Update on Capacity Constraints with Distribution System

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Committed to Connecting Renewables

- We know generators rely on us to manage our obligations in a manner that brings certainty to the timing of their projects.
- We understand that what we do and when we do it can have financial implications for generators. We will continue to work with generators to identify their issues proactively on technical solutions.
- As stewards of the Province's transmission and largest distribution system, we must identify solutions that ensure power quality and protect the integrity and reliability of the system for everyone in Ontario.

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Renewable Connections: Status 2010

- Hydro One has connected 112 generators to its distribution system totaling 377 MW and has more than 500 MW of RESOP contracted generation which the Company expects to connect in 2010.
- The Company has connected more than 5,500 MW of new generation to the transmission system since 2004 and in addition, there is almost 2,500 MW committed for connection to transmission.
- 1900 MW is renewable wind and hydro.

Agenda for Today

1. Overview of Capacity Challenges facing Hydro One and plans to manage issues
   - Feeder Distance Limitation
   - Short Circuit
   - Dual Windings Transformers
2. Q and A Session

Challenges with Capacity

- Capacity is fluid, not static
  - System load is continually changing, new generation outside of FIT
- Newly connected renewable generator sites are uncovering unforeseen impacts to the grid system
  - Long Feeder, Short Circuit Considerations, Transformer Limitations
- Objective is to balance requirement to protect the performance and reliability of the system with the objective to accommodate new renewable sources of generation
  - Required to ensure that new renewables can be connected in a way which does not adversely impact load customers
  - In everyone's best interests to ensure that new renewable generation is viewed by broader public as a reliable source of energy

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Hydro One Experience - Long Feeders

Presentation Overview

- Background
- Identify the developments
- Implications of a new consideration for long feeders
- Impact on Distribution Availability Test

