# Planning the Integration of DER in the Colombian Power Grid

2019 ESIG Spring Technical Workshop Distribution System Developments Sesion



## **Colombian Power System Overview**



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#### The Colombian power system



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#### **Power Market**



#### **Colombian DER - Forecast 2023**

- Around 2 GW of officially registered projects with capacity smaller than 20 MW
- 52% of the total capacity corresponds to solar projects
  45% small hydro
- 63% of registered projects have capacity below 1 MW
  Less than 2% of total capacity
- 97% of projects under 1 MW are solar
- Demand response programs just starting to be explored



	Projects	Capacity [MW]	Total (MW)	_
Solar PV	366	1137	1137	
Small hydro	93	978	1466	_
Thermal- Biomass	16	66	216	
Wind	3	10	10	_
TOTAL	478	2190	2829	Xn

## XM studies to understand the impact of DER



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### XM DER Modeling



#### DER < 5 MW

- Aggregated
- Generic impedance
- FRT capability
- Ramps
- Power factor=1
- Allows partial tripping

#### DER > 5 MW

- Individual
- WECC model
- FRT capability
- Ramps
- Voltage control
- Reactive or active current priority

## Technical studies Impact on system reliability



#### Scenarios:

- Focus on specific areas of the system according to signals of possible development
- Incremental participation growth scenarios to understand the impact
- we are working with NREL about creating the scenarios of DER integration



## Impact on frequency control and stability Generation-load imbalance

#### **Generation-load imbalance event:**

- Loss of a single generation unit (273 MW)
- 5% of the demand covered with solar resources connected in the distribution network
- Colombian connected to Ecuador
- Grid 2023



Systemic loss of generation in the distribution system around 5% of the demand becomes a critical contingency. The operating frequency ranges for solar generation in the distribution network must be consistent with the operating requirements and frequency regulation mechanisms

## Impact on frequency control and stability Reserves- Inertia

High participation of DER, can displace conventional generation reducing inertia in the system and the availability of resources capable of providing frequency regulation services - greater vulnerability to major events.

Reserve needs and ancillary services under review



Time (s)

## Impact on Voltage control and stability Voltage dip event - 115 KV with DER

Short Circuit event at a 220 kV line



## Impact on Voltage control and stability High penetration levels of DER

- High levels of DER can lead to reactive power deficit situations in critical cases
- In cases of low generation and low demand high voltages difficult to control may arise
- In cases of high thermal and wind generation and contingency N-1 at 500 kV, voltages can collapse
- Contribution of reactive power by utility scale DER at shares above 20% of demand in the area would become needed
- An agreement with distribution system operator is required



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#### **Measures to mitigate Impact of DER**









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