

Information documents are not authoritative. Information documents are for information purposes only and are intended to provide guidance. In the event of any discrepancy between an information document and any authoritative document<sup>1</sup> in effect, the authoritative document governs.

## 1 Purpose

This information document relates to the following authoritative documents:

- Section 304.8 of the ISO rules, *Event Analysis*;
- Section 502.1 of the ISO rules, *Wind Aggregated Generating Facilities Technical Requirements*;
- Section 502.2 of the ISO rules, *Bulk Transmission Line Technical Requirements*;
- Section 502.4 of the ISO rules, *Automated Dispatch and Messaging System and Voice Communication System Requirements*;
- Section 502.5 of the ISO rules, *Generating Unit Technical Requirements*;
- Section 502.13 of the ISO rules, *Battery Energy Storage Facility Technical Requirements*;
- Alberta Reliability Standard CIP-002-AB-5.1, *Cyber Security – BES Cyber System Categorization*;
- Alberta Reliability Standard CIP-003-AB-5, *Cyber Security – Security Management Controls*;
- Alberta Reliability Standard CIP-004-AB-5.1, *Cyber Security – Personnel & Training*;
- Alberta Reliability Standard CIP-005-AB-5, *Cyber Security – Electronic Security Perimeter(s)*;
- Alberta Reliability Standard CIP-006-AB-5, *Cyber Security – Physical Security of BES Cyber Systems*;
- Alberta Reliability Standard CIP-007-AB-5, *Cyber Security – System Security Management*;
- Alberta Reliability Standard CIP-008-AB-5, *Cyber Security – Incident Reporting and Response Planning*;
- Alberta Reliability Standard CIP-009-AB-5, *Cyber Security – Recovery Plans for BES Cyber Systems*;
- Alberta Reliability Standard CIP-010-AB-1, *Cyber Security – Configuration Change Management and Vulnerability Assessments*;
- Alberta Reliability Standard CIP-011-AB-1, *Cyber Security – Information Protection*;
- Alberta Reliability Standard EOP-001-AB1-2.1b, *Emergency Operations Planning*;
- Alberta Reliability Standard EOP-003-AB1-1, *Load Shedding Plans*;
- Alberta Reliability Standard EOP-004-AB-2, *Event Reporting*;
- Alberta Reliability Standard EOP-008-AB-1, *Loss of Control Centre Functionality*;
- Alberta Reliability Standard FAC-010-AB1-2.1, *System Operating Limits Methodology for the Planning Horizon*;
- Alberta Reliability Standard FAC-011-AB-2, *System Operating Limits Methodology for the Operations Horizon*;

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<sup>1</sup> “Authoritative documents” is the general name given by the AESO to categories of documents made by the AESO under the authority of the *Electric Utilities Act* and regulations, and that contain binding legal requirements for either market participants or the AESO, or both. Authoritative documents include: the ISO rules, the reliability standards, and the ISO tariff.

- Alberta Reliability Standard PER-003-AB-1, *Operations Personnel Credentials*;
- Alberta Reliability Standard PER-005-AB-2, *Operations Personnel Training*;
- Alberta Reliability Standard PRC-023-AB-2, *Transmission Relay Loadability*;
- Alberta Reliability Standard TPL-001-AB-0, *System Performance Under Normal Conditions*;
- Alberta Reliability Standard TPL-002-AB1-0, *System Performance Following Loss of a Single BES Element*;
- Alberta Reliability Standard TPL-003-AB-0, *System Performance Following Loss of Two or more BES Elements*;
- Alberta Reliability Standard TPL-004-AB-0, *System Performance Following Extreme BES Events*; and
- the ISO tariff.

The purpose of this information document is to provide market participants with clarity regarding the meaning of the radial circuit terms found in authoritative documents.

## 2 Radial Circuit Terms

The following terms are currently used in authoritative documents to refer to a “radial circuit”:

- radial bulk transmission line;
- radial connection;
- radial customers;
- radial line;
- radial transmission facility;
- radial transmission line;
- radial transmission system;
- radially connects;
- radially operated circuit; and
- transmission facility that radially connects.