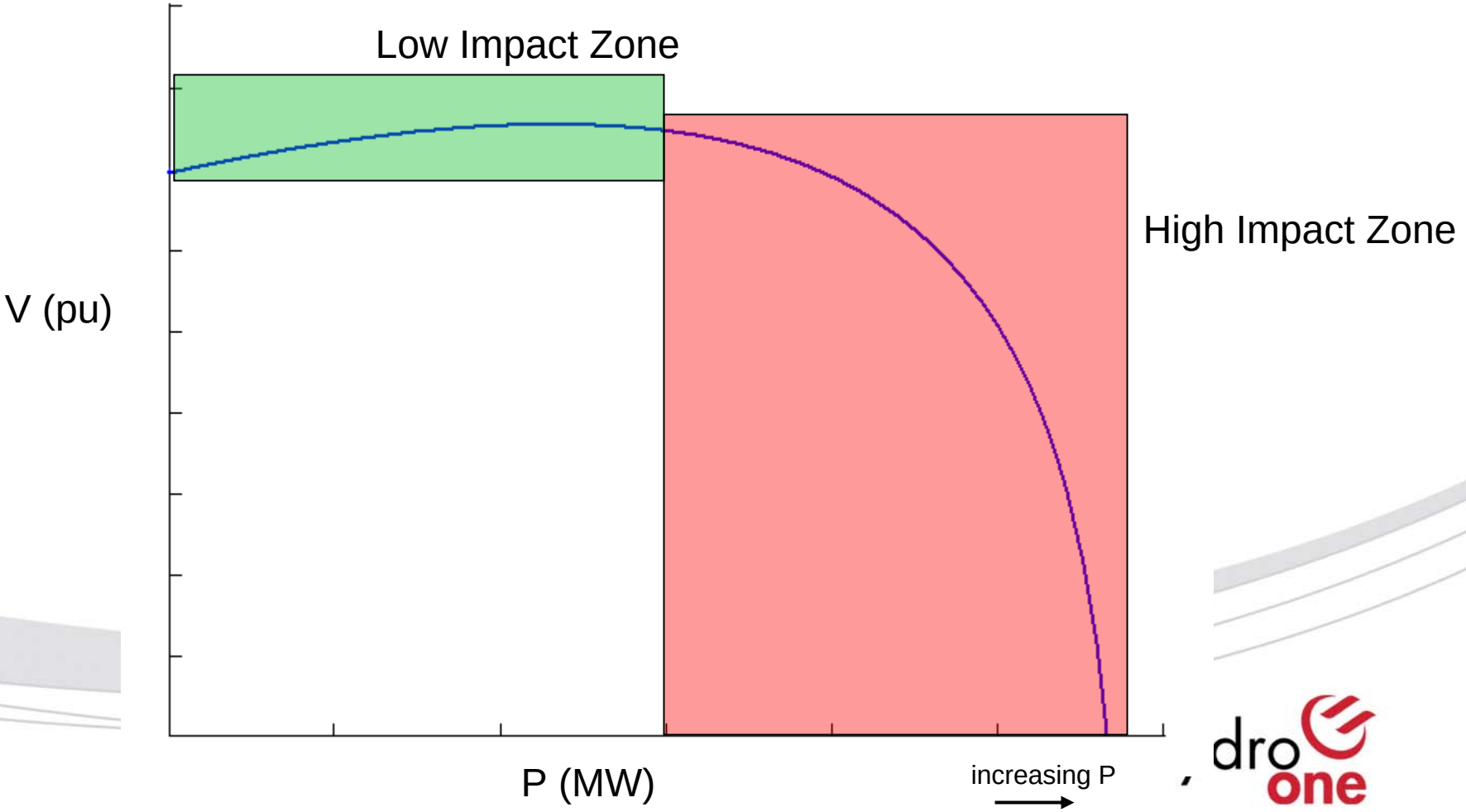
Background

- Connecting generators to distribution is a new experience:
  - Generation connected to long feeders
  - Short circuit considerations
  - Transformer station capacity
- Comparison with other jurisdictions
  - This is a learning experience for all

Hydro One Distribution Experience With Long Feeders

- As the distance of the connection point from the station increases, voltage becomes more sensitive to changes in injected power
- Large generators far from the station can have a significant impact on voltage levels in the vicinity of the connection as their power injection fluctuates
- Experience has shown that large changes in voltage (both over- and under-voltage) can occur and impact customers
- This is further aggravated when the connected load on the feeder is small, the generation is intermittent and the electrical system strength is weak

Voltage vs Power Profile for Generation Connections on Long Feeders

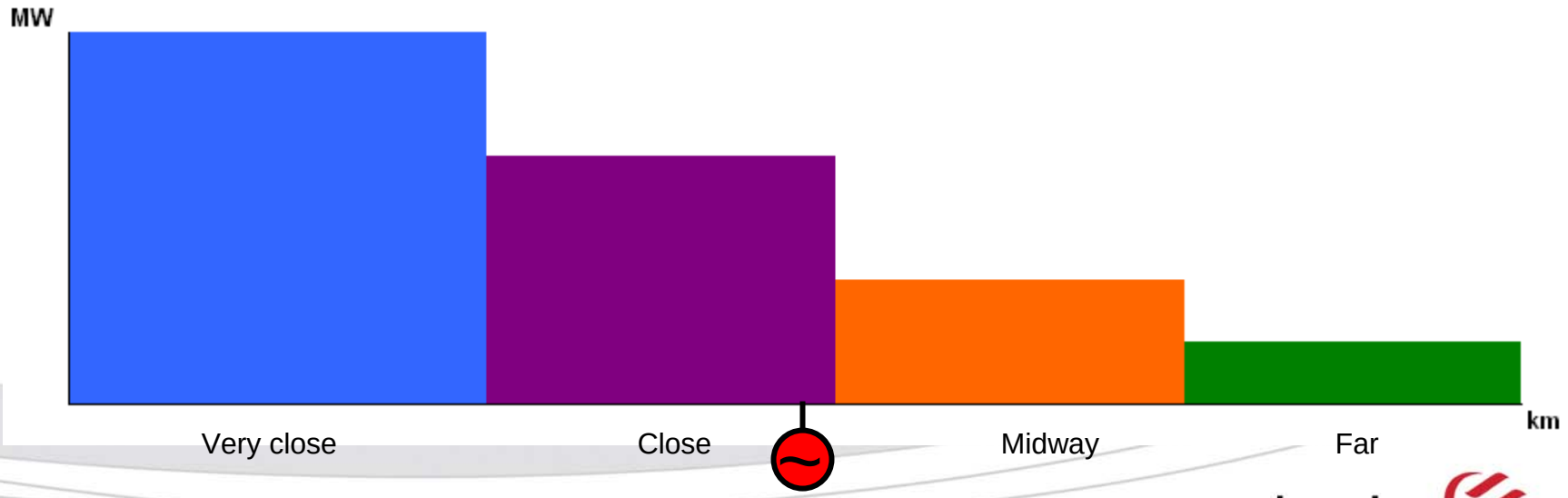


Considerations for Long Feeders

- Additional technical analysis in Distribution Availability Test and Connection Impact Assessment will consider the voltage impact of intermittent power sources on existing customers
  - Greater assurance that projects will be compatible with existing customers
- It is expected that less generation can be connected the further the generation is located on long rural feeders

