

ONS Real-Time Dynamic Simulator







Fifth largest country by area

• 8.5 million km²

Sixtieth most populous

• 213 million people

Operador Nacional do Sistema Elétrico

Country Size Comparison



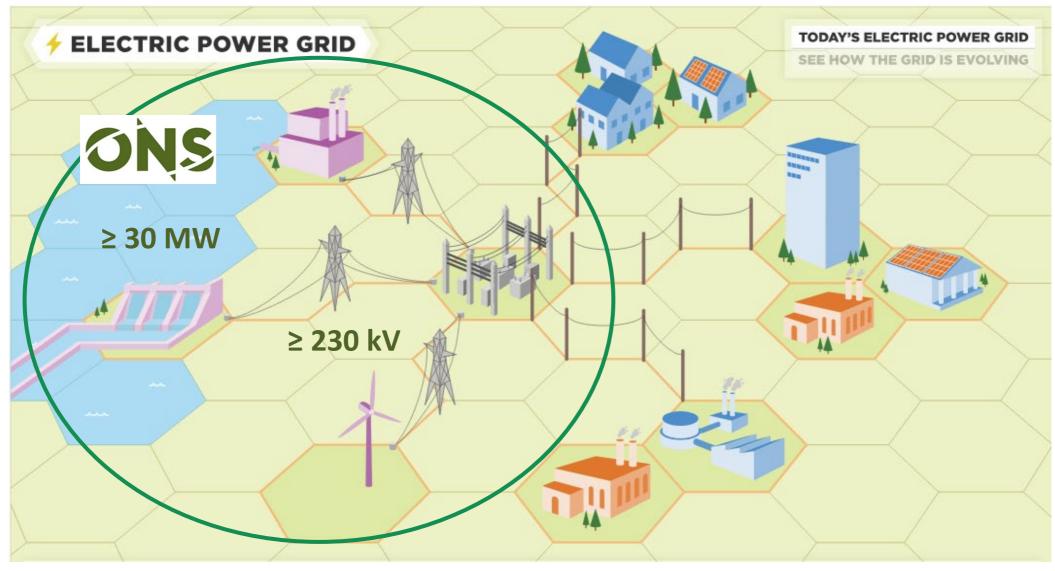
https://thetruesize.com/

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Brazilian ISO

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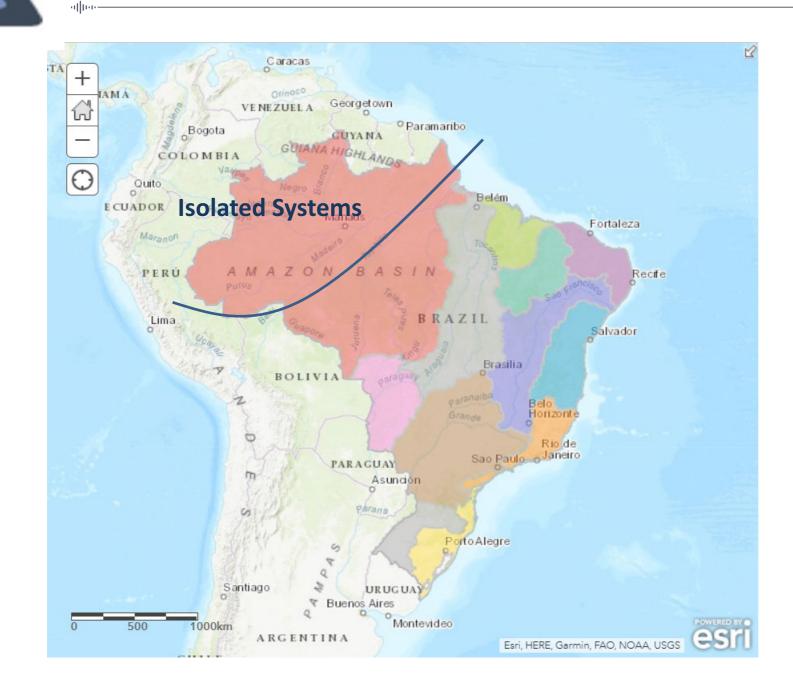


