# Anti-Islanding for Transmission Connected Resources

## Assessment Guideline

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# Executive Summary

## Purpose and Scope

The AESO has developed the Anti-islanding Assessment guideline to address emerging reliability challenges in Alberta Interconnected Electric System (AIES). This guideline:

- Addresses challenges unintentional islanding of transmission-connected resources poses to grid reliability
- Defines a standardized approach for anti-islanding assessments, including methodology, inputs, assumptions, performance criteria, reporting requirements and mitigation options
- Helps market participants (MPs) understand the requirements for connecting their facilities to the transmission system

## Rationale

Unintentional islanding can create several grid reliability challenges including:

- Abnormal voltage and frequency excursions
- Safety risks
- Asynchronous reclosing
- Protection misoperation

## Performance Criteria

- The AESO does not permit connection projects to operate in unintentional electrical islands
- Connection projects are required to perform an anti-islanding assessment and, where necessary, implement appropriate anti-islanding schemes

## Application

Anti-islanding requirements will be specified in the functional specification (FS). MPs are expected to apply this guideline when conducting and submitting the required assessments before energizing their facility.

# 1. Anti-Islanding Introduction

## 1.1 Background

The anti-islanding assessment for unintentional islanding of transmission-connected resources is not a new requirement and has been included in the AESO's functional specifications for connection projects for several years. This guideline is intended to outline how the assessment should be conducted to ensure consistency and transparency. The anti-islanding requirement is not included in any AESO Authoritative Document.

This guideline was developed to educate stakeholders about why an anti-islanding assessment is required and how a project will be assessed through a standardized approach. It provides transparency and guidance on how the responsible entity should conduct the applicability, pre-screening, screening and detailed study, and provide the detailed study report to the AESO, demonstrating adherence to the requirements in the AESO's functional specification, found in Appendix A.

This guideline is not authoritative and for information purposes only.

Islanding refers to a condition in which a portion of the electric system, containing both load and generation, becomes electrically isolated from the rest of the system while continuing to operate. Unintentional islanding is considered undesirable for the following reasons:

- Abnormal voltage and frequency excursions outside acceptable operating limits may occur, resulting in power quality issues and potential damage to facilities
- Safety risks may arise if a portion of the electric system remains energized by islanded operation, as personnel may perform work under the assumption that the system has been fully de-energized
- Asynchronous reclosing of an island to the interconnected electric system may cause damage to generating facilities, particularly rotating machines
  - Out-of-synchronism reclosing can result in large current and torque transients and may also lead to unintended operation of protection systems, potentially causing broader system disturbances
- Protection system performance and security may be compromised, as protection schemes are generally not designed to reliably detect and clear faults under unintentional islanding conditions

Given these risks, the AESO does not permit connection projects to operate in unintentional electrical islands. Accordingly, connection projects are required to perform an anti-islanding assessment and, where necessary, implement appropriate anti-islanding schemes.

Intentional islanding is outside the scope of this guideline and is addressed separately under the AESO's blackstart planning and system restoration plans. Anti-islanding schemes are expected to mitigate the risks of unintentional islanding during normal system operation for applicable islanding scenarios. During blackstart and system restoration activities, these schemes may be temporarily disabled to facilitate intentional islanding operation and subsequently enabled upon the return to normal system operation.

## 1.2 Roles and Responsibilities

This section outlines the high-level roles and responsibilities of various tasks in the study. All the parties can reach out AESO's project manager for details.

### Table 1: RACI Chart for System Restoration Cranking Path Assessment

**Note: R** – Responsible; **A** – Accountable; **C** – Consult; **I** – Inform

| Deliverable | AESO | Transmission Facility Owner (TFO) * | Generation Facility Owner (GFO) * | Market Participant (MP) |
|---|---|---|---|---|
| **Applicability and Pre-Screening**<br>(Earliest Connection Process Stage: Stage 1) | | | | |
| Identify if the anti-islanding assessment applies to connection project based on the applicability criteria and if so, include anti-islanding assessment requirement in functional specification | A, R | I | I | I |
| Identifies transmission system topologies that could result in an island of the connection project with part of the AIES | C | R | I | I |
| **Mitigation**<br>(Earliest Connection Process Stage: Stage 3) | | | | |
| Include the mitigation (anti-islanding scheme [AIS]) in the functional specification | A, R | C | C | C |
| **Energization Authorization**<br>(Earliest Connection Process Stage: Stage 5 and 6) | | | | |
| Proof of mitigation installation (if specified in Functional Specification [FS]): written confirmation to the AESO that AIS is active and enabled in the field, as built logic diagram | C | R | A | A |
| Accept the deliverables | A, R | C | C | C |

