

On June 13, 2013, FERC issued an order extending the effective date of the definition of Bulk Electric System developed in Phase 1. As a result, this reference document is outdated. Revisions to the document will be developed at a later date to conform to the definition being developed in Phase 2

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Phase 1: Bulk Electric System Definition Reference Document

April 2013

This technical reference was created by the Definition of Bulk Electric System drafting team to assist entities in applying the definition. It should be read in concert with the complete definition, found in the NERC *Glossary of Terms*, and any guidance issued by the ERO. The process for handling requests for exceptions to the definition is found in Appendix 5c of the NERC *Rules of Procedure*. Both the NERC *Glossary of Terms* and *Rules of Procedure* are posted on the [NERC website](http://www.nerc.com).

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Introduction

During the course of Project 2010-17 Definition of Bulk Electric System (DBES), several commenters requested the Standard Drafting Team (SDT) to create a reference document explaining how the revised definition will be applied. This document is intended to provide such a reference.

Disclaimer

This document is not an official position of NERC and will not be binding on enforcement decisions of the NERC Compliance Program. This reference document reflects the professional opinion of the DBES SDT, given in good faith for illustrative purposes only.

Background

On November 18, 2010 FERC issued Order 743 and directed NERC to revise the definition of BES so that the definition encompasses all Elements and Facilities necessary for the reliable operation and planning of the interconnected bulk power system. Phase I of Project 2010-17 DBES reached a significant milestone on January 25, 2012 with the official filing of the revised definition with FERC.

Purpose

The purpose of this document is to assist the industry with the application of the revised definition. Examples are provided where appropriate but should not be considered as all-inclusive. The document is intended to provide clarification and explanations for the application of the revised definition in a consistent, continent-wide basis for the majority of BES Elements.

Summary

An understanding of the core definition and each Inclusion and Exclusion is necessary to accurately and consistently apply the BES definition. (It should be noted that the BES definition applies to a.c. and d.c. power.) The application of the 'bright-line' BES definition is a three-step process that, when appropriately applied, will identify the vast majority of BES Elements in a consistent manner that can be applied on a continent-wide basis.

Commission (FERC) Order No. 773 directs implementation of the revised BES Definition to take into account the impact of sub-100 kV looped Facilities regardless of voltage level. This alters previous guidance on the analysis of radial systems and requires re-examination of these configurations as shown in the diagrams dealing with the radial system and local network exclusions as well as the system diagrams.

In step one (1), the BES 'core' definition is used to establish the bright-line of 100 kV, which is the overall demarcation point between BES and non-BES Elements. Additionally, the 'core' definition identifies the Real Power and Reactive Power resources connected at 100 kV or higher, as included in the BES. To fully appreciate the scope of the 'core' definition, an

understanding of the term Element is needed. Element is defined in the NERC Glossary of Terms as:

“Any electrical device with terminals that may be connected to other electrical devices such as a generator, transformer, circuit breaker, bus section, or transmission line. An element may be comprised of one or more components. “

Step two (2) provides additional clarification for the purposes of identifying specific Elements that are included through the application of the ‘core’ definition. The Inclusions address Transmission Elements and Real Power and Reactive Power resources with specific criteria to provide for a consistent determination of whether an Element is classified as BES or non-BES.

Step three (3) is to evaluate specific situations for exclusion from the BES (classification as non-BES Elements). The exclusion language is written to specifically identify Elements or groups of Elements for exclusion from the BES. Step three (3) should be applied in the following sequence:

- Exclusion E2 provides for the exclusion of the Real Power resources that reside behind-the-retail meter (on the customer’s side) and supersedes Inclusion I2.
- Exclusion E4 provides for the exclusion of retail customer owned and operated Reactive Power devices and supersedes Inclusion I5.
- Exclusion E3 provides for the exclusion of ‘transmission Elements’ from local networks that meet the specific criteria identified in the exclusion language. This does not allow for the exclusion of Real Power and Reactive Power resources captured by Inclusions I2 – I5. Exclusion E3 only speaks to the transmission component of the local network. The only inclusion that Exclusion E3 supersedes is Inclusion I1. (Small "t" transmission is meant as a qualifier to Elements and, thus, brings in the Glossary definition of Elements while limiting it to just transmission components identified in the definition of Element.)
- Exclusion E1 provides for the exclusion of ‘transmission Elements’ from radial systems that meet the specific criteria identified in the exclusion language. This does not allow for the exclusion of Real Power and Reactive Power resources captured by Inclusions I2 – I5. Exclusion E1 only speaks to the transmission component of the radial system. The only inclusion that Exclusion E1 supersedes is Inclusion I1. (Small "t" transmission is meant as a qualifier to Elements and, thus, brings in the Glossary definition of Elements while limiting it to just transmission components identified in the definition of Element.)

Therefore, this Reference Document has been divided into sections to accurately first illustrate how specific parts of the definition are applied, and then how the hierarchal application of the definition is accomplished. Section I is a list of figures. Sections II and III provide illustrative diagrams with accompanying text, where appropriate, describing the application of the BES definition, grouped according to the specific inclusion or exclusion. Section IV provides a series of system diagrams that depict the hierarchical application of the definition. Section V establishes the linkage to the Rules of Procedure Exception Process.

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II. Inclusions

Each inclusion is shown below with both text and diagrams explaining how to apply the BES definition for the specific configuration shown. These examples are not to be considered all-inclusive, and simply reflect the professional opinion of the DBES SDT and are provided in good faith for illustrative purposes only. This document is not an official position of NERC and will not be binding on enforcement decisions of the NERC Compliance Program.

Inclusion I3 does not include diagrams, as there are no application configuration issues associated with it. Blackstart Resources are included in the BES regardless of configuration or location.

Diagrams only show application of the definition to the specific Element in question. For example, in Figure I1-1 below, only the windings of the transformer are shown as being included in the BES. The lines coming out of the transformer are not delineated as BES or non-BES, as no assumptions are being made as to where and how those lines connect in the big picture.

Key to diagram color coding:

- **Blue** indicates that an Element is included in the BES
- **Green** indicates that an Element is not included in the BES
- **Orange** indicates 'points of connection'.
- **Black** indicates Elements that are not evaluated for the specific inclusion depicted in the individual diagrams being shown.

II.1 BES Inclusion I1

I1. Transformers with the primary terminal and at least one secondary terminal operated at 100 kV or higher unless excluded under Exclusion E1 [radial] or E3 [local network].

Note: Figures I1-1 through I1-4 are depictions of the application of Inclusion I1 and are intended to assist the user during the full application of the BES definition.

Figures I1-1 through I1-4 depict various types of transformers and operating configurations typically utilized in the electric utility industry.

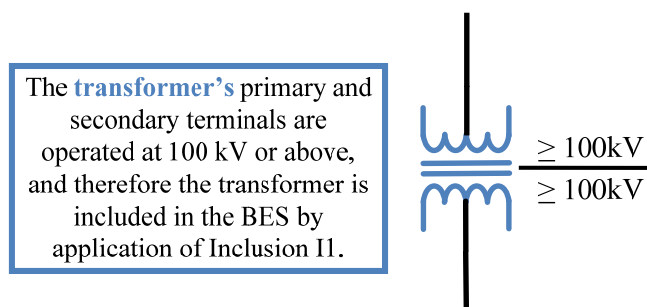


Figure I1-1: Typical Two Winding Transformer (BES)

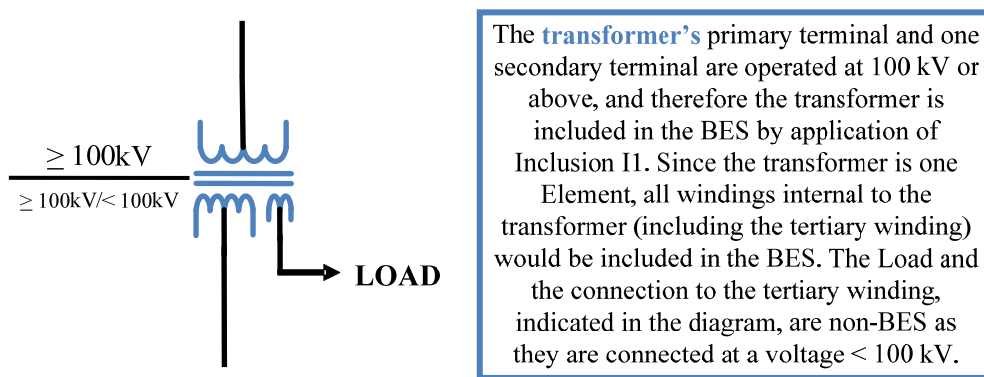


Figure I1-2: Typical Three Winding Transformer (BES)

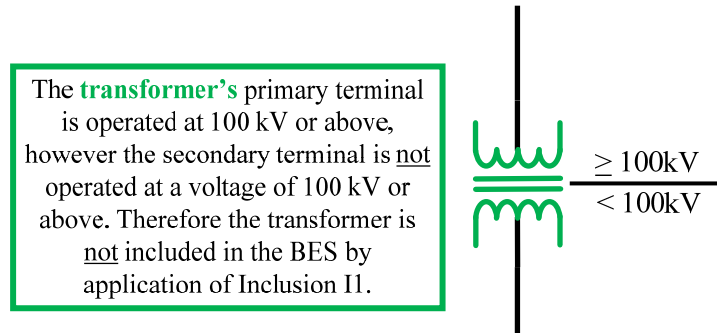


Figure I1-3: Typical Two Winding Transformer (non-BES)

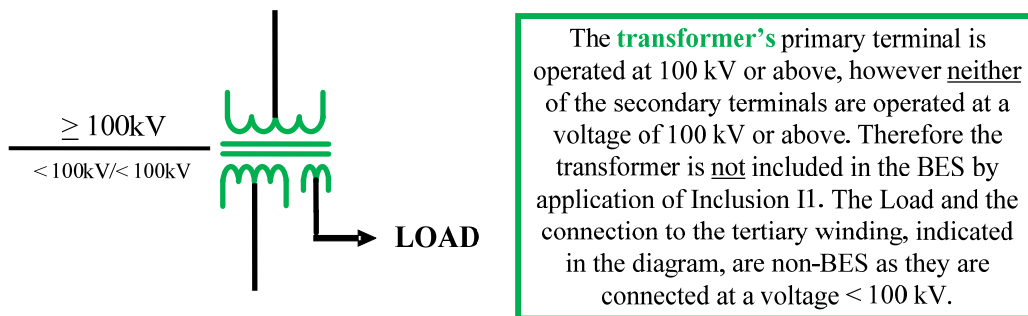


Figure I1-4: Typical Three Winding Transformer (non-BES)

11.2 BES Inclusion I2

I2. Generating resource(s) with gross individual nameplate rating greater than 20 MVA or gross plant/facility aggregate nameplate rating greater than 75 MVA including the generator terminals through the high-side of the step-up transformer(s) connected at a voltage of 100 kV or above.

Note: Figures I2-1 through I2-6 are depictions of the application of Inclusion I2 and are intended to assist the user during the full application of the BES definition.

Interpretation of the “or” statement in the inclusion definition is a hierarchical operator that has several steps as shown in the following diagrams.

Figure I2-1 depicts a single unit with gross individual nameplate rating greater than 20 MVA connected through the high-side of the step-up transformer connected at a voltage of 100 kV or above. By application of Inclusion I2, this generating unit is identified as a BES Element.

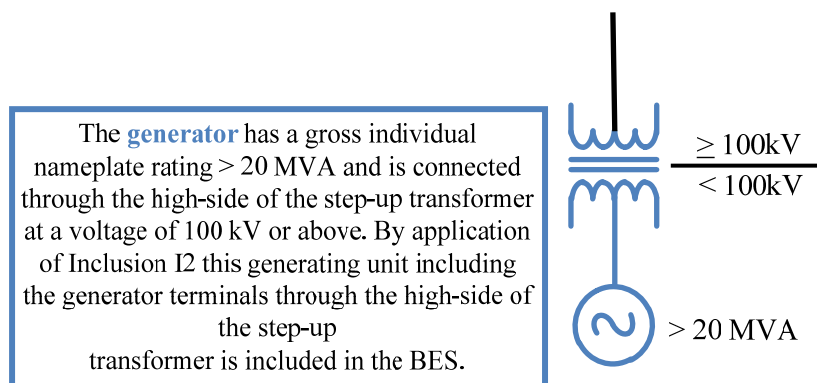


Figure I2-1: Single Generating Unit (BES)

Figure I2-2 depicts a single unit with gross individual nameplate rating less than 20 MVA connected through the high-side of the step-up transformer connected at a voltage of 100 kV or above. By application of I2, this unit is not a BES Element.

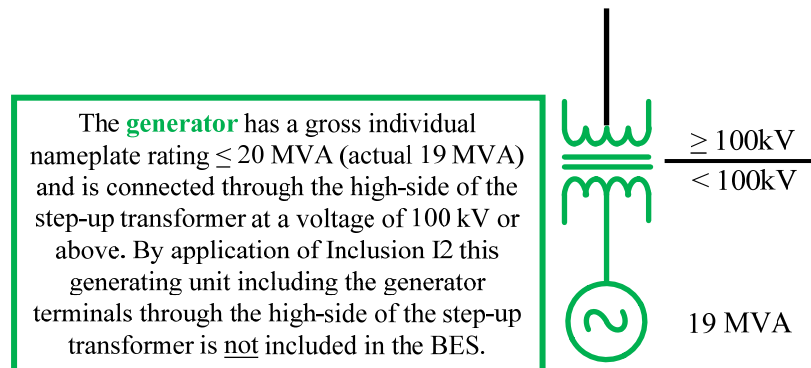


Figure I2-2: Single Generating Unit (non-BES)

Figure I2-3 depicts a site with multiple units connected through the high-side of the step-up transformer(s) at a voltage of 100 kV or above with a gross aggregate nameplate rating (connected @100 kV or above) greater than 75 MVA; therefore, by application of Inclusion I2, all of the units (connected @100 kV or above) are included.

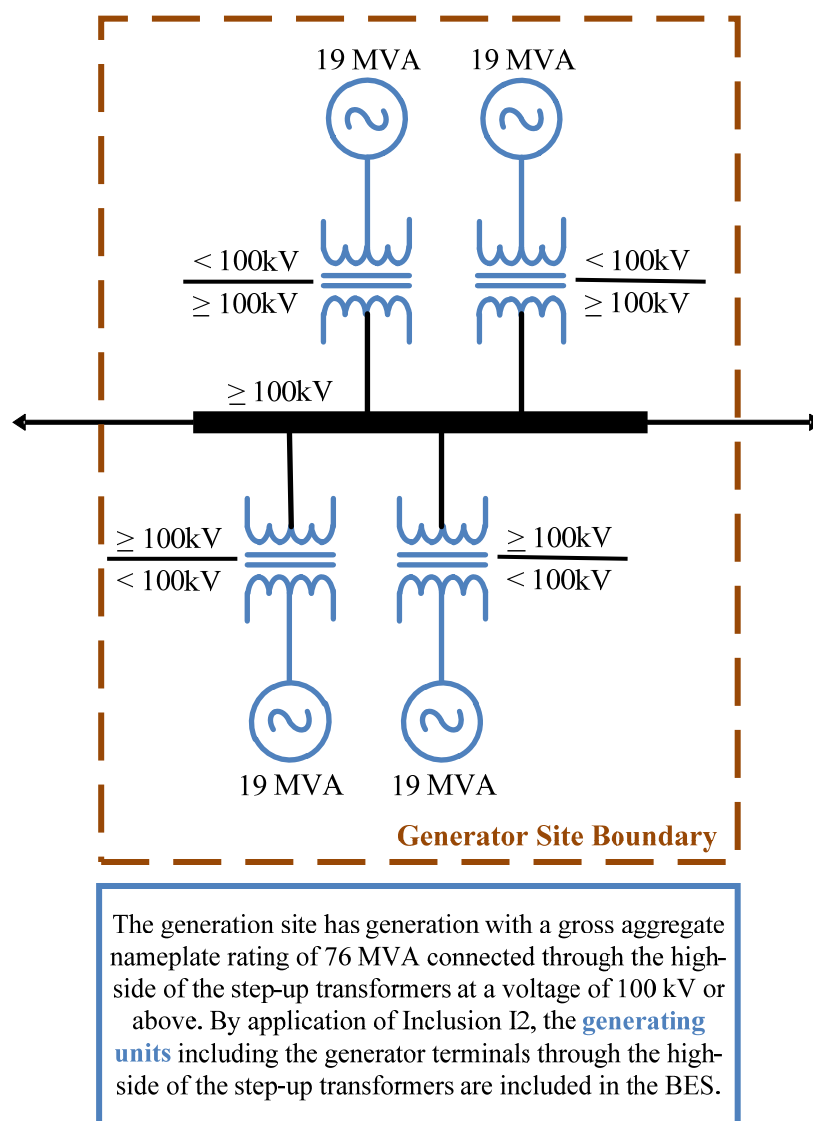


Figure I2-3: Multiple Unit Generating Site (BES)

Figure I2-4 depicts a site with multiple units connected through the high-side of the step-up transformer(s) at a voltage of 100 kV or above with an aggregate nameplate rating (connected @100 kV or above) less than 75 MVA. By application of Inclusion I2, only those units with a gross nameplate rating greater than 20 MVA connected through the high-side of the step-up transformer(s) at a voltage of 100 kV or above are included.

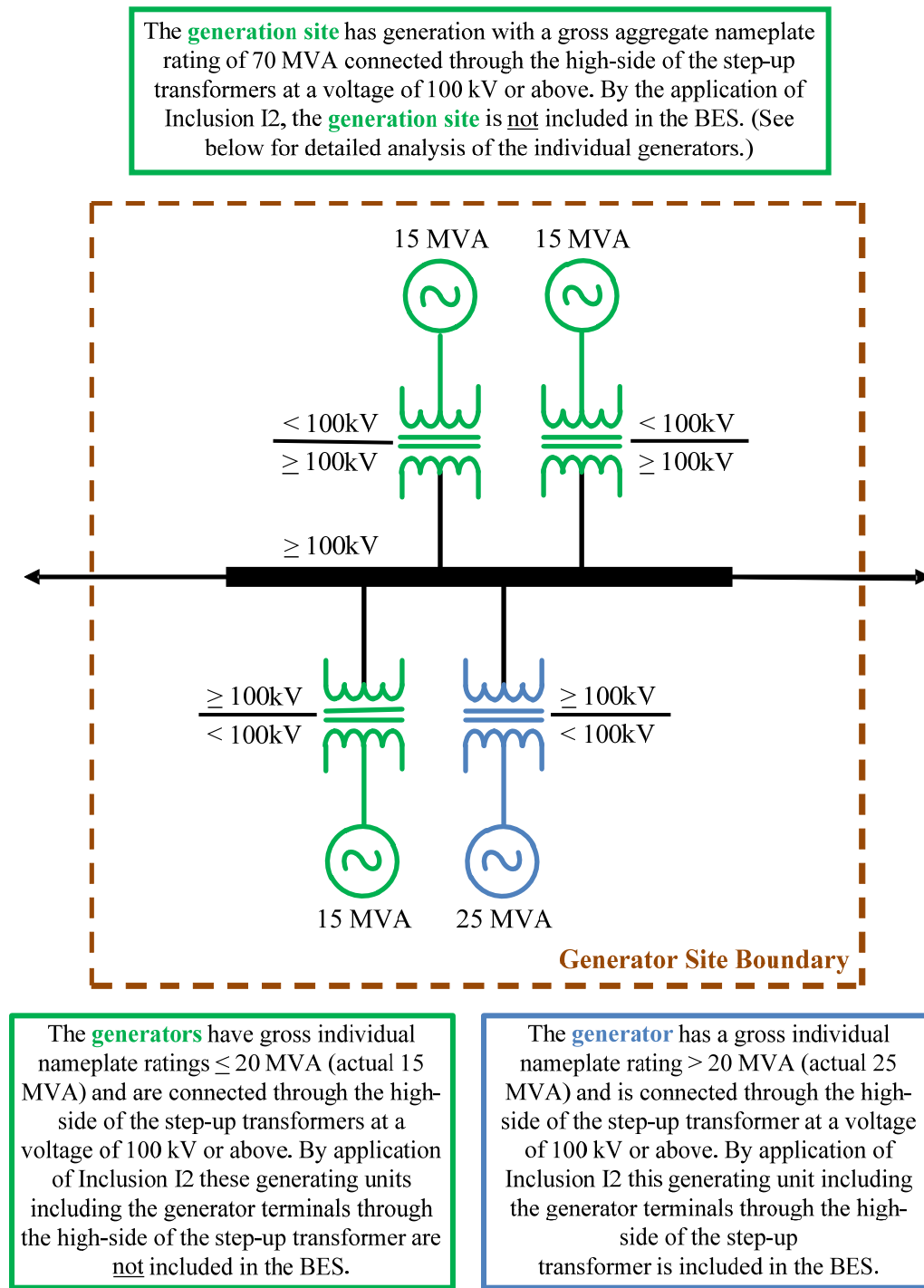


Figure I2-4: Multiple Unit Generating Site (BES & non-BES)

Figure I2-5 depicts a site with multiple units connected through the high-side of the step-up transformer(s) at a voltage of 100 kV or above with a gross aggregate nameplate rating (connected @100 kV or above) greater than 75 MVA. By application of Inclusion I2, all of these units (connected @100 kV or above) are included as BES. In accordance with Inclusion I2, the generator, including the generator terminals through the multiple step-up transformers with a high-side connection voltage of 100kV or above, are considered to be a single BES Element. The step-up transformers and the interconnecting bus work are installed for the purpose of stepping up the voltage output of the generator to a voltage of 100 kV or above.

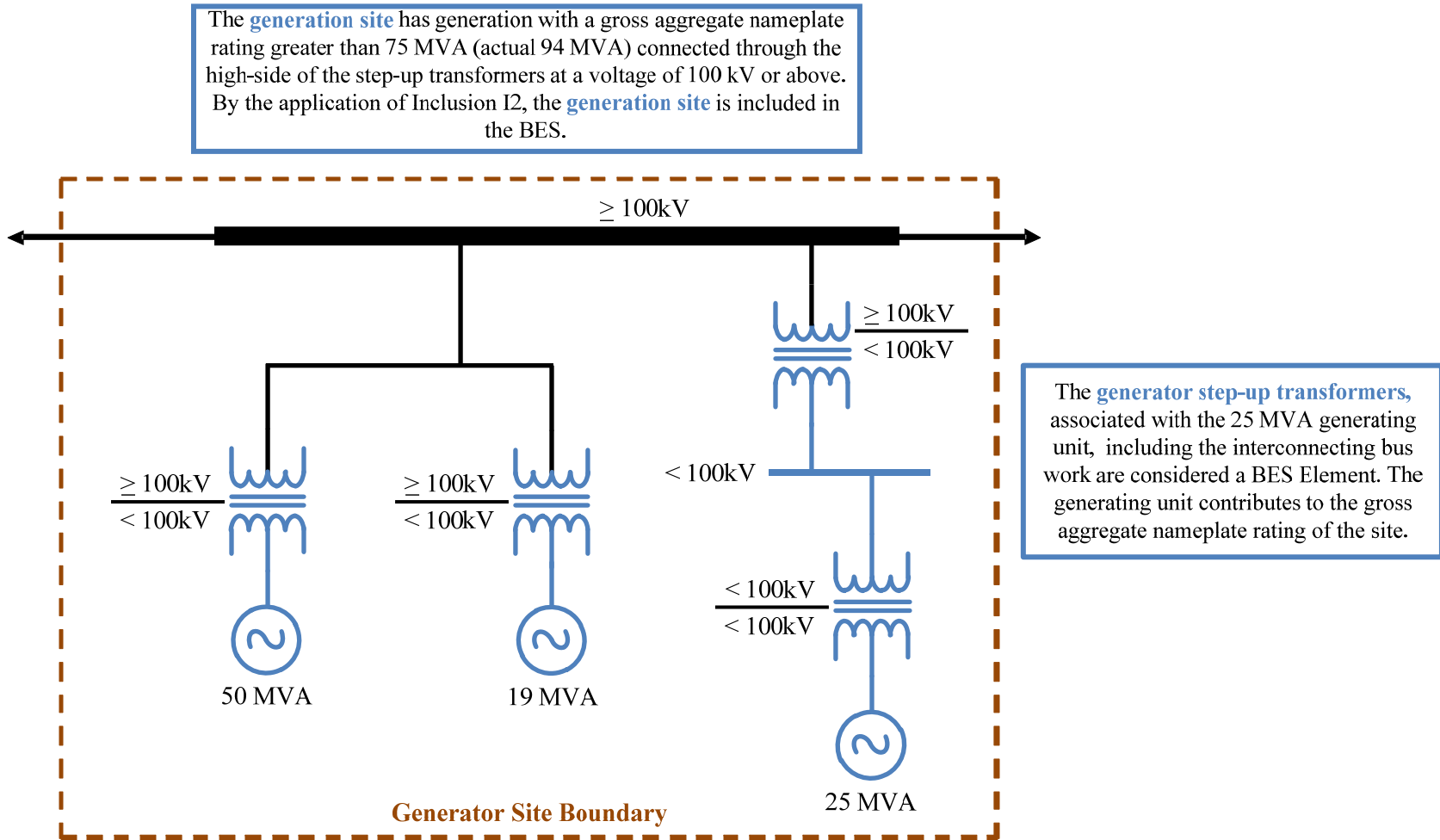


Figure I2-5: Multiple Unit Generating Site (BES)

Figure I2-6 depicts a site with multiple units connected through the high side of the step-up transformer(s) at a voltage of 100 kV or above with a gross aggregate nameplate rating (connected @100 kV or above) less than 75 MVA. Therefore, only the units that meet the single unit inclusion criteria of gross nameplate rating of greater than 20 MVA are included. The generator with the 25 MVA gross individual nameplate rating is not included in the BES or in the generation site total because the step-up transformers and the interconnecting bus work are installed for the purpose of serving Load. The NERC Glossary of Terms Used in NERC Reliability Standards defines Load as "an end-use device or customer that receives power from the electric system".