Source: www.epa.gov

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Brazilian ISO



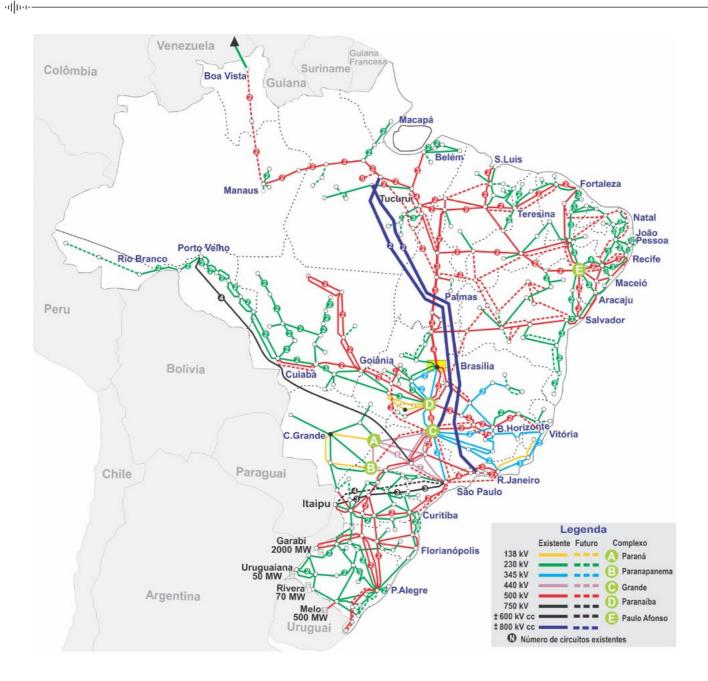
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99% Brazilian Load

Isolated Systems ≈ 300 cities Small thermal power plants

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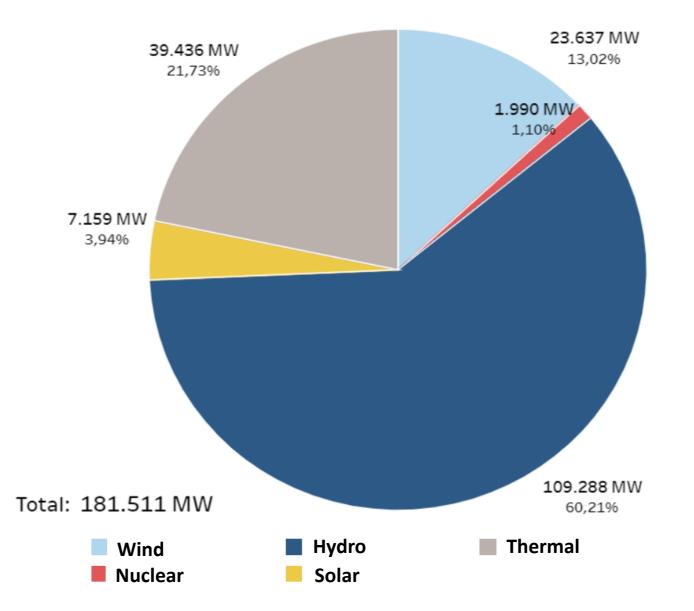
Transmission System