The AESO plans to replace the terms listed above within the authoritative documents with the term “radial circuit” in due course.

## 3 Radial Circuit Definitions

### 3.1 ISO Tariff

The ISO tariff radial circuit definition came into effect on January 1, 2021.<sup>2</sup>

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<sup>2</sup> Approved by the Alberta Utilities Commission through Decision 22942-D02-2019, *AESO 2018 ISO Tariff Decision* on September 22, 2019 and Decision 25175-D02-2020, *2018 ISO Tariff Compliance Filing* on November 30, 2020.

As in effect and included in the AESO's *Consolidated Authoritative Document Glossary* for use in the ISO tariff, "radial circuit"

means an arrangement of contiguous system elements extending from a single system element on the networked transmission system in a linear or branching configuration to the facilities of one or more market participants, which is the only circuit for power to flow between the networked transmission system and the facilities of one or more market participants under normal operating conditions, including when the circuit is connected to another circuit through a switching device that is operated normally open.

### 3.2 Reliability Standards

The AESO refined the ISO tariff radial circuit definition to add clarity for market participants. The reliability standards radial circuit definition was approved by the Alberta Utilities Commission for use in the reliability standards and is now in effect.<sup>3</sup> In the AESO's view, the radial circuit definition is consistent with the ISO tariff radial circuit definition provided above. This radial circuit definition is provided below.

As in effect and included in the AESO's *Consolidated Authoritative Document Glossary* for use in the reliability standards "radial circuit"

means an arrangement of contiguous system elements energized at 50 kV or higher that:

- (a) extend from a system element on the networked transmission system in a linear or branching configuration;
- (b) connect to one or more of a load facility, a generating unit, or an aggregated generating facility; and
- (c) comprise the only circuit by which power can flow between the networked transmission system and the facilities identified in item (b) under normal operating conditions,

and includes an arrangement where the circuit energized at 50 kV or higher is connected to another circuit energized at 50 kV or higher, either through a switching device that is operated normally open or through facilities energized at less than 50 kV where the circuit would be a radial circuit if the connection did not exist.

Market participants can assume that the terms listed in section 2 and found in the reliability standards all have the meaning provided in this radial circuit definition.

### 3.3 ISO Rules

The AESO is consulting on the use of the reliability standards radial circuit definition in the ISO rules through its consultation on the proposed new Section 502.17 of the ISO rules, *Voice Communication System Requirements* ("Section 502.17"). When the AESO applies to the AUC for approval of Section 502.17, the AESO also plans to request AUC approval of the reliability standards radial circuit definition for use in the ISO rules. Until this occurs, market participants can assume that the terms listed in section 2 and found in the ISO rules all have the meaning provided in the reliability standards radial circuit definition.

## 4 Double-Radial Configuration in the ISO tariff

In addition to the above listed radial circuit definition, two circuits with the same termination points are also considered a type of radial circuit as set out in Section 8 of the 2020 ISO tariff, *Construction Contributions for Connection Projects*, which is currently in effect. The 2020 ISO tariff refers to this

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<sup>3</sup> Approved by the Alberta Utilities Commission through Decision 25702-D01-2020, *Approval of New and Amended Alberta Reliability Standard Definitions* on August 6, 2020.

configuration as a “double-radial configuration” for the purposes of connection project cost classification. Figure 3, found in section 5 below, includes an example of a configuration that would be referred to as a “double-radial configuration” in the ISO tariff.

A “double-radial configuration” is not considered a type of radial circuit for purposes of the ISO rules and reliability standards.