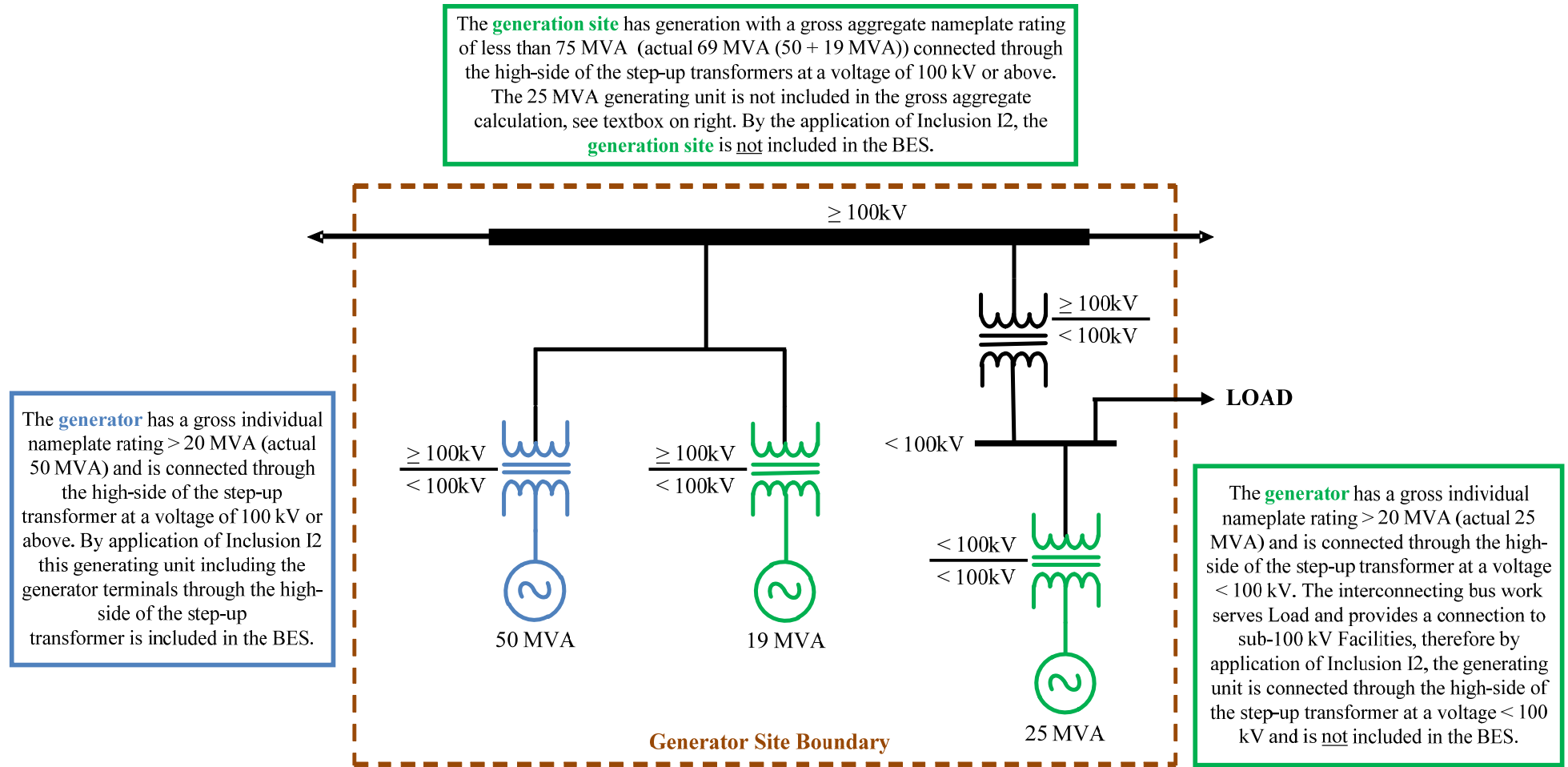


Figure I2-6: Multiple Unit Generating Site (BES & non-BES)

II.3 BES Inclusion I3

I3. Blackstart Resources identified in the Transmission Operator's restoration plan.

Inclusion I3 includes Blackstart Resources identified in the Transmission Operator's restoration plan. Blackstart Resources are included in the BES regardless of configuration or location.

The NERC Glossary of Terms Used in NERC Reliability Standards defines Blackstart Resource as follows:

"A generating unit(s) and its associated set of equipment which has the ability to be started without support from the System or is designed to remain energized without connection to the remainder of the System, with the ability to energize a bus, meeting the Transmission Operator's restoration plan needs for real and reactive power capability, frequency and voltage control, and that has been included in the Transmission Operator's restoration plan."

The Transmission Operator's restoration plan refers to the restoration plan identified in Reliability Standard EOP-005 System Restoration from Blackstart Resources.

Figures were not developed for Inclusion I3 due to the simplicity of the language in the inclusion.

II.4 BES Inclusion I4

I4. Dispersed power producing resources with aggregate capacity greater than 75 MVA (gross aggregate nameplate rating) utilizing a system designed primarily for aggregating capacity, connected at a common point at a voltage of 100 kV or above.

Note: Figures I4-1 through I4-4 are depictions of the application of Inclusion I4 and are intended to assist the user during the full application of the BES definition.

Inclusion I4 was directed at including renewable generation resources, such as wind farms and solar arrays (dispersed generation), and sought to establish a distinction between Inclusions I2 and I4.

Inclusion I4 specifically addresses wind farms and solar arrays as being dispersed power producing resources that: "... utilize[s] a system designed primarily for aggregating capacity." The language of Inclusion I4 stating: "Dispersed power producing resources . . . utilizing a system designed primarily for aggregating capacity, connected at a common point at a voltage of 100 kV or above," was selected so as not to include what is traditionally considered distributed generation.

Inclusion I4 speaks towards the inclusion of the generation resources themselves, not the transmission Element(s) of the collector systems operated below 100 kV.

Common Point of Connection

The common point of connection is where the individual transmission Element(s) of the collector system is connected to the 100 kV or higher Transmission system. (Note: This point is typically specified in the respective Transmission Owner and Generator Operator Interconnection Agreements.)

Figure I4-1 depicts a typical dispersed generation site and substation design with a single transformation of voltage.

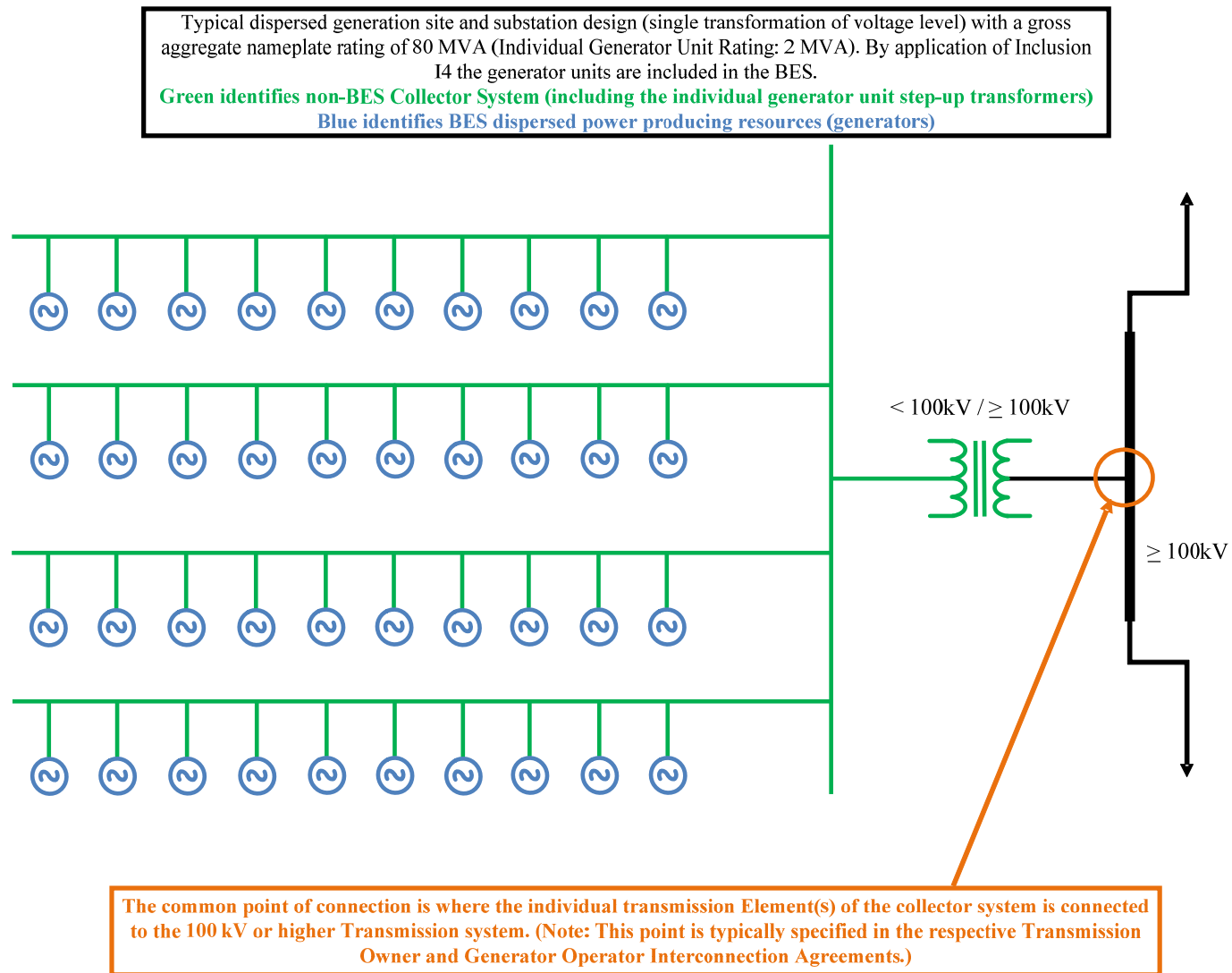


Figure I4-1: Dispersed Generation Site (Single Voltage Transformation) – Wind Farm

Figure I4-2 depicts a typical dispersed generation site and substation design with multiple levels of voltage transformation.

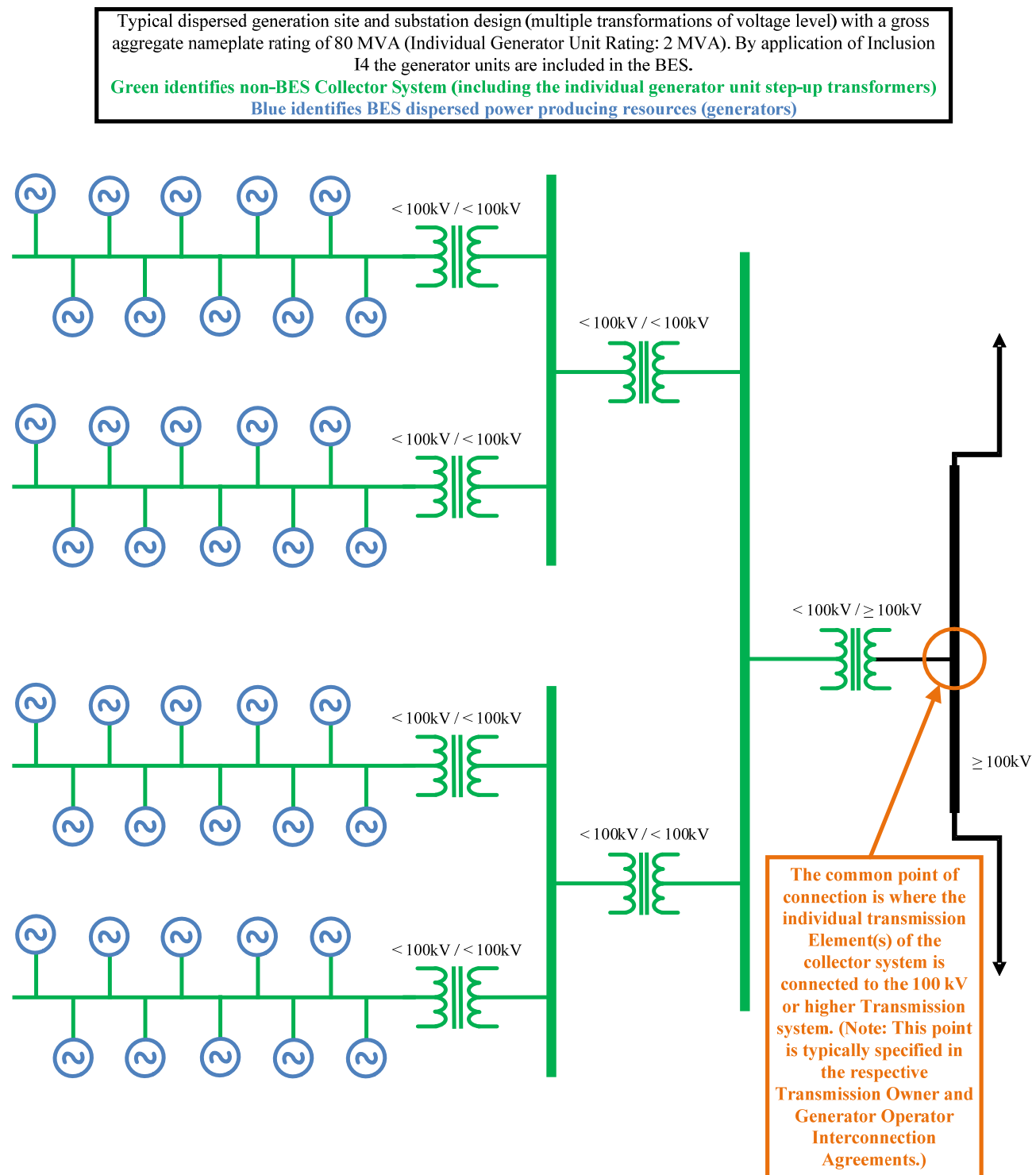


Figure I4-2: Dispersed Generation Site (Multiple Voltage Transformations) – Wind Farm

Figure I4-3 depicts a typical dispersed generation site and substation design with a single transformation of voltage.

Typical dispersed generation site and substation design (single transformation of voltage level) with a gross aggregate nameplate rating of 80 MVA (Individual Photovoltaic Bank Rating: 20 MVA). By application of Inclusion I4 the Photovoltaic Cells & Inverters (generator units) are included in the BES.

Green identifies non-BES Collector System.

Blue identifies BES dispersed power producing resources (Photovoltaic Cells & Inverters)

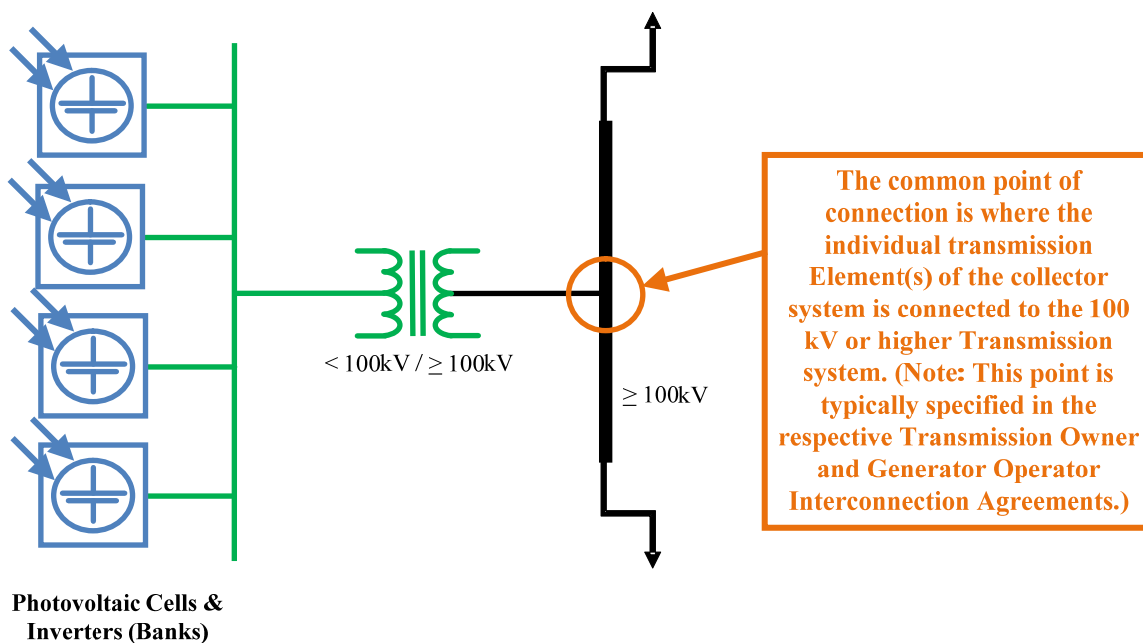


Figure I4-3: Dispersed Generation Site (Single Voltage Transformation) – Solar Array

Figure I4-4 depicts a typical dispersed generation site and substation design with multiple levels of voltage transformation.

Typical dispersed generation site and substation design (multiple transformations of voltage level) with a gross aggregate nameplate rating of 80 MVA (Individual Photovoltaic Bank Rating: 20 MVA). By application of Inclusion I4 the Photovoltaic Cells & Inverters (generator units) are included in the BES.

Green identifies non-BES Collector System.

Blue identifies BES dispersed power producing resources (Photovoltaic Cells & Inverters)

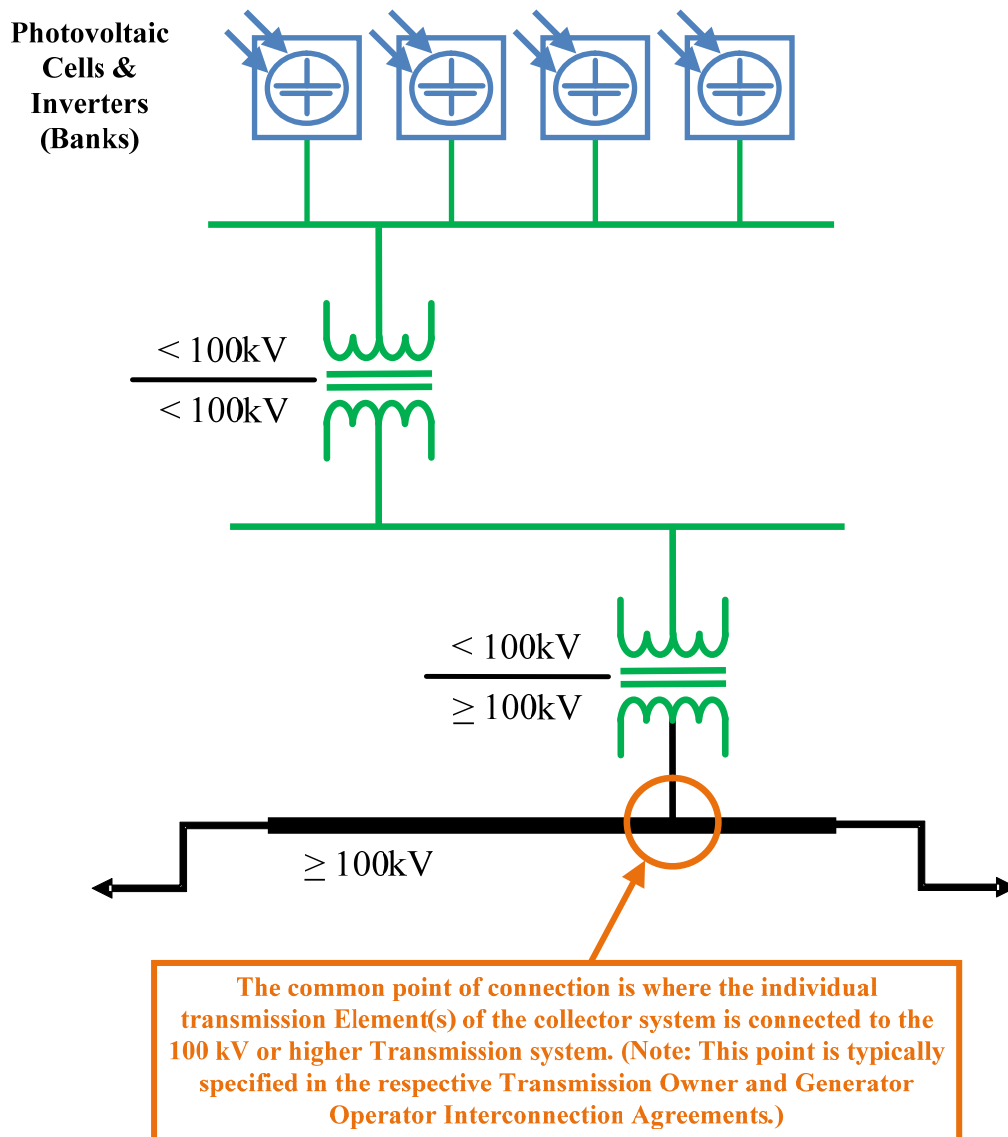


Figure I4-4: Dispersed Generation Site (Multiple Voltage Transformations) – Solar Array

11.4 BES Inclusion I5

I5. Static or dynamic devices (excluding generators) dedicated to supplying or absorbing Reactive Power that are connected at 100 kV or higher, or through a dedicated transformer with a high-side voltage of 100 kV or higher, or through a transformer that is designated in Inclusion I1.

Inclusion I5 identifies static or dynamic devices connected via any of the methods identified by the qualifiers within, regardless of the amount of Reactive Power output/input. It is important to note Inclusion I5 identifies only those static or dynamic “devices” to be included by meeting the qualifying connection criteria, and does not include any of the associating qualifiers (i.e., associated dedicated transformers). In the following examples, several reactive resources (electrically depicted as capacitors) are identified with various connection methods.

Note: Figure I5-1 depicts the application of Inclusion I5 and is intended to assist the user during the full application of the BES definition.

Figure I5-1 depicts several different methods of connecting reactive resources typically utilized in the electric utility industry

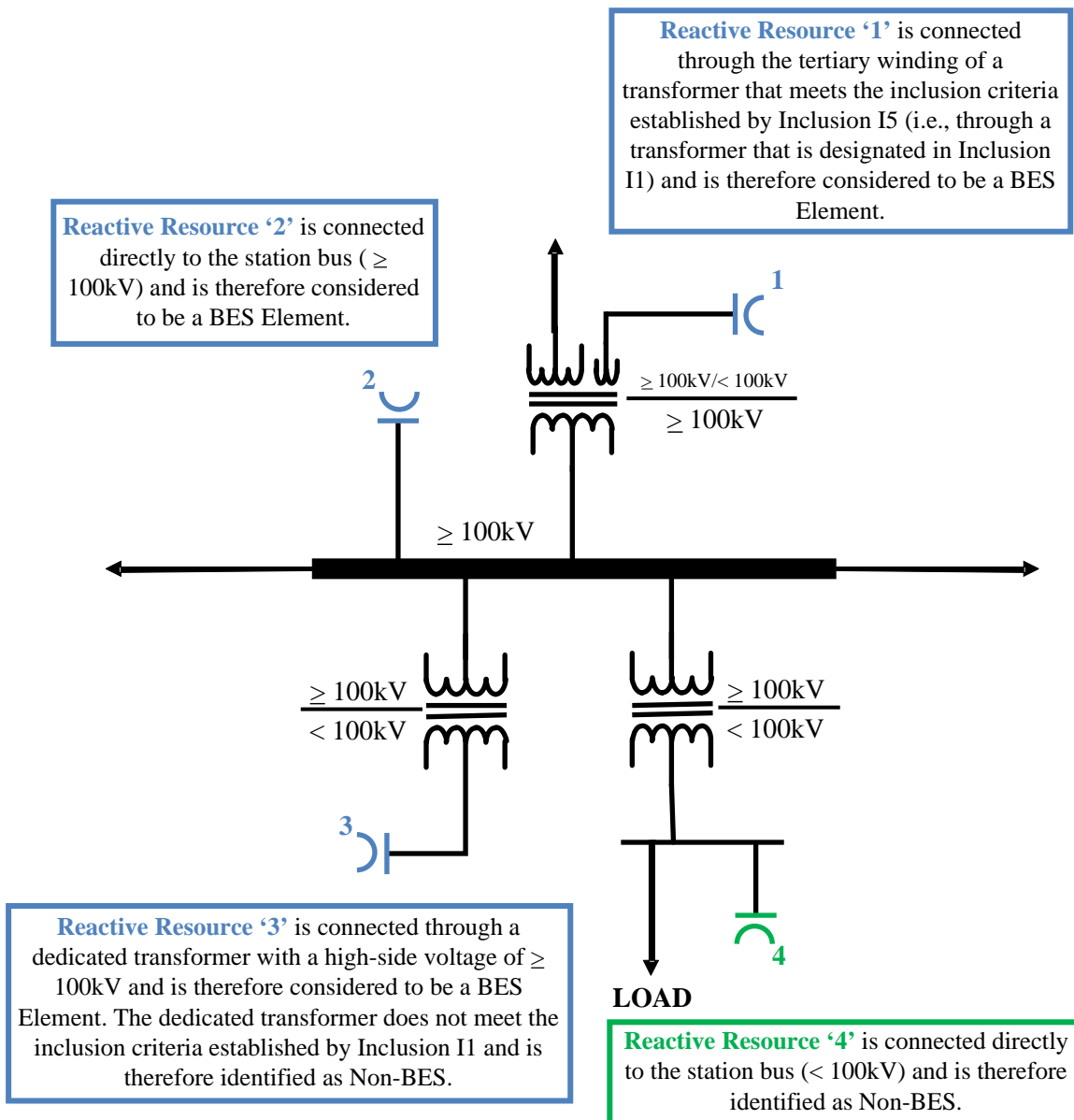


Figure I5-1: Reactive Resources (BES & non-BES)

III. Exclusions

Each exclusion, with the exception of Exclusion E4, is shown below with both text and diagrams explaining how to apply the BES definition for the specific configuration shown. These examples are not to be considered all-inclusive, and simply reflect the professional opinion of the DBES SDT and are provided in good faith for illustrative purposes only. This document is not an official position of NERC and will not be binding on enforcement decisions of the NERC Compliance Program.

Exclusion E4 is not included in this document as there are no application configuration issues associated with it.

Diagrams only show application of the definition to the specific Element in question, as previously explained.

Key to diagram color coding:

- **Blue** indicates that an Element is included in the BES.
- **Green** indicates that an Element is not included in the BES.
- **Orange** indicates 'points of connection'.
- **Black** indicates Elements that are not evaluated for the specific exclusion depicted in the individual diagrams being shown.

III.1 BES Exclusion E1

E1. Radial systems: A group of contiguous transmission Elements that emanates from a single point of connection of 100 kV or higher and:

- a.) Only serves Load. Or,
- b.) Only includes generation resources, not identified in Inclusion I3, with an aggregate capacity less than or equal to 75 MVA (gross nameplate rating). Or,
- c.) Where the radial system serves Load and includes generation resources, not identified in Inclusion I3, with an aggregate capacity of non-retail generation less than or equal to 75 MVA (gross nameplate rating).

Note - A normally open switching device between radial systems, as depicted on prints or one-line diagrams for example, does not affect this exclusion.

Exclusion E1 is for the contiguous transmission Elements connected at or above 100 kV. Generation resources connected within the radial system are qualifiers for this exclusion and are not excluded from the BES by application of Exclusion E1.

Single point of connection

The “single point of connection of 100 kV or higher” is where the radial system will begin if it meets the language of Exclusion E1, including parts a, b, or c. For example, the start of the radial system may be a hard tap of the Transmission line, or could be the tap point within a ring or breaker and a half bus configuration.

The connection to the radial system must be from only one point at 100 kV or higher. Any group of contiguous transmission Elements that have multiple connections at 100 kV or higher do not qualify for Exclusion E1. Normally open switching devices between radial systems, operated at a voltage of 100 kV or higher, will not disqualify a radial system from this exclusion. Commission (FERC) Order No. 773 directs implementation of the revised BES Definition to take into account the impact of sub-100 kV looped Facilities regardless of voltage level. This alters previous guidance on the analysis of radial systems and requires re-examination of these configurations. If there is a connection at the sub-100 kV level between two systems that would previously have been considered as radial, said systems cannot be evaluated for possible radial system exclusion. They must now be analyzed as part of local network analysis if an entity is seeking exclusion of the Elements. If these Elements have multiple connections at 100 kV or higher they may qualify for exclusion under Exclusion E3, and the applicable entity always has the option to seek exclusion through the exception process.

Evaluation of single points of connection within radial systems under consideration

If the radial system being evaluated for exclusion emanates from a single point of connection of 100 kV or higher but does not meet the criteria established in Exclusion E1, including parts a, b, or c, then the radial system does not qualify for exclusion from the BES as a radial system described in Exclusion E1 and its parts. However, further evaluation of the underlying Elements within the original radial system may be appropriate. Underlying radial systems, which emanate from a single point of connection of 100 kV or higher, may qualify for exclusion as radial systems of contiguous transmission Elements within the original area of consideration if the criterion established in Exclusion E1, including parts a, b, or c, is met for these Facilities. Such evaluations are not shown in

the figures in this section which concentrate on the bigger picture, but are detailed in the summary diagrams in Section IV where the hierarchical application of the definition is described and shown.

"transmission Element"

The word transmission is not capitalized and is used as a qualifier to the word Element and is meant to differentiate between the types of Elements that are identified in the NERC Glossary of Terms Used in NERC Reliability Standards definition of Element.

Element (NERC Glossary of Terms):

“Any electrical device with terminals that may be connected to other electrical devices such as a generator, transformer, circuit breaker, bus section, or transmission line. An element may be comprised of one or more components.”

The use of the words: “a group of contiguous transmission Elements,” means Elements at 100 kV or higher that are connected in a contiguous manner. This group of contiguous transmission Elements serves the radial system but does not include the Elements that are operated below 100 kV.