2022 179 311 km

2027 270 558 km

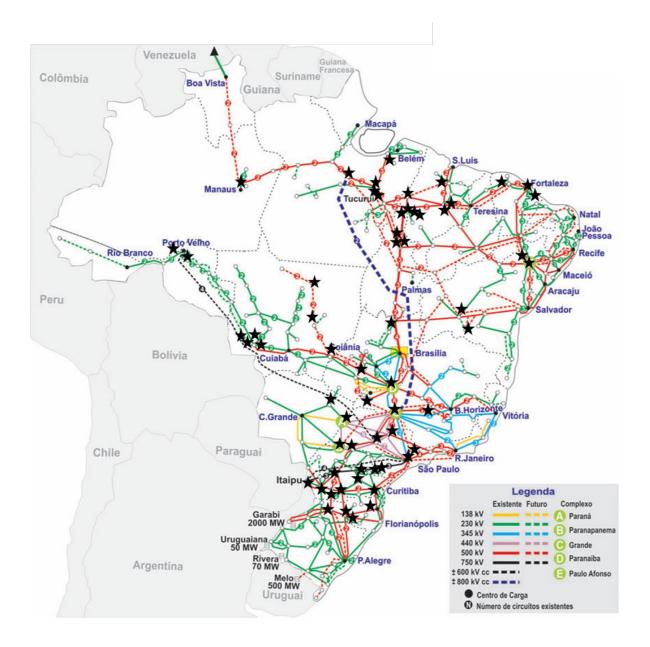




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PMU Deployment

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Status

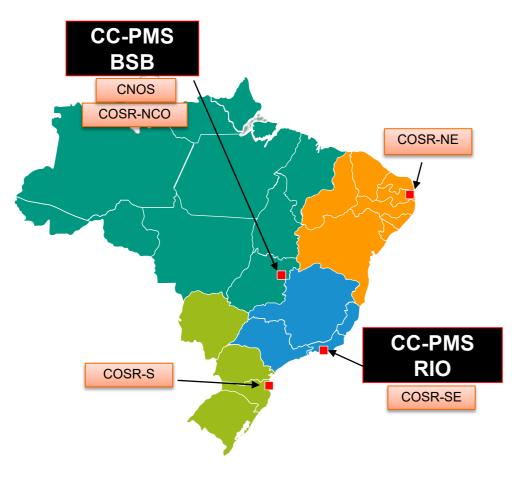
- > 350 PMUs in OP
- Data Quality ~ 80 % good
- Data Availability ~ 85 %

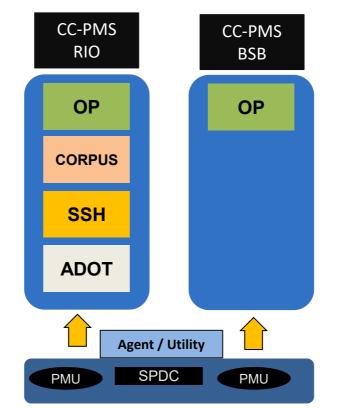


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CC-PMS - Layout





- **SCS** Supervision & Control System (4 sites)
- **CNOS National Control Center**
- **COSR-NCO** North Central-West Regional Control Center
- **COSR-NE** Northeast Regional Control Center
- **COSR-SE** Southeast Regional Control Center
- **COSR-S** South Regional Control Center

CORPUS - Corporate User System SSH - System Staging & Homologation ADOT - Application Development & Operator Training

OP - Operation Production

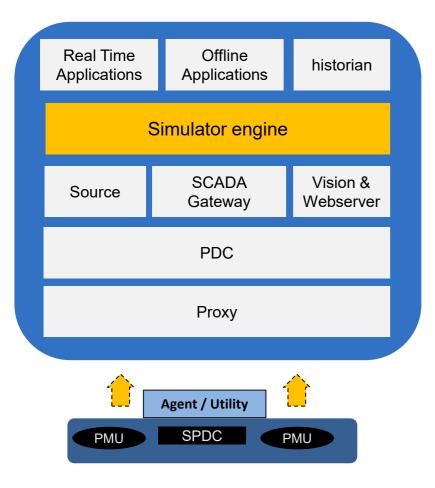
Real Time Alarm Management Composite Alarms Oscillation Monitoring F, V&I, Power Flow Monitoring System Disturbance Islanding & Restoration Dynamic Stability Assessment

Offline

User Calculations Spectral, Modal & Event Analysis Reporting capability Training Environment Historical Event Storage

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Special characteristics:

- Simulator generates current and voltage phasors based on fully electromechanical models. These phasors are sent to PDCs at a rate of 60 ftp using the IEEE C37.118 protocol and then sent to be consumed by applications in real time and offline. The simulator allows you to do:
 - > Start / stop the simulation
 - Changing generation & load
 - > Open & close equipment's (LT / TR / SC / EC / RE / CA)
 - Separate & reconnect bus bars
 - Generate errors in loads and phasor measurements
- The dynamic models are the same as those used by the planning and engineering teams and benefit from the evolutions made in the database of dynamic models by these teams.
- Supported models: hydraulic generators, wind generators, thermal units, HVDC, different load models, protection schemes. All lines and transformers receive standard protection automatically (zone protection, bus protection, etc.)

