Central Hudson Gas & Electric Corporation

# Transmission Planning Guidelines

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## Introduction

Central Hudson Gas & Electric Corporation has responsibility for the preparation of its Local Transmission Plan which addresses system infrastructure needs, regulatory compliance requirements, satisfying interconnection and open access requirements, improvement of system reliability, and meeting electric load growth in an orderly, economic and reliable manner. In developing such plans, results of security analyses are considered to ensure adequate Load Serving Capability of Central Hudson's Underlying Transmission System as well as sub-areas within that system.

These planning guidelines state principles and policies rather than design specifications. Development of detailed designs generally requires guidance from various industry or Company standards. Planning and designing the system includes consideration of ease of operation including, but are not limited to: utilization of standard components to facilitate availability of spare parts; mitigation of complex post-contingency switching operations; and reduction of operational risks (including employee & public safety and risks associated with the decreasing reliability of aging infrastructure).

These planning guidelines supplement the NYISO's planning processes and apply to Central Hudson's Underlying Transmission System.

## A. Central Hudson Bulk Power System (BPS)

I. Definition

Generally, this system would include all 230 kV and above lines, all transformers where both terminals are at least 230 kV, all shunt devices 230 kV and above and all generators 300 MW and above. Planning criteria and guidelines for these facilities are defined by the NERC, NPCC & NYSRC. Transmission planning for this system is performed within the NYISO's planning processes. Under these processes, the analyses performed include, but are not limited to, analyses of: thermal limits; voltage limits; stability limits; and transfer limits.

This system, typically, is considered to be the NPCC BPS; actual NPCC BPS buses, however, are defined by NPCC Criteria[1]. Although application of the methodology defined in NPCC A-10 may result in some of these facilities not being included in the NPCC BPS, for the purpose of these guidelines, these facilities will continue to be considered part of the BPS.

II. Reliability

Reliability criteria and guidelines for these facilities are defined by the NERC, NPCC & NYSRC.

III. Contingencies

Contingencies for these facilities are defined by the NERC, NPCC & NYSRC.

IV. Under Frequency Load Shedding (UFLS) & Manual Load Shedding

The capability to shed load, both automatically and manually, are required by NPCC BPS Criteria. These load shedding systems, however, are installed on non-BPS systems. UFLS and Manual Load Shedding are described in Sections E. II and E. III.

[1] Reference NPCC A-10.

**B. Central Hudson's Bulk Electric System (BES)**

I. Definition

The system that generally includes all 100 kV and above lines, all transformers where both terminals are at least 100 kV (e.g., 345/115 kV), all shunt devices 100 kV and above, all generators connected at a voltage of 100 kV or above with gross individual nameplate rating greater than 20 MVA or gross plant/facility aggregate nameplate rating greater than 75 MVA. Planning criteria and guidelines for these facilities are defined by the NERC. Responsibility for compliance with NERC Planning Standards is defined by the NYCA CFR Agreement[2]. Under this Agreement, the analyses performed include, but are not limited to, analyses of: thermal limits; voltage limits; stability limits; and transfer limits.

This system, typically, is considered to be part of the NERC BES. The BES is defined by NERC Criteria.

II. Reliability

Reliability criteria and guidelines for these facilities are defined by the NERC.

III. Contingencies

Contingencies for these facilities are defined by the NERC.

**C. Central Hudson's Underlying Transmission System**

I. Definition

Central Hudson's Underlying Transmission System consists of all Central Hudson electric facilities which are used to connect the Central Hudson BPS to the Central

[2] New York Control Area Coordinated Functional Registration Agreement for the NERC and NPCC Transmission Operator and Transmission Planner Functions."

Hudson Distribution System. The Underlying Transmission System includes, but is not necessarily limited to, all facilities operated at voltages between, but not including, 230 kV and 34.5 kV and the supply transformers (e.g., 345/115 kV and generator step-up transformers) for those facilities.

II. Reliability

Generally, no loss of load should result for the More Probable Contingencies, as listed in Section III.a., on Central Hudson's Underlying Transmission System with the exception of radial circuits.

Generally, new facilities should be designed to provide physical separation so that a single occurrence will not result in the simultaneous loss of two supplies to the same distribution substation.

System spare transformers will be maintained to replace each type of transformer owned by Central Hudson (e.g., 345/115 kV and 115/69 kV), within Central Hudson's Underlying Transmission System, should one fail.

