



1515 BROADWAY, NEW YORK, NY 10036-8901 TELEPHONE: (212) 840-1070 FAX: (212) 302-2782

February 17, 2009

NPCC Members

Re: Review of NPCC *Classification of Bulk Power System Elements*, Document A-10

Dear Sir/Madam:

The NPCC Working Group on Basic Criteria Review (CP-11) under the Task Force on Coordination of Planning (TFCP) has completed the review of Document A-10, *Classification of Bulk Power System Elements*. Draft revised A-10 was developed in response to comments received in the last Open Process posting of A-10 during the second quarter of 2007 and subsequent effort to develop additional and clarifying language to address other concerns related to A-10 criteria application and consistency in its implementation. During about a year and a half long of this effort, three rounds of review of draft A-10 by the Task Forces were conducted.

At the February 10, 2009 meeting of the Task Force on Coordination of Planning, it was suggested that because of the experience members already have with existing approved A-10 methodology, a lengthy period of testing the revised methodology is not necessary. Hence, it was decided that the Open Process posting of this draft revised A-10 be deferred to March 16, 2009 so that a time is given to testing prior to and to some extent in parallel with the Open Process posting period of 45 days through the end of April. Members are encouraged then to run tests on the draft revised methodology so that a more comprehensive set of comments may be developed than that can be expected from reviewing the document alone. Comments that may result from the tests can therefore be coordinated with the Open Process posting of this document scheduled on March 16, 2009.

In conjunction with the development of this revised document, TFCP has directed CP-11 to initiate the development of a procedure for the review and approval of classification of bulk power system element.

Thank you for your assistance in this endeavor.

Sincerely,

Hai (Quoc) Le

Chairman, CP-11 Working Group

Attachments

cc: CP-11 Working Group
NPCC Task Force Members
NPCC RCC Members
NPCC Staff



NORTHEAST POWER COORDINATING COUNCIL, INC.
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Classification of Bulk Power System Elements

DRAFT Revised February 4, 2009

Adopted by the Members of the Northeast Power Coordinating Council Inc., this April 28, 2007 based on recommendation by the Reliability Coordinating Committee, in accordance with Section VIII of the NPCC Inc. Bylaws dated May 18, 2006 as amended to date.

1.0 Introduction

NPCC defines specific requirements applicable to design, operation, and **protection** of the **bulk power system**. The object of this *Classification of Bulk Power System Elements* (Document A-10) is to provide the methodology to identify the **bulk power system elements**, or parts thereof, of the interconnected NPCC Region.

The methodology in this document is used to classify **elements** of the **bulk power system** and may result in **elements** being added to or removed from the existing lists. The methodology in this document is based on the following:

- Results of an analysis done on a bus basis can be applied to identify which **elements**, or portions thereof, connected to the bus are part of the **bulk power system**.
- **Elements** shall not automatically be included or excluded from the **bulk power system** based on voltage class. Application of this methodology may be omitted at buses that can be logically excluded from the **bulk power system** based on study results at other buses tested using this methodology. If a bus is determined to be **bulk power system**, all other buses with elements connected to that bus must be tested.
- **Elements** shall be evaluated based on this methodology when significant changes occur on the system that could change an **element's bulk power system** status; the evaluation may be limited to the affected part of the system.
- **Areas** and facility owners may adopt methodologies that exceed the requirements set forth in this document for their own purposes. However, only **elements** classified as **bulk power system** as a result of testing described in this document shall be included on the NPCC's list of **bulk power system elements**. NPCC criteria and compliance monitoring shall consider only the system **elements** listed on NPCC's list of **bulk power system elements**.

The Classification of **Bulk Power System Elements** is based on three defined terms: **bulk power system**, **local area** and **significant adverse impact**.

2.0 Definitions

Terms in italics in this document are defined in this section.

Terms in bold are defined in the *NPCC Glossary of Terms* (Document A-7).

2.1 *Bus*

Within this document the term *bus* refers to a junction with sensing or **protection** equipment within a substation or switching station at which the terminals of two or more **elements** are connected, regardless of whether circuit breakers are provided. In this context, *bus* may not have a direct correlation to the use of this term in substation design or a power flow data set.

In some configurations a *bus* may include more than one physical *bus*, such as in a breaker-and-a-half arrangement or a single-line-single-breaker arrangement in which two physical *buses* are connected through a *bus-tie* breaker. The examples in Figure 1 depict two of many possible configurations where two physical *buses* are tested as a single *bus*. *Buses* that are separated by normally open *bus-tie* breakers are considered as separate *buses*. The termination of line sections through switches should not be considered as a *bus* requiring testing unless the switches are activated as part of a **protection system** for the line which they sectionalize as part of normal **protection system** actions.