The AESO expects to address this discrepancy in the ISO tariff in the future by clarifying the terminology used to describe system-related and market participant-related costs. The AESO is also considering double radial configurations in the context of its upcoming response to the direction issued by the Alberta Utilities Commission, in Decision 22942-D02-2019, to work with legal owners of electric distribution systems to develop an objective set of criteria for the initiation of system transmission projects that reflects the Alberta Utilities Commission findings.<sup>4</sup>

## 5 Radial Circuit Examples

The transmission system configurations in this section are provided to help clarify the radial circuit definitions described in sections 3 and 4 above.

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<sup>4</sup> Decision 22942-D02-2019, paras. 607-608.

### 5.1 T-Tap Connected Circuit

Figure 1 shows a circuit that connects to the networked transmission system through a T-tap connection. In this example, this circuit is considered a radial circuit.

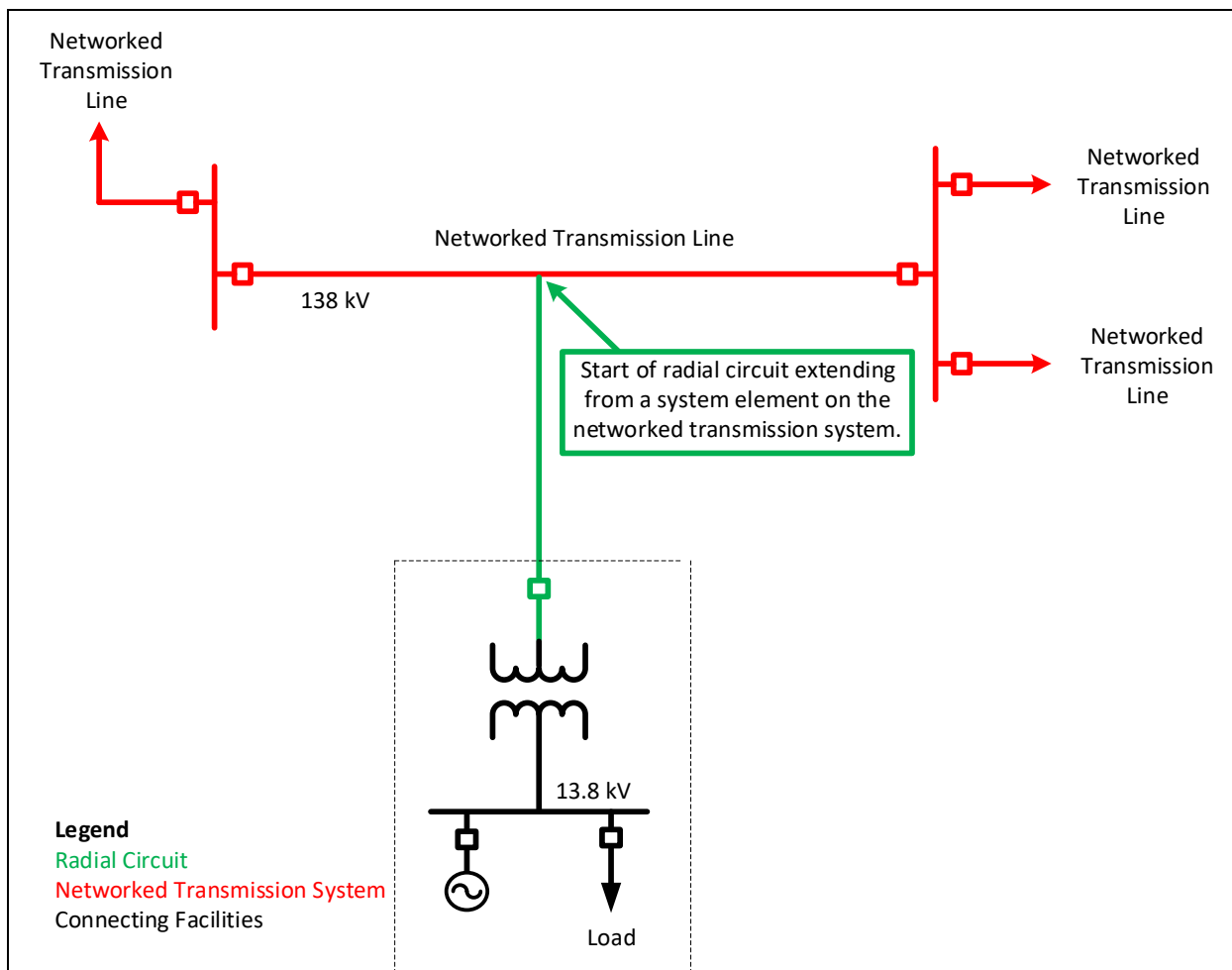


Figure 1: T-tap Connected Circuit

### 5.2 Two Circuits Connected through a Normally Open Breaker

Figure 2 shows two circuits that connect to separate sections of the same ring bus in a substation. The circuits are separated by a normally open bridging circuit breaker. As a result, each of the two circuits is considered a separate radial circuit.