Note:

**Responsible (R)** = “the doer”. Those who do work to achieve the task. There can be multiple resources responsible. The act of approving a deliverable can be categorized under the responsible party.

**Accountable (A)** = “the buck stops here”. The resource ultimately answerable for the correct and thorough completion of the task There can only be one “A” specified for each task.

**Consulted (C)** = “in the loop”. Those whose opinions are sought. Those who have special knowledge or expertise needed to make decisions or solve problem. Two-way communication.

**Informed (I)** = “in the picture”. Those who are kept up to date on progress and decisions (once made). May be impacted by decision but are not active in final decision. One-way communication.

* If the connecting facility is owned by the TFO or GFO, they will retain their designated roles in this RACI chart and assume the responsibilities assigned to the MP, as they are acting as the owner of the connecting project.

## 1.3 Applicability

This guideline applies to projects including:

- Transmission-connected generation projects

This guideline does not apply to distributed energy resources (DERs). The AESO will continue to apply the DERs anti-islanding screening and study guideline for applicable DERs in the connection process.[1]

## 1.4 Pre-Screening

In this assessment, the TFO identifies all transmission system topologies (N-1 and N-1-1)[2] that could result in an island of the connection project with part of the AIES. System reconfiguration or sectionalization may be required to open additional lines as a result of an N-1 outage to manage system reliability in operations. Such configurations are also included based on operational practices. If the identified islanding scenarios can be mitigated by a solution already existed, the TFO can include the information as the result of screening.

The AESO will then review the identified islanding scenarios and confirm them in consultation with the TFO.

## 1.5 Mitigation Implementation

The AESO will update the functional specification to include the appropriate mitigation, which is the AIS, also known as direct transfer trip (DTT) for the identified islanding scenarios. The responsible entities (TFOs and MPs) will be responsible to implement the mitigation.

It should be noted that the AESO does not allow the use of passive or active islanding detection schemes for transmission-connected facilities.[3] This is because:

[1] Refer to this webpage for the latest version: https://www.aeso.ca/grid/grid-related-initiatives/distributed-energy-resources/der-roadmap-integration-papers/.
[2] In general, the definition of N-1 and N-1-1 contingencies follow categories B and C in the TPL-001-AB-0 Appendix 1 or P1 and P6 in near future TPL-001-AB-5.1 Table 1.
[3] Refer to the AESO’s DER Anti-islanding Screening and Study Guideline for details on passive and active schemes.

- Active schemes may cause instability or power quality issues on the transmission system in certain conditions such as weak grid.[4, 5, 6]
- Passive schemes, including frequency, voltage, rate of change of frequency (RoCoF) and phase shift, could be sensitive to system condition (e.g., generation/load profile) at the time of connection study and may not be effective considering future system changes and/or addition of other facilities
- Per the AESO's experience and observations from other jurisdictions' disturbance events such as California and Electric Reliability Council of Texas (ERCOT), the passive schemes are prone to the risk of misoperation causing plant tripping in system-wide frequency events or transmission faults
  - Plant tripping, especially for large-size plants connected to the transmission system, may cause significant reliability risks on the bulk power system operation leading to the risk of under-frequency load shed or cascading outages

## 1.6 Energization Requirements

The AESO authorizes the project to connect to the AIES and achieve energization when the project meets all the AESO's energization checklist requirements, outlined in the 100-day and 30-day energization packages. The AESO encourages the MP to check with AESO's project manager to fully understand how to meet the energization requirements. If a mitigation is included in the project functional specification, then the proof of installation in the form of applicable single-line diagram (SLD) and other relevant documentation should be submitted and shared with the AESO for the records as part of the Stage 5, 100-day energization package and post-energization package.