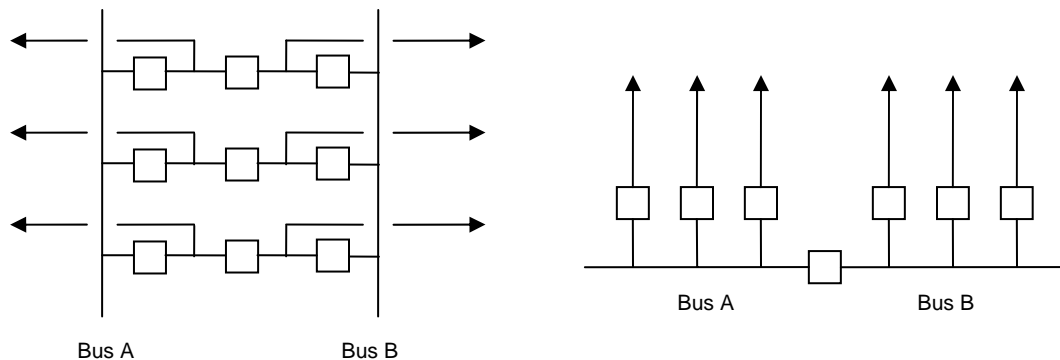


Figure 1 – Configurations where *Bus A* and *Bus B* are tested as one *bus*.

In some configurations **elements** may not be terminated to the *bus* through circuit breakers, such as the generator *bus* for a unit connected generator or a *bus* between a transmission line and transformer that are switched as a single circuit. The examples in Figure 2 depict two of many configurations where two physical *buses* are tested as separate *buses*.

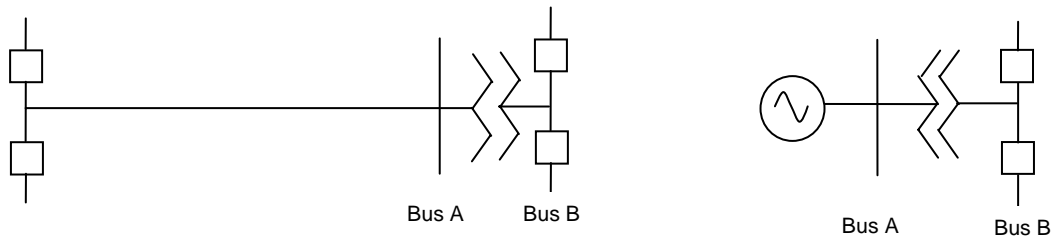


Figure 2 – Configurations where *Bus A* and *Bus B* are tested as two separate *buses*.

2.2 *Uncleared Locally*

Within this document the phrase *uncleared locally* is used to denote failure of the **protection** for the *bus* under test to initiate tripping of all associated interrupting devices regardless of their location and to initiate **Special Protection System** operation.

Protection located at other *buses* is assumed to operate as designed when that **protection** cannot be disabled by failure of a single component in common with the **protection** at the *bus* under test. For example, consider the case where the **protection** for **elements** connected to higher voltage level and lower voltage level *buses* in the same station share a dc source, and an independent dc source is provided for second **protection groups** associated with **elements** connected to the higher voltage level *bus*. In this case, it is acceptable when testing the lower voltage level *bus* to assume correct operation of any **protection groups** associated with **elements** connected to the higher voltage level *bus* capable of detecting the **fault** and supplied by the independent dc source.

In cases where circuit breakers are not provided at the terminals of the **element** at the *bus* under test (as shown in Figure 2, *bus A*), *uncleared locally* includes a failure to clear a **fault** by circuit breakers located at another *bus* within the same substation, unless back-up **protection** at that other *bus* using an independent dc source would detect the **fault** and initiate clearing.

3.0 Classification of Bulk Power System Elements

3.1 Testing Conditions and Assumptions

Studies conducted for the purpose of determining the **elements** of the **bulk power system** shall assume the following conditions:

- 3.1.1. Power flow transfers, **load** and **generation** patterns expected to exist for the period under study which stress the system in a manner critical to the classification of the *bus* to be tested. All **reclosing** facilities rendered inoperative.
 - 3.1.2. Operation of **Special Protection Systems**, undervoltage **load shedding** and underfrequency **load shedding** modeled as designed.
 - 3.1.3. Load models used in the Transient Test are consistent with **Area** practices for the studies of rotor angle stability.
 - 3.1.4. Load models used for steady state testing are either constant MVA or are based on actual system testing with LTC movement.
 - 3.1.5. Stability simulation runs until the system response can be clearly determined.
 - 3.1.6. Generic or detailed relay models to monitor, after tripping of remote terminals, the potential for tripping of un-faulted **elements**.
- 3.2 Test Methodology

Both **transient stability** and steady-state tests are used to determine the impact on system performance resulting from power system **faults**.

Testing is based on application of a *bus fault* at a single voltage level that is *uncleared locally*. Tripping of un-faulted **elements** associated with clearing the test **fault** does not constitute a **significant adverse impact**.