Simulator



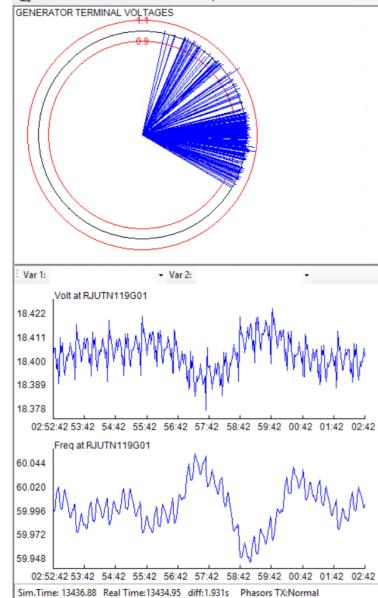
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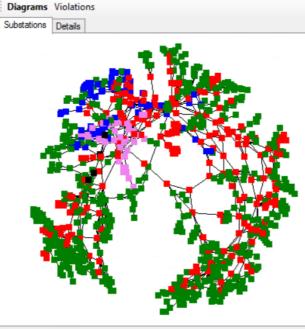
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🐹 File Run Controls Window Help

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Generator	SVC	LTC	Branch	Protection	Switches	Volts	DC Link	PMU		
Name		Gen B	us	Volt		Angle		MW	Mvar	/
RJUTN119	G01	10		0.968		1.10		655.60	9.28	
RJUTN225	6G02	11		0.965		1.45		1350.34	-40.67	
SPUSLB2	2GR	12		0.988		-4.74		259.13	-134.92	
SPUSLB13	3PG03Q	13		0.969		-8.56		0.04	-104.44	
RJUSFL2	GR	14		1.003		-8.40		94.50	3.67	
MGUSF6	GR	16		0.972		-6.50		719.25	-351.81	
MGUSIM	4GR	18		0.983		7.21		884.17	-356.14	
MGUSIM13PG06Q		19		0.987	0.987			0.07	-88.79	
MGUSMR5GR		20		1.044	1.044			562.95	-268.40	
MTUSMS-2GR		21		0.963	0.963		-1.84		-38.73	
MGUSMM-4GR 22		22		1.020		-6.43		150.43	-37.22	
MGUSMM3GR 24		0.997		-7.37		78.91	57.58			
MGUSCL3GR 28		1.034	1.034			158.02	41.59			
RJUSSC-2GR 32		0.989	0.989			318.22	11.36			
GOUSCB	3GR	35		0.962		9.73		243.10	-74.72	
