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Executive summary

With the introduction of competition to the RTEP process via FERC Order 1000, PJM and its stakeholders determined that a set of common minimum requirements for all entities proposing a transmission project via the competitive planning process was required. The Designated Entity Design Standards Task Force (DEDSTF) was chartered to develop these minimum requirements. Comprised of PJM stakeholders representing multiple sectors, and all PJM Transmission Owners, the DEDSTF elected to develop these standards within sub-groups, containing industry veterans and subject matter experts. The task force branched out into three sub groups which, in parallel, reviewed existing accepted industry requirements, existing PJM Transmission Substation Subcommittee guidelines and Manuals, and composed sets of minimum required standards, for Transmission Lines, Substation equipment and Protection and Controls. These minimum required standards must be adhered to by all entities proposing a competitive solution in the PJM Competitive Planning Process that requires the signing of a Designated Entity Agreement. This set of standards was accepted by the PJM members via a Planning Committee endorsement, and is posted to PJM.com.
Purpose of this report

This report will review and describe the work done by the Task Force of the Planning Committee: Designated Entity Design Standards Task Force (DEDSTF). The group met fifty six times from October 2015 through October 2017. The final version of the DEDSTF Minimum Required Standards was endorsed by the PJM Planning Committee at the November 9th 2017 meeting. This report serves as final documentation from the task force, to its parent committee that the deliverables outlined in the Issue Charge and Problem Statement has been completed.

Issue review

FERC issued a Final Rule on Order No. 1000 in July 2011 and PJM has subsequently submitted a number of compliance filings to establish the process by which the revised planning and cost allocation requirements of the Order are being implemented. PJM has now implemented the process over the course of the last 2 years and, together with the stakeholders, have gained significant experience in managing the competitive planning process contemplated by the Order. Over that time, it has become apparent to PJM and the stakeholders that a number of issues have arisen in carrying out the process that suggest the need for process improvement to make the process more effective and efficient for both PJM and the stakeholder, while maintaining compliance with the Order. PJM, under the auspices of the Planning Committee, is conducting a number of stakeholder feedback sessions, both at the Planning Committee and at other venues, to gather feedback from the stakeholders as to their suggestions for process improvements. This Problem Statement is focused on a specific issue that was identified by stakeholders, Engineering Design standards to be used for greenfield projects that are competitively solicited. For Greenfield projects that are designated as a result of the competitive process, the Designated Entity may follow design standards that differ from those of the zonal transmission owner. Questions were raised at PC/TEAC and Lessons Learned regarding the potential for introducing a weak point in the system or reducing the reliability by lest robust solutions. Feedback provided by stakeholders consisted of the following items:

- Ensure new project does not reduce the performance
- Consideration of physical geography and environment
- Consideration of other local requirements or codes
- Well integrated protection
- Robustness of physical construction
- Emergency Restoration
- Future considerations

Based on feedback, PJM recommends the development of minimum design standards, which would take into consideration geography, and physical and other local needs (noise level, undergrounding requirements, etc.) of the
The design standards would apply to projects that are competitively solicited and address the following areas.

- Transmission Lines
- Substations
- System Protection and Control Design and Coordination

**DEDSTF Organizational Structure**

The DEDSTF was facilitated by a group from PJM including a Chairman, Secretary and a team of Subject Matter Experts. The facilitation team identified co-leads, two individuals from PJM member companies with industry experience in their respective fields, for each of the 3 sub-groups, and additional experts as required for specific segments requiring detailed knowledge. These co-leads had the responsibility of developing requirements, coordinating comments/revisions while representing all stakeholders involved in the development of the DEDSTF minimum requirements. The final details of what was and was not included in these documents resided wholly with the stakeholders. PJM provided guidance and recommendations but did not develop these minimum requirements.

**Education provided**

The DEDSTF continually provided education to its members on a series of detailed design and procedural topics. The descriptions below are a high level explanation of the topics that were presented to the members of the DEDSTF.