Depending on system configuration or topology, testing only **faults** at *buses* can fail to uncover **significant adverse impacts** arising from some design criteria contingencies. Any design criteria **fault** with a simultaneous failure of all **protection systems** at a bus which may reasonably be expected to result in a **significant adverse impact** must also be assessed.

A **transient stability** test may be done first to identify *buses* at which **faults** may cause a **significant adverse impact** outside of the **local area**.

For those *buses* which are not classified as **bulk power system** in the **transient stability** test, a steady-state test is used to identify *buses* at

which **faults** may cause a **significant adverse impact** outside of the **local area**.

Step 1 - Transient Test

Simulate the transient condition of a three-phase **fault** with delayed clearing at the *bus* under test (step 1a). If the test results in a positive **bulk power system** determination, more detailed testing (step 1b) may be applied to obtain a more precise determination.

1a. Apply a three-phase **fault** for at least 10 seconds at the *bus* which is *uncleared locally*, and then simulate tripping of all terminals of each **element** connected to the *bus* under test. In cases where there is no **fault** interrupting device at the remote terminal of an **element**, open all terminals of all **elements** between the *bus* under test and the interrupting device(s) that will open to clear the **fault**. This test is performed as an efficient, but conservative method for evaluating the impacts of:

- *bus faults* which would result in faster clearing time, and
- **faults** off the *bus*.

It is recognized that due to the conservative nature of this test some **elements** could be classified unnecessarily as part of the **bulk power system**. If the above test results in a positive **bulk power system** determination, the following additional testing may be utilized to obtain a more precise determination. Subsequent testing utilizes design clearing times for the conditions being tested, as stated below.

1b. Apply a three-phase **fault** at the *bus*, which is *uncleared locally* and trip the remote terminals of all **elements** that will open to clear the **fault**. Remote clearing times shall be based on design **fault clearing** times, assuming no communications from the station under test to the remote terminals.

Transformers and other **elements** connected to the *bus* shall only be tripped by operation of independent remote **protection groups** capable of clearing a **fault** on the *bus* under test.

Some **protection groups** (e.g. directional comparison blocking) at remote terminals may provide high-speed **fault clearing** for faults

at the bus under test. In order to test the effects of longer **fault clearing** times for fault conditions when these remote **protection groups** would not provide high speed **fault clearing**, for either test (1a) or (1b) above:

- High-speed **fault clearing** at remote terminals must be ignored; or
- Testing must vary the placement of the 3-phase **fault** on the elements connected to the bus under test to include locations beyond the reach of the high-speed tripping relay element at the remote terminal.

However, the **protective relay** settings may be reviewed to determine whether the *bus* could be classified as "non-bulk" if faster remote **fault** clearing can be achieved. If **protective relay** settings are modified, an assessment shall be conducted to ensure that the faster clearing time does not compromise the security of the **protection system**. Until the **protective relay** settings are modified, the *bus* must be classified as **bulk power system**.

- 1c. The test above is meant to cover the majority of design criteria contingencies. However, the **elements** associated with the *bus* under test must be reviewed to ensure adverse consequences from transmission design criteria contingencies are not overlooked. For example, if a circuit terminating at the *bus* under test shares a multiple circuit tower with an adjacent circuit that does not terminate at the *bus* under test, the adjacent circuit design contingency must also be assessed. In such cases, simultaneous permanent phase to ground **faults** on different phases of each of two adjacent transmission circuits shall be applied at critical common tower locations. The **fault** on the circuit associated with the *bus* under test which is *uncleared locally*, shall be simulated with **normal fault clearing** at the remote terminal and on the adjacent circuit.

If the **fault** has a **significant adverse impact** outside of the **local area**, the *bus* is classified as part of the **bulk power system**.

For *buses* not classified as part of **bulk power system** in Step 1, continue with the Steady State Test in step 2.

Step 2 - Steady State Test

Simulate the post-**contingency** steady-state conditions based on one of the

following outcomes of the **fault** applied to the *bus* under test:

- 2a. If the **fault** was cleared based on design **fault clearing** times in the Transient Test, open the same **elements** that were opened to clear the **fault** in the Transient Test. Post-**contingency** conditions shall reflect operation of all automatic devices.
- 2b. If the **fault** was not cleared based on design **fault clearing** times in the Transient Test, assume that the **fault** propagates to the nearest location where it can be detected by independent **protection groups** and open the **elements** that would be opened by the **protection groups** to clear the **fault**. Note that because **fault clearing** will occur at interrupting devices capable of clearing the **fault**, it may be necessary to open multiple **elements** between the *bus* under test and the relevant interrupting devices, for example, a transmission line and transformer in series as shown in Figure 2.
- 2c. As in Step 1, the steady state test above is meant to cover the majority of design criteria contingencies. However, the **elements** associated with the *bus* under test must be reviewed to ensure adverse consequences from transmission design criteria contingencies are not overlooked. For example, the post-contingency analysis must assess the loss of any adjacent circuit on common towers with a circuit terminating at the *bus* under test in addition to the **elements** associated the *bus* under test.