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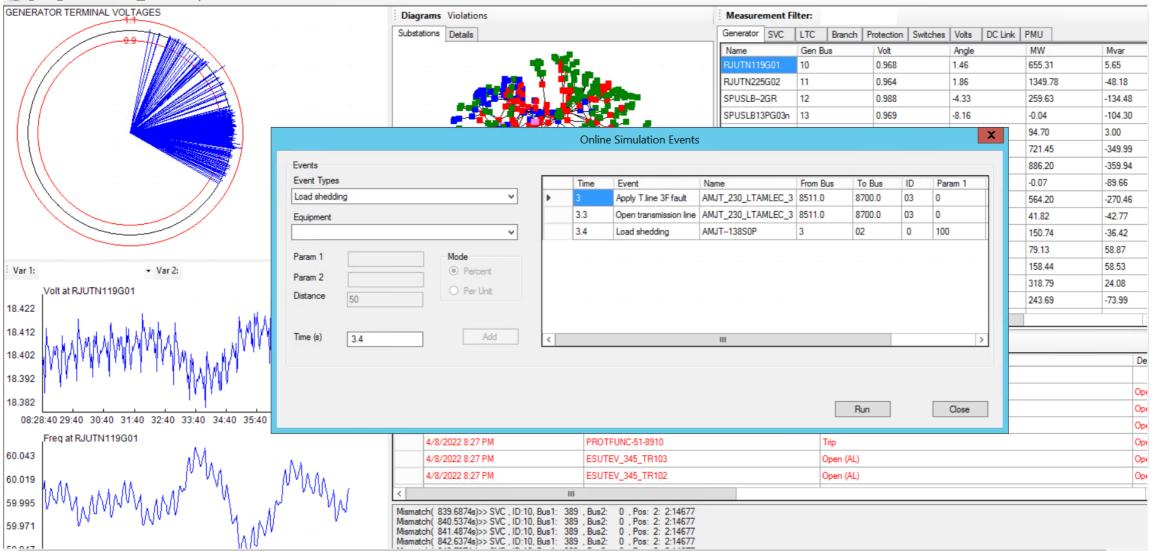
Date & Time	Equipament	Signal	Descr
4/7/2022 11:18 AM	Simulation started		
4/7/2022 11:18 AM	PROTFUNC-59-RE2PNO	Open (AL)	Operat
4/7/2022 11:18 AM	PROTFUNC-59-RB1STA	Open (AL)	Operat
4/7/2022 11:18 AM	PROTFUNC-59-RB2STA	Open (AL)	Operat
4/7/2022 11:21 AM	PROTFUNC-51-8910	Trip	Operat
4/7/2022 11:21 AM	ESUTEV_345_TR103	Open (AL)	Open
4/7/2022 11:21 AM	ESUTEV_345_TR102	Open (AL)	Open
<	ш		>
Mismatch(13432.0260s)>> SVC, ID:10, Bus Mismatch(13433.0760s)>> SVC, ID:10, Bus Mismatch(13433.9260s)>> SVC, ID:10, Bus Mismatch(13434.8260s)>> SVC, ID:10, Bus Mismatch(13435.8760s)>> SVC, ID:10, Bus	1: 389 , Bus2: 0 , Pos: 2: 2:14677 1: 389 , Bus2: 0 , Pos: 2: 2:14677 1: 389 , Bus2: 0 , Pos: 2: 2:14677 1: 389 , Bus2: 0 , Pos: 2: 2:14677		

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Simulator

🖳 <u>F</u>ile <u>R</u>un Controls <u>W</u>indow Help

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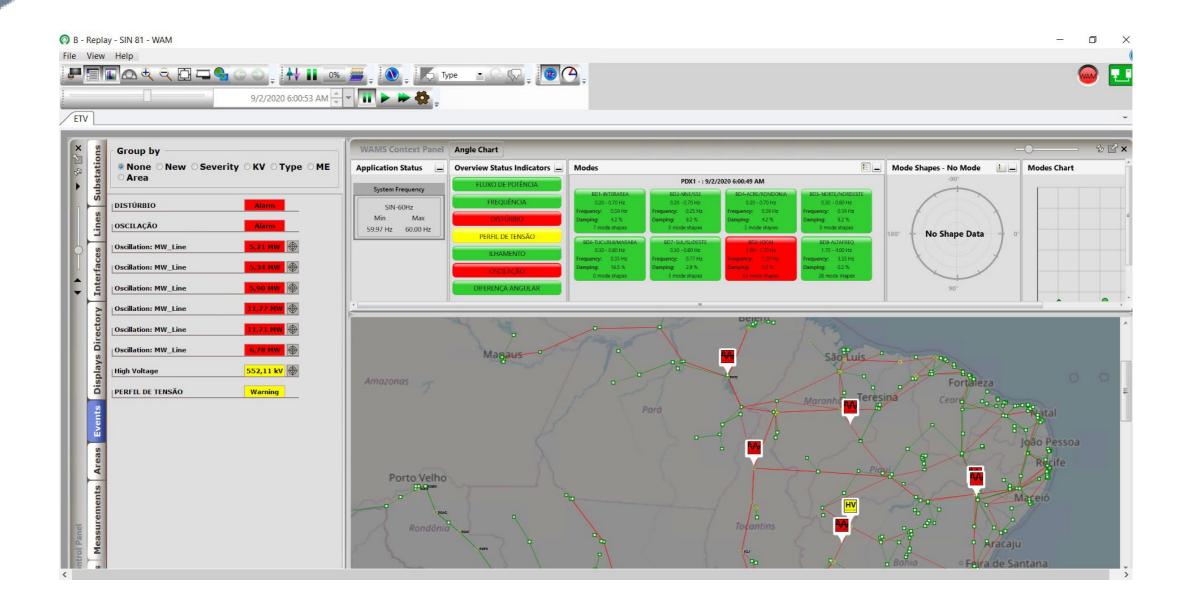
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Simulator Output

