclusion can only be determined after a ‘criteria by criteria’ analysis by the responsible Task Force.

## Recommended Action Plan for Directory Review

Directory	Title	Task Force	Action-Next Step <sup>41</sup>
1	Design and Operation of the Bulk-Power System	<b>TFCP</b>	<b>Additional Analysis</b> at a future date TBD- After the A10 project is completed
2	Emergency Operations	<b>TFCO</b>	<b>None</b> Recently reviewed and approved by NPCC Members on 6/29/2018
4	System Protection	<b>TFSP</b>	<b>Additional Analysis</b> Currently under review by TFSP
5	Reserve	<b>TFCO</b>	<b>Additional Analysis</b> Currently under review by TFCO
6	Reserve Sharing Group	<b>TFCO</b>	<b>None</b> Scheduled for TFCO review in 2019
7	Special Protection Systems	<b>TFSP</b>	<b>Additional Analysis</b> Currently under review by TFSP
8	System Restoration	<b>TFCO</b>	<b>Additional Analysis</b> Currently under review by TFCO
9	Verification of Generator Gross and Net Real Power Capability	<b>TFCO</b>	<b>None</b> NPCC Full Member Committee approved the retirement of D#9 on August 3, 2017 effective July 1, 2019 upon the full enforcement of MOD- 25-2.
10	Verification of Generator Gross and Net Reactive Power Capability	<b>TFCO</b>	<b>None</b> NPCC Full Member Committee approved the retirement of D#10 on August 3,

<sup>41</sup> The project scope limits the action choices to the following:

- **None** (retain as is),
- **Open** (address lack of incremental reliability benefit),
- **Additional Analysis** (reliability benefits of the more stringent Criteria might not be worth the on-going costs of implementing them),
- **Retire** (no incremental benefit)

			2017 effective July 1, 2019 upon the full enforcement of MOD-25-2.
11	Disturbance Monitoring Equipment	<b>TFSP</b>	<b>None</b> Scheduled for TFSP review in 2019
12	Underfrequency Load Shedding	<b>TFSS</b>	<b>None</b> Pending regulatory approval of revisions to PRC 006-NPCC-01 TFSS will consider retirement recommendation. <sup>42</sup>

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<sup>42</sup> Note that TFSS is expected to recommend retiring D#12 pending regulatory approvals of current revisions to PRC-006-NPCC-1

# Action Plan

## Strategic Review of NPCC Criteria

### Introduction

The NPCC Board of Directors (BOD) has directed NPCC to conduct a high-level comprehensive strategic review of the need for its regionally specific, more stringent reliability criteria in 2018. As the NERC Continent-wide Standards have continued to be revised, graded for quality and content, and moved towards “steady-state”, the BOD has identified a need to review the criteria to determine if criteria related reliability benefits continue to exist for Northeast North America. This strategic review will be conducted as a separate effort from the regular NPCC Task Force activities. The Task Forces have been engaged in both the development of the NERC Standards and the necessary revisions and retirements of NPCC Directories in order to maintain only the more specific and/or stringent criteria reliability requirements.

### Approach

NPCC Staff will develop an initial strategic high-level review arranged by focus area (e.g. Operations, Planning, and System Protection), rather than a Directory specific or requirement-by-requirement assessment. The evaluation will identify the overarching reliability benefits of the Criteria and recommend whether NPCC should retain the Criteria within that focus area. Each NPCC Directory has a responsible Task Force (TF) and the results of the evaluation will be shared with the respective Task Force(s) for their comment. Subsequent to Task Force review a draft report will then be developed and posted for a 30-day comment period for the RCC and RSC. A final report for the NPCC Board, with due consideration of comments received, will be developed and submitted to the RCC and the RSC for their consideration.

### Schedule

1. NPCC Staff to submit a draft Action Plan to the TFCP for comment at their February 5, 2018 meeting
2. Incorporate TFCP comments into the draft Action Plan
3. TFCP submits the draft Action Plan to the RCC for discussion at their February 28, 2018 meeting
4. TFCP develops a final Action Plan in March 2018 based on RCC input
5. NPCC Staff develops a draft scope of work in March for review with all the Task Forces
6. NPCC Staff and Task Forces finalize the scope of work by April 30, 2018
7. NPCC Staff conducts an evaluation by topic (Operations, Planning, and System Protection) and submits for comments to all the Task Forces by June 30, 2018.