PJM Subject matter experts led several educational sessions around the FERC orders, documentation and requirements of the competitive planning process. This included detailed explanations of the following:

- FERC Order #1000 and subsequent PJM filings
- PJM Designated Entity Agreement
- PJM Interconnection Coordination Agreement
- PJMs implementation of the Competitive Planning Process
- Existing Transmission and Substation Subcommittee practices and guidelines
- Minimum Design Standards currently in place at SPP and MISO
- Relay Subcommittee practices and responsibilities

Additionally, PJM and its stakeholders led several educational sessions focused on specific detailed aspects of design criteria including:
Protection and Controls industry design standards and practices

Substation equipment industry design standards and practices

Transmission Lines industry design standards and practices

Underground Lines design standards and practices

HVDC Technologies

Individual Stakeholders recommendations of specific requirements from existing documentation

Final set of Minimum Required Standards

The DEDSTF developed a set of minimum required standards for each of the 3 major sections identified in the problem statement (Protection and Controls, Substation Equipment and Transmission Lines).

At the June 2017 Planning Committee, the following sections were endorsed by PJM Stakeholders:

- Overhead Transmission Lines
- Substation Equipment
- System Protection and Control Design Coordination

The task force continued to finalize the requirements of the Underground Transmission lines sections, which was ultimately endorsed by the Planning Committee at their November 2017 meeting.

It is important to note that the DEDSTF received education on HVDC technologies and determined that it was not appropriate to establish minimum standards for HVDC at this time, and that the need for this would be revisited at a future date.

It is also important to note that per the Problem Statement/Issue Charge, the discussion of ratings methodology was outside of the scope of this task force, and therefore is not included in the final set of minimum requirements.

The official set of DEDSTF Minimum Required Standards can be found at the following link:


and are posted to the Design, Engineering & Construction Page, within the planning section of www.pjm.com.
Conclusion

The final product of the DEDSTF was presented to the Planning Committee with the full support of the DEDSTF membership, therefore no alternatives were presented, and the group has completed all requirements and deliverables included in the Problem Statement/Issue Charge.

PJM and the DEDSTF members feel strongly that even though the deliverables have been completed, there will be a need for a periodic review of these minimum required standards, and therefore is recommending revisions to the charter of the DEDSTF that include a biennial review. In order to incorporate this ongoing review the task force will need to transform into a subcommittee, as reflected in the proposed charter revisions.
Appendix

Planning Committee materials:

November 9, 2017: Seeking PC endorsement of Underground Lines Section of DEDSTF Minimum Required Standards

- DEDSTF Underground Lines Presentation
- DEDSTF Underground Lines Redline
- DEDSTF Underground Lines Clean

October 12, 2017: PC first read of Underground Lines Section of DEDSTF Minimum Required Standards

- DEDSTF Underground Lines Presentation
- DEDSTF Underground Lines Redline
- DEDSTF Underground Lines Clean

June 8, 2017: Seeking PC endorsement of Overhead Lines, Protection and Substation Sections of DEDSTF Minimum Required Standards

- DEDSTF Overhead Lines, Substation and Protection Presentation
- DEDSTF Overhead Lines, Protection and Substation Combined Sections

May 4, 2017: PC first read of Overhead Lines, Protection and Substation Sections of DEDSTF Minimum Required Standards

- DEDSTF Overhead Lines, Substation and Protection Presentation
- DEDSTF Overhead Lines Section
- DEDSTF Protection Section
- DEDSTF Substation Section
April 13, 2017: PC pre-first read of Overhead Lines, Protection and Substation Sections of DEDSTF
Minimum Required Standards

- DEDSTF Update to Planning Committee
- Substation Group Draft Requirements
- Lines Group Draft Requirements
- Protection Group Draft Requirements

March 9, 2017: DEDSTF Update to PC

- DEDSTF Update to Planning Committee
- Substation Group Draft Requirements
- Lines Group Draft Requirements
- Protection Group Draft Requirements