Voltages and thermal loading will be assessed for **significant adverse impact** outside of the **local area** following automatic actions. In cases where a power flow solution is not obtained, other techniques shall be used to assess the impact of the event on the power system.

If the **fault** has a **significant adverse impact** outside of the **local area**, the *bus* is classified as part of the **bulk power system**.

Note that Step 2 can be done prior to Step 1. If a *bus* is classified as part of the **bulk power system** by the Steady State Test (Step 2), the Transient Test (Step 1) needs not be done for that *bus*.

3.3 Utilization of Test Results to Classify on an **Element-by-Element** Basis.

Classification of **bulk power system elements** is achieved by applying the results of the above tests to the **elements** connected to the tested *bus*.

An **element** with only one terminal such as a generator, shunt reactor, or capacitor bank, is classified as part of the **bulk power system** if the *bus* at which it is connected is classified as part of the **bulk power system**.

An **element** with multiple terminals such as a transformer or transmission line is classified as part of the **bulk power system** if any terminal of the **element** is connected to a *bus* that is classified as part of the **bulk power system**. The **bulk power system** classification may be limited to only a portion of the **element** if all of the following conditions are met:

- At least one terminal is connected to a *bus* that is not part of the **bulk power system**.
- The Steady State Test has been applied at the *buses* connected to all terminals of the **element** and none of these *buses* have been classified as part of the **bulk power system** based on results of the Steady State Test.
- The Transient Test has been applied between the terminals of the **element** to identify those portions of the **element** for which the Transient Test will not result in a **significant adverse impact** outside of the **local area**.

3.4 Documentation

- 3.4.1 The rationale for the test conditions and assumptions used that are not listed above in 3.1 shall be included.
- 3.4.2 Documentation of **bulk power system** testing and determination shall include voltage and thermal criteria used.

4.0 Application and List Maintenance

The 'NPCC **Bulk Power System List**' will be maintained by the Task Force on System Studies (TFSS). Additions and removals to the NPCC **Bulk Power System List** will be submitted by TFSS to the Reliability Coordinating Committee (RCC) for approval.

4.1 Addition of Elements to the Bulk Power System List

When application of this methodology identifies a non-**bulk power system element** that should be classified as a **bulk power system**

element, documentation of the analysis shall be presented to the TFSS. Once classification of the **element** is recommended by TFSS and approved by the RCC the **element** will be added to or removed from the NPCC **Bulk Power System List** with the appropriate comments and information. The Task Force on System Protection and the Compliance Committee will be notified once an **element** is approved by the RCC to be added or removed from the **Bulk Power System List**. A plan and schedule for achieving compliance shall be provided to TFSP for review and acceptance. TFSP may require modifications to the proposed plan and schedule.

4.2 Removal of Elements from the Bulk Power System List

When application of this methodology identifies a **bulk power system element** that no longer should be classified as a **bulk power system element**, documentation of the analysis shall be submitted to the TFSS. If reclassification of the **element** is recommended by TFSS and approved by the RCC, the **element** will be removed from the NPCC **Bulk Power System List**.

Lead Task Force:	Task Force on Coordination of Planning
Reviewed for concurrence by:	TFSS, TFCO, TFSP, and TFIST
Review frequency:	4 years
References:	<i>Basic Criteria for Design and Operation of Interconnected Power Systems</i> (Document A-2) <i>NPCC Glossary of Terms</i> (Document A-7)

Document A-10



NORTHEAST POWER COORDINATING COUNCIL, INC.
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Classification of Bulk Power System Elements

DRAFT Revised February 4, 2009

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Adopted by the Members of the Northeast Power Coordinating Council Inc., this April 28, 2007 based on recommendation by the Reliability Coordinating Committee, in accordance with Section VIII of the NPCC Inc. Bylaws, dated May 18, 2006 as amended to date.

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1.0 Introduction

~~The NPCC defines *Basic Criteria for Design and Operation of Interconnected Power Systems* (Document A-2) and related criteria documents define~~ specific requirements applicable to design, operation, and **protection** of the **bulk power system**. ~~The object of this *This Classification of Bulk Power System Elements* (Document A-10) is to provide~~ provides the methodology ~~to identify~~ for the **bulk power system** ~~identification of those elements, or parts thereof, of the interconnected NPCC Region, to which NPCC bulk power system criteria are applicable.~~

~~Each Area has an existing list of bulk power system elements.~~ The methodology in this document is used to classify **elements** of the **bulk power system** and may result in **elements** being added to or removed from the existing lists.