8. NPCC Staff receives comments from Task Forces by the end of July.
9. NPCC Staff and TFCP compile TF comments and produce a first draft report for review with all the Task Forces by August 15, 2018.
10. RCC review the report at the September 5, 2018 RCC meeting and the RSC on their September 14, 2018 teleconference, with a 30 day RCC/RSC comment period
11. NPCC Staff produces a final report by October 31, 2018 and submits to the TFCP for endorsement at their November 8-9, 2018 meeting
12. TFCP submits final draft to RCC and the RSC for consideration at their December 2018 meetings

Approved by TFCP at March 19, 2018 Teleconference.

## Scope of Work

# Strategic Review of the NPCC Reliability Criteria

### **A. Background**

As part of the “Risk Responsive Reliability Standards” section of the approved NPCC Corporate Goals for 2018, the NPCC will “conduct a strategic review of the need for NPCC’s regionally specific, more-stringent reliability Criteria. The evaluation will identify the overarching reliability benefits and recommendation on whether NPCC should retain the Criteria within topic areas, such as operations, planning, protection, etc.”

### **B. Objectives**

This review was initiated by the NPCC Board of Directors to determine if, with the continuous enhancement and strengthening of the NERC standards, there is still a need for the regional Criteria to close potential reliability gaps in the NERC Reliability Standards or whether any additional specificity or stringency beyond the NERC standards is necessary.

To support the above goal, the scope will include a review and consideration of benefits of all Criteria in NPCC relative to NERC Standards and recognize those criteria requirements that continue to be more stringent, more specific or facilitate compliance with existing NERC standard requirements. Also, it will identify any NPCC Criteria that could be viewed as duplicative to existing or, if time permits, future approved NERC requirements.

### **C. Approach:**

Identify how the existing NPCC Criteria apply to the broad topic areas of: Planning, Operations, System Protection and NPCC processes.

1. Document the purpose of the Criteria with respect to each of the topic areas.
2. Identify the NERC Standards that are intended to address the same reliability purpose as the Criteria identified within each topic area.
3. Identify NPCC criteria that are duplicative or do not provide incremental reliability benefit beyond that established by the NERC Standards.
4. Verify that each NPCC criteria that is more stringent, provides incremental reliability benefit, or facilitates compliance with the NERC Standards.
5. To the extent practicable, evaluate the continued reliability need and benefit of having each of the more stringent Criteria.



6. Identify where a more in-depth analysis is required to determine if the reliability benefits of the more stringent Criteria might not be worth the on-going costs of implementing them.
7. Comment on any area of risk observed during the review (such as duplication of regulations or risk of gaps).

The TFCP will coordinate this review among NPCC Task Forces. The comments from the Task Forces will be reviewed and incorporated into the final report.

#### **D. Deliverables**

The review will be concluded with a report meeting the described Objectives and Approach, with the following structure:

1. NPCC Cover Page
2. Introduction, statement of need for review
3. Executive Summary- Findings
4. Background of Criteria-General and History – (use existing information in the applicable Directory to provide)
5. Discussion of Report Structure – By topic - Planning, Operations, Protection, Process, then by Directory number under the parent topic

For each Directory related to each of the topics:

1. Directory number and title
2. Purpose -statement of that Directory (Use information in the applicable Directory)
3. Identify the associated NERC Standards and their titles (these are listed in each Directory)
4. Need Statement: What is the more stringent, specific or item that augments the NERC Standard, or facilitates compliance with NERC Standards, that is needed in that Directory.
5. Redundancies identified in the reliability objective of the criteria with existing or future approved standards awaiting implementation
6. Other findings and conclusions to support the Objectives and Approach
7. Recommended further actions, e.g., None (retain as is), Open (address lack of incremental reliability benefit), Additional Analysis (reliability benefits of the more stringent Criteria might not be worth the on-going costs of implementing them), Retire (no incremental benefit)

The review will provide a recommendation regarding which Criteria should be considered for revision or retirement, based on its incremental reliability benefit, to the extent practicable given the nature of the review. The review will include a summary that captures NPCC and NERC standards and categories to map minimum NERC requirements and where applicable more stringent NPCC requirements and any regional considerations that may justify an increased or decreased requirement. As such, the review will

also provide recommendations regarding whether or not to conduct further analysis on specific Criteria.

#### **E. Schedule**

The schedule will support the approved Action Plan of the Review. Hence, the final report needs to be accepted by the TFCP by November 8-9, 2018.

Approved by TFCP – April 30, 2018