III. Contingencies

Central Hudson's Underlying Transmission System should be designed to sustain the following contingencies, on all facilities exceeding 34.5 kV, during all load levels, while meeting applicable voltage guidelines and limiting equipment loadings to within Applicable Ratings:

a. More Probable Contingencies

Central Hudson's Underlying Transmission System will be planned to sustain the following contingencies without loss of load, except for loss of those customers and substations that depend solely on the circuit identified in the contingency.

| More Probable Contingencies<br>With Applicable Ratings | | | | | | |
|---|---|---|---|---|---|---|
| | | | | All Facilities within | | |
| | Contingency Description | | | Normal Limits | Long Term Emergency Limits | Short Term Emergency Limits |
| 1 | Loss of any one transmission line | | Cable / Overhead | | X | See Note 2 |
| 2 | Loss of any one transformer | | | | X | See Note 2 |
| 3 | Loss of any one bus section | | | | X | See Note 2 |
| 4 | Loss of any one generating unit | | | X | | |
| 5 | Overlapping outage of any generating unit and | any transmission circuit | Cable / Overhead | | X | See Note 2 |
| 6 | | any transformer | | | X | |
| 7 | Overlapping outage of any two generating units (scheduled or unscheduled) | | | X | | |
| The intent of the following contingencies are to determine the impact of NPCC BPS Criteria contingencies on Central Hudson's Underlying Transmission System. | | | | | | |
| 8 | BPS Contingencies called for by NPCC A-02 Criteria and not covered by 1-7, above. For the purpose of this contingency analyses, the BPS is defined in Section I by voltage level and not by any other classification methodology (e.g., NPCC's A-10). | | | | | |
| 8a | BPS Breaker Failure | | | | X | See Note 2 |
| 8b | BPS Common Tower Failure (If multiple circuit towers are used only for station entrance and exit purposes, and if they do not exceed five towers at each station, then this condition is an acceptable risk and therefore can be excluded) | | | | X | |
| 8c | BPS HVDC Bi-pole loss | | | | X | |
| 8d | The failure of a circuit breaker to operate when initiated by an SPS following loss of any element or bus. | | | | X | |

Notes:

1. Loss of a generating unit includes loss of a combined cycle unit.
2. For transmission facilities connected to a dedicated Generating Station Switchyard within Central Hudson's Underlying Transmission System, post-contingency flows not to exceed STE limits are allowed provided that sufficient controls and generation rundown capability is available to reduce flows to LTE Limits within 15 minutes and to Normal limits within 30 minutes (each time measured from the start of the contingency).

b. Less Probable Contingencies

Occurrence of the following specific contingencies are to be examined for consequences. As a guideline, should they result in a system outage greater than 20% of the total system load for a duration greater than one hour, or 10% for four hours, potential solutions should be evaluated. The transfer of load by rearrangement of lines and buses and the readjustment of generator outputs following outages are acceptable means to restore service.

| **Less Probable Contingencies** | |
|---|---|
| 1 | Overlapping outage of any transmission line and any transformer |
| 2 | Overlapping outage of any generating unit and any bus section |
| 3 | Overlapping outage of any two transmission lines |
| 4 | Overlapping outage of all transmission lines on a single right-or-way[3] |
| 5 | Overlapping outage of any two transformers |
| 6 | Overlapping outage of any two adjacent bus sections (e.g., internal bus-tie breaker fault) |
| 7 | Overlapping outage of any three generating units |
| 8 | Overlapping outage of all generating units at a single generating station |
| Note:<br>1. Loss of a generating unit includes loss of a combined cycle unit. | |

IV. Voltage

Central Hudson's Underlying Transmission System shall be planned with controls capable of maintaining voltages at levels which will not exceed the limits of the connected equipment during both normal and contingency conditions and will allow for meeting the criteria for customer voltage as specified in Central Hudson's Distribution Engineering Guides. Generally, the voltages on Central Hudson's Underlying Transmission System will be maintained as shown in the following table:

[3] The effected load shall be limited to no more than the total load of the substations that are supplied by the transmission lines.

| | Minimum Voltage | Maximum Voltage | Steady State Deviation |
|---|---|---|---|
| Pre-contingency | 0.95 | 1.05 | - |
| Post-contingency[4] | 0.90 | 1.05 | 0.15 |

V. Transformers Connected for Phase Angle Control (i.e., Phase Angle Regulators or PARs)

For both normal and emergency or post-contingency conditions, use of up to 100% of the phase shift capability will be acceptable.

VI. Maintenance of Central Hudson's Underlying Transmission System and Generator Outages

The system design must provide for outages associated with the scheduled maintenance of lines, transformers, and substation equipment as well as for generator outages. In cases where a substation or group of substations serving the Distribution System have only two transmission supplies, Central Hudson will accept loss of load for the more probable contingencies (as listed in Section IIIa) when one supply is out of service for maintenance. During such maintenance and generator outages, the transition from the normal condition to contingency conditions will not result in any equipment loadings exceeding the applicable emergency rating nor will the voltage be outside of the post-contingency voltage limits.