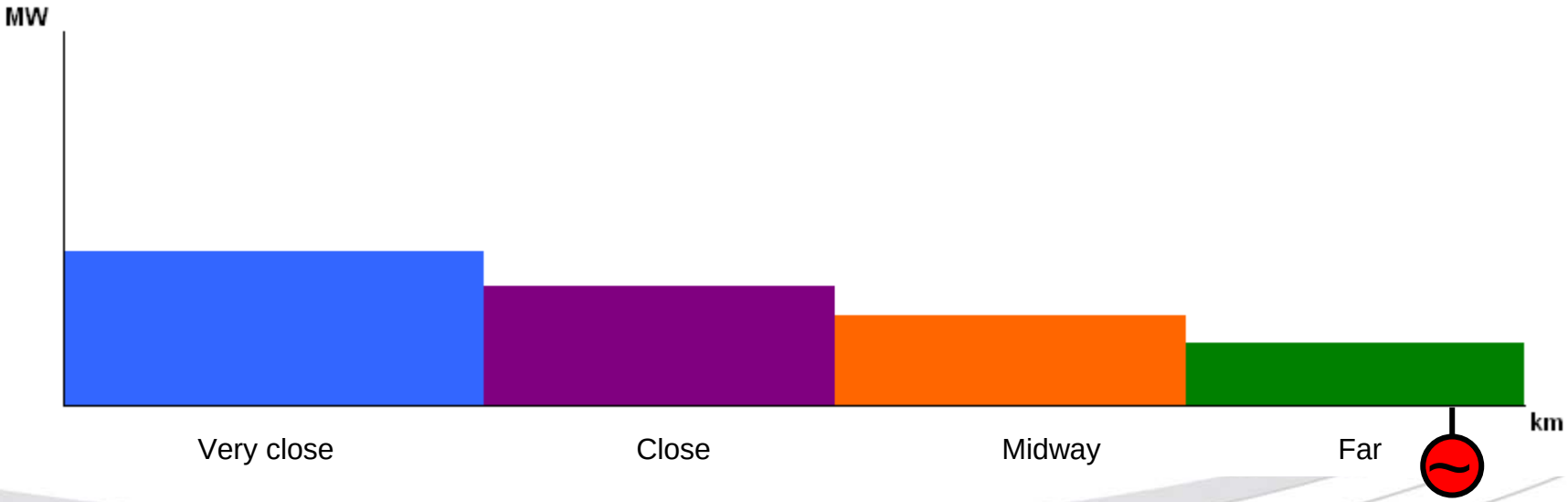
Considerations for Long Feeders

- More generation can be accommodated the closer they are to the transformer station
- Published capacity assumes generators are ideally situated



Considerations for Long Feeders

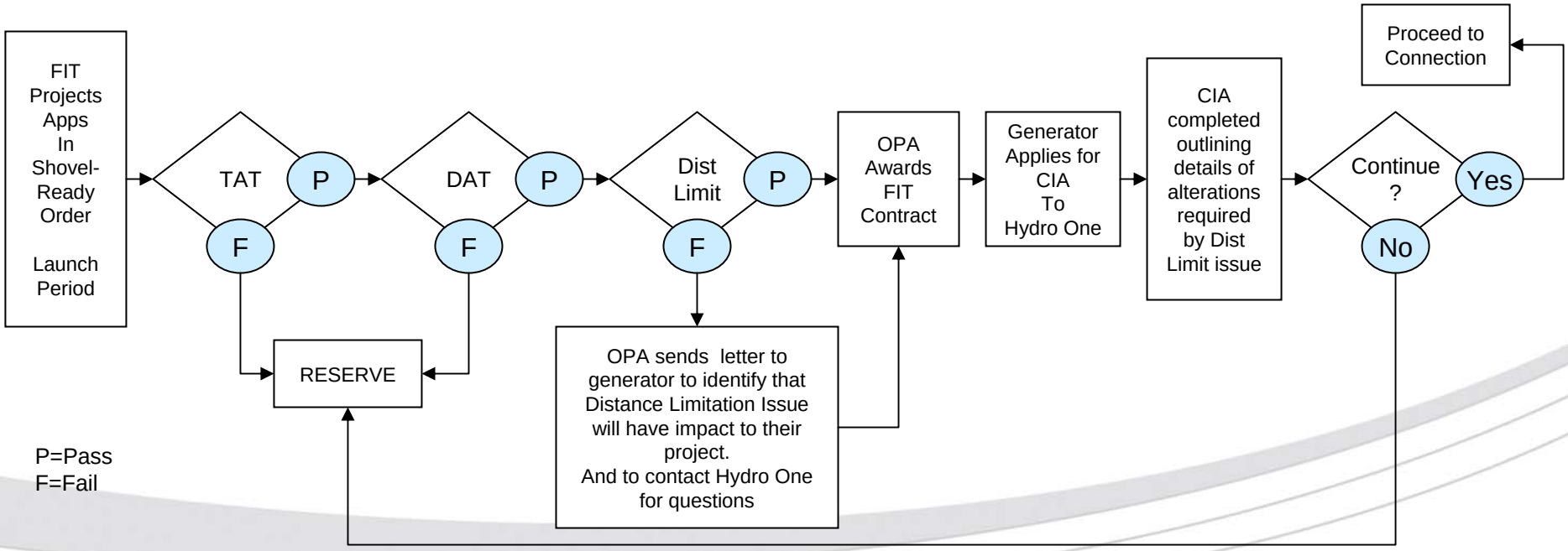
- A generator connected far away from the transformer station can affect the capability of the overall feeder