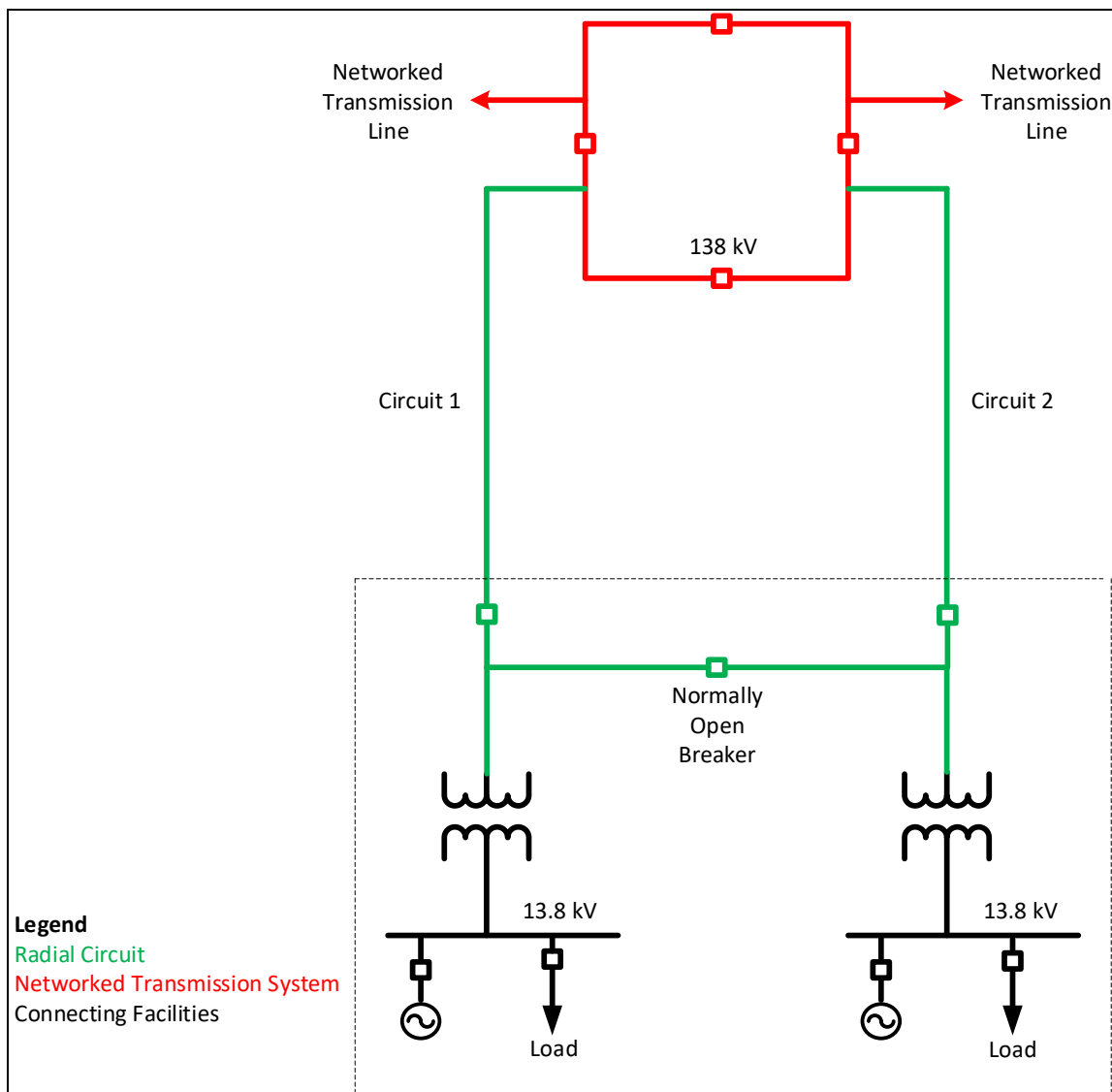


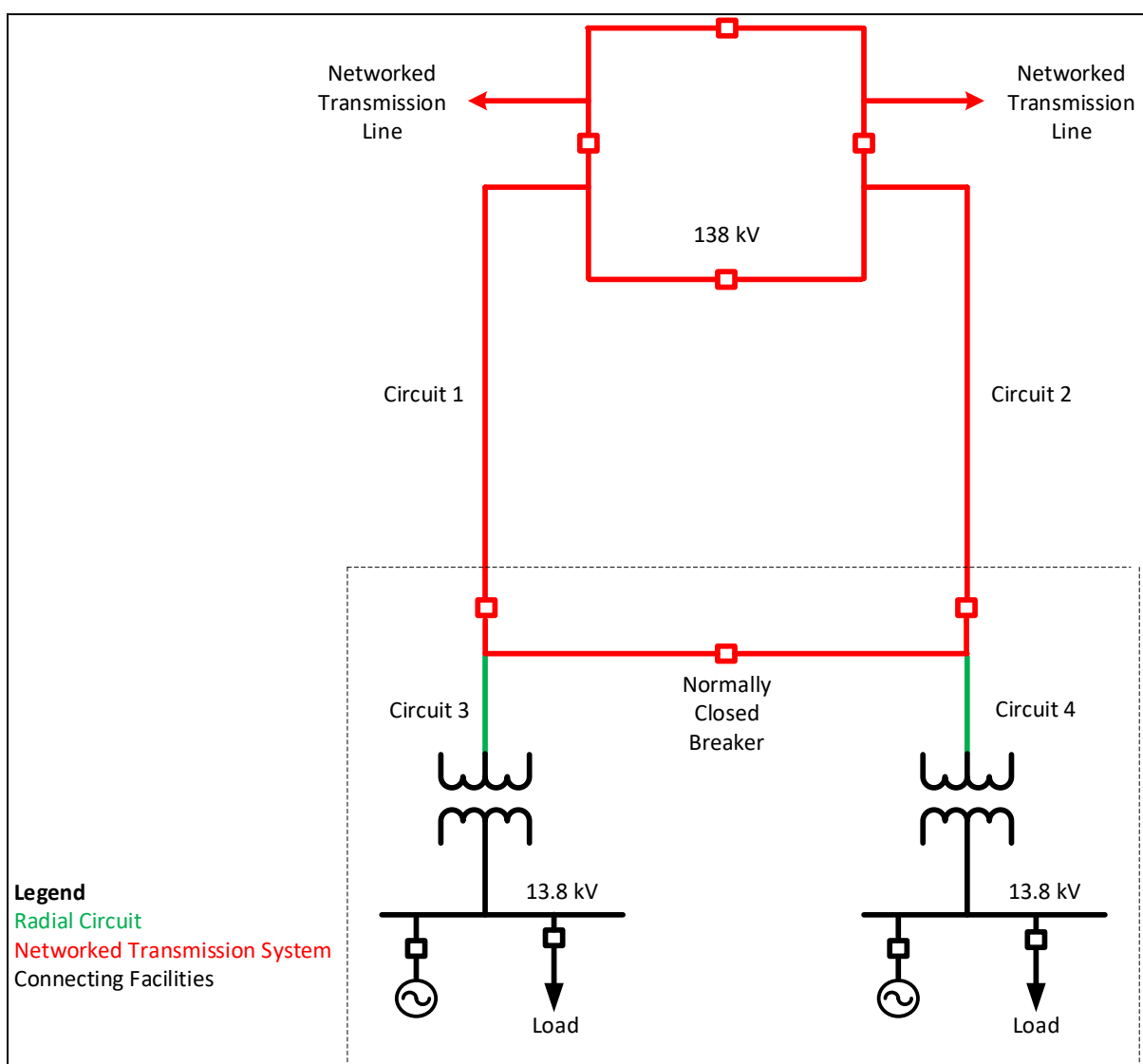
Figure 2: Two Circuits Connected through a Normally Open Breaker