## D. Ratings

The methodologies and criteria Central Hudson uses in rating Central Hudson's Bulk Power System and Underlying Transmission System facilities largely are described in the NYPP Tie-Line Ratings Task Force's Final Report on Tie Line Ratings (dated November 1995) as supplemented by Central Hudson's "Transmission Ratings Methodology." The following Final Report on Tie Line Ratings definitions are repeated here to promote a common understanding of rating terms:

<table>
<tr><td>Assumed Hours of Operation at Rated Temperatures[5]</td><td>It is assumed that only when the rated limiting temperatures are reached will annealing and loss of strength occur. In general, an environment more favorable than assumed results in a system whose line conductors are rarely operating near their thermal limit under normal operation. No more than 10 percent loss of life/strength is assumed over the life of the equipment. The estimated number of hours of operation at rated temperatures for each mode of operation over the 40 year assumed life of conductors are:
<table>
<tr><th>Rating</th><th>Operating Hours over life of conductor</th></tr>
<tr><td>Normal</td><td>7655</td></tr>
<tr><td>LTE</td><td>300</td></tr>
<tr><td>STE</td><td>12.5</td></tr>
</table>
To estimate loss of strength of overhead conductors, annealing is assumed to occur only during operation at one of the three limiting (rated) temperatures that correspond to Normal, LTE, STE ratings for an assumed number of hours</td></tr>
<tr><td>Normal Rating[6]</td><td>Capacity (Amps or MVA as applicable) which may be carried through consecutive twenty-four load cycles without exceeding agreed upon conductor or hottest spot equipment temperatures for this mode of operation.</td></tr>
<tr><td>LTE Rating[7]</td><td>Capacity (Amps or MVA as applicable) which may be carried through infrequent non-consecutive, appropriate four hour periods without exceeding agreed-upon maximum conductor or hottest spot equipment temperatures for this mode of operation.</td></tr>
<tr><td>STE Rating[8]</td><td>Capacity (Amps or MVA as applicable) which may be carried during very infrequent contingencies of fifteen minutes or less duration without exceeding agreed upon maximum conductor temperatures for this mode of operation.</td></tr>
</table>

In practice, these definitions result in the following rating periods:

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[4] Prior to the operation of of load tap changing (LTC) transformers and switched shunts.
[5] This definition applies to overhead conductors.
[6] This definition applies to all equipment.
[7] This definition applies to all equipment.

| Rating | Transformers[9] | All[10] Other Equipment |
|---|---|---|
| Continuous | Defined by Equipment Nameplate | Defined by Equipment Nameplate |
| Normal | Peak flow of a typical 24 hour load cycle | Daily peak flow (the maximum flow that can be carried normally, but not continuously) |
| LTE | Peak flow of a typical 24 hour load cycle | 4 hour Continuous Flow during a 24 hour period |
| STE | 15 minutes (from time Normal Rating was exceeded) | |

## E. System Frequency & Load Control

I. Standard Frequency

The standard frequency on the Central Hudson system nominally is 60 Hertz. A sustained frequency excursion of ±0.2 Hertz is an indication of a major load-generation unbalance and possible formation of an island. The load shedding program has been developed in order to provide selectivity and flexibility.

II. Under Frequency Load Shedding (UFLS)

Under frequency relays are required by NPCC BPS Criteria but are installed on non-BPS and non-BES systems to provide additional insurance against widespread system disturbances. Central Hudson complies with the NPCC mandated criteria as defined in NPCC Directory #12[11], PRC-006-NPCC-1, and related documents.

III. Manual Load Shedding[12]

Each area in NPCC must be capable of shedding at least 50% of its load in ten minutes or less. The first half of the load shed by operator action should not include load that is part of any automatic load shedding plan. Care should be taken that manual load

8 This definition applies to all equipment.
9 Includes, but not necessarily limited to: step-down transformers; step-up transformers; voltage regulators; PARs.
10 Includes, but not necessarily limited to: conductors (overhead & underground); circuit breakers; bus conductors; Current Transformers; line traps; switches (air, oil, vacuum, etc.); series reactors.
11 NPCC. "Under frequency Load Shedding Program Requirements." July 9, 2013.

shedding plans do not interrupt transmission paths.

## F. System Reactive Requirements

On the distribution system, Central Hudson installs capacitor banks, for both voltage support and loss reduction, to correct typical distribution circuits as follows:

- Summer Peaking: correct on-peak load to a power factor of approximately 0.98 to 0.99+
- Winter Peaking: correct on-peak load to a power factor of approximately 1.0-.

For the Underlying Transmission System, Central Hudson installs capacitors banks to provide voltage support for post-contingency conditions.

## G. Stability

Similar to planning for the BPS, system stability analyses generally are performed at the NYISO level. Stability issues regarding individual generators within Central Hudson's Underlying Transmission system are evaluated as necessary (e.g., associated with significant changes in network topology or supply).