December 15, 2016: DEDSTF Update to PC

- DEDSTF Update to Planning Committee

September 15, 2016: DEDSTF Update to PC

- DEDSTF Update to Planning Committee

June 9, 2016: DEDSTF Update to PC

- DEDSTF Update to Planning Committee

January 7, 2016: DEDSTF Charter Endorsement

- DEDSTF Charter Endorsement

December 3, 2015: DEDSTF Charter First Read

- DEDSTF Charter First Read
July 9, 2015: PC Endorsement of Problem Statement

DEDSTF Meeting materials

October 19, 2017: Finalize revisions to underground standards, HVDC on hold discussion

September 21, 2017: Revise underground standards, HVDC discussion

September 7, 2017: HVDC Presentation
August 17, 2017: Review underground standards updates and review HVDC meeting outline

Agenda

HVDC Presentation Outline

Underground Standards – 2017/07/20 Post Meeting Markup

Underground Standards – 2017/08/17 Meeting Revisions

Underground Standards – Post Meeting

Underground Standards – Nextera Comments

July 20, 2017: Discuss and review of underground standards updates

Agenda

Underground Standards

Underground Standards – Post Meeting

HVDC Outline

June 15, 2017: Discuss and review of underground standards updates

Agenda

Underground Standards

May 22, 2017: Discuss and review of DEDSTF Protection Document

DEDSTF Protection Document – Relay Subcommittee Review

May 18, 2017: Discuss and review of underground standards, HVDC outline, substation subgroup, and DEDSTF format documents

Agenda

Substation Subgroup – BGE Comments

Substation Subgroup – ComEd Comments
Substation Subgroup – Ameren Comments

DEDSTF Document Format

Substation Subgroup

Underground Standards

HVDC Outline – Post Meeting

May 15, 2017: Discuss and review of substation subgroup document

Substation Subgroup – ComEd Comments

Substation Subgroup – 2017/05/01 Version

Substation Subgroup – Ameren Comments

Substation Subgroup – BGE Comments

May 9, 2017: Discuss and review of DEDSTF protection document

DEDSTF Protection – BGE Comments

DEDSTF Protection – ComEd Comments

DEDSTF Protection – DUKE Comments

DEDSTF Protection – MD Comments

May 1, 2017: Discuss and review of substation subgroup document

Substation Subgroup – ComEd Comments

Substation Subgroup

Substation Subgroup – BGE Comments

April 26, 2017: Discuss and review of substation subgroup and lines subgroup documents

Agenda

Substation Subgroup
Lines Subgroup with Unresolved Issues
Substation Subgroup – FE Comments
Lines Subgroup – Underground Submarine Cable Rating
Lines Subgroup – Underground Standards Markup
Substation Subgroup – Bus Configuration
Substation Subgroup – DEDSTF Design Criteria
Substation Subgroup – BGE Comments
Lines Subgroup – Post Meeting Resolutions

April 10, 2017: Discuss and review of TSS guidelines and DEDSTF substation documents
Underground Submarine Transmission Cable
Interim TSS Guidelines – Spares
Interim TSS Guidelines – O&M
Interim TSS Guidelines – Underground Section Markups
DEDSTF Substation – DLC Comments
DEDSTF Substation – Dominion Comments
DEDSTF Substation

April 3, 2017: Discuss and review of substation document
Substation Civil/Structural – DLC Comments
Substation Civil/Structural – BGE Comments
Substation Civil/Structural – NEER Comments

March 30, 2017: Discuss and review of DEDSTF protection document
DEDSTF Protection – PJM Comments
DEDSTF Protection – DLC Comments
March 28, 2017: Discuss and review of line document

- **Lines Document – DLC Comments**
- **Lines Document – LS Power Comments**
- **DEDSTF Lines Subgroup – LSP, DLC, & FE Proposal**