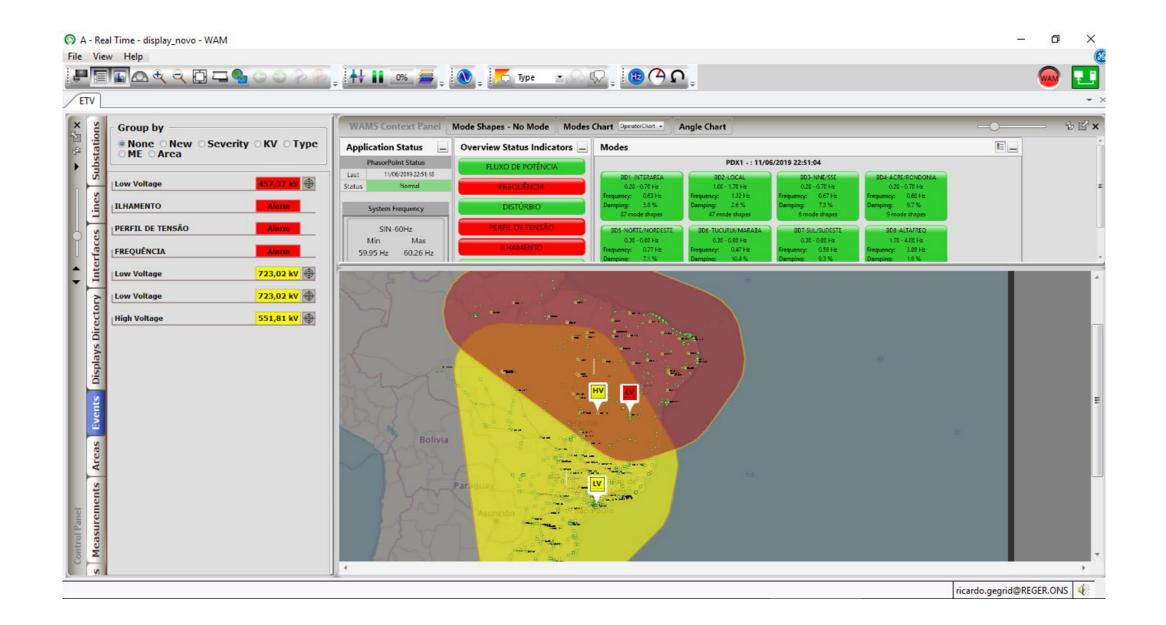
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Simulator Output

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CC-PMS – Simulator Characteristics

Real-time Environment – What was observed by a PMU near the problem

Simple to use - get a pre-fault base case from State Estimator, start a simulation, and reproduce the disturbance.

Simulator – What was observed by the same PMU





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Team

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Arthur Mouco, Ph.D. Senior Power Systems Engineer



Hector Volskis Power Systems Specialist



Janio Los Senior Power Systems Engineer



Jeanderson Mingorança, M.Sc. Power Systems Engineer սվիս

Ons Operador Nacional do Sistema Elétrico	Thank You!					
		Questions?				