Management Plan – Long Feeder Issue

Communication to Impacted FIT Projects

- Met with known proponents who will be impacted by distance issue
- If required, alteration options will be explored in detail during CIA phase



Management Plan – Long Feeder Issue

Grid Integration of Existing RESOP Projects

- There are existing RESOP projects currently being implemented on long feeders
- Alterations to projects being considered on a case-by-case basis
- Do not foresee any impact to planned In-Service Dates. Alterations in some cases may be made post in-service date
- Communication to individual projects will be made when definitive plans are ready to be discussed.

Management Plan – Long Feeder Issue

Development of a Longer Term Solution

- Working group being formalized to collect input from generators and manufacturers to consider possible options in dealing with the issue
- Outstanding considerations include
  - Impacts from different types of generation
  - Voltage Control technology options
  - Manufacturer input to possible methods of controlling voltage at PCC

Station Capacity

Summary

- Station capacity on Hydro One's List of Allocated Capacity was adjusted in preparation for FIT
- The Connection Availability Table posted by the OPA at FIT launch includes station capacity values
- OPA's values account for RESOP contracts awarded at the time of FIT launch
- Station capacity values represent the technical capability of the station to accept new generation

Summary

- Hydro One's List of Allocated Capacity shows allocated capacity for projects including those that do not have RESOP contracts

- The following slides provide further background for the recent changes to station capacity values

Background

- Hydro One substations have been designed, rated and operated as step-down substation with power flowing from higher system voltage to lower system voltage
- Large accumulation of distribution connected generation on these stations could result in reversal of normal power flows
- Distribution connected generation on these stations increases the Short Circuit level at the substation low voltage bus

Station Capacity Limits Definition

- Reflecting our obligations as both a transmitter and a distributor, the following technical capacity limit has been determined by Hydro One:
  - Reverse power flow is not to exceed 60% of station capacity to protect the system in a situation where 1 transformer is out of service
- Short Circuit levels at the station low voltage bus must be within Transmission System Code limits

HONI Experience with Station Capacity

In preparation for FIT, Hydro One reviewed station capacity considering actual experience and new information.

Highlights:

- Some dual secondary winding transformers do not allow for reverse power flow conditions
- There was a reduction in minimum system load
- Short Circuit levels are already high at some stations

Station Thermal Capacity Limit

Two types of transformers:

- Single secondary winding

  one HV winding, one LV winding

- Dual secondary winding

  one HV winding, two LV winding

Dual Secondary Winding Transformers

- Equal reverse flow in the two secondary windings cannot be assumed
- Based on information from transformer manufacturers, Hydro One has determined that some dual secondary winding transformers cannot withstand forward flow in one secondary winding while there is reverse flow in the other secondary winding
- Excessive imbalance between the two secondary windings causes overheating and potential failure of the transformer

Thermal Capacity Conclusions

- The station capacity shown on Hydro One's List of Allocated Capacity and OPA's Connection Availability Table reflects:
  - Dual secondary winding transformer capacity
  - Reduction in system load
  - More detailed analysis