Non-retail Generation

Non-retail generation is any generation that is not behind a retail customer’s meter. The radial system is limited to less than 75 MVA of non-retail generation.

Retail generation is behind the meter generation with all or some of the generation serving Load. The NERC Glossary of Terms Used in NERC Reliability Standards defines Load as “an end-use device or customer that receives power from the electric system”.

Any retail generation not consumed on site can flow to the BES, and the amount of retail generation does not impact Exclusion E1.

Generation and Reactive Resources

Exclusion E1 provides for the exclusion of ‘transmission Elements’ from radial systems that meet the specific criteria identified in the exclusion language. This does not allow for the exclusion of Real Power and Reactive Power resources captured by Inclusions I2 – I5. Exclusion E1 only speaks to the transmission component of the radial system.

Generation Limits

There are two conditions under which generation resources can prevent a radial system from qualifying for Exclusion E1:

1. The aggregate nameplate capacity of the non-retail generation capacity within the radial system in question exceeds 75 MVA; or
2. Any generation within the radial system in question is identified as a Blackstart Resource in the Transmission Operator’s restoration plan (pursuant to Inclusion I3).

If either of these conditions applies, the radial system does not qualify for Exclusion E1. It should be noted that BES generation may reside within the confines of an excluded non-BES radial system. For instance, a 30 MVA generator connected through its generator step-up transformer at 100 kV or above within the radial system will be considered to be BES, but this designation does not prevent the exclusion of the remaining radial Facilities.

Exclusion E1 allows for the exclusion of contiguous transmission Elements (i.e., transformers, circuit breakers, bus sections, Transmission lines, etc.) emanating from a single point of connection at a voltage of 100 kV or higher.

Note: Figures E1-1 through E1-14 are depictions of the application of Exclusion E1, and are intended to assist the user during the full application of the BES definition.

E1.a–Serves Load Only

Figure E1-1 depicts a radial system that contains only Load. There is no limit to the amount of Load within the radial system.

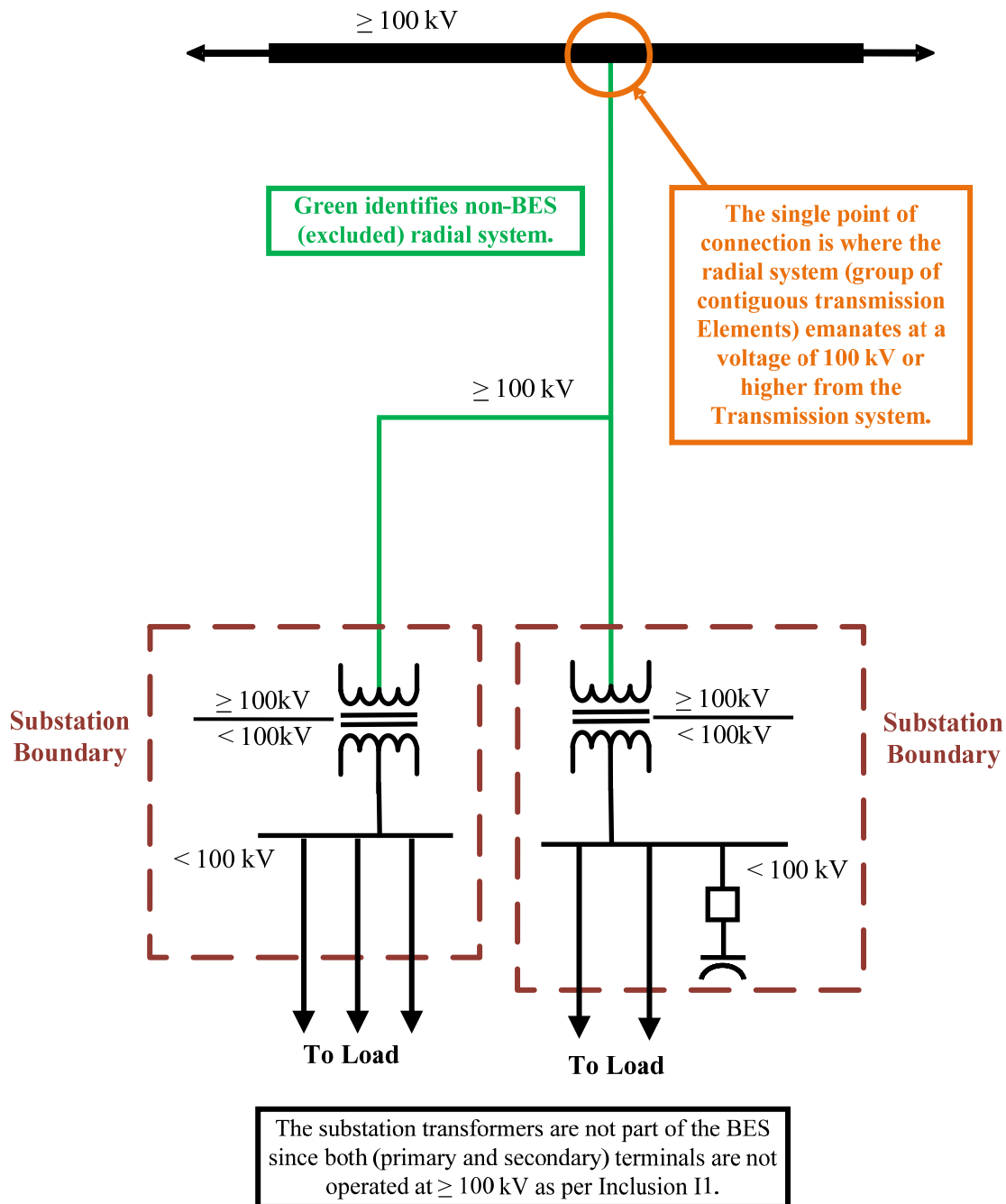


Figure E1-1: Radial System: Serving Only Load

Commission (FERC) Order No. 773 directs implementation of the revised BES Definition to take into account the impact of sub-100 kV looped Facilities regardless of voltage level. This alters previous guidance on the analysis of radial systems and requires re-examination of these configurations. Figure E1-2 depicts such a situation which requires analysis based on the Exclusion E3 criteria (see Figures E3-4 and E3-5).

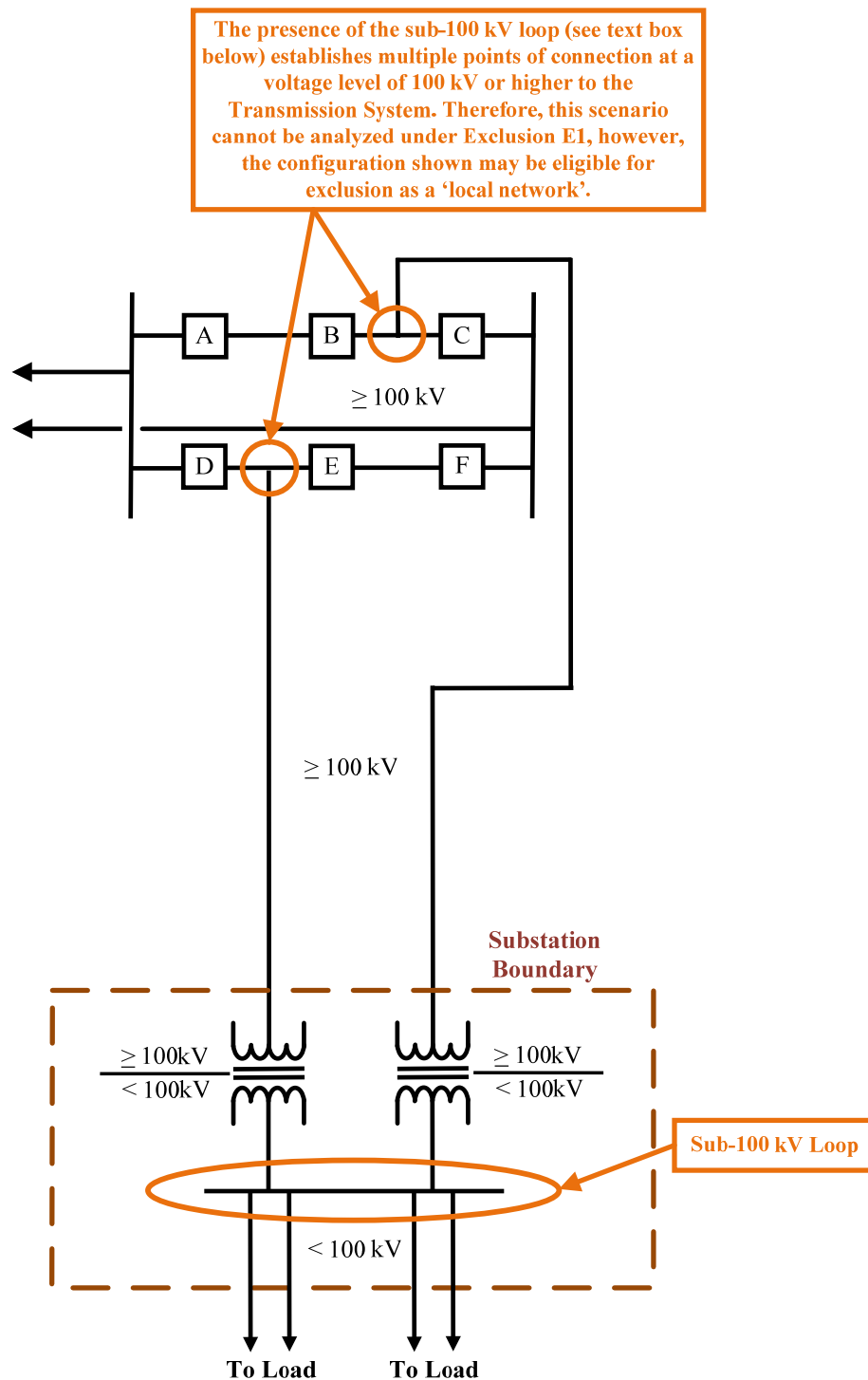


Figure E1-2: Impact of Sub-100 kV Looped Facilities

E1.b–Generation Only

Exclusion E1.b refers to a radial system that contains only generation. The threshold of the allowable generation (75 MVA gross nameplate rating) was chosen to be consistent with the existing threshold in the ERO Statement of Compliance Registry Criteria.

Figure E1-3 depicts a radial system with a single generation resource (non-retail) and no Load.

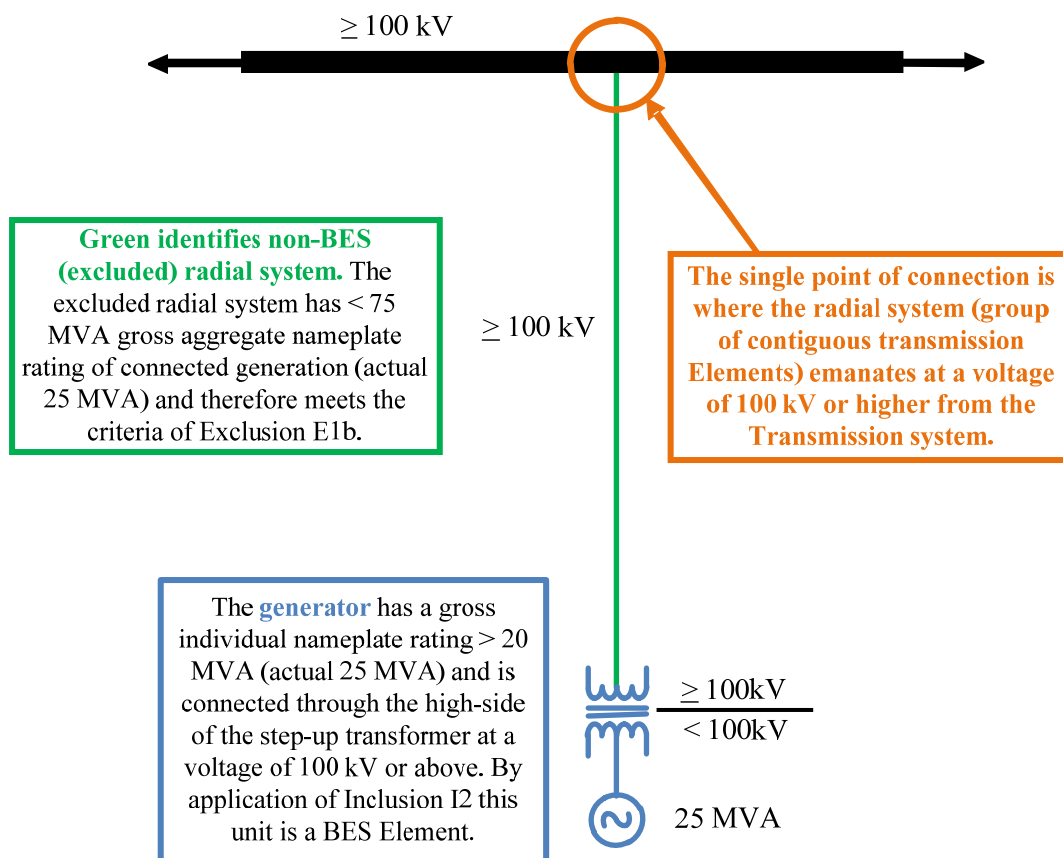


Figure E1-3: Radial System: Single BES Generation Resource

Figure E1-3 shows the application of the definition as filed in Phase 1. Figure E1-3a shows how the same diagram would appear after the application of the Phase 2 definition based on the changes required by FERC Orders 773 and 773a with regard to BES generation in radial systems and local networks.

Figure E1-3a depicts a radial system with a single generation resource (non-retail) and no Load.

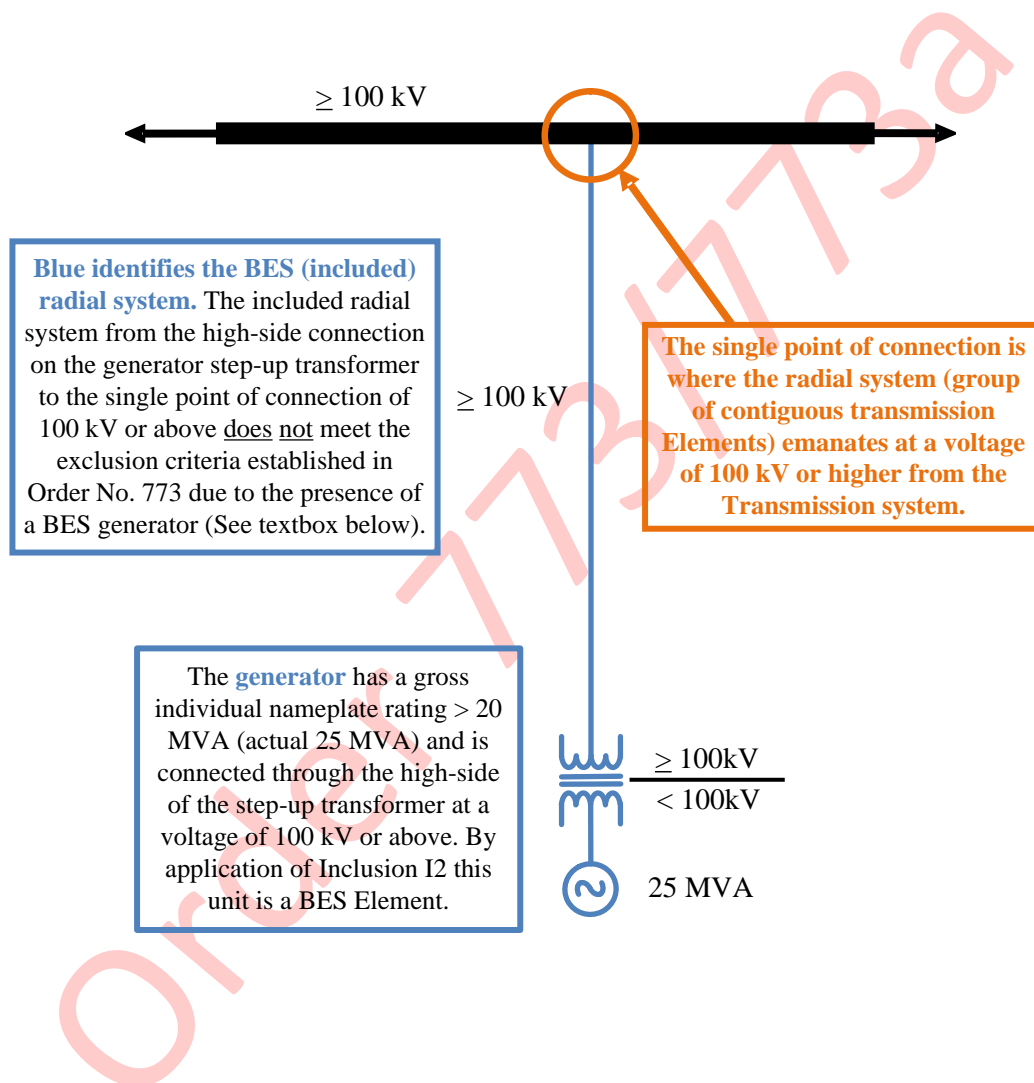


Figure E1-3a: Radial System: Single BES Generation Resource (Proposed Phase 2 Application)

Figure E1-4 depicts a radial system with multiple generation resources (non-retail) and no Load.

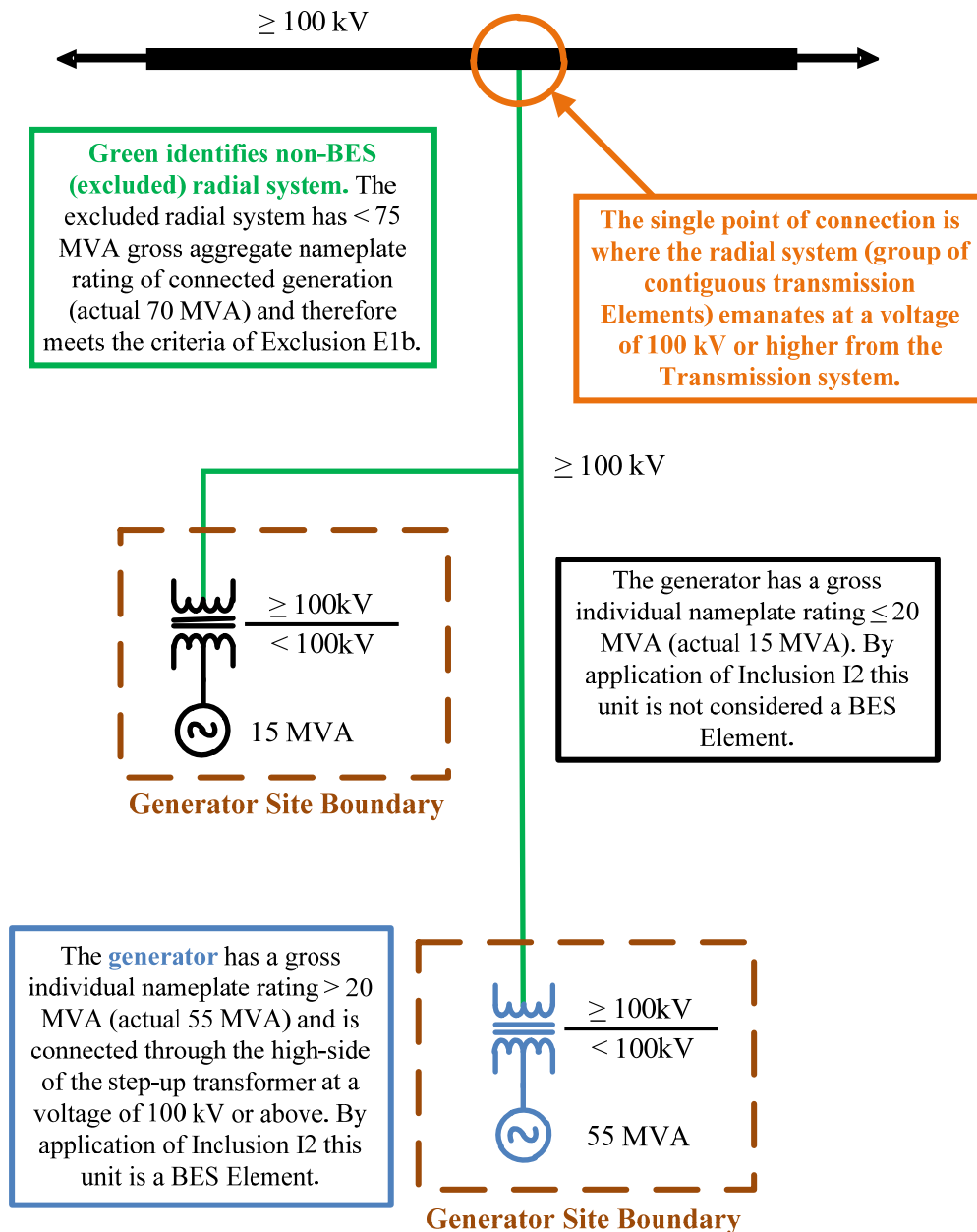


Figure E1-4: Radial System: Multiple (BES & non-BES) Generation Resources (Non-Retail)

Figure E1-4 shows the application of the definition as filed in Phase 1. Figure E1-4a shows how the same diagram would appear after the application of the Phase 2 definition based on the changes required by FERC Orders 773 and 773a with regard to BES generation in radial systems and local networks. Note that further evaluation of underlying elements may be required to complete the full application of the definition. As noted above, such analysis is not shown in the individual sections of this document but may be seen in the system diagrams.

Figure E1-4a depicts a radial system with multiple generation resources (non-retail) and no Load.

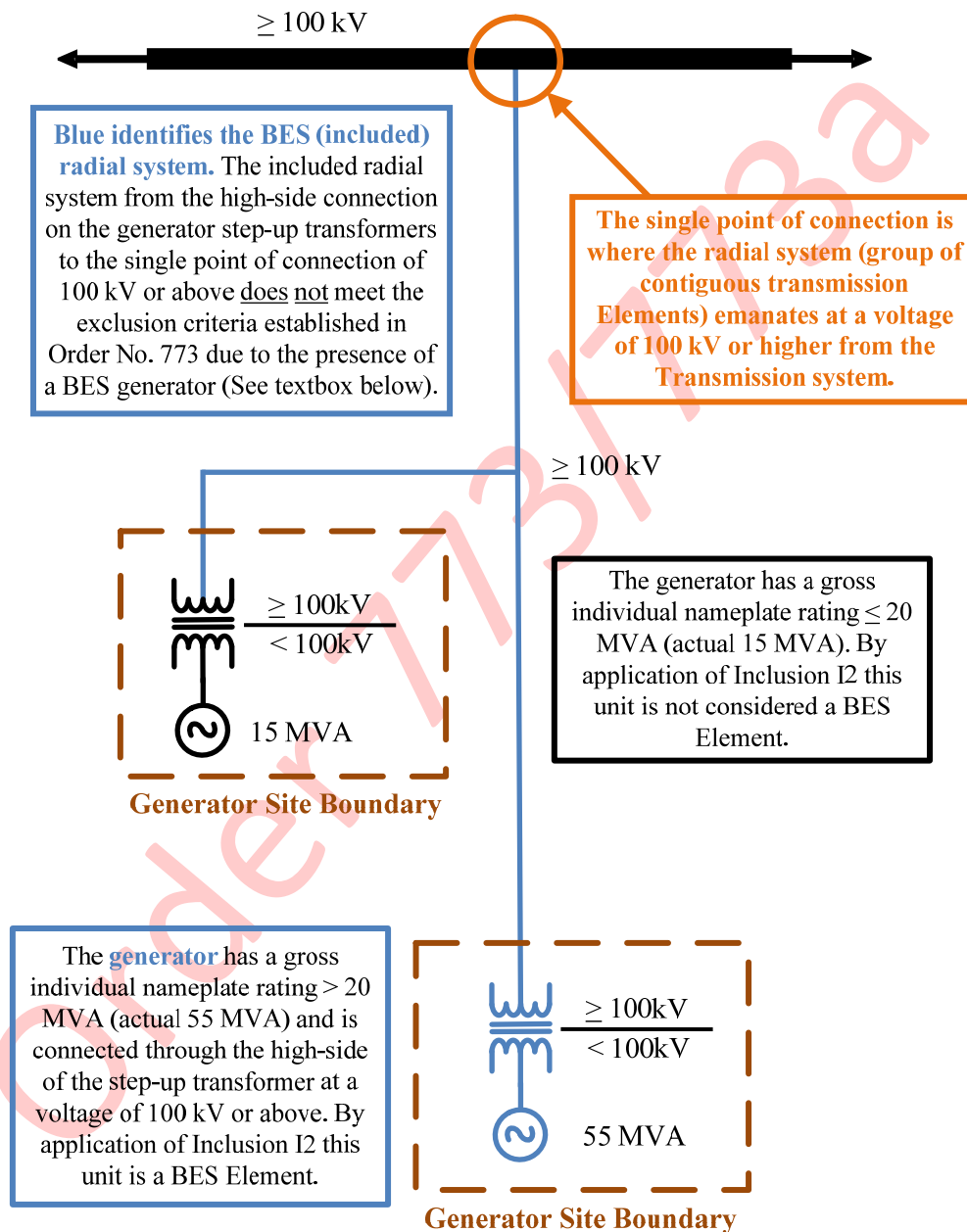


Figure E1-4a: Radial System: Multiple (BES & non-BES) Generation Resources (Non-Retail) (Proposed Phase 2 Application)

Figure E1-5 depicts a radial system with multiple generation resources and no Load. The aggregate gross nameplate values of the generation resources exceed the 75 MVA threshold established by Exclusion E1.b. Since the area under consideration does not meet the criteria established by Exclusion E1.b, further evaluation of the underlying Elements may be appropriate. Each underlying Element must meet the criteria established by Exclusion E1, including parts a, b, or c, to qualify for exclusion from the BES. Such evaluations are not shown in Figure E1-5, which concentrates on the bigger picture, but are detailed in the summary diagrams in Section IV where the hierarchical application of the definition is described and shown.