### 5.3 Two Circuits Connected Through a Normally Closed Breaker

Figure 3 shows a configuration that has similarities to both Figures 1 and 2. Like Figure 2, Figure 3 shows two circuits that connect to separate sections of the same ring bus in a substation. However, in Figure 3 the circuits are connected by a normally-closed bridging breaker. As a result, Circuit 1 and Circuit 2 are not considered radial circuits.

For the purpose of the ISO tariff, Circuit 1 and Circuit 2 would be referred to as a “double-radial configuration”.

In addition, Figure 2 is similar to Figure 1 in that Circuit 3 and Circuit 4 are connected to the networked transmission system through a T-tap connection. As a result, Circuit 3 and Circuit 4 are considered radial circuits.



**Figure 3: Two Circuits Connected Through a Normally Closed Breaker**

#### 5.4 Two Circuits Connected Through a Normally Closed Low-voltage Breaker

Figure 4 shows a configuration that is similar to Figure 3. Like Figure 3, Figure 4 shows two circuits that connect to separate sections of the same ring bus in a substation. However, in Figure 4 the circuits are connected by a normally-closed bridging breaker on the low voltage-side, which is less than 50 kV. In alignment with the findings of NERC's *White Paper on Bulk Electric System Radial Exclusion (E1) Low Voltage Loop Threshold*,<sup>5</sup> the AESO assumes that the high-side circuits would not experience power flow reversal in the majority of cases that will be encountered in industry. Therefore, Circuit 1 and Circuit 2 are considered radial circuits in this example.

For the purpose of the ISO tariff, Circuit 1 and Circuit 2 would be referred to as a "double-radial configuration".

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<sup>5</sup> NERC, *White Paper on Bulk Electric System Radial Exclusion (E1) Low Voltage Loop Threshold*, September 2013, Available at: [https://www.nerc.com/pa/Stand/Project%20201017%20Proposed%20Definition%20of%20Bulk%20Electri/bes\\_white\\_paper\\_draft3\\_PUBLIC.pdf](https://www.nerc.com/pa/Stand/Project%20201017%20Proposed%20Definition%20of%20Bulk%20Electri/bes_white_paper_draft3_PUBLIC.pdf). Accessed: November 2, 2020.