The methodology in this document is based on the following ~~principles~~:

- ~~Results of an analysis done on a bus basis can be applied to identify which~~ **elements, or** ~~The objective is to determine which elements, or parts thereof, are part of the bulk power system. In practice however, the analysis is performed on a bus basis. Results of the analysis for a bus can be applied to determine which elements or portions thereof, connected to the bus are part of the bulk power system.~~
- ~~It is applicable to all voltage levels.~~ **Elements** shall not automatically be included or excluded from the **bulk power system** based on voltage class. Application of this methodology may be omitted at buses that ~~are already classified as part of the bulk power system, and at buses that~~ can be logically excluded from the **bulk power system** based on study results at other buses ~~tested using this methodology.~~ **If a bus is determined to be bulk power system, all other buses with elements connected to that bus must be tested.**
- **Elements** shall be evaluated based on this methodology when significant changes occur on the system that could change an **element's bulk power system** status; the evaluation may be limited to the affected part of the system.
- **Areas and facility owners** may adopt methodologies that exceed the requirements set forth in this document for their own purposes. However, **only elements** classified as **bulk power system** as a result of testing described in this document shall be included on the NPCC's list of **bulk**

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power system elements. NPCC criteria and compliance monitoring shall consider only the system **elements** listed on NPCC's list of that qualify as **bulk power system elements** under the NPCC criteria.

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(Terms that appear in bold typeface through out the document are defined in the Glossary located in Document A-7, the NPCC Glossary of Terms.)

The Classification of **Bulk Power System Elements** is ~~are~~ based on three defined terms: **bulk power system**, **local area**, and **significant adverse impact**.

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2.0 Definitions

Terms in italics in this document are defined in this section.

Terms in bold are defined in ~~for these are included in Document A-7,~~ the NPCC Glossary of Terms (Document A-7).

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2.1 *Bus*

Within this document, the term *bus* refers to **a junction with sensing or protection equipment** ~~an electrical node~~ within a substation ~~or switching station at to~~ which ~~the terminals of two or more~~ **multiple elements** are connected, ~~regardless of whether.~~ ~~In some cases faults may be cleared locally by~~ circuit breakers ~~are provided.~~ ~~In this context,~~ ~~located at another~~ *bus* ~~may not have a direct correlation to within~~ the ~~use of this term in same~~ substation ~~design or a power flow data set.~~

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~~The examples in Figure 1 depict two such configurations.~~ In some configurations a *bus* may include more than one physical *bus*, such as in a breaker-and-a-half arrangement or a single-line-single-breaker arrangement ~~in which, where~~ two physical *buses* are connected through a *bus-tie* breaker. ~~The examples in Figure 1 depict two of many possible configurations where two physical buses are tested as a single bus.~~ *Buses* ~~that are separated by normally open bus-tie breakers are considered as separate buses.~~ The termination of line sections through switches should ~~not be considered as a bus requiring testing unless the switches are activated as part of a protection system for the line which they sectionalize as part of normal protection system actions.~~

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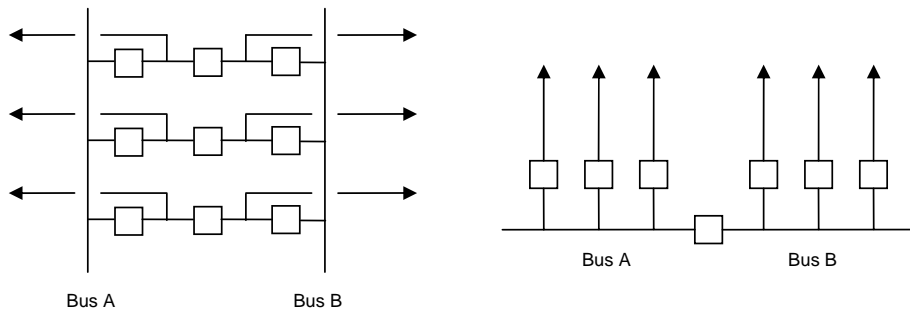


Figure 1 – Configurations where *Bus A* and *Bus B* are tested as one bus.

In some configurations **elements** may not be terminated to the *bus* through circuit breakers, such as the generator *bus* for a unit connected generator or a *bus* between a transmission line and transformer that are switched as a single circuit. The examples in Figure 2 depict two of many possible configurations where two physical *buses* are tested as separate. Regardless of the impedance between them, two switchyards at the same voltage level that are connected by an open bus-tie breaker or have separate control buildings are considered as two *buses*.

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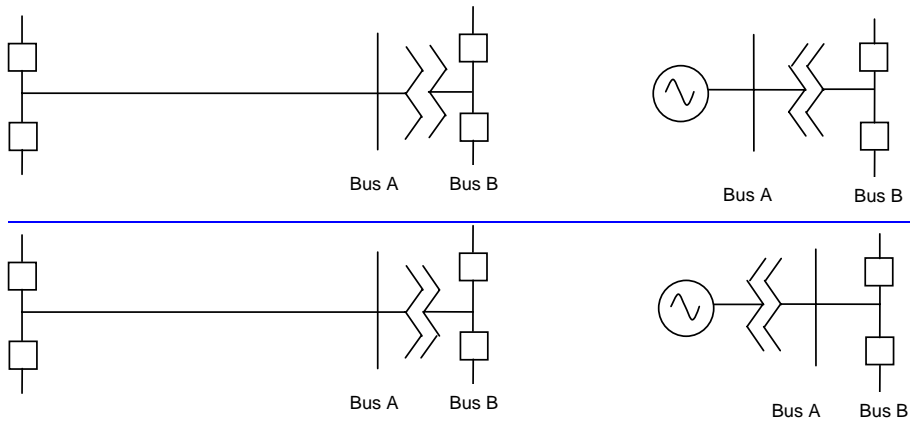


Figure 1 – Configurations where *Bus A* and *Bus B* are tested as two separate buses.