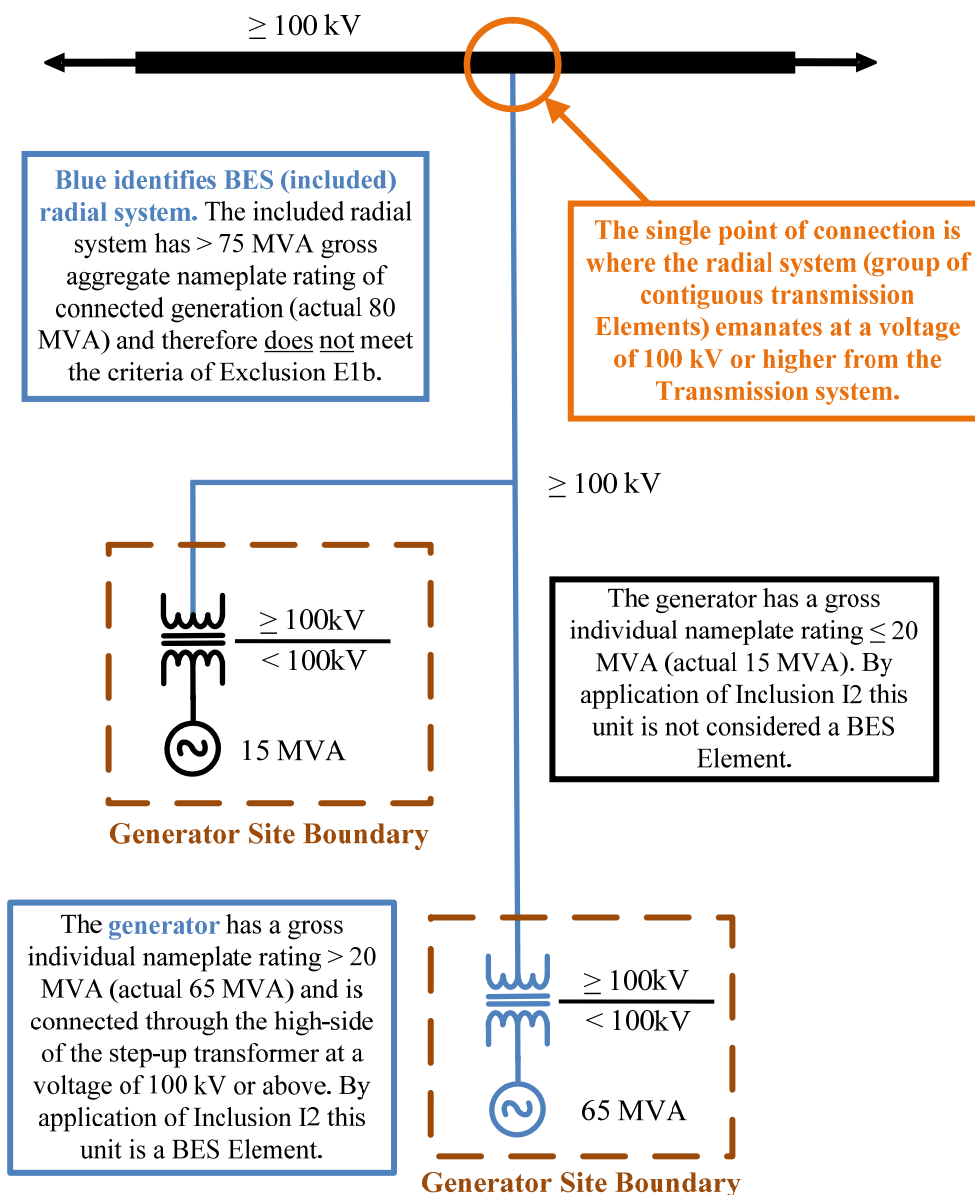


Figure E1-5: Radial System: Multiple (BES & non-BES) Generation Resources (Non-Retail)

Figure E1-6 depicts a radial system with multiple generation resources (non-retail), including a Blackstart Resource, and no Load. The Radial System does not meet the exclusion criteria of E1.b. due to the presence of the Blackstart Resource. Since the area under consideration does not meet the criteria established by Exclusion E1.b, further evaluation of the underlying Elements may be appropriate. Each underlying Element must meet the criteria established by Exclusion E1, including parts a, b, or c, to qualify for exclusion from the BES. Such evaluations are not shown in Figure E1-6, which concentrates on the bigger picture, but are detailed in the summary diagrams in Section IV where the hierarchical application of the definition is described and shown.

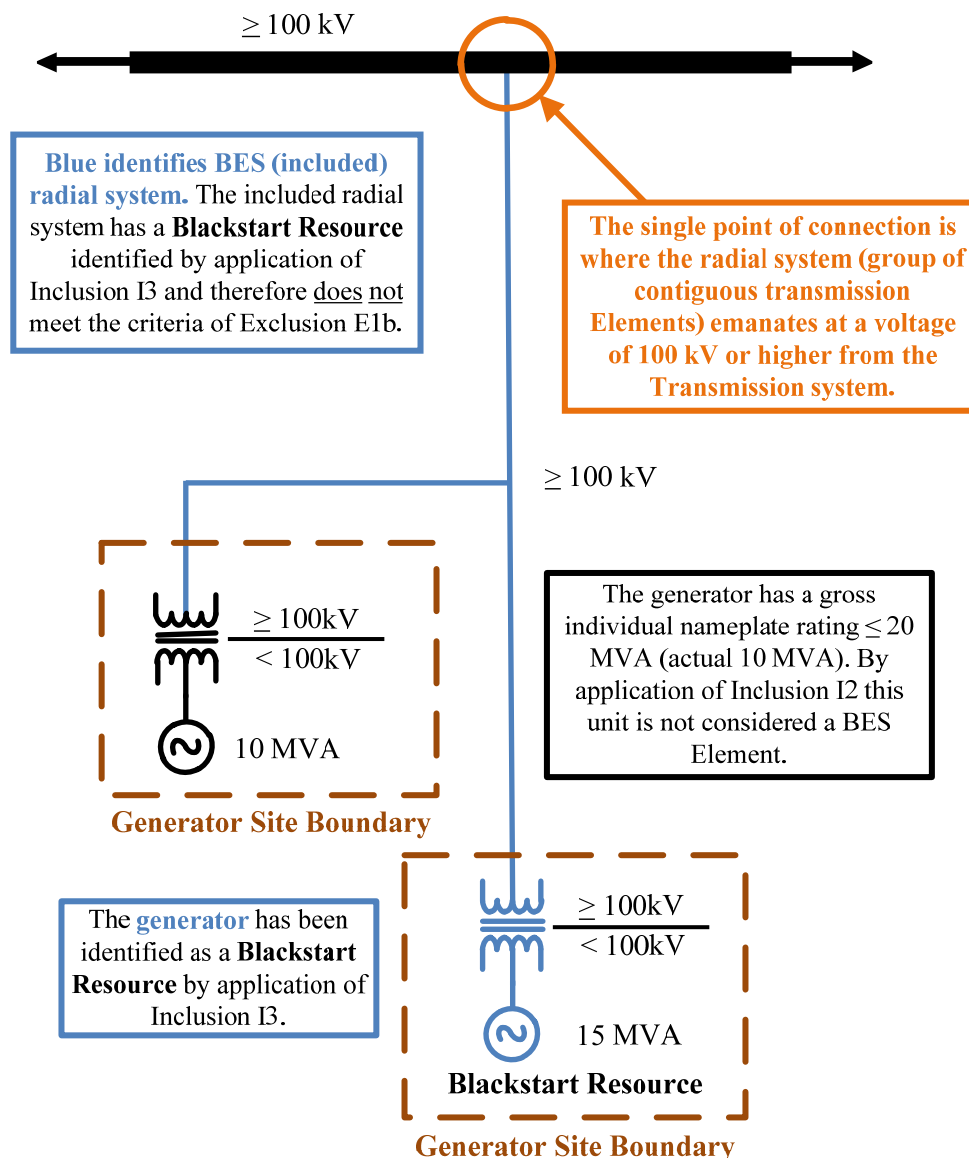


Figure E1-6: Radial System: Multiple (BES & non-BES) Generation Resources (Non-Retail & Blackstart Resource)

E1.c - Generation and Serves Load

Exclusion E1.c refers to a radial system that contains generation and serves Load. As in Exclusion E1.b, the amount of generation is limited to 75 MVA aggregate (gross nameplate rating) of connected non-retail generation within the radial system. The 75 MVA threshold was chosen to be consistent with the existing threshold in the ERO Statement of Compliance Registry Criteria. As in Exclusion E1.a, there is no limit to the amount of Load within the radial system. Exclusion E1.c is determined by first applying Exclusion E1.a and then Exclusion E1.b prior to evaluating the configuration under Exclusion E1.c.

Figure E1- 7 depicts a radial system with generation resources (non-retail) and serves Load.

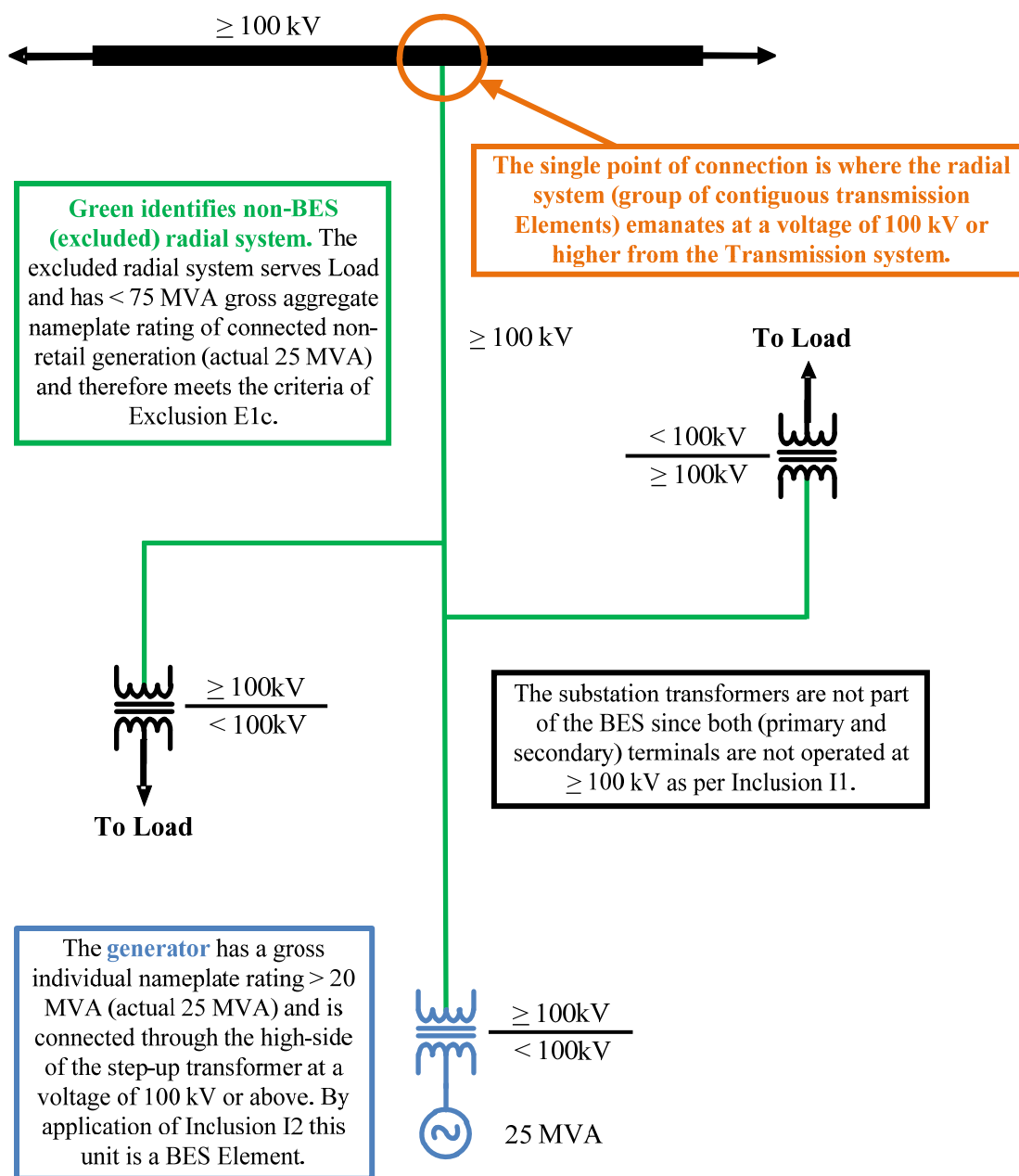


Figure E1-7: Radial System: Generation Resource (Non-Retail) & Serving Load

Figure E1-7 shows the application of the definition as filed in Phase 1. Figure E1-7a shows how the same diagram would appear after the application of the Phase 2 definition based on the changes required by FERC Orders 773 and 773a with regard to BES generation in radial systems and local networks. Note that further evaluation of underlying elements may be required to complete the full application of the definition. As noted above, such analysis is not shown in the individual sections of this document but may be seen in the system diagrams.

Figure E1- 7a depicts a radial system with generation resources (non-retail) and serves Load.

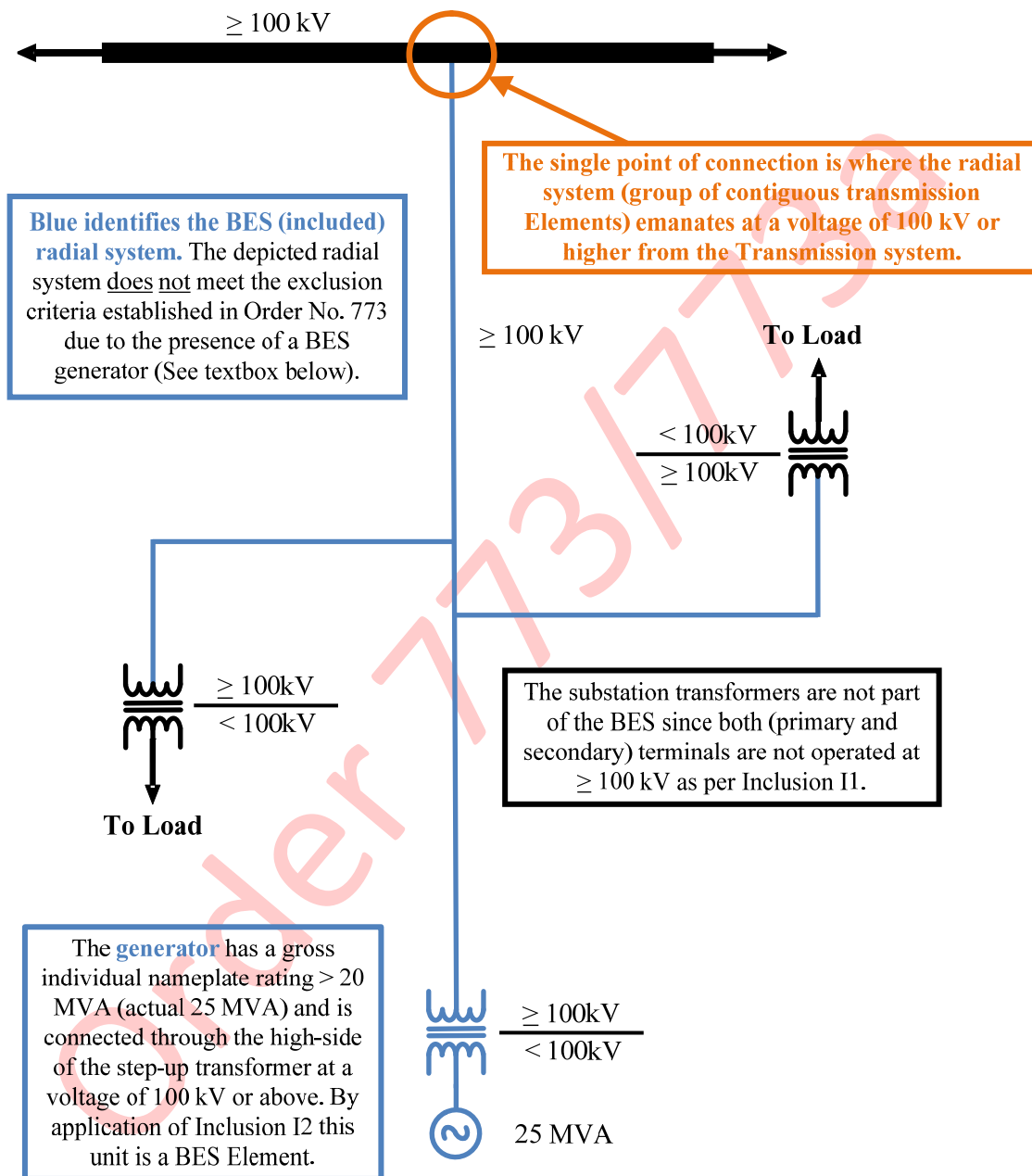


Figure E1-7a: Radial System: Generation Resource (Non-Retail) & Serving Load (Proposed Phase 2 Application)

Figure E1-8 depicts a radial system with generation resources (retail and non-retail) and serves Load.

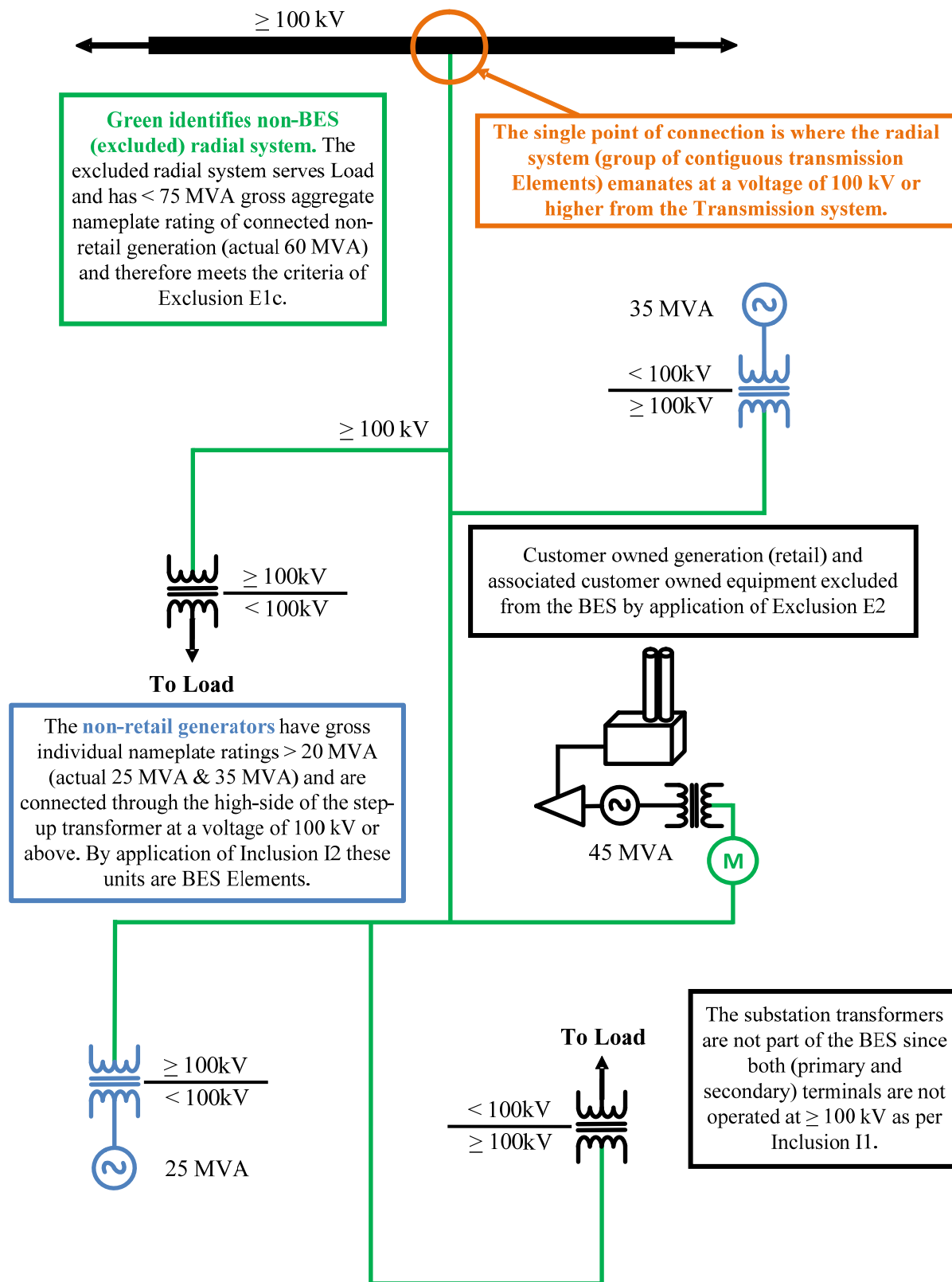


Figure E1-8: Radial System: Multiple Generation Resources (Retail & Non-Retail) & Serving Load

Figure E1-8 shows the application of the definition as filed in Phase 1. Figure E1-8a shows how the same diagram would appear after the application of the Phase 2 definition based on the changes required by FERC Orders 773 and 773a with regard to BES generation in radial systems and local networks. Note that further evaluation of underlying elements may be required to complete the full application of the definition. As noted above, such analysis is not shown in the individual sections of this document but may be seen in the system diagrams.

Figure E1-8a depicts a radial system with generation resources (retail and non-retail) and serves Load.

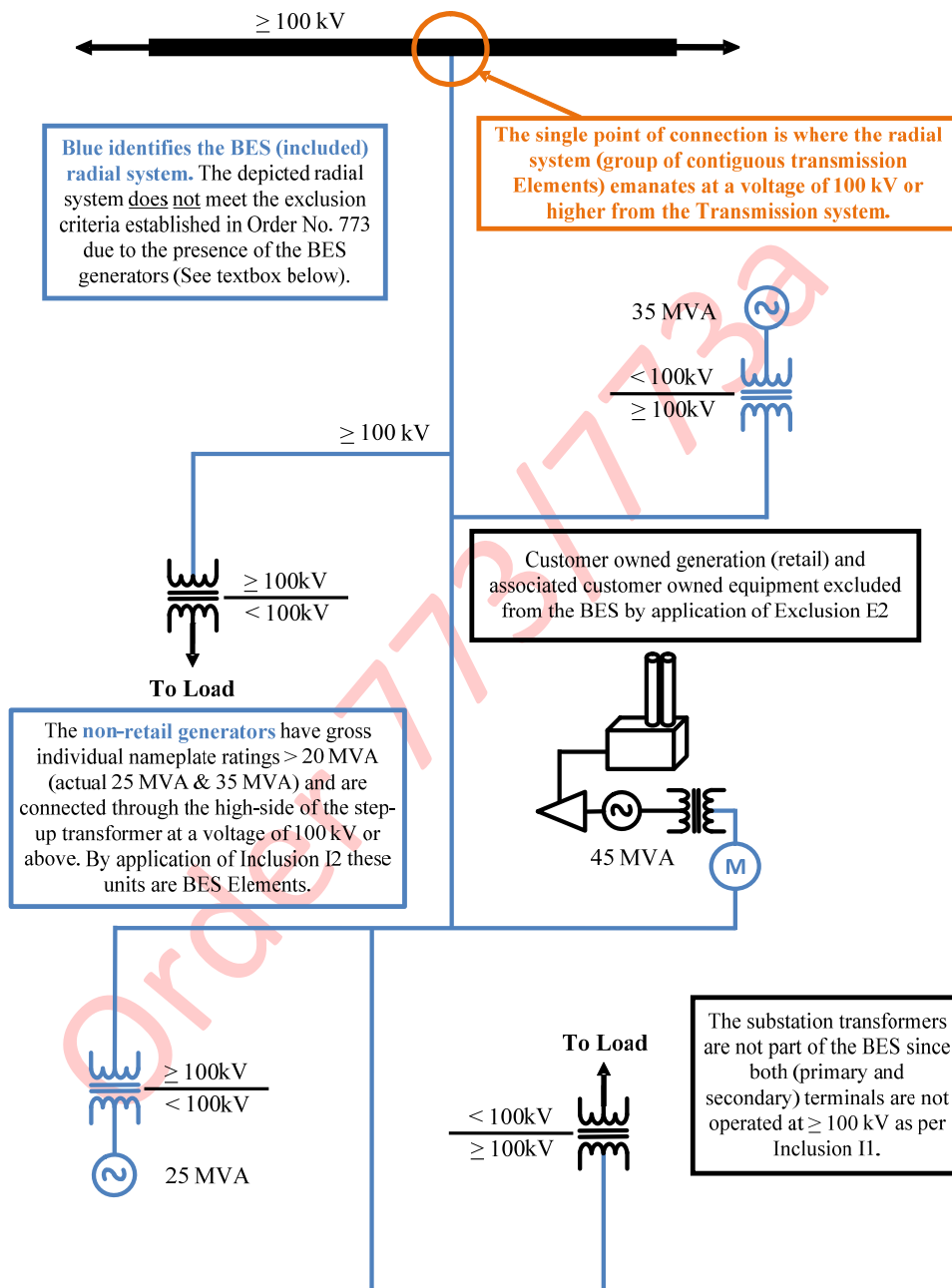


Figure E1-8a: Radial System: Multiple Generation Resources (Retail & Non-Retail) & Serving Load
(Proposed Phase 2 Application)

Figure E1-9 depicts a radial system with multiple generation resources and serves Load. The aggregate gross nameplate values of the generation resources exceed the 75 MVA threshold established by Exclusion E1. c. Since the area under consideration does not meet the criteria established by Exclusion E1.c, further evaluation of the underlying Elements may be appropriate. Each underlying Element must meet the criteria established by Exclusion E1, including parts a, b, or c, to qualify for exclusion from the BES. Such evaluations are not shown in Figure E1-9, which concentrates on the bigger picture, but are detailed in the summary diagrams in Section IV where the hierarchical application of the definition is described and shown.

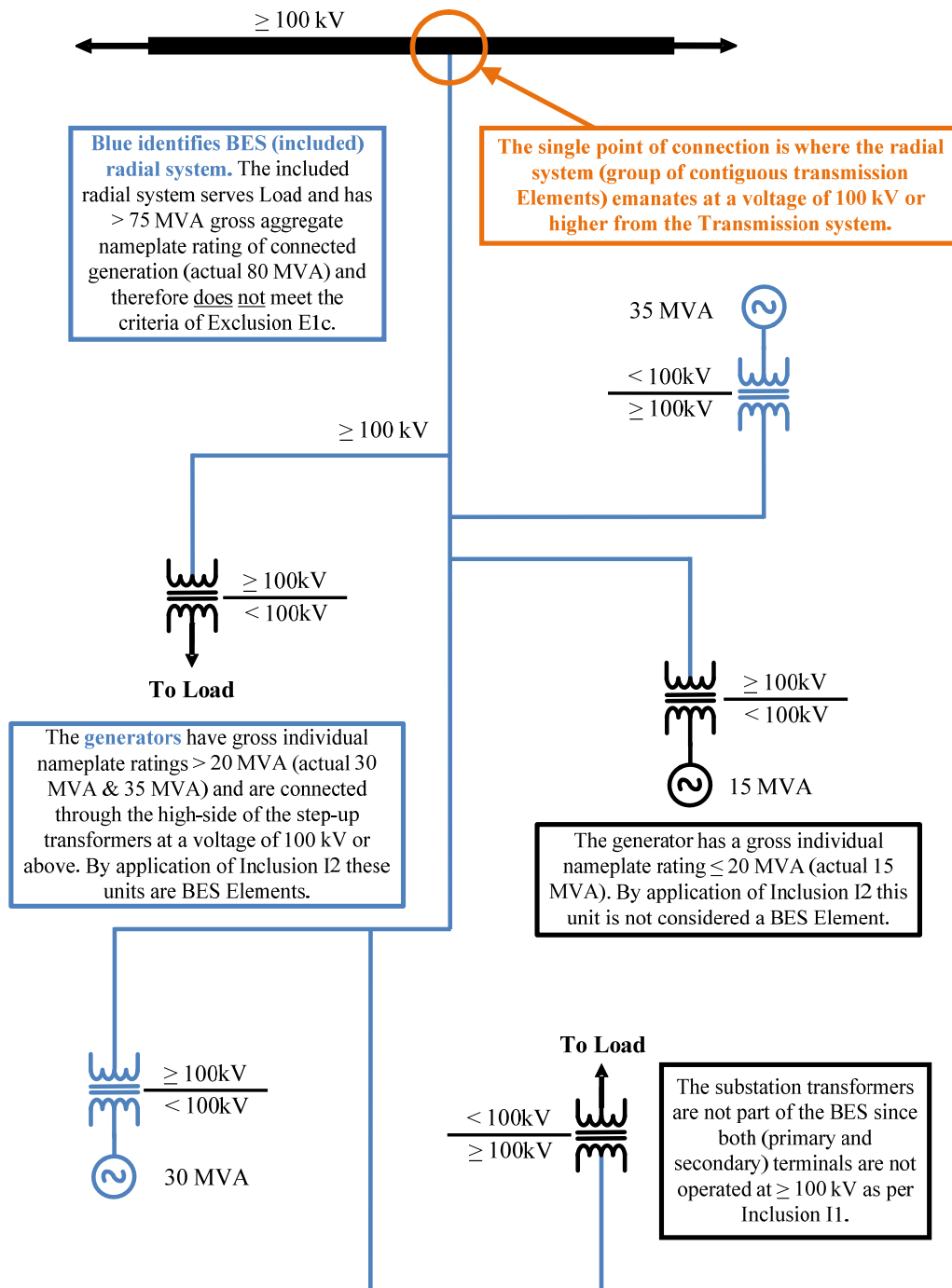


Figure E1-9: Radial System: Multiple Generation Resources (Non-Retail) & Serving Load

Figure E1-10 depicts a radial system with multiple generation resources, including a Blackstart Resource, and serves Load. The Radial System does not meet the exclusion criteria of E1.c due to the presence of the Blackstart Resource. Since the area under consideration does not meet the criteria established by Exclusion E1.c, further evaluation of the underlying Elements may be appropriate. Each underlying Element must meet the criteria established by Exclusion E1, including parts a, b, or c, to qualify for exclusion from the BES. Such evaluations are not shown in Figure E1-10, which concentrates on the bigger picture, but are detailed in the summary diagrams in Section IV where the hierarchical application of the definition is described and shown.