March 27, 2017: Discuss and review of substation document

- **Substation Document – Dominion Comments**

March 16, 2017: Discuss and review of line, protection, and substation documents

- **Agenda**
- **Lines Subgroup – PJM TSS Underground Cable Guidelines**
- **Lines Subgroup – Underground Submarine Cable**
- **Protection Subgroup – DEDSTF Protection**
- **Protection Subgroup – Manual 7 Appendix F Revision 2**
- **Substation Subgroup – DEDSTF Layout**

February 16, 2017: Discuss and review of line, protection, and substation documents

- **Agenda**
- **DEDSTF Battery Poll**
- **DEDSTF Format**
- **Lines Subgroup – DEDSTF Draft Edits**
- **Protections Subgroup – DEDSTF Revision 1**
- **Substation Subgroup – DEDSTF Layout**
- **DEDSTF Protection Wording Comparison**
- **DEDSTF Draft Edits**
February 8, 2017: Discuss and review of coordination and substation documents

  AC Station Service – ME Comments
  Coordination Trade Off
  Substation Subgroup – DEDSTF Layout

February 7, 2017: Discuss and review of substation documents

  Substation Subgroup – DEDSTF Layout

January 24, 2017: Discuss and review of line, PJM manual, protection, and substation documents

  Agenda
  Lines Subgroup – DEDSTF Draft
  Lines Subgroup – DEDSTF Draft Post Meeting
  PJM Relay Committee – Manual 7 Appendix F Revision 2
  Protection Subgroup – DEDSTF Design Revision 1
  Substation Subgroup – DEDSTF Layout

January 19, 2017: Discuss and review of line documents

  Lines Subgroup – DEDSTF Draft Meeting Edits

January 11, 2017: Discuss and review of line documents

  Lines Subgroup – DEDSTF Draft

January 5, 2017: Discuss and review of substation documents

  Substation Subgroup – DEDSTF Layout (Control Cubicle)

December 12, 2016: Discuss and review of lines, substation, and protection documents

  Agenda
Lines Subgroup – DEDSTF TEC Requirements
Lines Subgroup – DEDSTF TEC Structural Loading
Lines Subgroup – Clearance & Galloping Post Meeting
Lines Subgroup Update
Substation Subgroup Update
Protection Subgroup – DEDSTF Design
Substation subgroup – DEDSTF Layout

November 30, 2016: Discuss and review of lines documents

Lines Subgroup Requirements Update
Lines Subgroup – Structural Loading Post Meeting

November 29, 2016: Discuss and review of protection document

Protection Subgroup Design

November 15, 2016: Discuss and review of protection, substation, and lines documents

Agenda
Protection Subgroup – DEDSTF Protection
Substation Subgroup – DEDSTF Layout
Lines Subgroup – Lines Clearance Draft
Lines Subgroup – Structural Loading Post Meeting
Lines Subgroup – PJM DEDSTF Educational Material
Lines Subgroup – DEDSTF 235 Presentation

October 25, 2016: Discuss and review of substation, lines, and protection documents

Agenda
Substation Subgroup – DEDSTF Layout
Substation Subgroup – DEDSTF Substation Design
Substation Subgroup – SPP Draft Design Standards
Line Subgroup – Lines Clearance Draft
Lines Subgroup – Structural Loading
Lines Subgroup – MDS Loading Criteria
Protection Subgroup – Document Update
Protection Subgroup – ComEd Interconnection Example
Protection Subgroup – AEP Requirements
Protection Subgroup – Minimum Design Requirements for FERC 1000

October 5, 2016: Discuss and review of lines documents
   Lines Subgroup – DEDSTF Structural Loading Requirements
   Lines Subgroup – TSSS MDS Loading Criteria Comparison
   Lines Subgroup – SPP Transmission MDS Excerpt Draft
   Lines Subgroup – Line Clearances Draft

September 12, 2016: Discuss and review substation documents
   Agenda
   Substation Subgroup – DEDSTF Layout
   Substation Subgroup – DEDSTF Substation Design Topics
   Substation Subgroup – SPP Draft Minimum Design Standards