## H. Load Serving Capability

Load Serving Capability (LSC) analyses are performed for Central Hudson's Underlying Transmission System as a whole as well as for sub-areas within that system, as appropriate.

The LSC of Central Hudson's Underlying Transmission System is defined as the ability to serve load without violating a thermal or voltage limit following the contingencies specified in these guidelines. Generally, this is the import capability of Central Hudson's Underlying Transmission System including power from available generation. The import capability of

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[12] Section 4.3.2.1 from NPCC "Regional Reliability Reference Directory #2 Emergency Operations, Appendix B: Guideline and Procedure for Emergency Operations," June 26, 2009.

Central Hudson's Underlying Transmission System is determined by summing algebraically the MW flows on the following[13] lines, transformers, and all connected generation:

| | | | | |
|---|---|---|---|---|
| East Fishkill | | | 345/115 kV | Transformer 1 |
| East Fishkill | | | 345/115 kV | Transformer 2 |
| Hurley Avenue | | | 345/115 kV | Transformer 1 |
| Pleasant Valley | | | 345/115 kV | Transformer S1 |
| Rock Tavern | | | 345/115 kV | Transformer 1 |
| Rock Tavern | | | 345/115 kV | Transformer 3 |
| Feura Bush (N.G.) | to | North Catskill | 115 kV | 2 Line |
| Blue Circle (N.G.) | to | Pleasant Valley | 115 kV | 8 Line |
| Hudson (N.G.) | to | Pleasant Valley | 115 kV | 12 Line |
| Churchtown (NYSEG) | to | Pleasant Valley | 115 kV | 13 line |
| Sylvan Lake (NYSEG) | to | Fishkill | 115 kV | FP/990 Line |
| West Woodbourne (NYSEG) | | | 115/69 kV | Transformer 1 |
| Vinegar Hill | | | 115/34.5 kV | Transformer 1 |
| Salisbury (NU) | to | Smithfield | 69 kV | 690/FV Line |
| Walden (NYSEG) | to | East Walden | 69 kV | WM (862) Line |
| Walden (NYSEG) | to | Montgomery | 69 kV | WM (862) Line |
| Blooming Grove (O&R) | to | WM Line Tap | 69 kV | WM Line |
| Amenia (NYSEG) | to | Smithfield | 69 kV | SA (825) Line |
| | | | | |
| All Generation | | | | |

To determine the LSC, first, two load flow cases with different load levels are solved[14] with all lines in service that are normally in service. These cases are then used to test the contingencies defined in these Transmission Planning Guidelines. The LSC then is determined by using the minimum limits that appear for the set of contingencies considered. This will be performed for several different generation levels although the specific study being performed may necessitate analyses of additional generation and/or load levels or configurations.

[13] This definition may change from time-to-time as Central Hudson's Underlying Transmission System changes.
[14] AC solution techniques are used for all pre and post contingency analyses.

1. No Generation in service

   Analysis of this level, typically is performed with ALL generation connected to Central Hudson's Underlying Transmission System modeled out of service. This analysis determines the capability of Central Hudson's Underlying Transmission System to supply load under a "Load Pocket" scenario.
2. Other generation levels, as appropriate.

Flows and voltages outside the appropriate limits shown through the analyses of LSC may be corrected by several methods including: up-rating or upgrading the limiting facility; reconfiguring the system to eliminate the contingency; or adding shunt devices to control voltage.

Proposed reinforcements that significantly reduce LSC at any generation level should be modified to mitigate those reductions in LSC.

## I. Special Protection Systems (SPS) / Remedial Action Schemes (RAS)

SPSs and RASs typically are control schemes that control (e.g., trip, runback) a power system element in response to an adverse system condition other than the isolation of faulted elements. UFLS systems are not considered SPSs or RASs.

The use of SPSs or RASs on any portion of Central Hudson's system, generally, is not allowed. SPSs and RASs would be considered only as a temporary mitigation measure and only while facilities are being constructed for the long-term correction of any adverse system condition(s).

**Appendix -- List of Acronyms**

| Acronyms | |
|---|---|
| BES | The NERC Bulk Electric System |
| BPS | The NPCC Bulk Power System |
| CHG&E | Central Hudson Gas & Electric |
| LSC | Load Serving Capability |
| LTC | Load Tap Changing |
| LTE | Long Term Emergency |
| NERC | North American Electric Reliability Corporation |
| NPCC | Northeast Power Coordinating Council |
| NYCA | New York Control Area |
| NYISO | New York Independent System Operator |
| NYPP | New York Power Pool |
| NYSRC | New York State Reliability Council |
| PAR | Phase Angle Regulator |
| SPS | Special Protection System |
| STE | Short Term Emergency |
| UFLS | Under-Frequency Load Shedding |