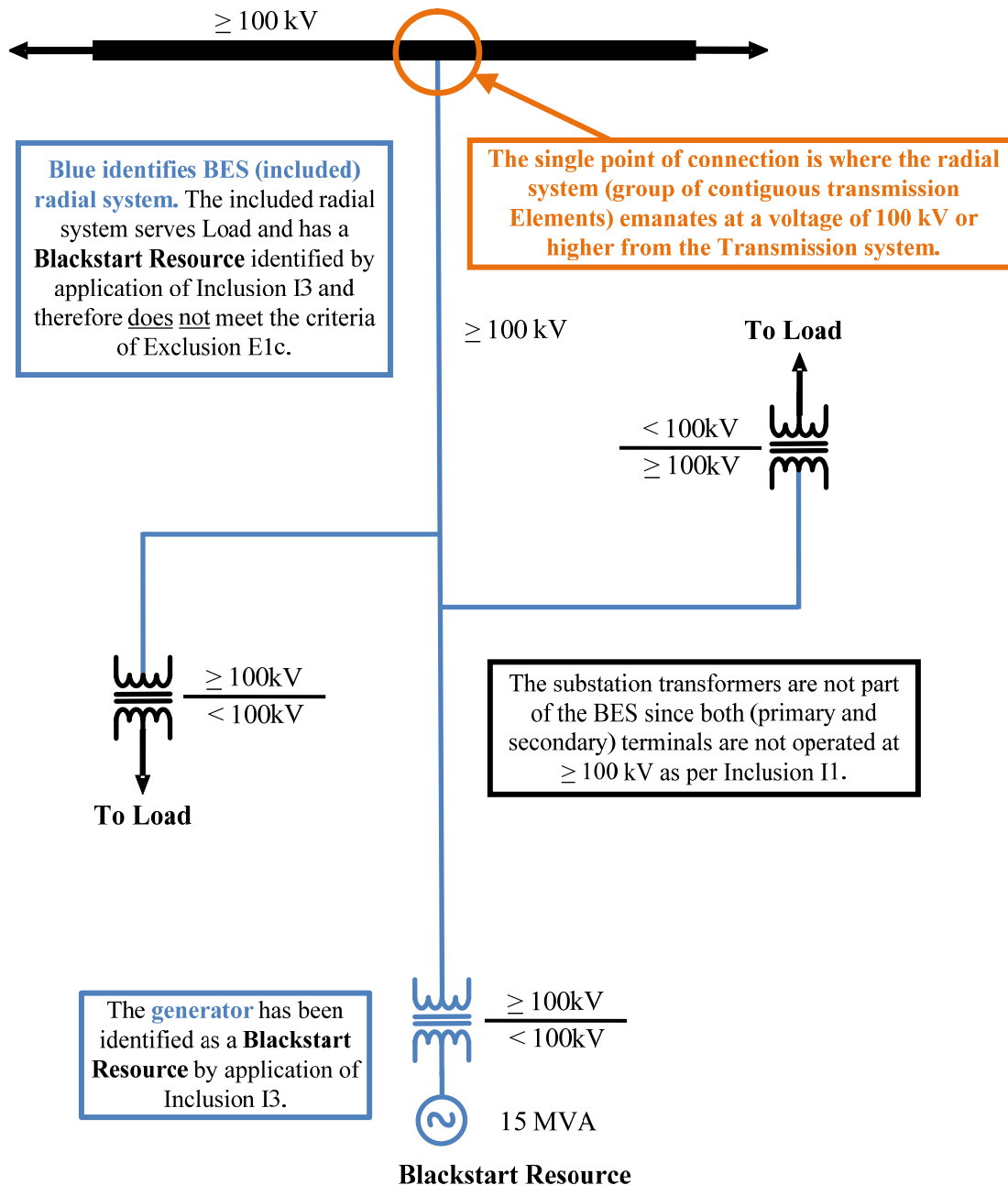


Figure E1-10: Radial System: Multiple (BES & non-BES) Generation Resources (Non-Retail & Blackstart Resource) & Serving Load

Normally open switching device

Radial systems should be assessed with all normally open (N.O.) devices in the open position. N.O. devices installed at any voltage level will not prevent the owner or operator from using this exclusion. The N.O. device(s) must be identified on prints and one-line diagrams that are used by the operating entity.

Figure E1-11 depicts multiple radial systems separated by a N.O. switching device operated at 100 kV or above.

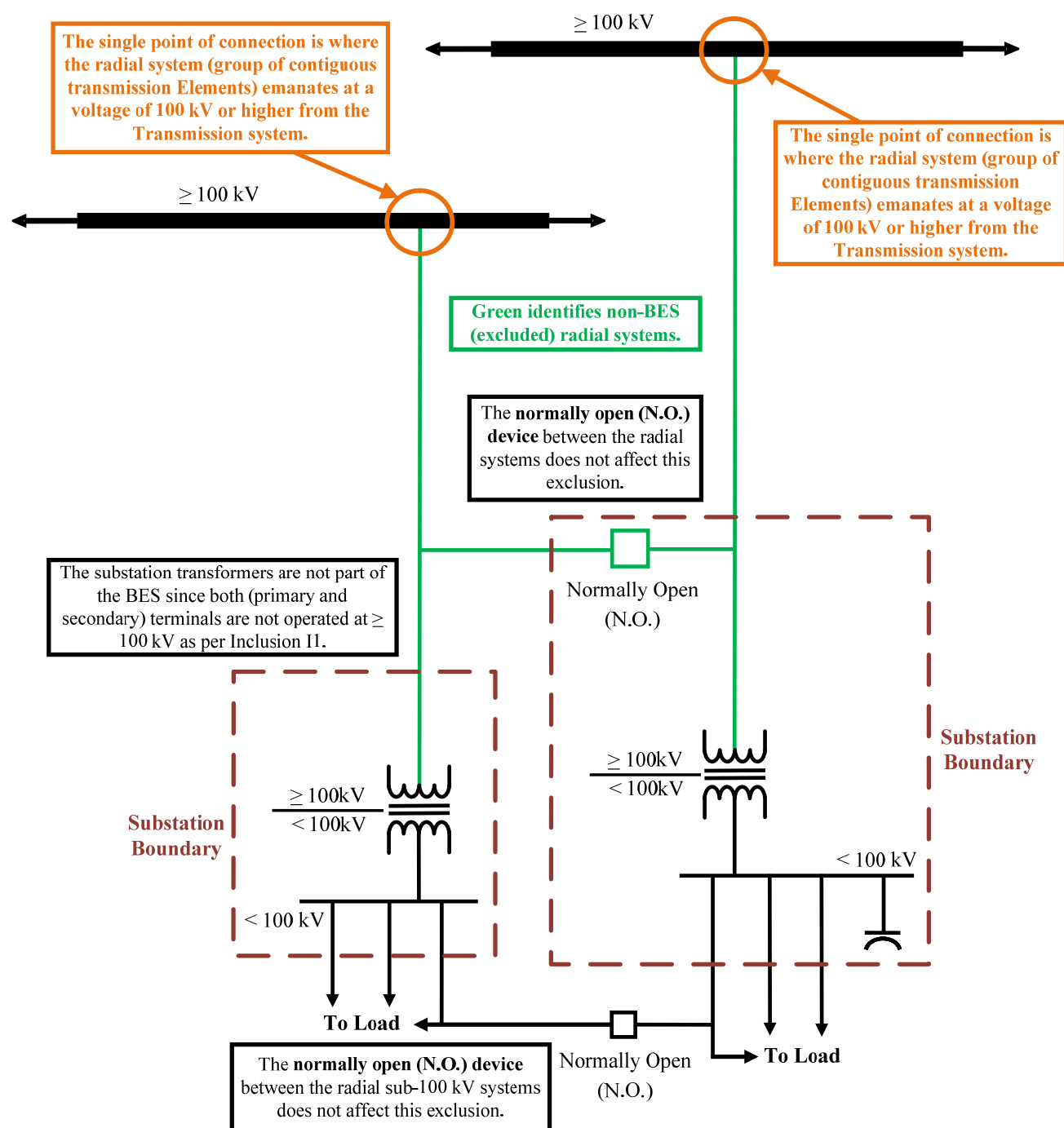


Figure E1-11: Radial System: Normally Open Switching Device between Load Serving Radial Systems

Commission (FERC) Order No. 773 directs implementation of the revised BES Definition to take into account the impact of sub-100 kV looped Facilities regardless of voltage level. This alters previous guidance on the analysis of radial systems and requires re-examination of these configurations. Figure E1-12 depicts such a situation which requires analysis based on the Exclusion E3 criteria (see Figures E3-6 and E3-7).

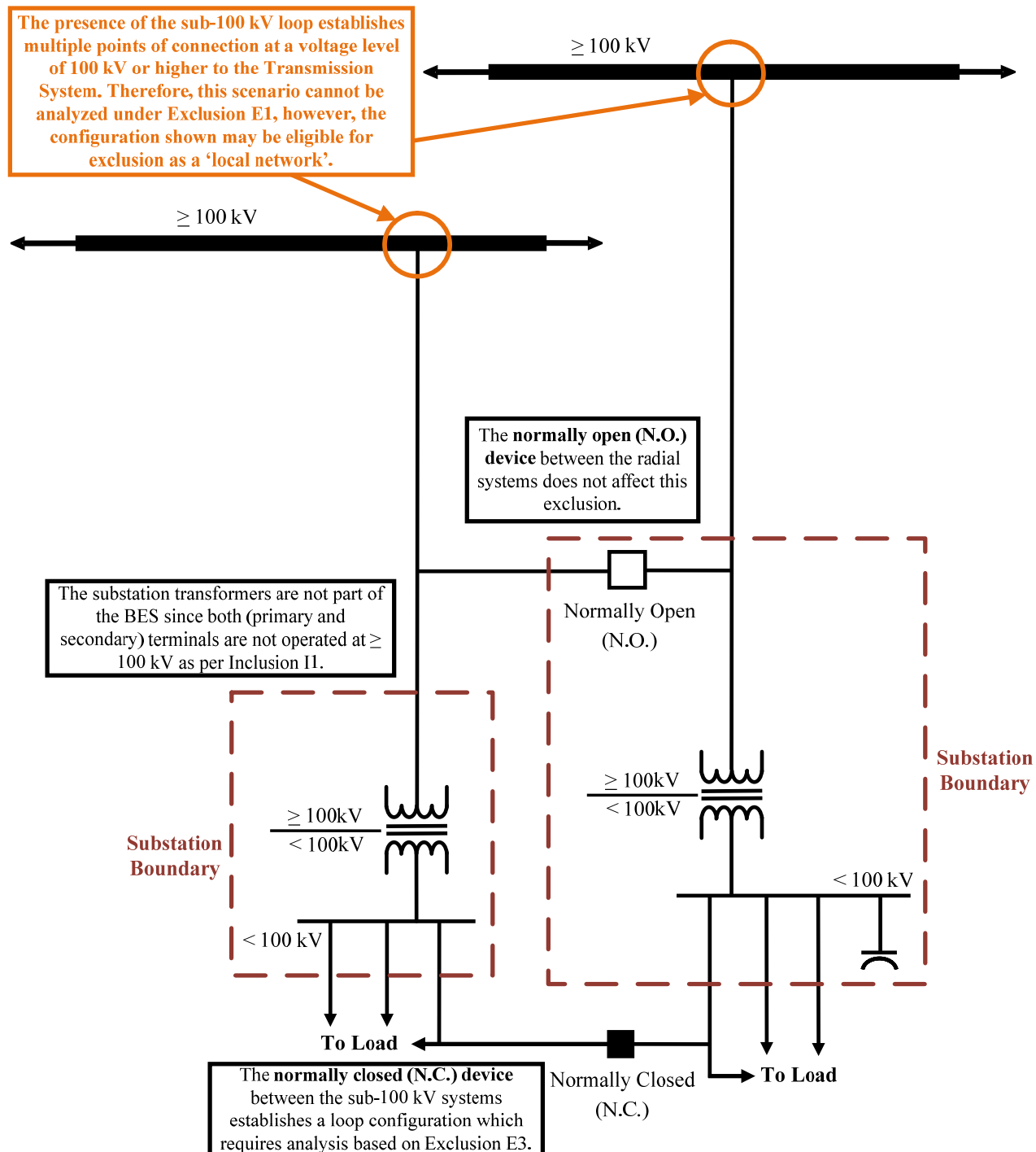


Figure E1-12: Impact of Sub-100 kV Looped Facilities (Switching Devices Identified (N.O. ≥ 100 kV & N.C. < 100 kV))

III.2 BES Exclusion E2

E2. A generating unit or multiple generating units on the customer's side of the retail meter that serve all or part of the retail customer Load with electric energy on the customer's side of the retail meter if: (i) the net capacity provided to the BES does not exceed 75 MVA, and (ii) standby, back-up, and maintenance power services are provided to the generating unit or multiple generating units or to the retail Load by a Balancing Authority, or provided pursuant to a binding obligation with a Generator Owner or Generator Operator, or under terms approved by the applicable regulatory authority.

Exclusion E2 provides for the exclusion of the Real Power resources that reside behind the retail meter (on the customer's side) and supersedes Inclusion I2. The exclusion is a restatement of the exclusion in Section III.c.4 of the *ERO Statement of Compliance Registry Criteria* (v.5), as clarified by the SDT in response to industry comments and recommendations:

"As a general matter, a customer-owned or operated generator/generation that serves all or part of retail load with electric energy on the customer's side of the retail meter may be excluded as a candidate for registration based on these criteria if (i) the net capacity provided to the bulk power system does not exceed the criteria above or the Regional Entity otherwise determines the generator is not material to the bulk power system and (ii) standby, back-up and maintenance power services are provided to the generator or to the retail load pursuant to a binding obligation with another generator owner/operator or under terms approved by the local regulatory authority or the Federal Energy Regulatory Commission, as applicable."

Exclusion E2 is dedicated to the situation faced by behind-the-meter (i.e., retail customer owned) generation that are qualifying facilities as defined by the Public Utility Regulatory Policies Act (PURPA) in the US (e.g., see 18 CFR Part 292 for the regulations that are applicable in the US), and similarly situated facilities in Canada. These facilities—often referred to as combined heat and power (CHP) facilities—are commonly employed at petroleum refineries, chemical and food processing plants, pulp and paper mills, steel mills, and large commercial applications requiring both electrical and thermal energy.

The primary purpose of retail customer owned generation in the context of Exclusion E2 is the integrity of steam production that supports a manufacturing process. The electrical Load of that host process does not exist without steam. However, Exclusion E2 might apply to other situations as well.

Exclusion E2 references the net generation (in MWs) since that is how the generation is operated, and the residual ("net") amount exported to the BES is what is deemed relevant to the exclusion and reliability, not the nameplate rating in MVA. The Real Power (physical) export is subject to a 75 MVA threshold. Condition (ii) in Exclusion E2 is derived from FERC or provincial regulations applicable to qualifying cogeneration and small power production facilities (i.e., QFs). For example, see 18 CFR §292.101 and §292.305(b) for the requirements specific to the US. Condition (ii) requires that the generation serving the retail customer Load self-provide reserves (i.e., standby, backup, and maintenance power), and is essential for the integrity of the exclusion. These reserves

maintain steam generation and the load to sustain the manufacturing process. In the US, the terms and conditions of standby, backup, and maintenance services are defined and administered by State Public Service Commissions (PSC) (i.e., the “applicable regulatory authority” in the US) subject to FERC oversight. These services are provided under contract or tariff with Generator Owners, Generator Operators, or Balancing Authorities in regions that do not have Independent System Operators (ISOs) or Regional Transmission Operators (RTOs), and provided by ISOs and RTOs where “organized markets” operate. These terms and conditions will be understood in Balancing Authority Areas where it is applicable, as it reflects existing industry practice.

Multiple connection points to the BES do not preclude the use of Exclusion E2.

Net capacity

The net capacity determination for Exclusion E2 is the net flow to the BES as measured by integrated hourly revenue metering for the most recent 12 month period. Periods of net capacity to the BES that exceed the threshold value when directed by the applicable Balancing Authority does not preclude the ability to utilize this exclusion.

Note: Figures E2-1 and E2-2 are depictions of the application of Exclusion E2 and are intended to assist the user during the full application of the BES definition.

Figure E2-1 depicts customer owned generation residing behind the retail meter. The cogeneration operation is resulting in a net capacity to the BES of 50 MVA.

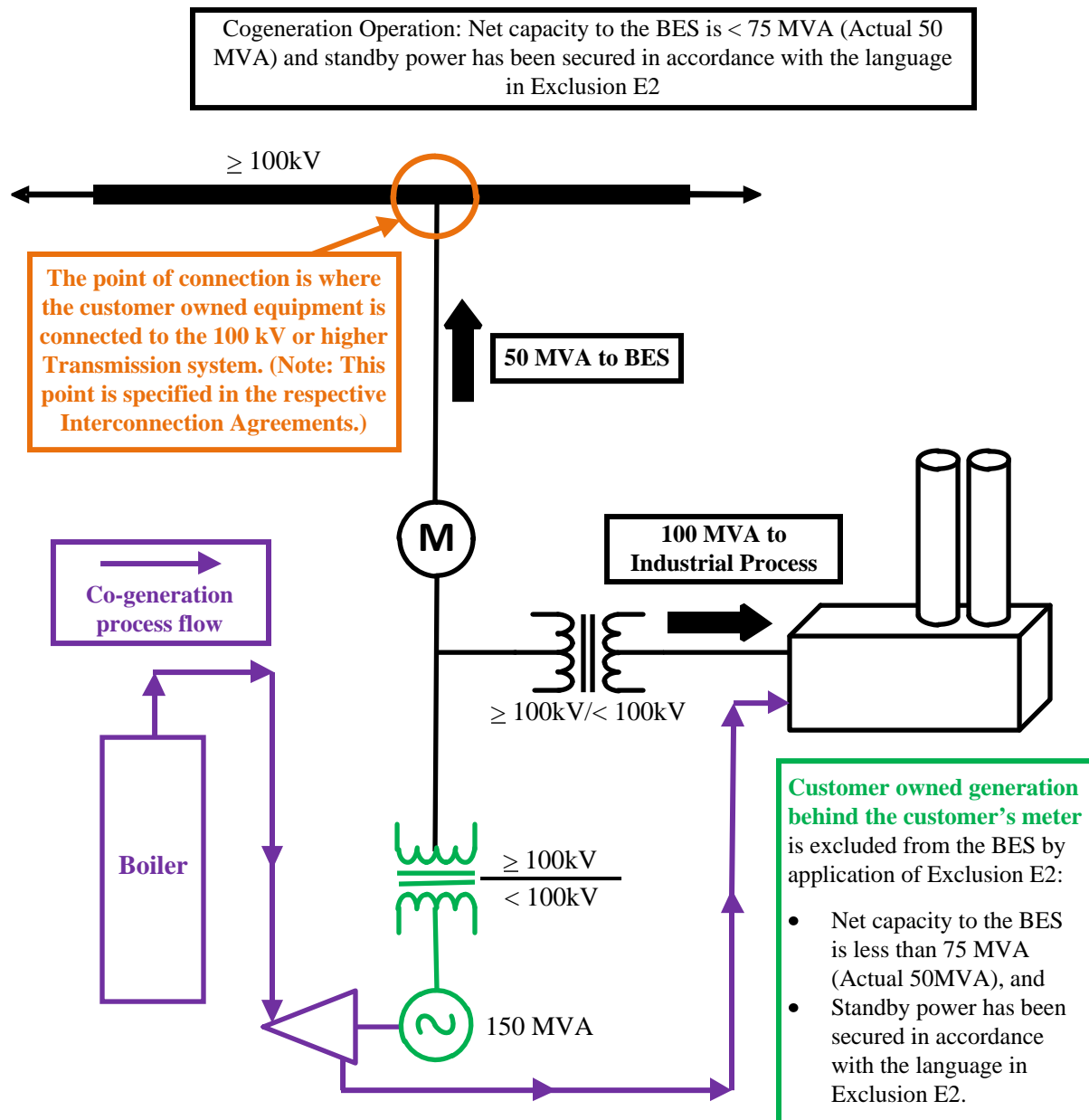


Figure E2-1: Behind-the-Meter Generation: Net Capacity to the BES Less Than 75 MVA

Figure E2-2 depicts customer owned generation residing behind the retail meter. The cogeneration operation is resulting in a net capacity to the BES of 100 MVA.

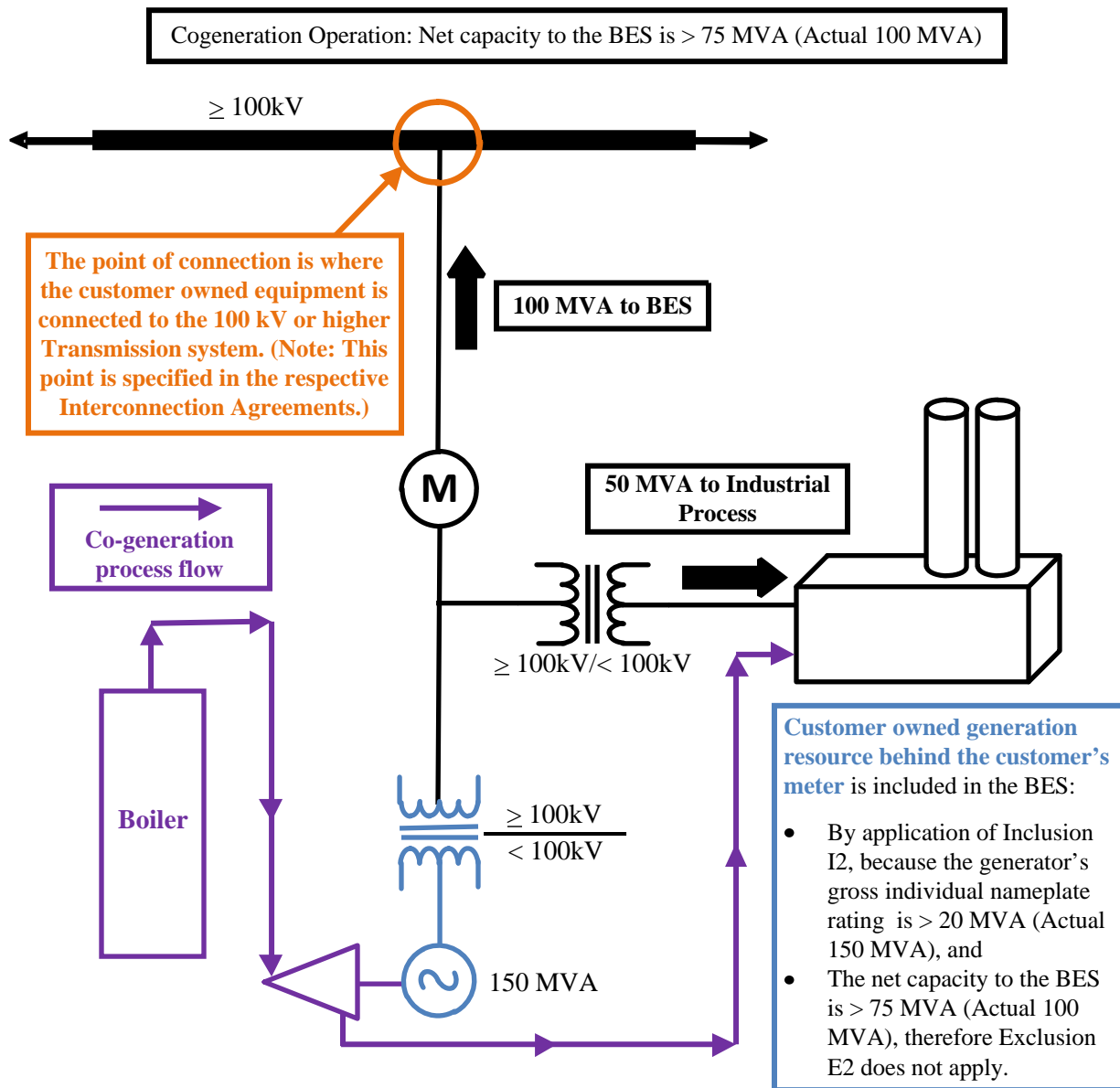


Figure E2-2: Behind-the-Meter Generation: Net Capacity to the BES Greater Than 75 MVA

III.3 BES Exclusion E3

E3. Local networks (LN): A group of contiguous transmission Elements operated at or above 100 kV but less than 300 kV that distribute power to Load rather than transfer bulk power across the interconnected system. LN's emanate from multiple points of connection at 100 kV or higher to improve the level of service to retail customer Load, and not to accommodate bulk power transfer across the interconnected system. The LN is characterized by all of the following:

- a.) Limits on connected generation: The LN and its underlying Elements do not include generation resources identified in Inclusion I3 and do not have an aggregate capacity of non-retail generation greater than 75 MVA (gross nameplate rating);
- b.) Power flows only into the LN and the LN does not transfer energy originating outside the LN for delivery through the LN; and
- c.) Not part of a Flowgate or transfer path: The LN does not contain a monitored Facility of a permanent Flowgate in the Eastern Interconnection, a major transfer path within the Western Interconnection, or a comparable monitored Facility in the ERCOT or Quebec Interconnections, and is not a monitored Facility included in an Interconnection Reliability Operating Limit (IROL).

Exclusion E3 is an exclusion for the contiguous transmission Elements that operate at or above 100 kV but less than 300 kV and emanate from multiple points of connection at 100 kV or higher. The local network exclusion is not dependent on the existence of a switching device at the points of connection to the BES (i.e., automatic interrupting device, manual disconnects, etc.). Generation resources connected within the local network, power flow criteria, and Element classification (i.e., Flowgate, transfer path) are qualifiers for this exclusion.

Exclusion E3 does not allow for the exclusion of generation resources that meet the criteria for generation resources as described in Inclusions I2, I3, and I4. Reactive resources that meet the criteria described in Inclusion I5 cannot be excluded by application of Exclusion E3. The presence of Reactive resources does not preclude the ability to invoke Exclusion E3. Exclusion E3 allows for the exclusion of contiguous transmission Elements (i.e., transformers, circuit breakers, bus sections, and transmission lines) emanating from multiple points of connection at a voltage of 100 kV or higher. The power flow criterion describes the Real-time operational characteristics of the local network. And, by definition the local network, cannot be part of a designated Flowgate or transfer path.

Entities should be prepared to justify local network determinations.

Generation and Reactive Resources

Exclusion E3 does not allow for the exclusion of generation resources that meet the criteria described in Inclusions I2, I3, and I4.

Reactive resources that meet the criteria described in Inclusion I5 cannot be excluded by application of Exclusion E3. The presence of reactive resources does not preclude the ability to invoke Exclusion E3.

Generation Limits

There are two conditions under which generation resources can prevent a network from qualifying for Exclusion E3:

3. The aggregate nameplate capacity of the non-retail generation capacity within the network in question exceeds 75 MVA; or
4. Any generation within the network in question is identified as a Blackstart Resource in the Transmission Operator's restoration plan (pursuant to Inclusion I3).

If either of these conditions applies, the network does not qualify for Exclusion E3. It should be noted that BES Generation may reside within the confines of an excluded non-BES local network. For instance, a 30 MVA generator connected through its generator step-up transformer at 100 kV or above within the local network will be considered to be BES, but this designation does not prevent the exclusion of the remaining network Facilities.