August 31, 2016: Discuss and review protection document
   Agenda
   Protection Subgroup – JAB Comments
   Example Substations
August 17, 2016: Discuss and review of line, protection, and substation documents

**Agenda**

*Line Subgroup – DEDSTF Line Clearance Draft*
*Line Subgroup – DEDSTF Structural Loading Requirements*
*Protection Subgroup – DEDSTF Protection Document JAB Comments*
*Protection Subgroup – Example Substations*
*Protection Subgroup Update*
*Substation Subgroup – PJM TSS Sed Sec III*
*Substation Subgroup Update*
*Lines Subgroup Update*

August 10, 2016: Discuss and review of protection document

*Protection Subgroup – DEDSTF Protection Document*

August 8, 2016: Discuss and review of line document

*Line Subgroup – DEDSTF TEC Requirements*

July 19, 2016: Discuss and review of substation, line, and protection documents

**Agenda**

*Substation Subgroup – Proposed Section II Changes*
*Substation Subgroup – NERC-CIP-006-6 Standard*
*Lines Subgroup – SPP Draft*
*Lines Subgroup – OH Standards*
*Protection Subgroup – Topic Outline*
*Lines Subgroup – Conductors*
*Lines Subgroup – DEDSTF Galloping Design Standard*
*Substation Subgroup – PJM TSS Std Sec III*
Response to Lines Subgroup Questions

July 11, 2016: Discuss and review of line document

Lines Subgroup – Electrical Parameters
Lines Subgroup – Live Line Consideration
Lines Subgroup – Live Line Talking Points

June 15, 2016: Discuss and review of protection, substation, and line documents

Agenda

Education Materials

Lines Subgroup – OH Design Standards
Lines Subgroup – Spreadsheet Item List

Protection Subgroup – Topic Outline

SPP Draft – Minimum Standards for Competitive Upgrades
Substation Subgroup – Introduction
Substation Subgroup – Substation Design Topics

Synchrophasors – PMU Placement Strategy
Synchrophasors – PMU Placement Strategy & Generator PMUs

June 9th PC Meeting Update

May 16, 2016: Discuss and review of protection, substation, and line documents

Agenda

Protection Subgroup – Topic Outline

Protection Subgroup Update
Substation Subgroup – Design Topics
Substation Subgroup Update

Lines subgroup Update
Lines Subgroup – Status

Lines Subgroup – Scope & Guiding Principles

Lines Subgroup – OH Standards Worksheet

April 14, 2016: Discuss and review of substation, line, and protection documents

Agenda

Substation Subgroup – Design Topics

Lines Subgroup – Scope & Guiding Principles

Protection Subgroup – Manual 7 Revision 2 Draft

Lines Subgroup – Standards Worksheet

March 22, 2016: Review of DEDSTF material

Agenda

DEDSTF – Draft Minutes

DEDSTF – Charter

DEDSTF – Poll & Comments

Documentation Links

Problem Statement Examples & Requirements Document

DEDSTF – Educational Materials

February 23, 2016: Review of DEDSTF poll

Agenda

DEDSTF – Draft Minutes

Poll Questions

Poll Results & Next Steps

January 21, 2016: Discuss and review of protection, substation, and line documents
Agenda
Minutes
DEDSTF – Draft Minutes
Charter
Work Plan
DEDSTF – Organization Options

December 16, 2015: DEDSTF discussions
Agenda
Minutes
DEDSTF – Draft minutes
Charter
Interest Identification
Educational Materials
Relay Subcommittee PJM Manual
Options Matrix Design Components
Work Plan

November 12, 2015: Review DEDSTF plan and other materials
Agenda
DEDSTF – Draft Minutes
Charter for December Endorsement
Work Plan
Educational Materials
ITC Presentation
Interest Identification
Interest Identification – Post Meeting
October 12, 2015: DEDSTF introductions and discussion

- **Agenda**
- **Problem Statement & Issue Charge**
- **Draft Charter**
- **Work Plan**
- **Consensus Resolution Process**
- **Educational Materials**