[4] North American Electric Reliability Corporation (NERC) Reliability Guideline, "BPS-Connected Inverter-Based Resource Performance", September 2018; available at: https://www.nerc.com/comm/RSTC_Reliability_Guidelines/Inverter-Based_Resource_Performance_Guideline.pdf.

[5] NERC Disturbance Report, "2023 Southwest Utah Disturbance", August 2023; available at: https://www.nerc.com/globalassets/our-work/reports/event-reports/nerc_2023_southwest_ut_disturbance_report.pdf.

[6] "IEEE Standard for Interconnection and Interoperability of Inverter-Based Resources (IBRs) Interconnecting with Associated Transmission Electric Power Systems," in IEEE Std 2800-2022, vol., no., pp.1-180, 22 April 2022, doi: 10.1109/IEEESTD.2022.9762253.

# Appendix A: GRIP Overview

## Introduction

The Alberta Interconnected Electric System (AIES) is undergoing a period of grid transformation driven by multiple factors, including the increasing integration of inverter-based resources (IBRs) such as wind and solar, changes in system topology, and evolving operating conditions. Collectively, these factors present the following challenges to the Alberta Electric System Operator (AESO):

- High penetration of IBRS, which can reduce system capability to manage and maintain frequency stability, system strength and operational flexibility
- Restrictions on the availability of reliability support through interties due to weak connectivity with the Western interconnection, where excessive reliance on external resources increases the risk of intertie tripping
- Increasing operational limitations associated with newly energized facilities
- An increase in reliability-related phenomena observed during real-time operations

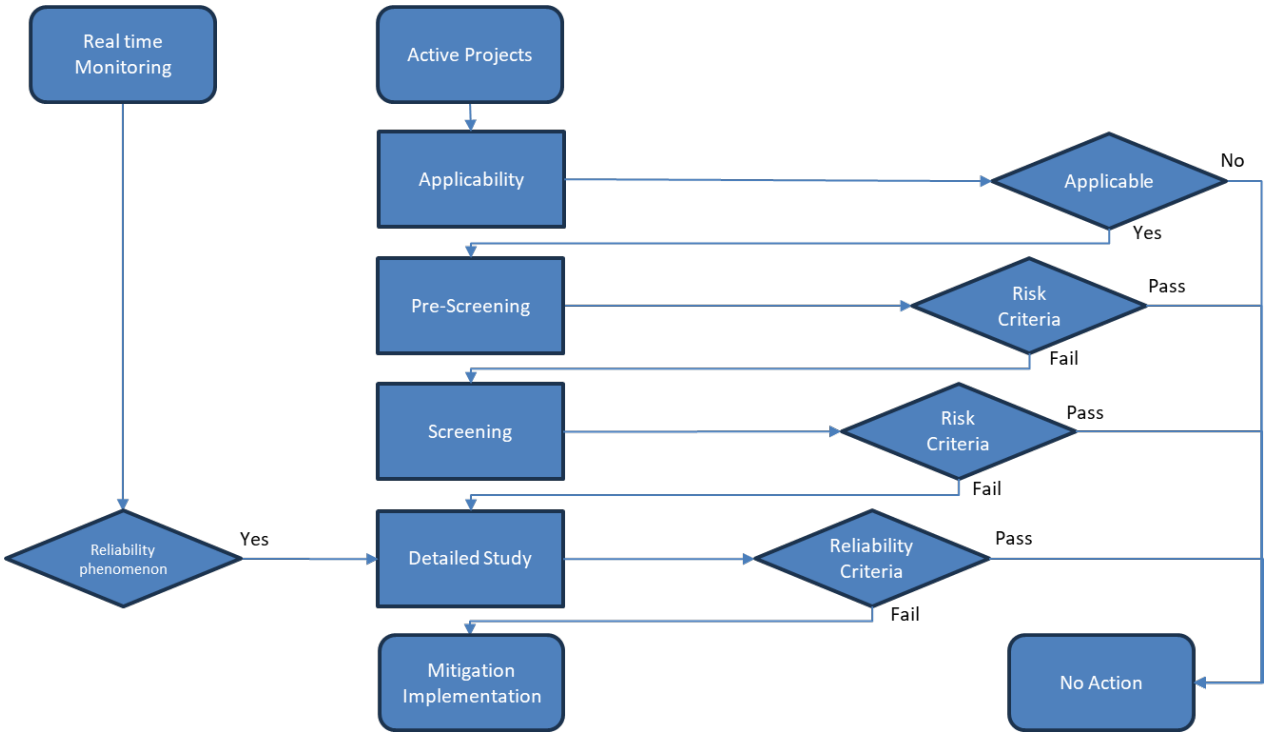
As a result of these emerging AIES reliability challenges, the AESO has identified several areas where performing Grid Readiness, Integration and Performance (GRIP) Requirements would be beneficial. System reliability, due to issues/reasons mentioned in the next section, is also heavily dependent on how market participants (MPs) conduct technical assessments and design their facilities to meet connection requirements prior to energization. Therefore, we have created standard guidelines on how to conduct GRIP. We have adopted a risk-based approach, which considers the risk to the reliability of the AIES using project information, beginning with high-level screening assessments for all active connection projects and, where necessary, proceeding to more detailed studies. These studies may identify potential mitigation measures to be implemented during the connection process. This approach seeks to balance moving efficiently through the connection process with the due diligence required to ensure system reliability.