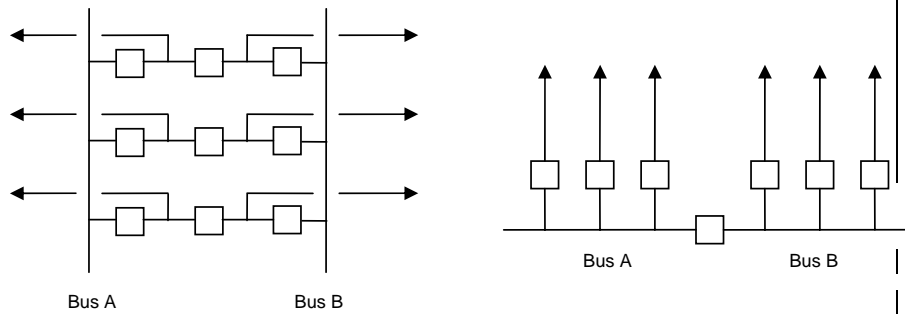


Figure 2 – Configurations where *Bus A* and *Bus B* are tested as two separate buses on one bus.

2.2 *Uncleared Locally*

Within this document the phrase *uncleared locally* is used to denote failure of the **protection** for the *bus* under test to initiate tripping of all associated interrupting devices regardless of their location and to initiate **Special Protection System** operation.

Protection located at other *buses* is assumed to operate as designed when that **protection** cannot be disabled by failure of a single component in common with the **protection** at the *bus* under test. For example, consider the case where the **protection** for **elements** connected to higher voltage level and lower voltage level *buses* in the same station share a dc source, and an independent dc source is provided for second **protection groups** associated with **elements** connected to the higher voltage level *bus*. In this case, it is acceptable when testing the lower voltage level *bus* to assume correct operation of any **protection groups** associated with **elements** connected to the higher voltage level *bus* capable of detecting the **fault** and supplied by the independent dc source.

In cases where circuit breakers are not provided at the terminals of the **element** at the *bus* under test (as shown in Figure 2, *bus A*), *uncleared locally* includes a failure to clear a **fault** by circuit breakers located at another *bus* within the same substation, unless back-up **protection** at that other *bus* using an independent dc source would detect the **fault** and initiate clearing.

3.0 **Classification of Bulk Power System Elements**

3.1 Testing Conditions and Assumptions

Studies conducted for the purpose of determining the **elements** of the **bulk power system** shall assume the following power flow conditions:

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- 3.1.1. Power flow ~~utilizing~~ transfers, **load** and **generation** patterns expected to exist for the period under study ~~conditions~~ which stress the system in a manner critical to the classification of the *bus* to be tested. ~~These studies shall be based on the interface limits, **load** and **generation** conditions expected to exist for the period under study.~~ All **reclosing** facilities ~~shall be assumed in service unless it is known that such facilities will be~~ rendered inoperative.
- 3.1.2. Operation of **Special Protection Systems**, undervoltage load **shedding** and underfrequency load **shedding** modeled as designed.
- 3.1.3. Load models used in the Transient Test are consistent with **Area** practices for the studies of rotor angle stability.
- 3.1.4. Load models used for steady state testing are either constant MVA or are based on actual system testing with LTC movement.
- 3.1.5. Stability simulation runs until the system response can be clearly determined.
- 3.1.6. Generic or detailed relay models to monitor, after tripping of remote terminals, the potential for tripping of un-faulted **elements**.

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3.2 Test Methodology

~~Both~~ These criteria utilize both **transient stability analysis** and steady-state **tests** are used ~~power flow analysis~~ to determine the impact on system performance resulting from power system **faults**. ~~The criteria steps are ordered to reduce the required number of simulations. **Fault clearing** by the remote **protection** is acceptable.~~

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Testing is based on application of a *bus* **fault** at a single voltage level that is *uncleared locally*. Tripping of un-faulted **elements** associated with clearing the test **fault** does not constitute a **significant adverse impact**.

Depending on system configuration or topology, testing only **faults** at *buses* can fail to uncover **significant adverse impacts** arising from some design criteria contingencies. Any design criteria **fault** with a simultaneous failure of all **protection systems** at a bus which may reasonably be expected to result in a **significant adverse impact** must also be assessed.