Power Flow at BES Interface

An entity who determines that all or a portion of its Facilities meet the local network exclusion should be able to demonstrate, by inspection of actual system data, that flow of power is always into the local network at each point of interface with the BES at all times. The SDT's intent was that hourly integrated power flow values over the course of the most recent two-year period would be sufficient to make such a demonstration.

In order for transmission Elements to qualify for Exclusion E3, power flow direction at all points of BES interface must be into the local network. Therefore, the second characteristic of Exclusion E3 (E3.b that: "... the LN does not transfer energy originating outside the LN for delivery through the LN") will also be satisfied in that energy is not being transferred through the local network.

Voltage Thresholds

The local network exclusion applies to electric transmission Elements operated between 100 kV and 300 kV, and cannot extend to any Facilities operated above 300 kV. Facilities operated below 100 kV are excluded from the BES by application of the core definition, and warrant no further exclusion under Exclusion E3.

Further evaluation of the underlying Elements may be appropriate. Each underlying Element must meet the criteria established by Exclusion E3, including parts a, b, and c, to qualify for exclusion from the BES. Such evaluations are not shown in Figures E3-1 through E3-9, which concentrate on the bigger picture, but are detailed in the summary diagrams in Section IV where the hierarchical application of the definition is described and shown.

Note: Figures E3-1 through E3-9 are depictions of the application of Exclusion E3 and are intended to assist the user during the full application of the BES definition.

Figure E3-1 depicts an excluded local network which contains retail and non-retail generation resources and serves Load. The local network operates at a voltage of 138 kV and has non-retail generation resources with an aggregate nameplate rating of 55 MVA and power only flows into the local network at each point of connection.

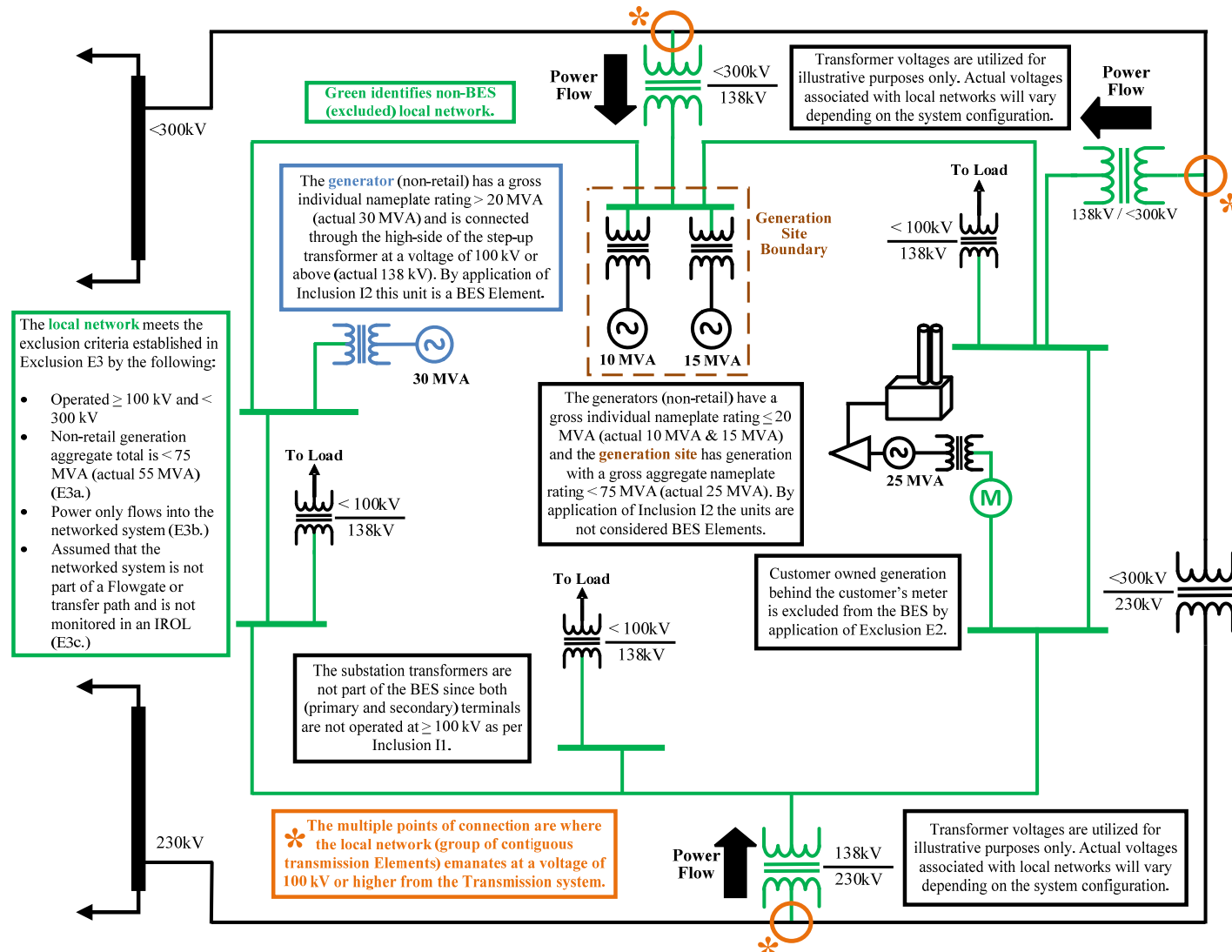


Figure E3-1: Local Network (non-BES) with Retail & Non-Retail Generation Resources & Serving Load

Figure E3-3 depicts an excluded local network with reactive resources (BES & Non-BES) connected through various methods.

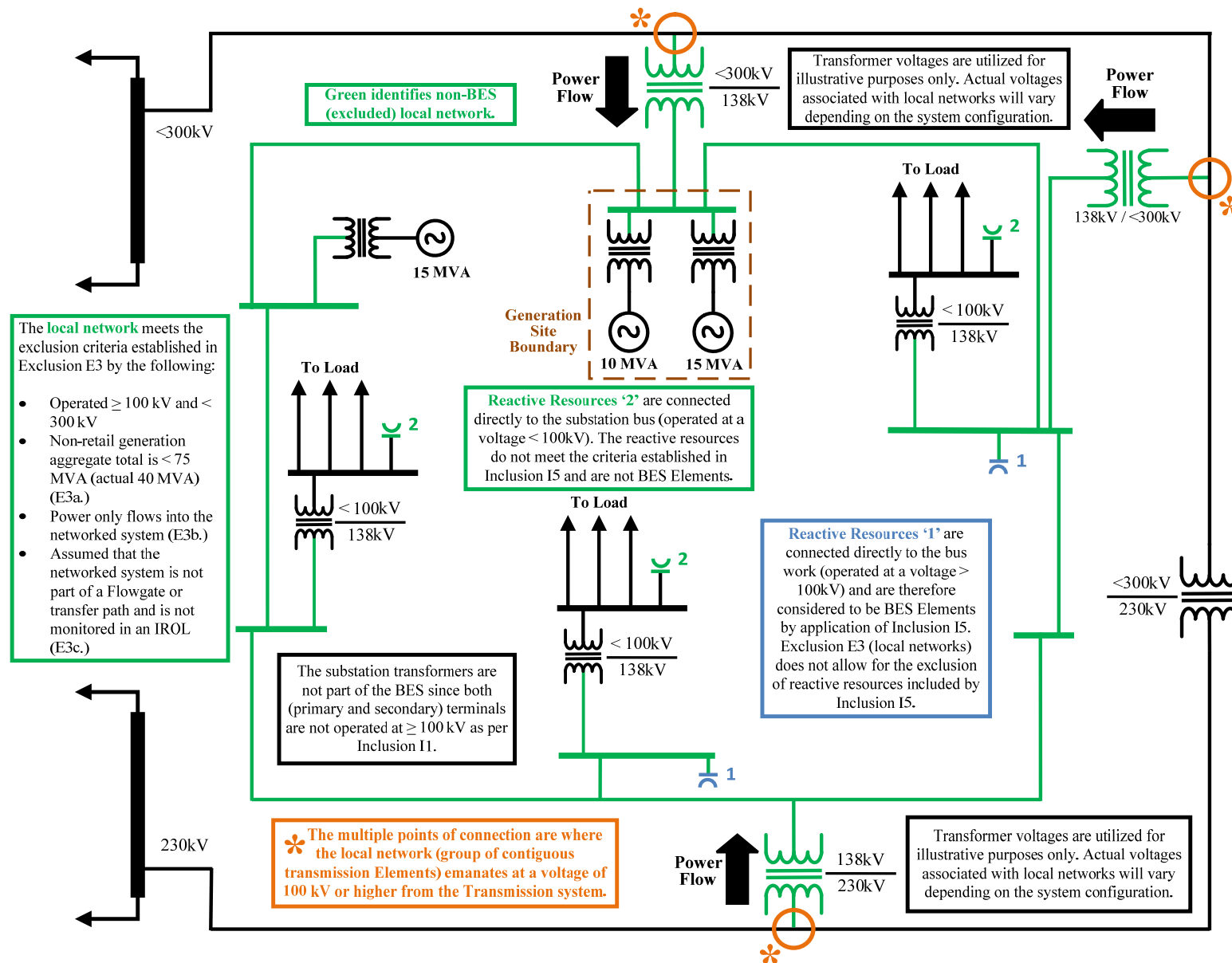


Figure E3-3: Local Network (non-BES) with Reactive Resources (BES & non-BES)

Commission (FERC) Order No. 773 directs implementation of the revised BES Definition to take into account the impact of sub-100 kV looped Facilities regardless of voltage level. This alters previous guidance on the analysis of local networks and requires re-examination of these configurations. Figure E3-4 depicts such a situation which requires analysis based on the Exclusion E3 criteria (see Figure E1-2).

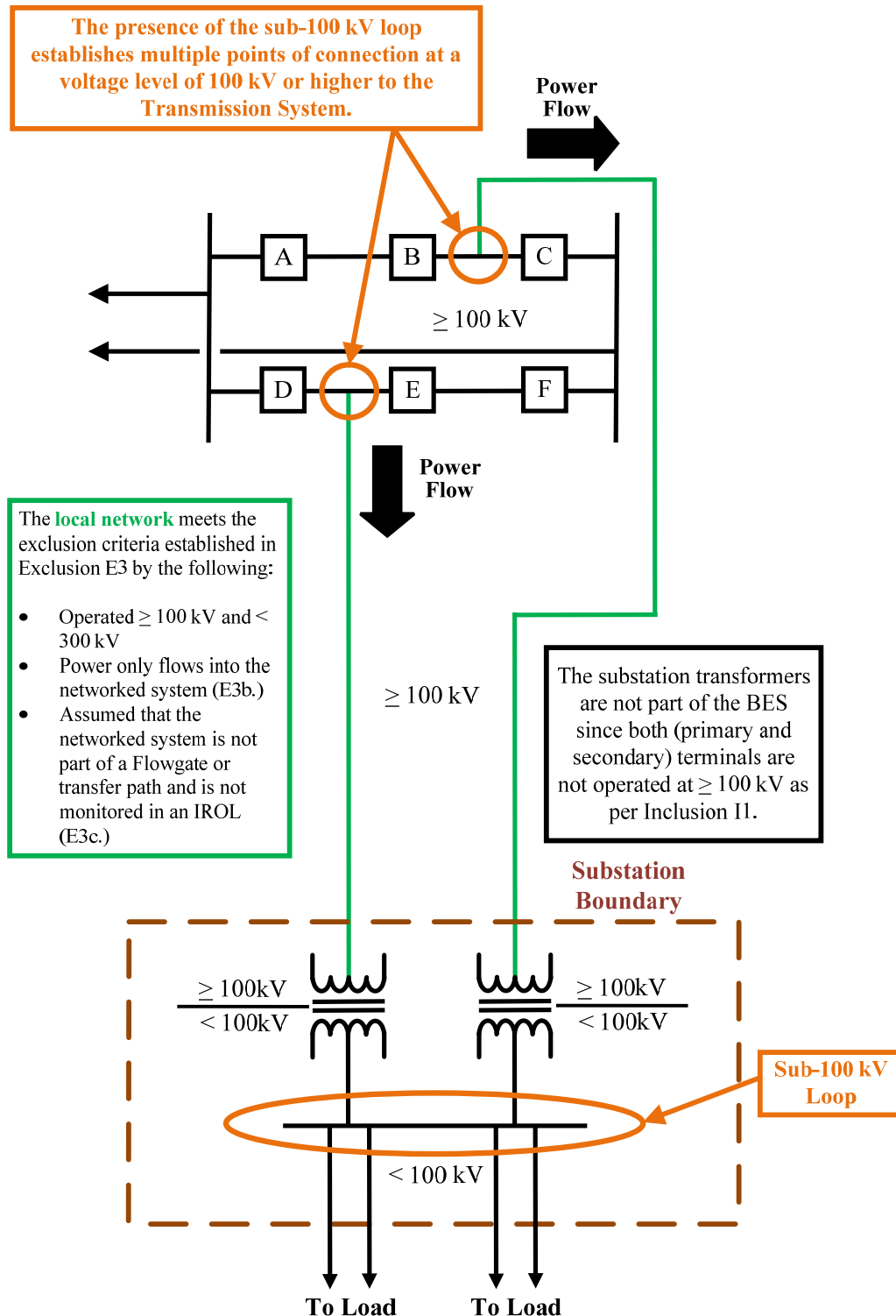


Figure E3-4: Local Network (non-BES) with Sub-100 kV Loop

Commission (FERC) Order No. 773 directs implementation of the revised BES Definition to take into account the impact of sub-100 kV looped Facilities regardless of voltage level. This alters previous guidance on the analysis of local networks and requires re-examination of these configurations. Figure E3-5 depicts such a situation which requires analysis based on the Exclusion E3 criteria (see Figure E1-2).

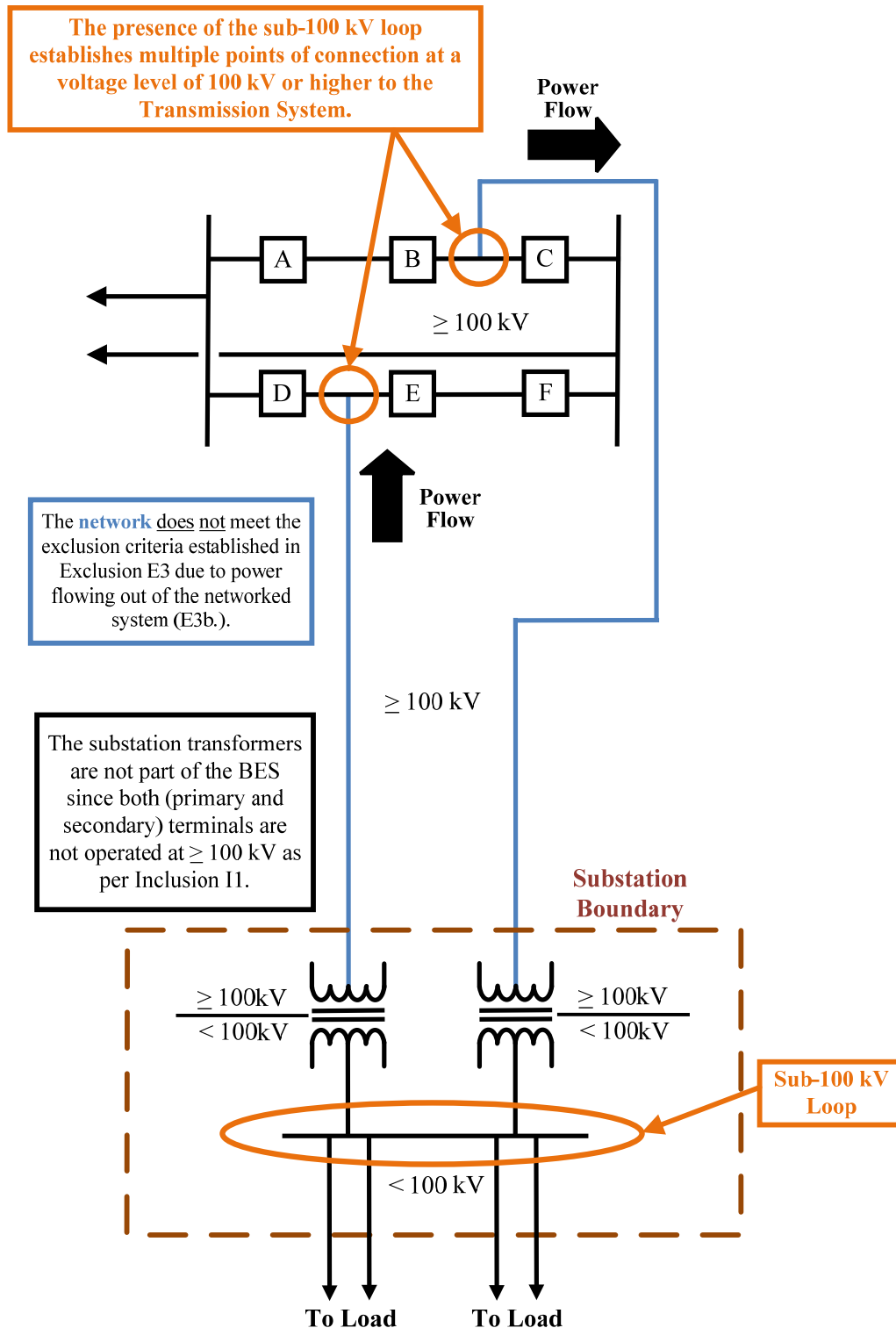


Figure E3-5: Local Network (BES) with Sub-100 kV Loop

Commission (FERC) Order No. 773 directs implementation of the revised BES Definition to take into account the impact of sub-100 kV looped Facilities regardless of voltage level. This alters previous guidance on the analysis of radial systems and requires re-examination of these configurations. Figure E3-7 depicts such a situation which requires analysis based on the Exclusion E3 criteria (see Figure E1-11a).

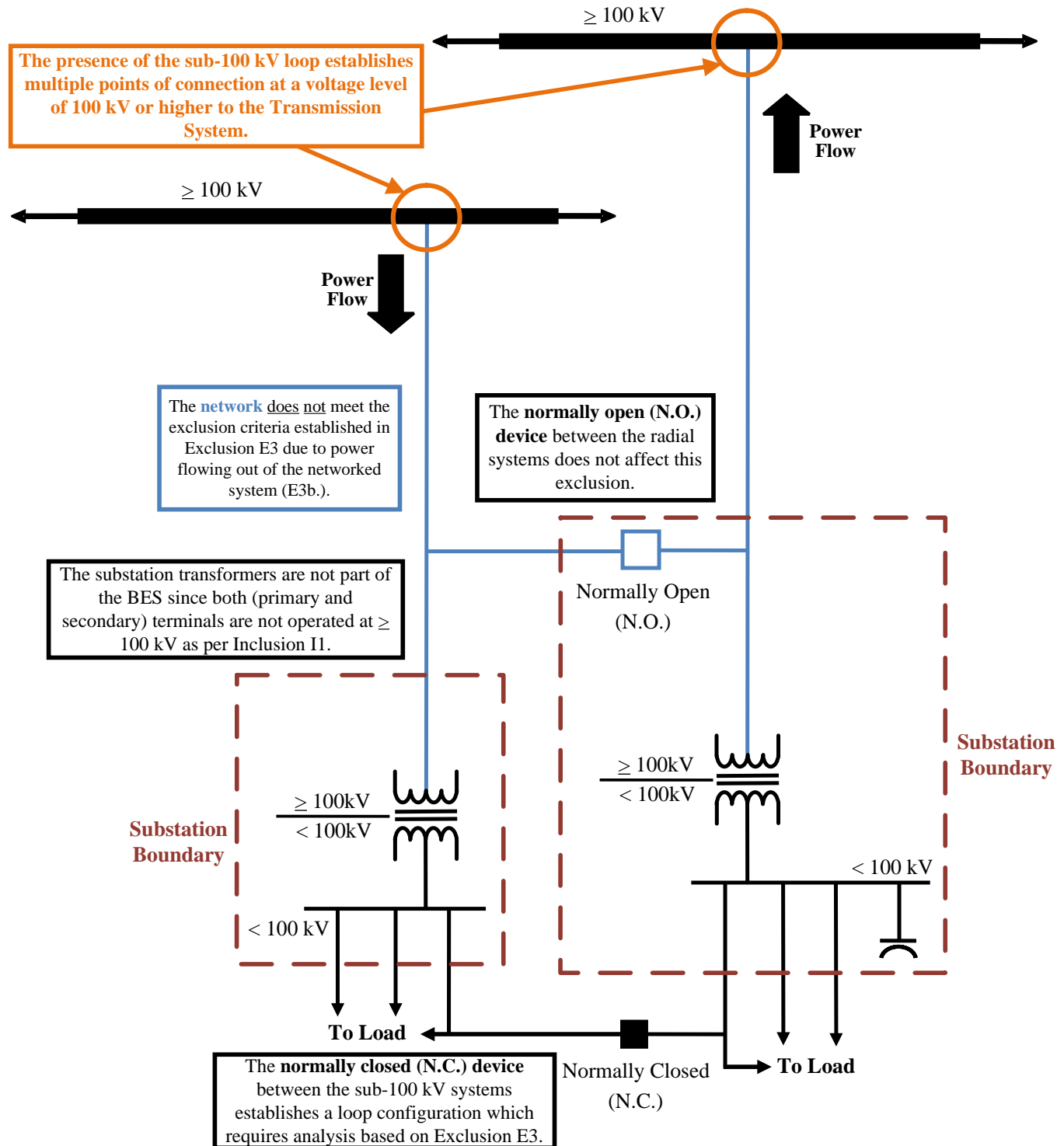


Figure E3-7: Local Network (BES) with Sub-100 kV Looped Facilities (Switching Devices Identified (N.O. ≥ 100 kV & N.C. < 100 kV))

Commission (FERC) Order No. 773 directs implementation of the revised BES Definition to take into account the impact of sub-100 kV looped Facilities regardless of voltage level. This alters previous guidance on the analysis of radial systems and requires re-examination of these configurations. Figure E3-8 depicts such a situation which requires analysis based on the Exclusion E3 criteria (see Figure E1-12a).

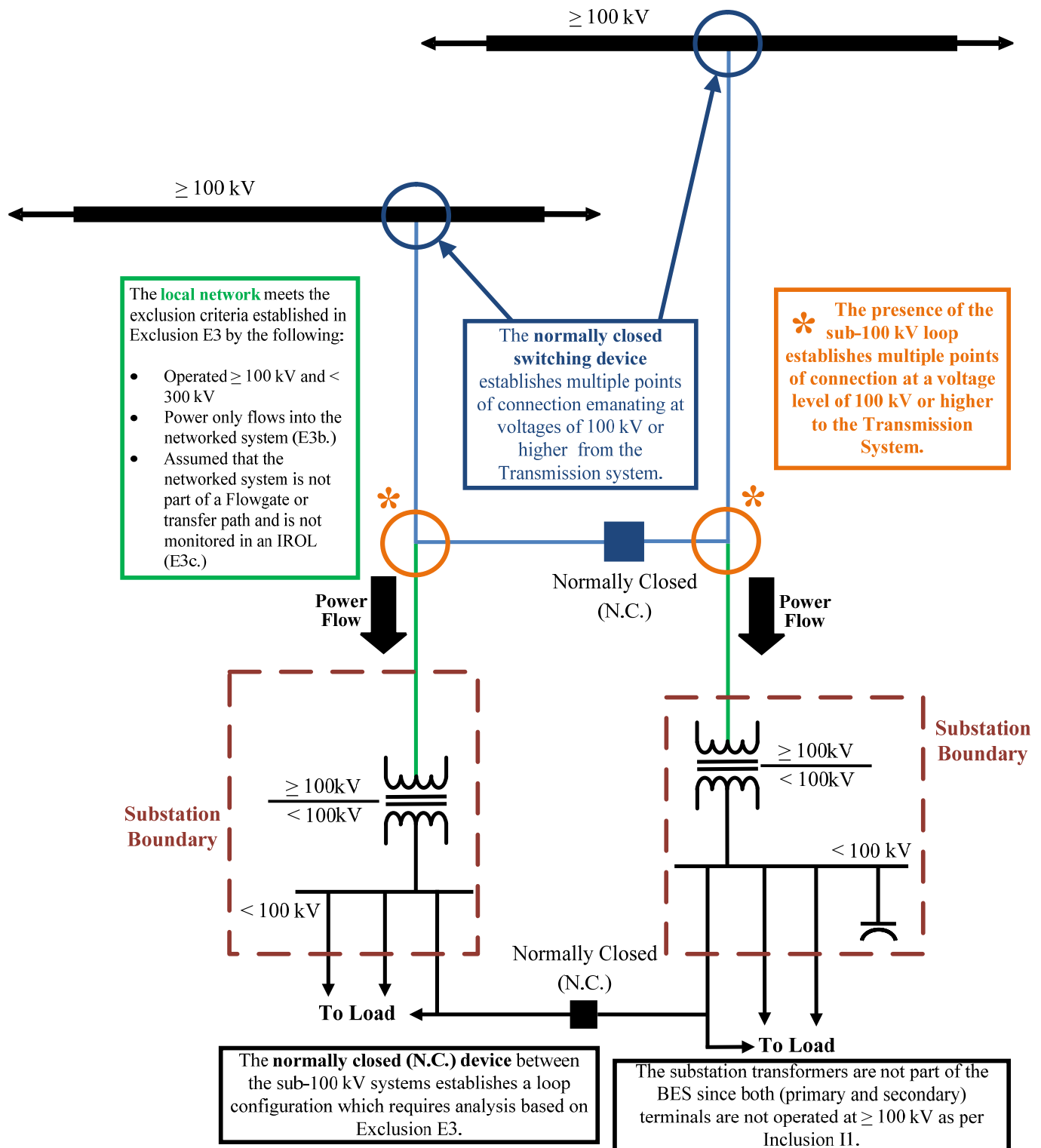


Figure E3-8: Local Network (non-BES) with Sub-100 kV Looped Facilities (Switching Devices Identified (N.C. $\geq 100 \text{ kV}$ & N.C. $< 100 \text{ kV}$))

Commission (FERC) Order No. 773 directs implementation of the revised BES Definition to take into account the impact of sub-100 kV looped Facilities regardless of voltage level. This alters previous guidance on the analysis of radial systems and requires re-examination of these configurations. Figure E3-9 depicts such a situation which requires analysis based on the Exclusion E3 criteria (see Figure E1-12a).