## AESO's Risk-Based Assessment Approach

The AESO's process for GRIP uses a risk-based framework, as shown in Figure A1, which consists of:

- Applicability
- Pre-screening
- Screening
- Detailed study, report and submission
- Result acceptance
- Mitigation implementation

## Figure A1: Risk-Based Assessment Approach




The phases of this process occur at different points throughout the AESO's Connection Process. For topics related to AESO Authoritative Documents, MPs are responsible for completing applicability, pre-screening and screening steps independently, and are encouraged to use the approach and methodology outlined in this guideline. In all other cases, the AESO will conduct these initial steps. These steps will determine whether a facility requesting system access can be excluded from further analysis or requires further study as a high-risk project. Projects identified as high risk will result in the AESO including a detailed study requirement in the project's functional specification. This guideline provides additional details on the recommended approach for conducting those detailed studies. Upon receiving the detailed study, the AESO will work with MPs to review and comment on the report in accordance with this guideline. The AESO may revise project's functional specification if the report results in changes to a project's scope of work.

*Applicability*

The objective of applicability phase identifies projects requiring further assessment using applicability criteria by the AESO based on accessible project information available early in the customer connection process such as facility type and technology.

*Pre-Screening*

The objective of pre-screening is to assess whether a project qualifies as high-risk. Projects are identified as high-risk, based on identified islanding scenarios, move directly to the mitigation stage.

*Screening*

Screening is not applicable to this guideline because all credible islanding scenarios identified in the pre-screening must proceed directly to the mitigation phase.

*Detailed Study*

A detailed study is not applicable to this guideline as all credible islanding scenarios identified in pre-screening must directly proceed to the mitigation phase.

*Mitigation*

The pre-screening may identify a reliability issue. When this occurs, the AESO will assess connection alternatives and propose mitigations and the project functional specification will be revised to reflect the required mitigations, as applicable. Deliverables related to anti-islanding mitigations shall be submitted prior to the project energization, preferably 100 days prior to the project energization and must be accepted to achieve project energization. Details of the AESO's approach are presented in the following sections.

*Result Acceptance*

If required by the AESO, the responsible entity or entities must submit the proof of implementation of the mitigation solution, which must be accepted by the AESO before the in-service date of project. The AESO will review the submission promptly and may provide comments, requesting the responsible entity to respond prior to our acceptance. Any delay on the submission may result in a delay in project energization.

It is important to note that this guideline is meant to assist the AESO in understanding and mitigating the risks to reliability of the AIES. This risk-based assessment is not conclusive and if the reliability phenomenon is observed in real-time, we will work with the MP on real-time mitigation measures. Furthermore, project changes, accepted through the AESO's Project Change Proposal process may trigger the need for additional applicability, pre-screening, and mitigation.

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