A **transient stability** test ~~may be done~~ ~~is used~~ first to identify *buses* at which **faults** may cause a **significant adverse impact** outside of the **local area**. ~~This test is done based on either conservative fault clearing time assumptions, or actual fault clearing times at remote terminals. Either actual or conservative fault clearing times may be used.~~

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~~The test is based on application of a bus fault at a single voltage level that is un-cleared locally. Tripping of un-faulted elements as a consequence of the fault is part of the test and does not constitute a significant adverse impact. Operation of Special Protection Systems, including undervoltage load shedding, shall be taken into account in these tests.~~

For those *buses* which are not classified as **bulk power system elements** in the **transient stability** first test, a ~~steady-state power flow~~ test is used to identify *buses* at which **faults** may cause a **significant adverse impact** outside of the **local area** based on steady state parameters such as post-contingency thermal loading and voltage.

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Step 1 - Transient Test

Simulate the transient condition of a three-phase fault with delayed clearing at the bus under test (step 1a). If the test results in a positive bulk power system determination, more detailed testing (step 1b) may be applied to obtain a more precise determination.

1a. Apply a three-phase fault for at least 10 seconds at the bus which is un-cleared locally, and then simulate tripping of all terminals of each element connected to the bus under test. In cases where there is no fault interrupting device at the remote terminal of an element, open all terminals of all elements between the bus under test and the interrupting device(s) that will open to clear the fault. This test is performed as an efficient, but conservative method for evaluating the impacts of:

- bus faults which would result in faster clearing time, and
- faults off the bus.

It is recognized that due to the conservative nature of this test some elements could be classified unnecessarily as part of the bulk power system. If the above test results in a positive bulk power system determination, the following additional testing may be utilized to obtain a more precise determination. Subsequent testing

utilizes design clearing times for the conditions being tested, as stated below.

1b. If either the transient stability test or the power flow test identifies a **significant adverse impact**, then a determination must be made as to whether the **significant adverse impact** is contained within the **local area**. Determination that a **significant adverse impact** is contained within a **local area** is made by **Area(s)**, and affirmed by NPCC.

Transient Stability Based Test

1. The Transient Stability Based Test may be conducted either by simulating an extended fault assuming a conservative clearing time at remote terminals, or by using actual clearing times, as stated in option (a) or (b) below:

- a) Apply a three-phase **fault** at the bus, **uncleared locally**[†], and simulate tripping of the remote terminals of all transmission lines that will open to interrupt the **fault**. Remote clearing times shall be based on a conservative estimate of **fault clearing** times assuming no communications from the station under test to the remote terminals. Transformers connected to the *bus* shall not be tripped.

If the **fault** has a **significant adverse impact** outside the **local area**, then the *bus* is classified as part of the **bulk power system**, or option (b) may be used to classify the bus. Otherwise, continue with the Power Flow Based Test in Step 2.

- b) Apply a three-phase **fault** at the *bus*, which is **uncleared locally** and **trip locally**[†] and simulate tripping of the remote terminals of all **elements** that will open to **clear** interrupt the **fault**. Remote clearing times shall be based on **design designed fault clearing** times, assuming no communications from the station under test to the remote terminals.

Transformers **and other elements** connected to the *bus* shall **only** be tripped by operation of independent remote **protection groups** capable of clearing a **fault** on the *bus* under test.

If the **fault** has a **significant adverse impact** outside the **local area**, the *bus* is classified as part of the **bulk power system**. Otherwise, continue with the Power Flow Based Test in step 2.

[†] Local clearing includes operation of all circuit breakers required to clear the fault at one substation and may include operation of circuit breakers at another bus, as defined in Section 1.0.

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Some **protection groups** (e.g. directional comparison blocking) at remote terminals may provide high-speed **fault clearing** for faults at the bus under test. In order to test the effects of longer **fault clearing times** for fault conditions when these remote **protection groups** would not provide high-speed **fault clearing**, for either test (1a) or (1b) above:

- High-speed **fault clearing** at remote terminals must be ignored; or
- Testing must vary the placement of the 3-phase **fault** on the elements connected to the bus under test to include locations beyond the reach of the high-speed tripping relay element at the remote terminal.

However, if a bus is classified as part of the bulk power system in step 1, the protective relay settings may be reviewed to determine whether the bus could be classified as "non-bulk" if faster remote fault clearing can be achieved. If protective relay settings are modified, an assessment shall be conducted to ensure that the faster clearing time does not compromise the security of the protection system. Until the protective relay settings are modified, the bus must be classified as bulk power system.

1c. The test above is meant to cover the majority of design criteria contingencies. However, the elements associated with the bus under test must be reviewed to ensure adverse consequences from transmission design criteria contingencies are not overlooked.