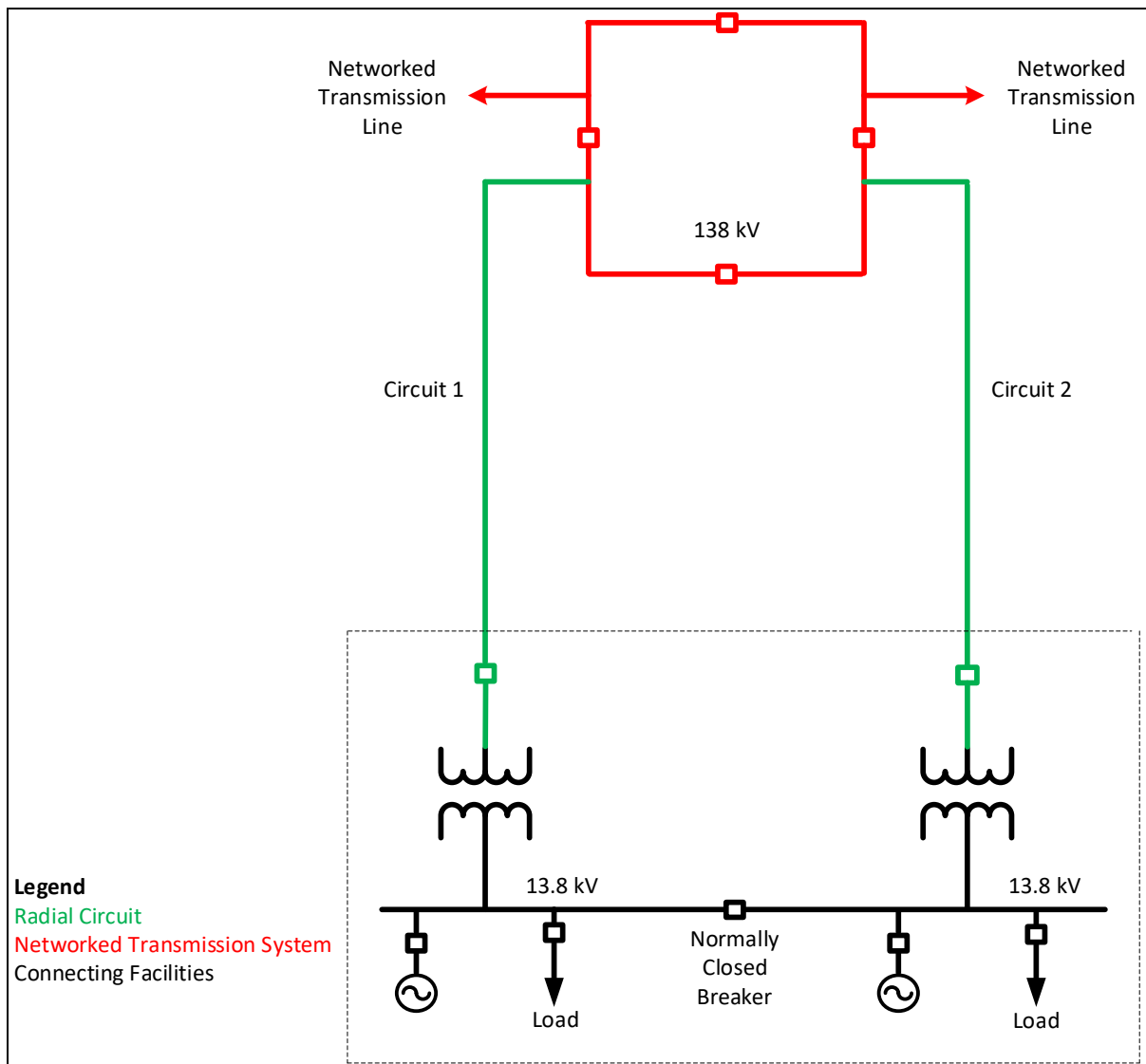


Figure 4: Two Circuits Connected Through a Normally Closed Low-voltage Breaker

**Revision History**

<b>Posting Date</b>	<b>Description</b>
2021-02-09	Updated Section 3 with the latest status on the ISO tariff and reliability standard radial circuit definitions. Minor editorial revision to section 5 to improve clarity.
2020-11-20	Updated Section 2 with the latest information on the radial circuit definition approved for use in the reliability standards and proposed for use in the ISO rules. Updated Section 4 to provide added detail. Added Section 5 to provide radial circuit examples for market participants. Minor editorial made throughout the document to improve clarity.
2020-06-08	Updated with latest information on the ISO tariff radial circuit definition. Added the radial circuit definition proposed for use in the reliability standards. Provided clarity regarding the current use of “double radial configurations” in the ISO tariff. Updated document to align with the latest AESO drafting practices.
2017-06-15	Initial release