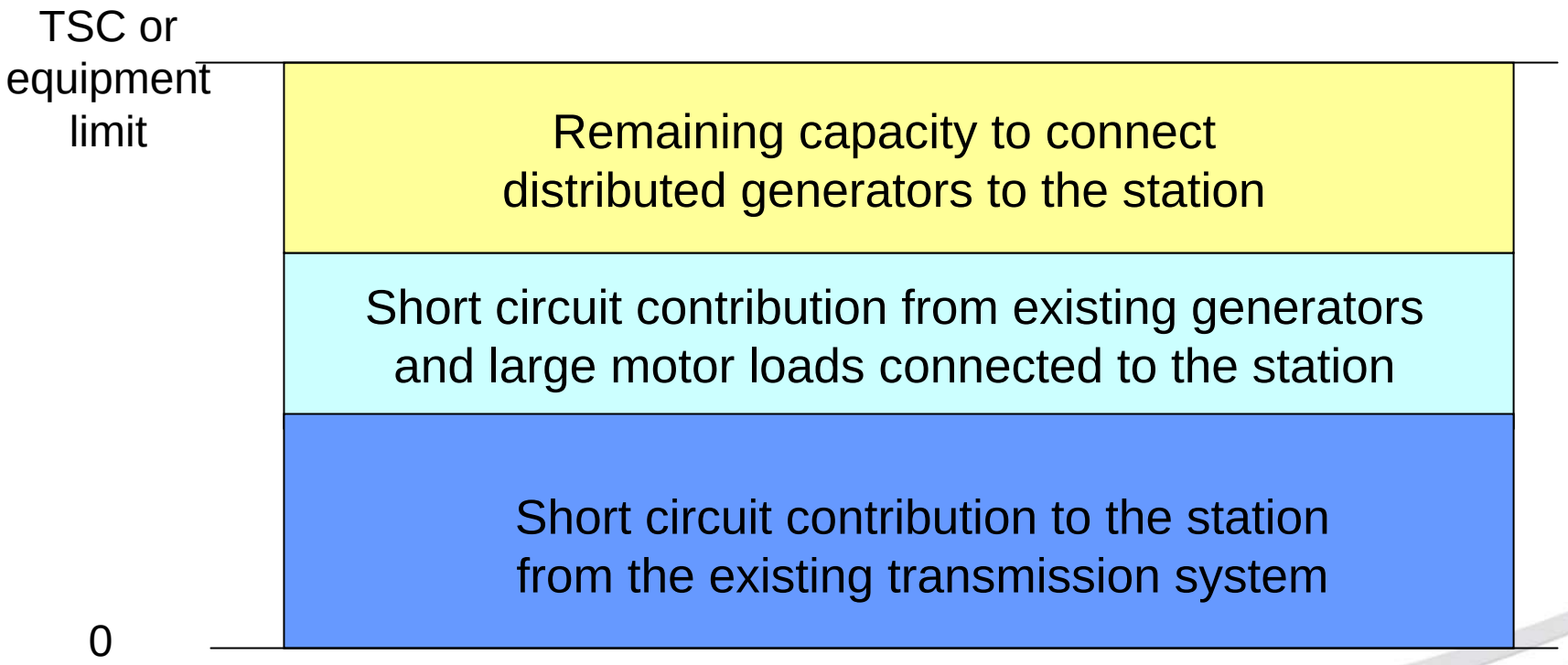
Management Plan to Address Transformer Issue

- Reductions in capacity due to transformer issues were adjusted to accommodate expected projects in FIT launch
- Currently reviewing priortization plans to replace end-of-life transformers. Most problematic transformers are scheduled for replacement.
- Evaluating on a station-by-station basis, options to deal with dual secondary winding transformer issue and minimize the impact on the generator.

Short Circuit

- Short circuit limitations were previously identified after a Connection Impact Assessment (CIA) was completed
- Some short circuit limitations are presently identified on Hydro One's List of Allocated Capacity and on OPA's Connection Availability Table
- Short circuit information is not considered in TAT, but evaluated during the CIA.

Short Circuit



Short Circuit

- The short circuit contribution of a generator at a station depends on the following parameters:
  - Generator technology (inverter, rotating machine)
  - Distance from the station (greater distance results in lower short circuit contribution)

Short Circuit Conclusions

- Station capacities shown on Hydro One's List of Allocated Capacity and on OPA's Connection Availability Table presently reflect known short circuit limits
- Short Circuit issues will not be considered in TAT and DAT tests
- Short circuit levels will be studied in the Connection Impact Assessment (CIA). Required upgrades to correct any short circuit issues will be provided at CIA stage.

Transforming Ontario's Power Grid

While there are short-term challenges, Hydro One is dedicated to enabling the transformation of Ontario's power system and connecting renewable generators.

Thank You

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