Power Flow Based Test

2. For example, if a circuit terminating at the bus under test shares a multiple circuit tower with an adjacent circuit that does not terminate at the bus under test, the adjacent circuit design contingency must also be assessed. In such cases, simultaneous permanent phase to ground faults on different phases of each of two adjacent transmission circuits shall be applied at critical common tower locations. The fault on the circuit associated with the bus under test which is *uncleared locally*, shall be simulated with **normal fault clearing** at the remote terminal and on the adjacent circuit.

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If the **fault** has a **significant adverse impact** outside of the **local area**, the *bus* is classified as part of the **bulk power system**.

For those *buses* not already classified as part of the **bulk power system** in Step 1, continue with the Steady State Test in step 2.

Step 2 - Steady State Test

Simulate~~1, simulate~~ the post-**contingency** steady-state conditions based on one of the following **outcomes of the fault** applied to the *bus* under test:

2a. If the **fault** was cleared based on design **fault clearing times** in the Transient Test, open the same **fault** at a *bus* that is un-cleared locally and cleared by tripping of the remote terminals of all **elements** that were opened~~may open to clear~~ interrupt the **fault** in:

~~In cases where transformers are connected to the Transient Test. Post-**contingency** conditions~~bus~~, the transformers shall reflect be tripped by operation of all automatic devices.~~

2b. If the **fault** was not cleared based on design **fault clearing times** in the Transient Test, assume that the **fault** propagates to the nearest location where it can be detected by independent ~~remote~~ **protection groups** and open the **elements** that would be opened by the **protection groups** to clear the **fault**. Note that because **fault clearing** will occur at interrupting devices capable of clearing the **fault**, it may be necessary to open multiple **elements** between the *bus* under test and the relevant interrupting devices, for example, a transmission line and transformer in series as shown in Figure 2, fault on the *bus* under test. ~~In cases where the transformer would not be tripped, all elements connected to the same buses as the transformer terminals shall be tripped.~~

2c. As in Step 1, the steady state test above is meant to cover the majority of design criteria contingencies. However, the **elements** associated with the *bus* under test must be reviewed to ensure adverse consequences from transmission design criteria contingencies are not overlooked. For example, the post-contingency analysis must assess the loss of any adjacent circuit on common towers with a circuit terminating at the *bus* under test in addition to the **elements** associated the *bus* under test.

Voltages and thermal loading will be assessed for **significant adverse**

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3.4.1 The rationale for the test conditions and assumptions ~~may be used~~ that are not listed above in 3.1 shall be included. ~~to determine what portion of the element is part of the bulk power system.~~

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3.4.2 Documentation of **bulk power system** testing and determination shall include voltage and thermal criteria used.

4.0 Application and List Maintenance

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~~The 'NPCC Each Area shall be responsible for application of the Classification of Bulk Power System List Elements as described in this document, and shall maintain a list of bulk power system elements. These lists will be compiled into the "NPCC Inc. BPS List" and maintained by the Task Force on System Studies (TFSS). Additions and removals to the NPCC Bulk Power System List will be submitted by TFSS) and presented as an informational item to the Reliability Coordinating Committee (RCC) for approval, annually. The Areas shall review and update their lists as necessary at least every three years. Application of NPCC criteria and compliance monitoring shall be based upon these lists of bulk power system elements.~~

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4.1 Addition of **Elements** upgraded to the **Bulk Power System List**~~BPS~~

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~~When application of this methodology identifies a non-bulk power Existing system element elements that should be are reclassified as a bulk power BPS as a result of system element, documentation of the analysis changes shall be presented to the TFSS. Once classification of the element is recommended by TFSS and approved by the RCC the element will be added to or removed from the NPCC Bulk Power System List TFSS. If design and construction is required as a result of the reclassification, a proposed implementation plan shall be included. Once the BPS element and implementation plan are approved by TFSS, it will be added to the NPCC Inc. BPS list with the appropriate comments and information. The Task Force on System Protection and the Compliance Committee will be notified once an element is approved by the RCC to be added or removed from the Bulk Power System List. A plan and schedule for achieving compliance shall be provided to TFSP for review and acceptance. TFSP may require modifications to the proposed plan and schedule.~~

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4.2 Removal of **Elements** downgraded from the **Bulk Power System List**~~BPS~~

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When application of this methodology identifies a **bulk power system element** that no longer should be classified as a **bulk power system element**, documentation of the analysis shall be submitted to the TFSS. If reclassification of the **element** is recommended by TFSS and approved by the RCC, the **element** will be removed from the NPCC **Bulk Power System List**. ~~After obtaining TFSS approval, elements that are reclassified as no longer being part of the BPS as a result of system changes will be removed from the NPCC Inc. BPS list.~~

Lead Task Force: Task Force on Coordination of Planning System ~~Studies~~

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Reviewed for concurrence by: TFSS, TFCO, TFSP, ~~TFCP~~, and TFIST

Review frequency: 4 years

References: *Basic Criteria for Design and Operation of Interconnected Power Systems* (Document A-2)
NPCC Glossary of Terms (Document A-7)