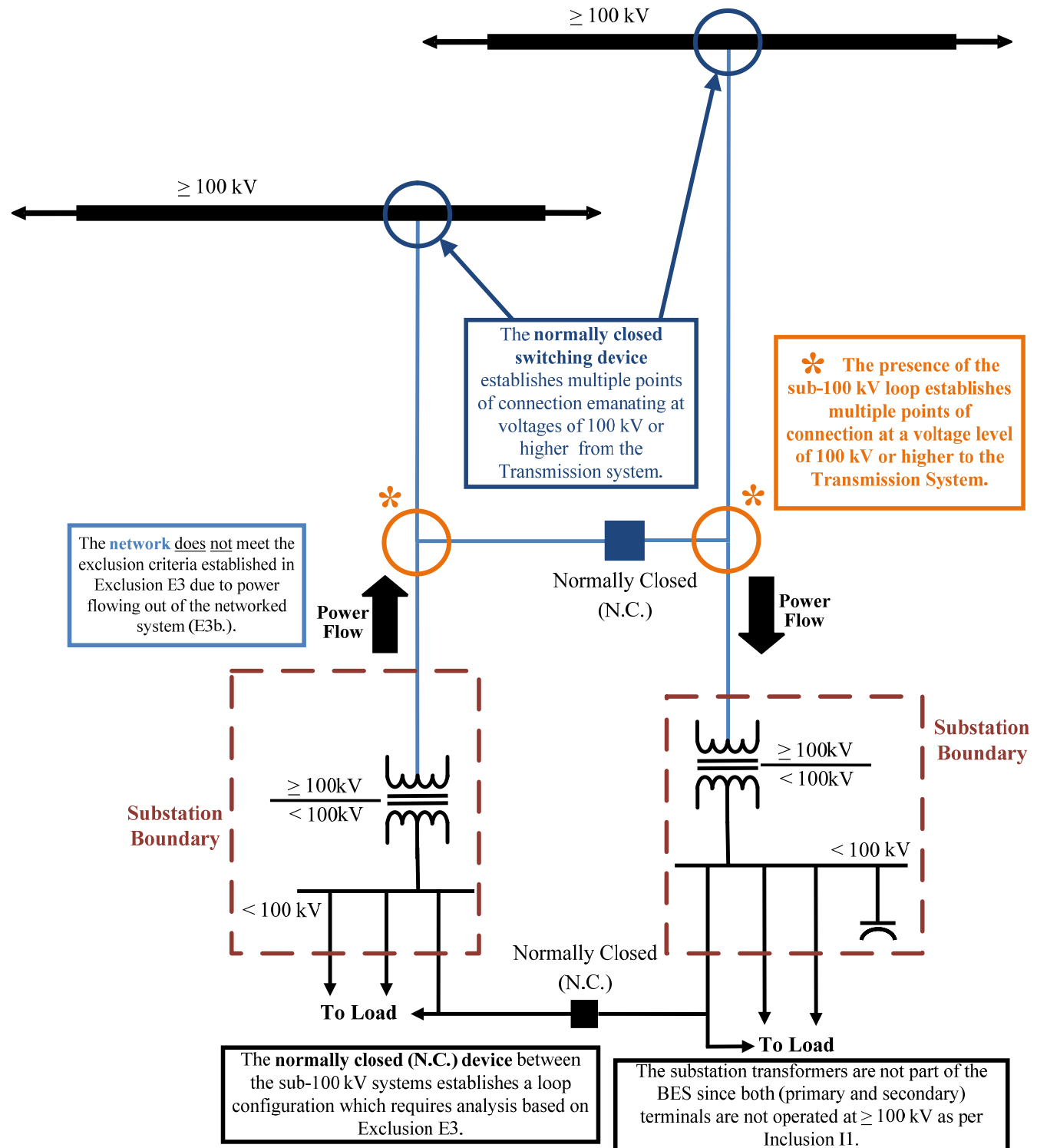


Figure E3-9: Local Network (BES) with Sub-100 kV Looped Facilities (Switching Devices Identified (N.C. $\geq 100\text{ kV}$ & N.C. $< 100\text{ kV}$))

III.4 BES Exclusion E4

E4. Reactive Power devices owned and operated by the retail customer solely for its own use.

Exclusion E4 is dependent on the ownership and intended function of the Reactive Resource, not the specific Element configuration; therefore, figures were not developed for Exclusion E4 due to the simplicity of the language in the exclusion.

IV. Hierarchical Application of the Definition

The hierarchical application of the definition is depicted in a series of diagrams based on a fictional system configuration and follows the sequenced application of the definition described below.

The application of the ‘bright-line’ BES definition is a three-step process that, when appropriately applied, will identify the vast majority of BES Elements in a consistent manner that can be applied on a continent-wide basis.

In step one (1), the BES ‘core’ definition is used to establish the bright-line of 100 kV, which is the overall demarcation point between BES and non-BES Elements. Additionally, the ‘core’ definition identifies the Real Power and Reactive Power resources connected at 100 kV or higher, as included in the BES. To fully appreciate the scope of the ‘core’ definition, an understanding of the term Element is needed. Element is defined in the NERC Glossary of Terms as:

“Any electrical device with terminals that may be connected to other electrical devices such as a generator, transformer, circuit breaker, bus section, or transmission line. An element may be comprised of one or more components. “

Step two (2) provides additional clarification for the purposes of identifying specific Elements that are included through the application of the ‘core’ definition. The Inclusions address Transmission Elements and Real Power and Reactive Power resources with specific criteria to provide for a consistent determination of whether an Element is classified as BES or non-BES.

Step three (3) is to evaluate specific situations for exclusion from the BES (classification as non-BES Elements). The exclusion language is written to specifically identify Elements or groups of Elements for exclusion from the BES. Step three (3) should be applied in the following sequence:

- Exclusion E2 provides for the exclusion of the Real Power resources that reside behind-the-retail meter (on the customer’s side) and supersedes Inclusion I2.
- Exclusion E4 provides for the exclusion of retail customer owned and operated Reactive Power devices and supersedes Inclusion I5.
- Exclusion E3 provides for the exclusion of ‘transmission Elements’ from local networks that meet the specific criteria identified in the exclusion language. This does not allow for the exclusion of Real Power and Reactive Power resources captured by Inclusions I2 – I5. Exclusion E3 only speaks to the transmission component of the local network. The only inclusion that Exclusion E3 supersedes is Inclusion I1. (Small “t” transmission is meant as a qualifier to Elements and, thus, brings in the Glossary definition of Elements while limiting it to just transmission components identified in the definition of Element.)
- Exclusion E1 provides for the exclusion of ‘transmission Elements’ from radial systems that meet the specific criteria identified in the exclusion language. This does not allow for the exclusion of Real Power and Reactive Power resources captured by Inclusions I2 – I5. Exclusion E1 only speaks to the transmission component of the radial system. The only inclusion that Exclusion E1 supersedes is

Inclusion I1. (Small "t" transmission is meant as a qualifier to Elements and, thus, brings in the Glossary definition of Elements while limiting it to just transmission components identified in the definition of Element.)

Proposed Phase 2 Application: Diagram S1-9a shows how the size of a generator embedded within what could otherwise be classified as a local network can affect the exclusion status of that local network. Subsequent diagrams S1-9b and S1-9c show the hierarchical progression analysis of the sample configuration.

Key to diagram color coding:

- **Blue** indicates that an Element is included in the BES
- **Green** indicates that an Element is not included in the BES
- **Orange** indicates 'points of connection'.
- **Black** indicates Elements that are not evaluated for the specific exclusion depicted in the individual diagrams being shown.

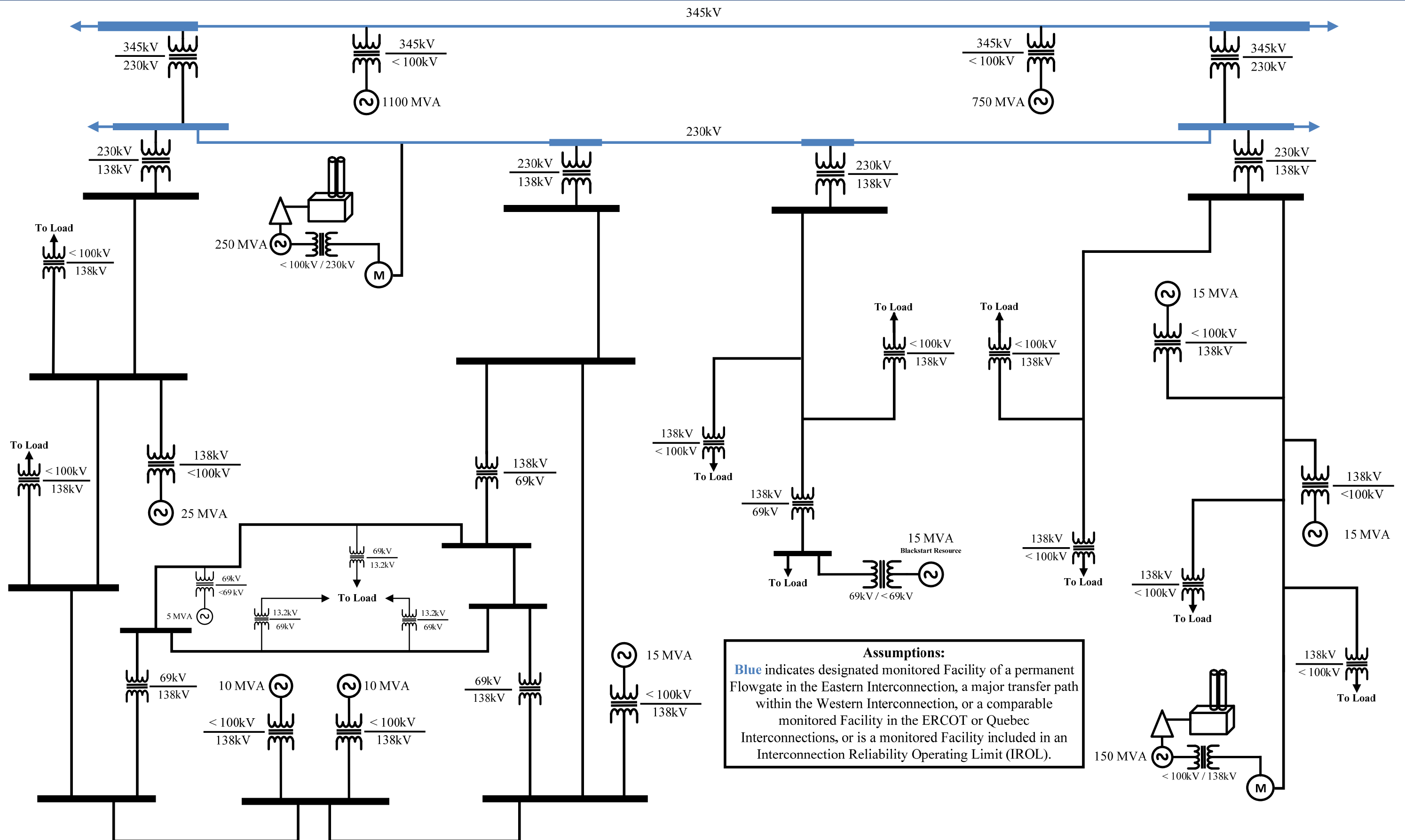


Figure S1-2: System Diagram - Assumptions

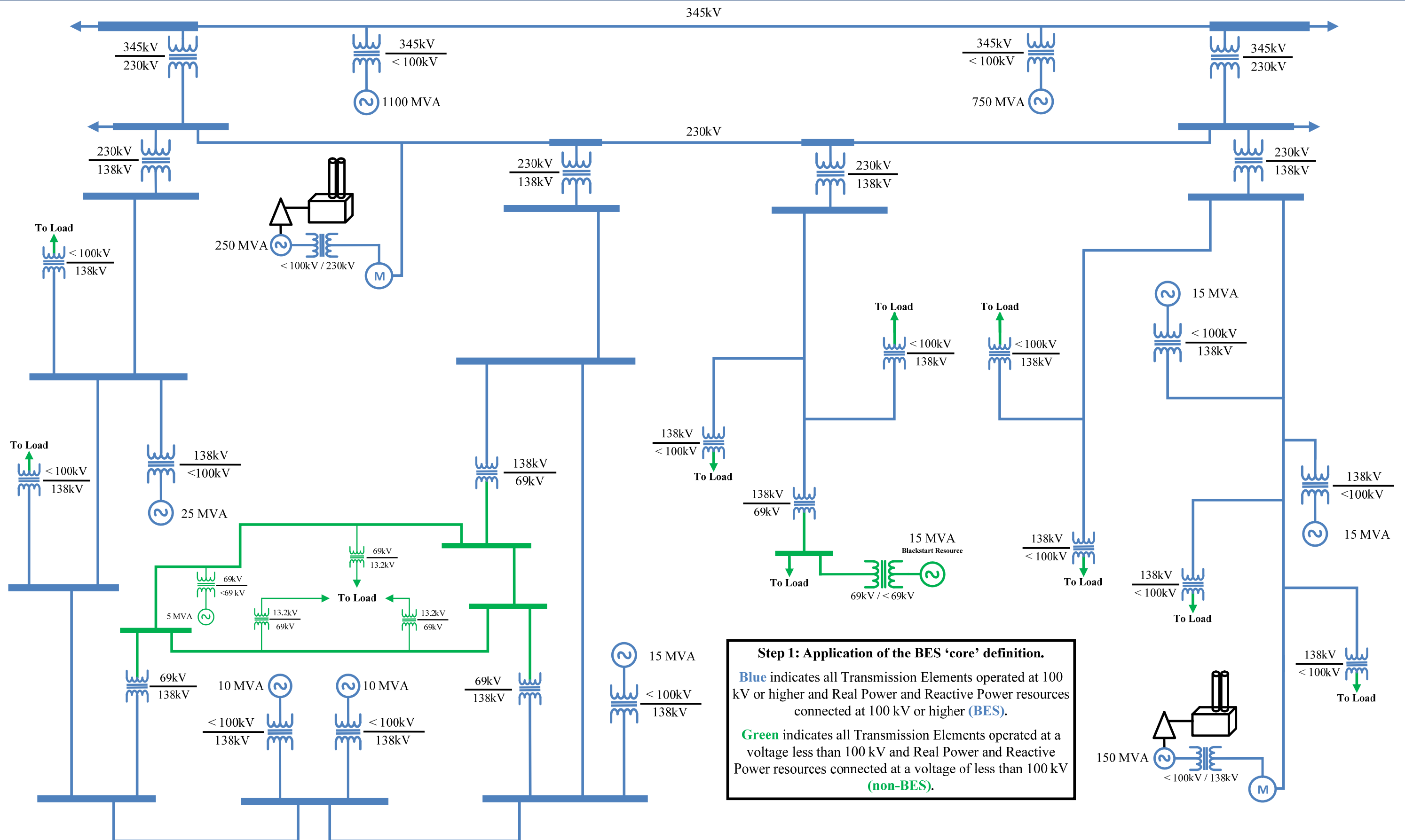


Figure S1-3: System Diagram – Application of 'Core' Definition

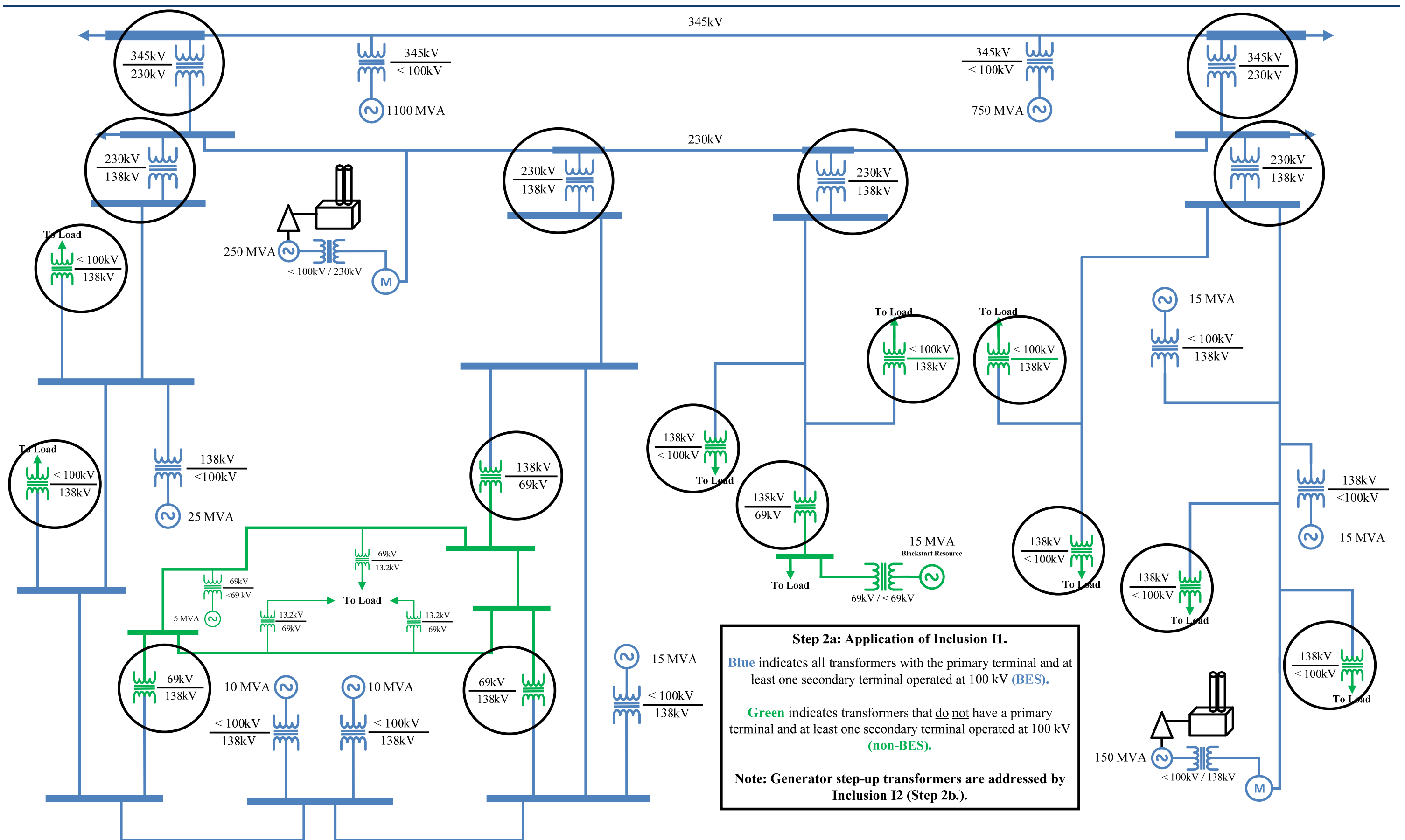


Figure S1-4: System Diagram – Application of Inclusion I1

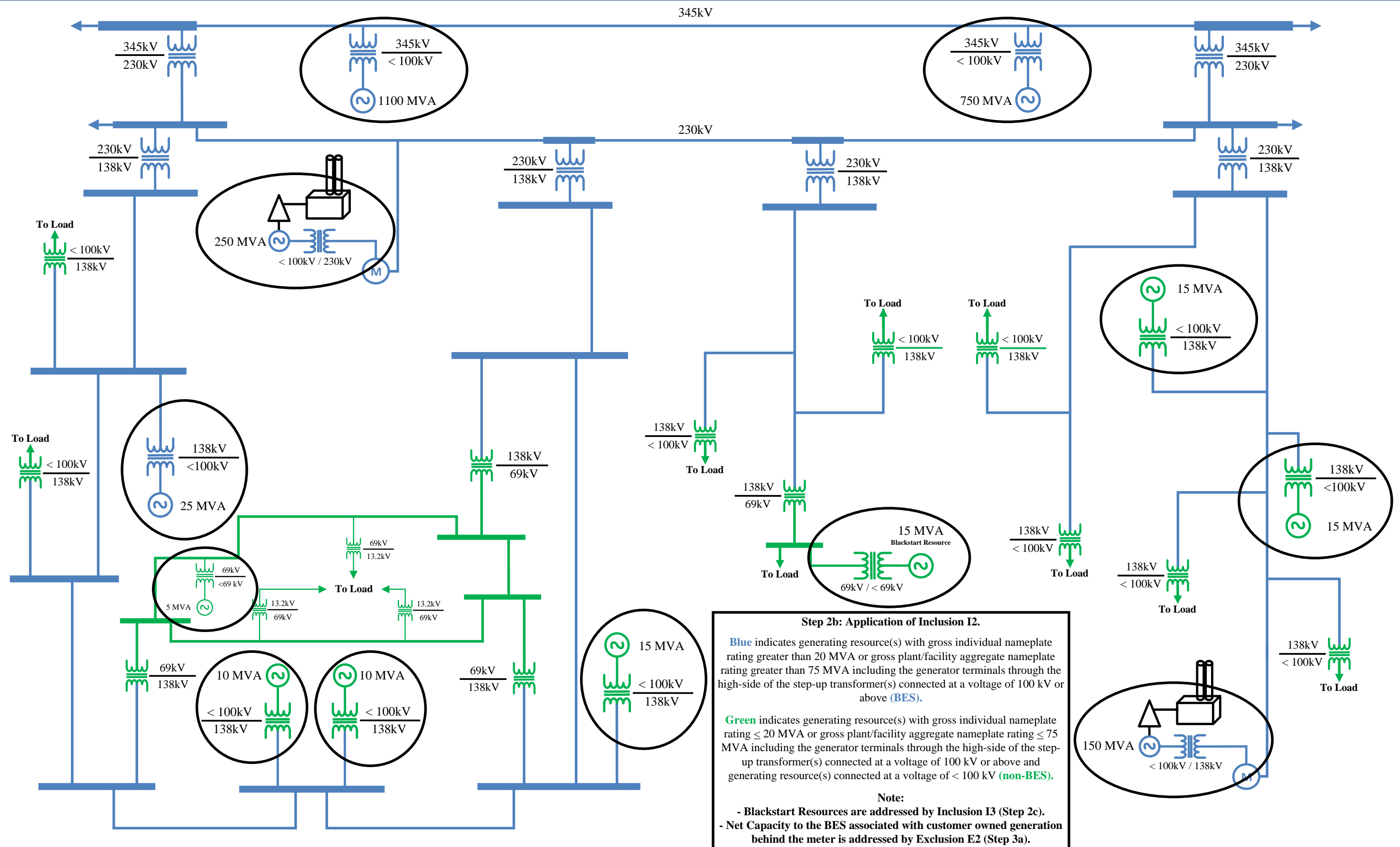


Figure S1-5: System Diagram – Application of Inclusion I2

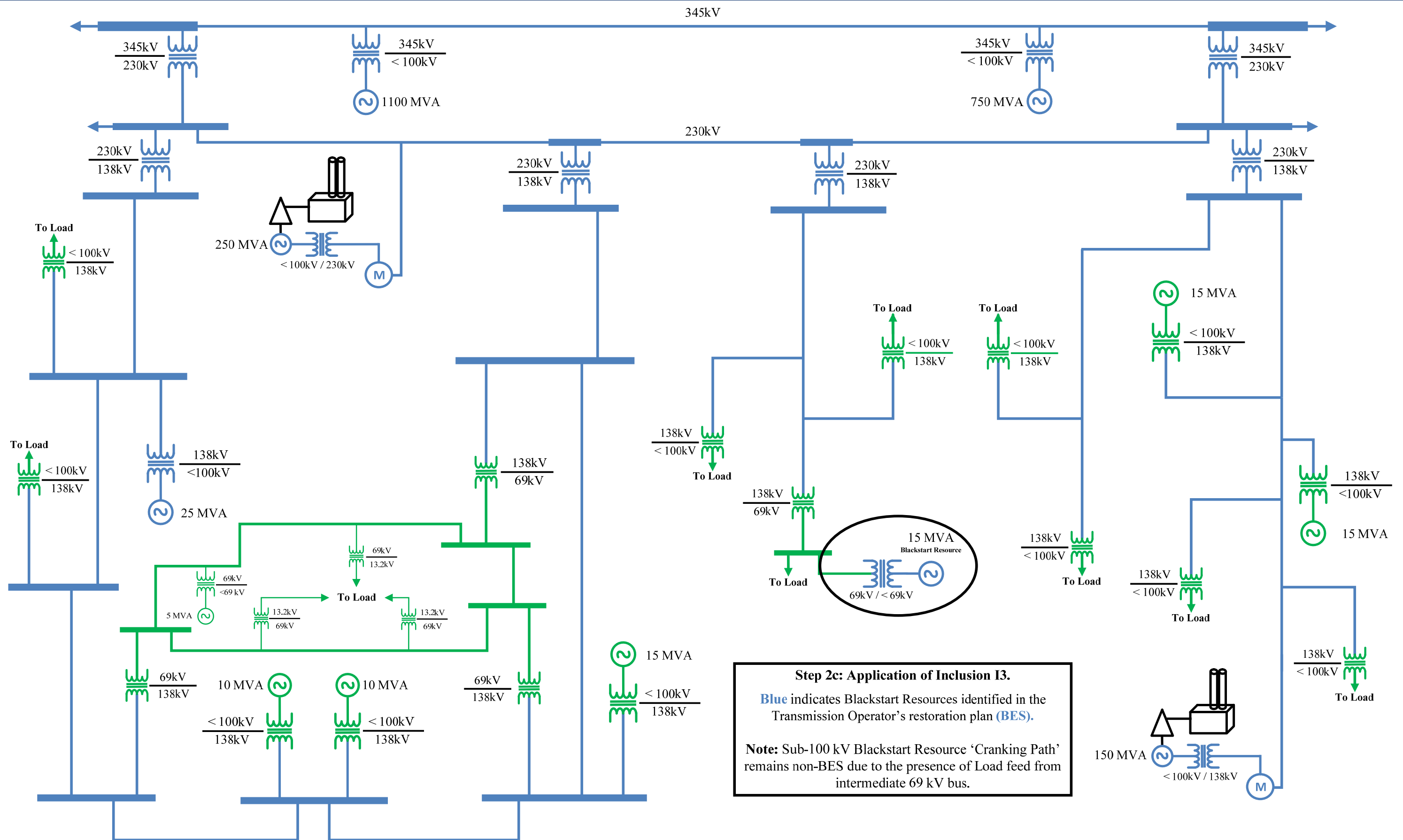


Figure S1-6: System Diagram – Application of Inclusion I3

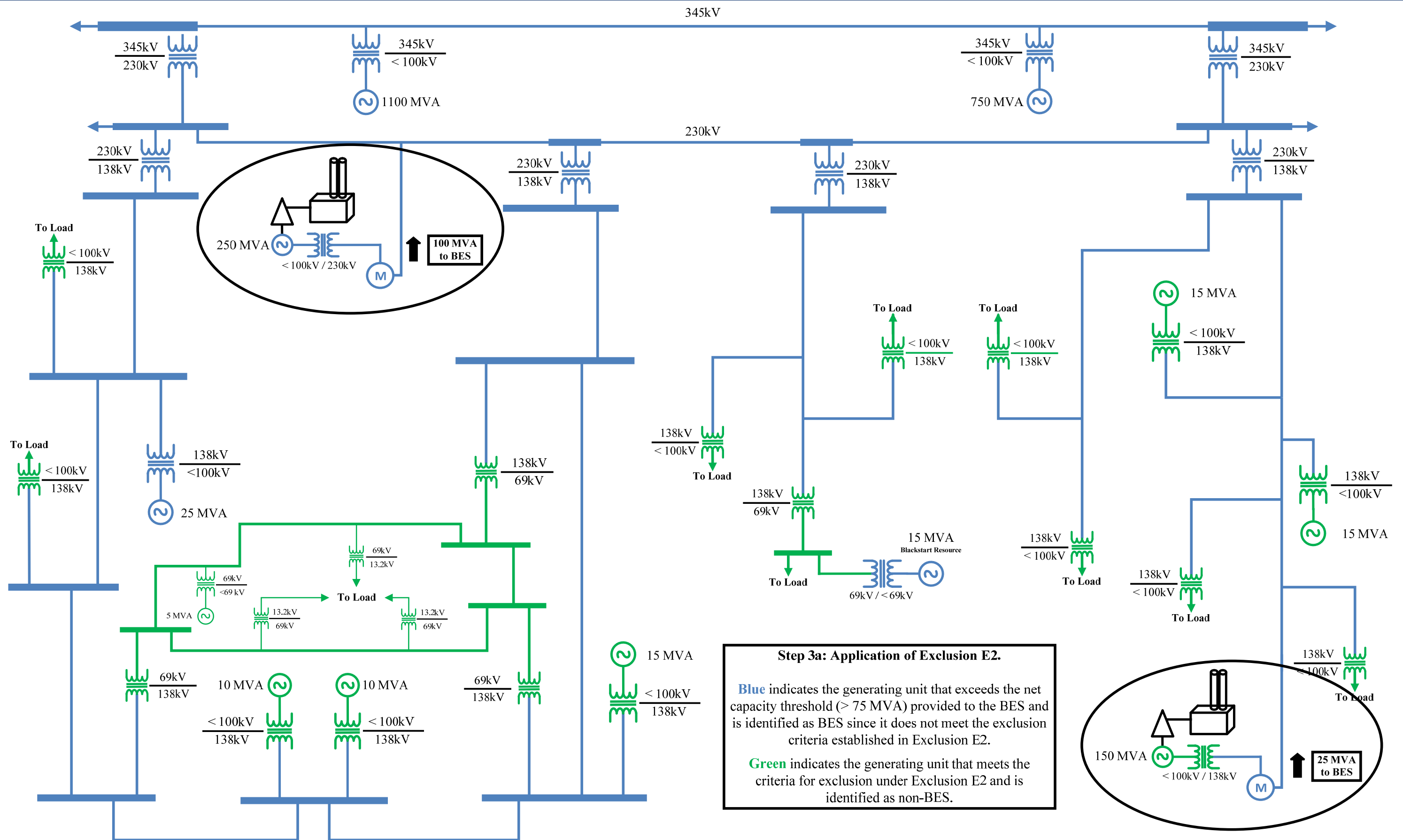


Figure S1-8: System Diagram – Application of Exclusion E2

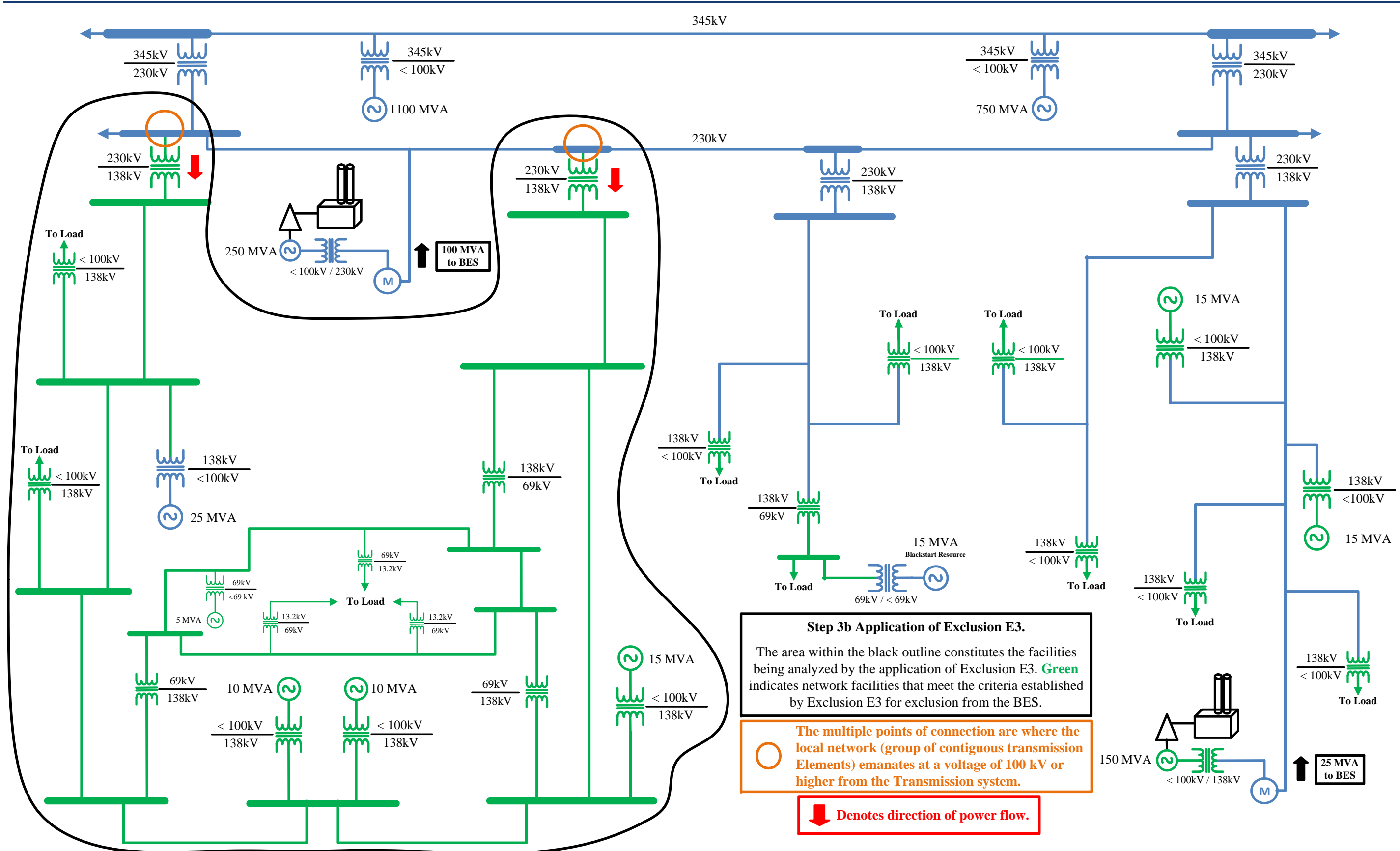


Figure S1-9: System Diagram – Application of Exclusion E3

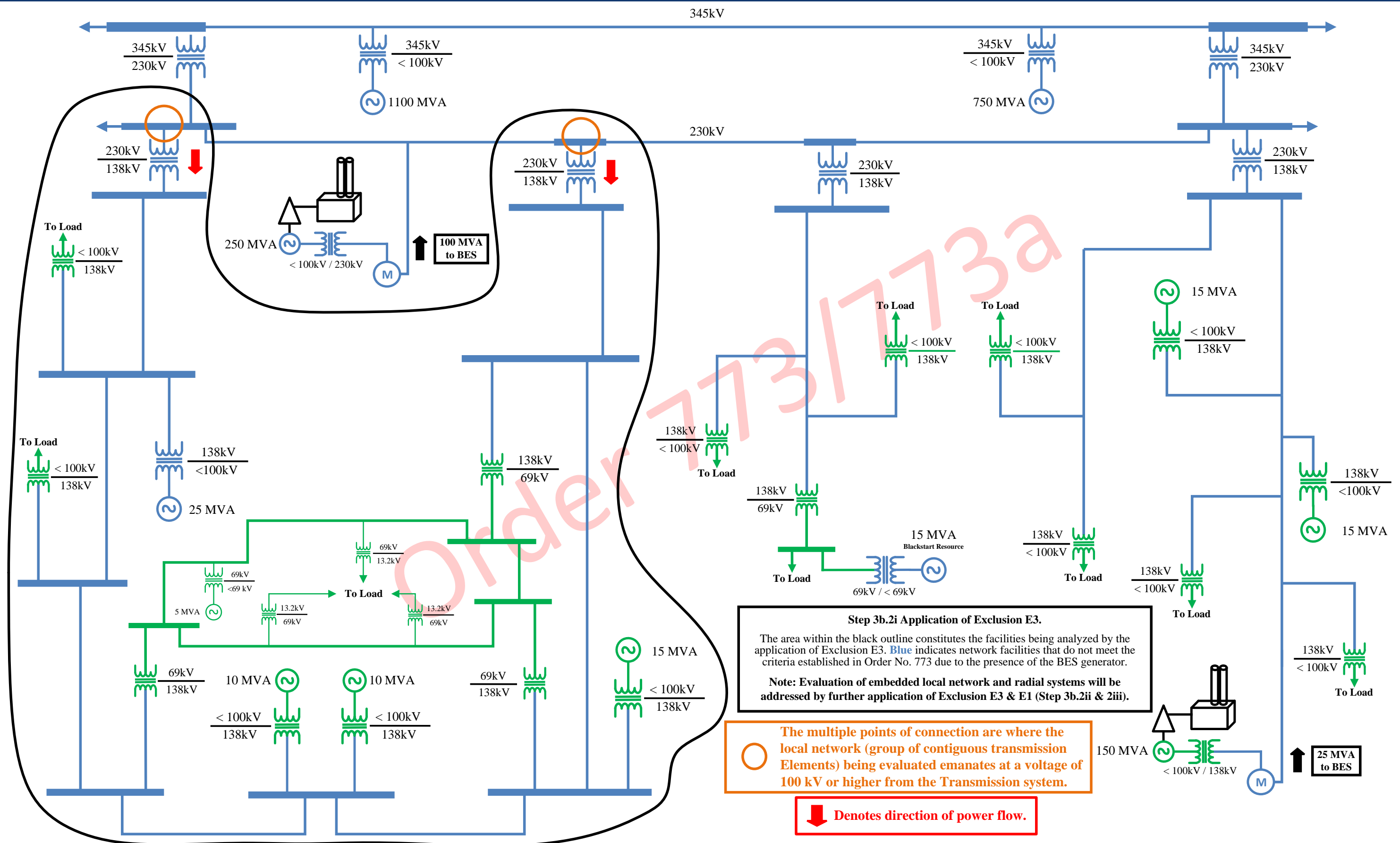


Figure S1-9a: System Diagram – Application of Exclusion E3 (Proposed Phase 2 Application)

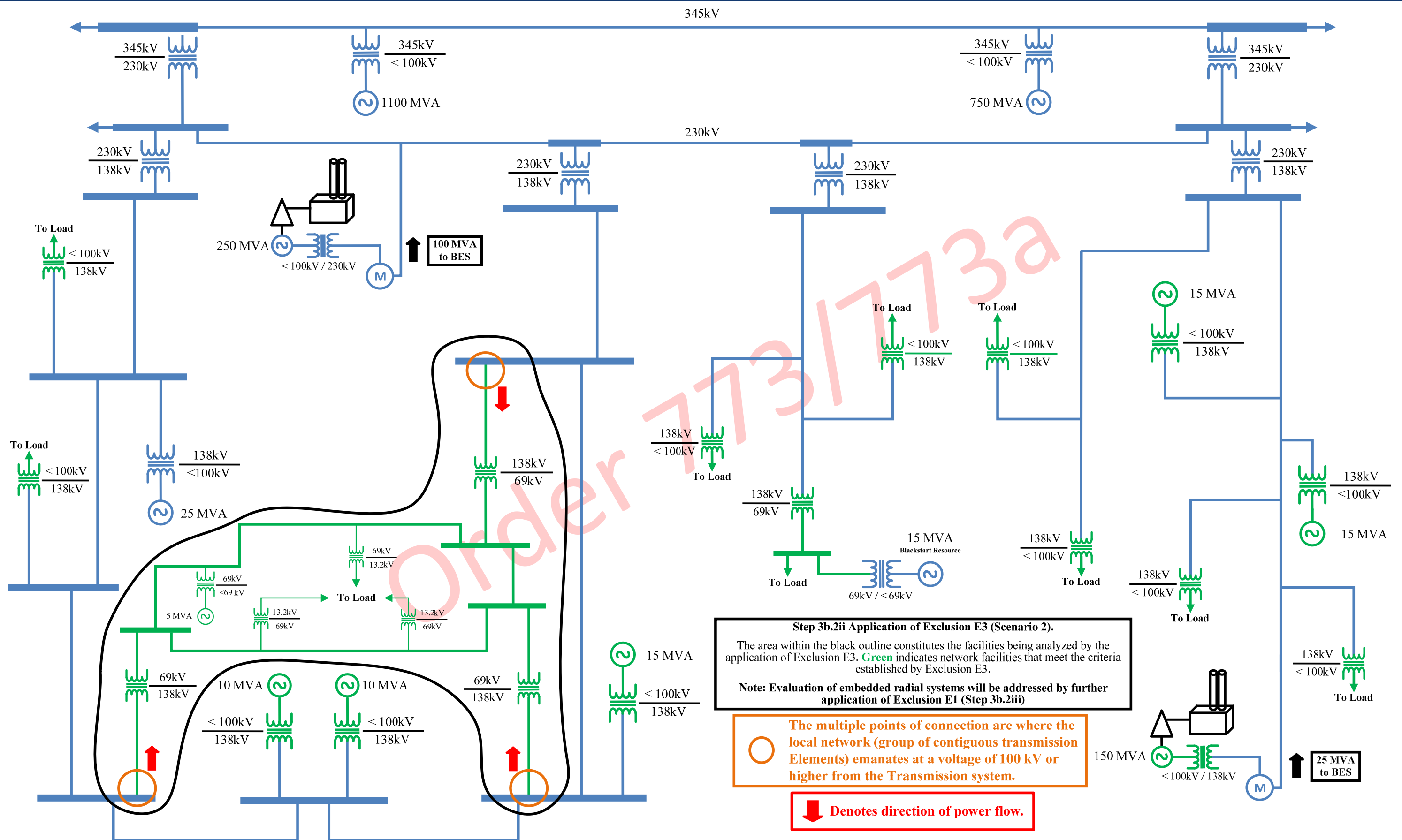


Figure S1-9b: System Diagram – Application of Exclusion E3 (Proposed Phase 2 Application)

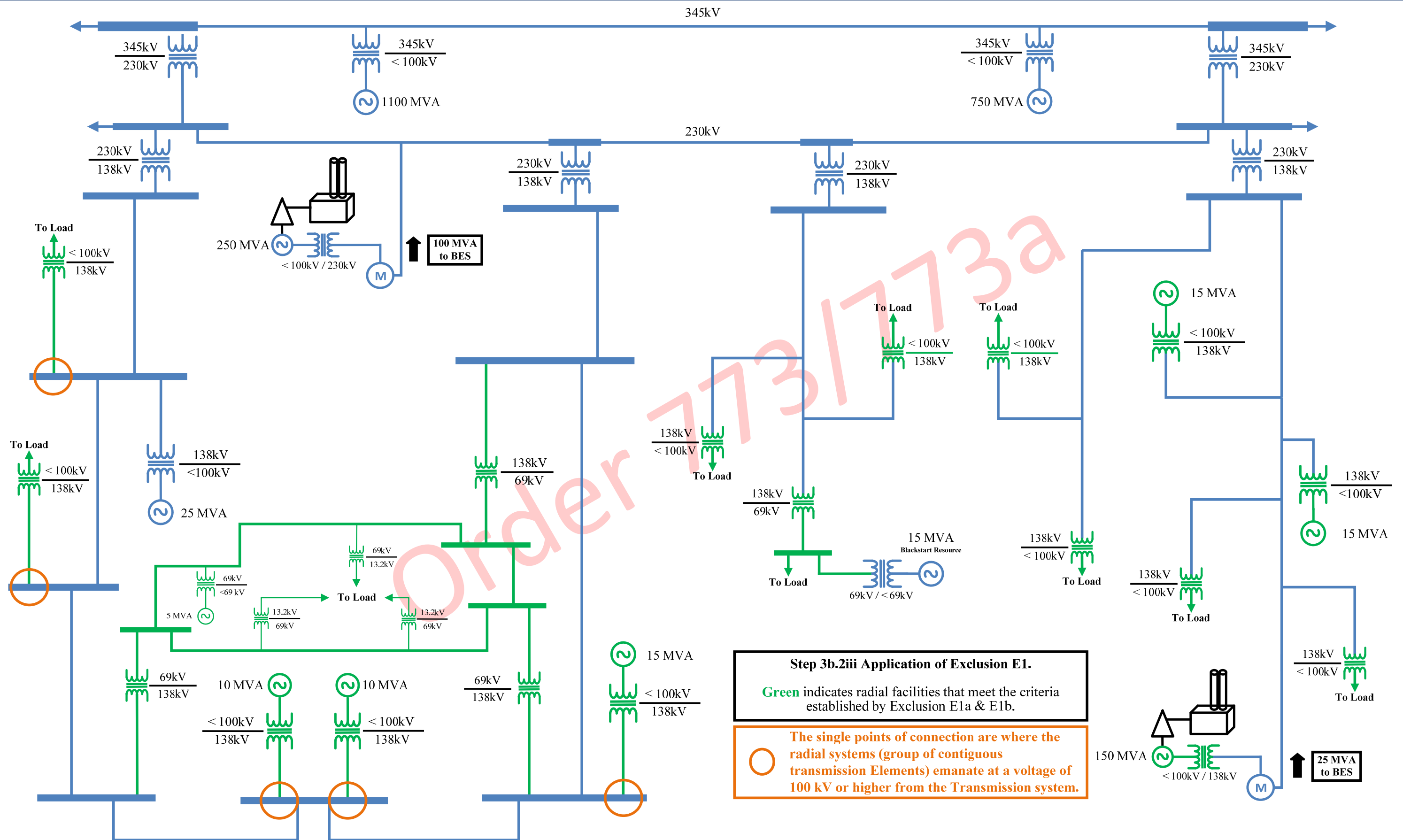


Figure S1-9c: System Diagram – Application of Exclusion E3 (Proposed Phase 2 Application)

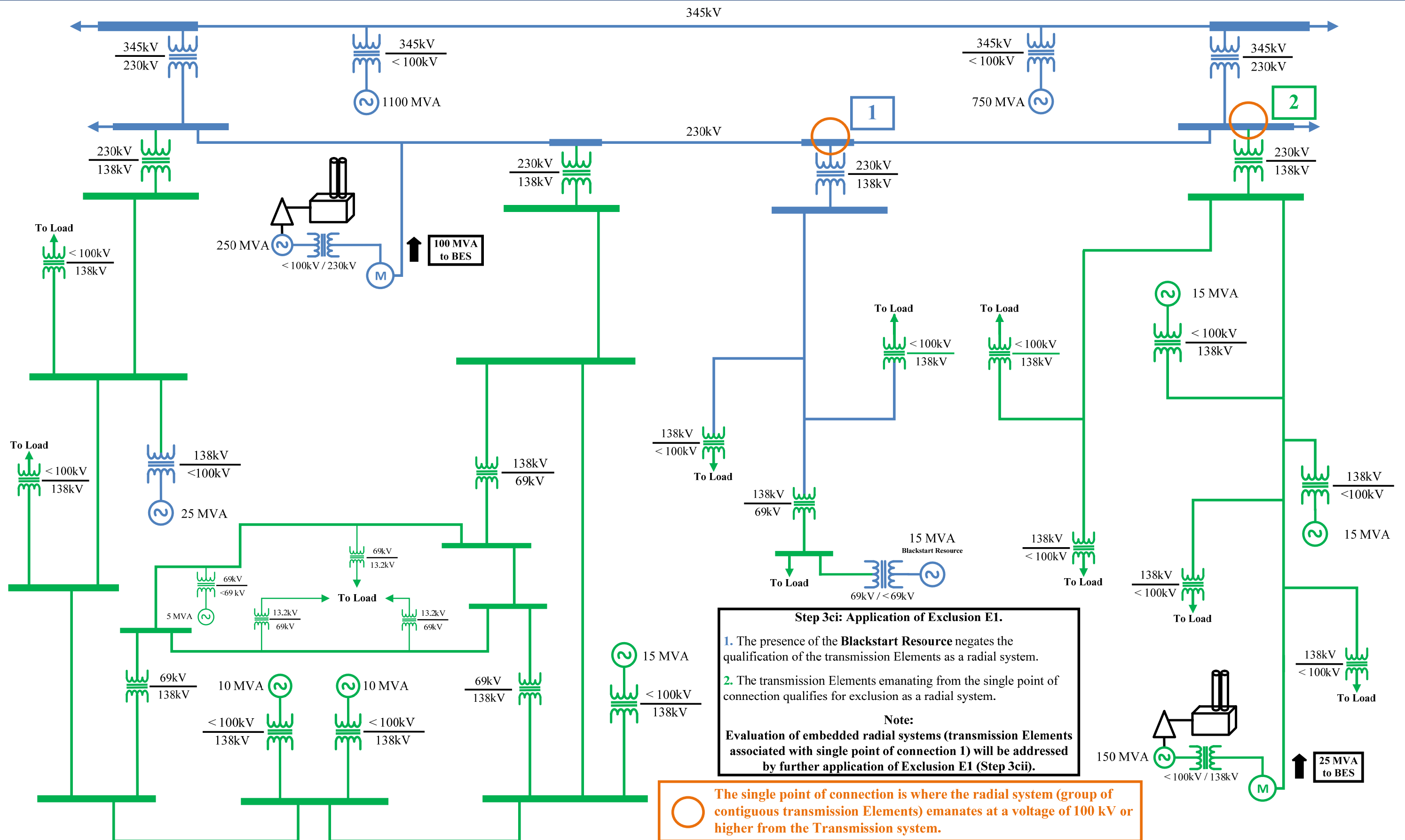


Figure S1-10: System Diagram – Application of Exclusion E1 (Part 1)

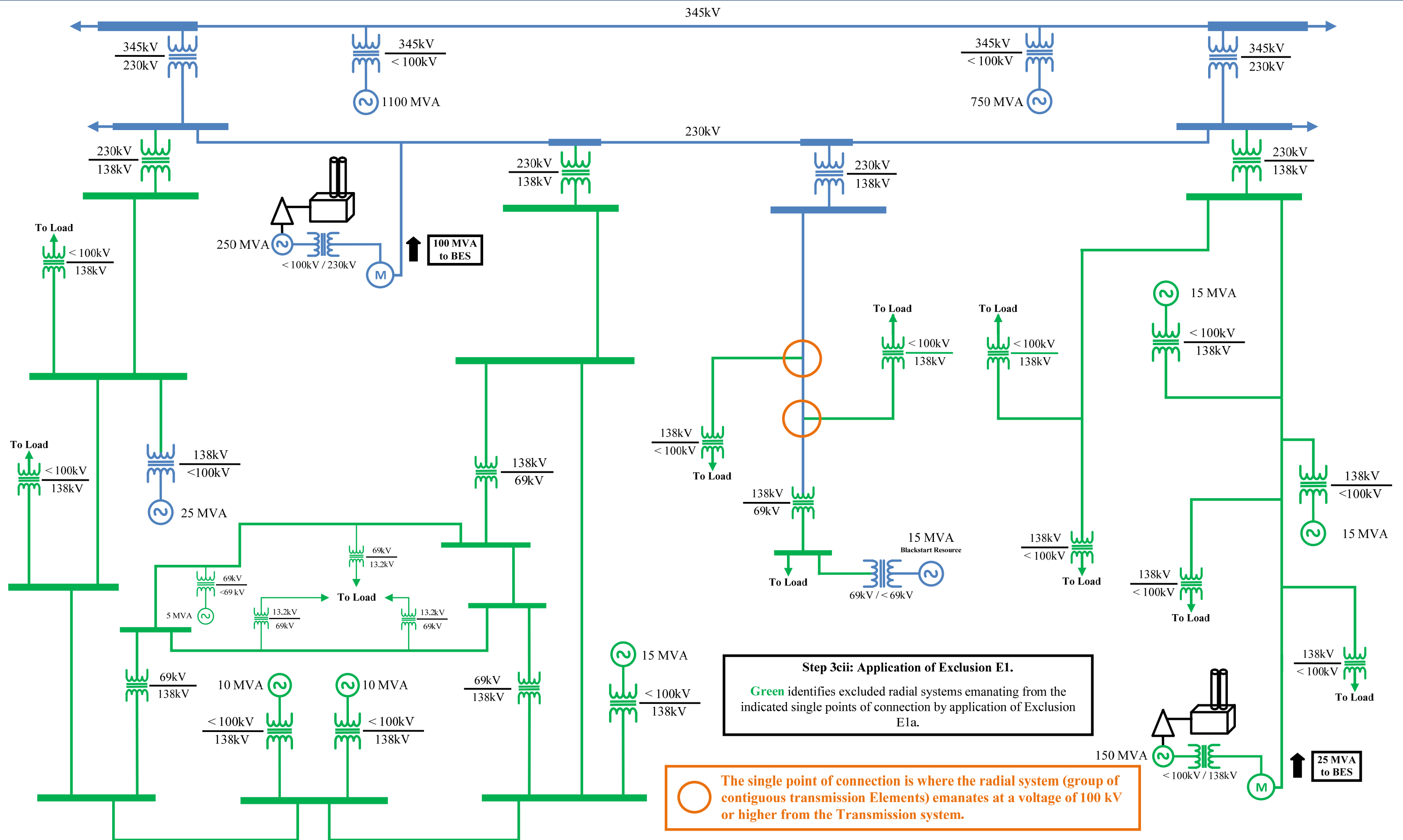


Figure S1-11: System Diagram – Application of Exclusion E1 (Part 2)

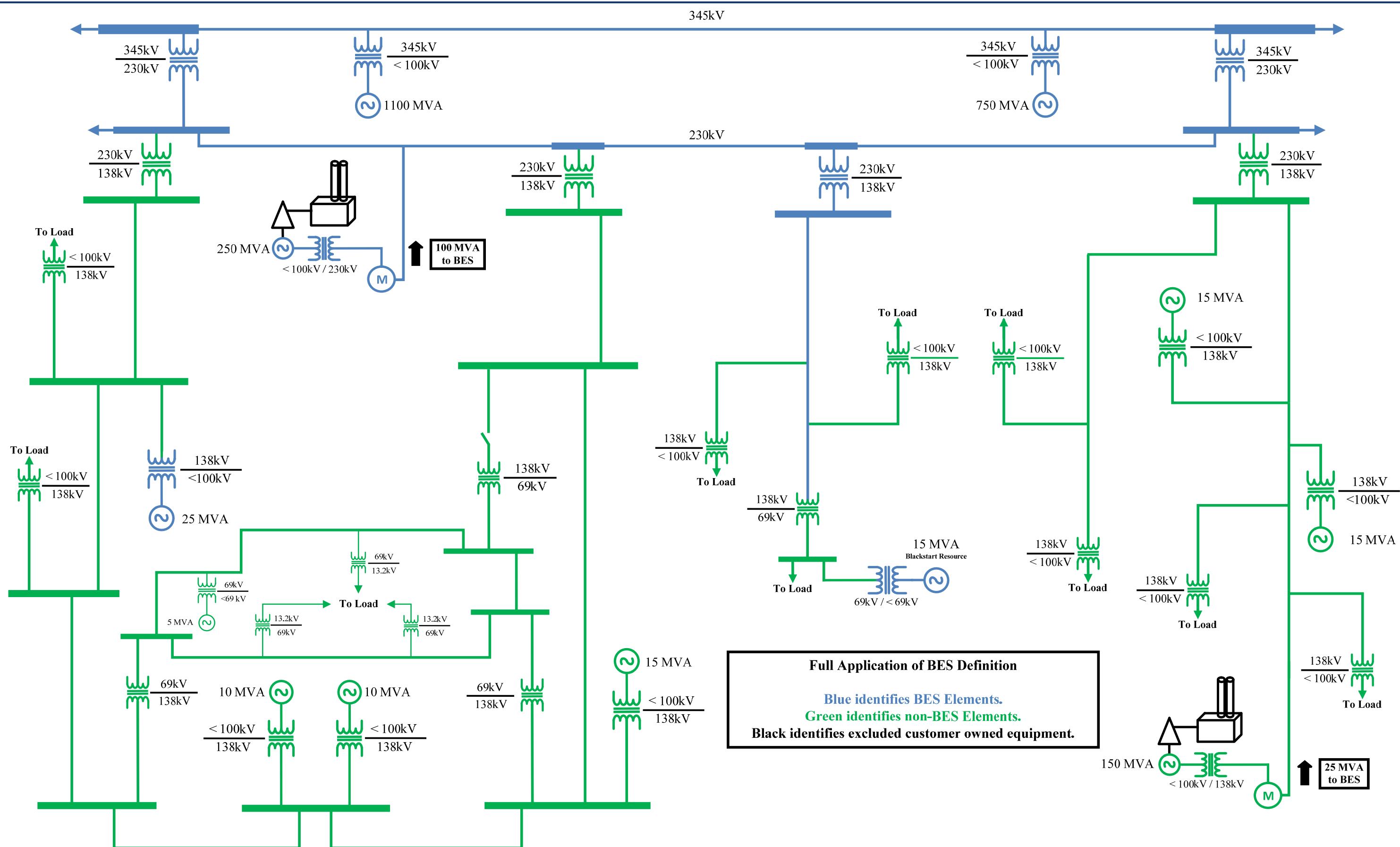


Figure S1-12: System Diagram – Full Application of BES Definition

V. Availability of Exception Process

In the event that the BES definition designates an Element as BES that an entity believes is not necessary for the reliable operation of the interconnected Transmission network or designates an Element as non-BES that an entity believes is necessary for the reliable operation of the interconnected Transmission network, the ERO Rules of Procedure exception process may be utilized on a case-by-case basis to either include or exclude an Element.

The exception process can be found in Section 5C of the ERO Rules of Procedure: “Procedure for Requesting and Receiving an Exception from the Application of the NERC Definition of Bulk Electric System.”