

Simulation Model for Threat and Impact Analysis on Modern Electrical Power Systems

5th GI/ACM I4.0 Workshop on Standardization of Automation
and Control Systems (IACS)

28 September 2020

Deeksha Gupta, TU Dresden

Yongjian Ding, Magdeburg-stendal University of Applied Sciences

Dharini Govindaraj, Hochschule Darmstadt

Mathias Lange, Magdeburg-stendal University of Applied Sciences

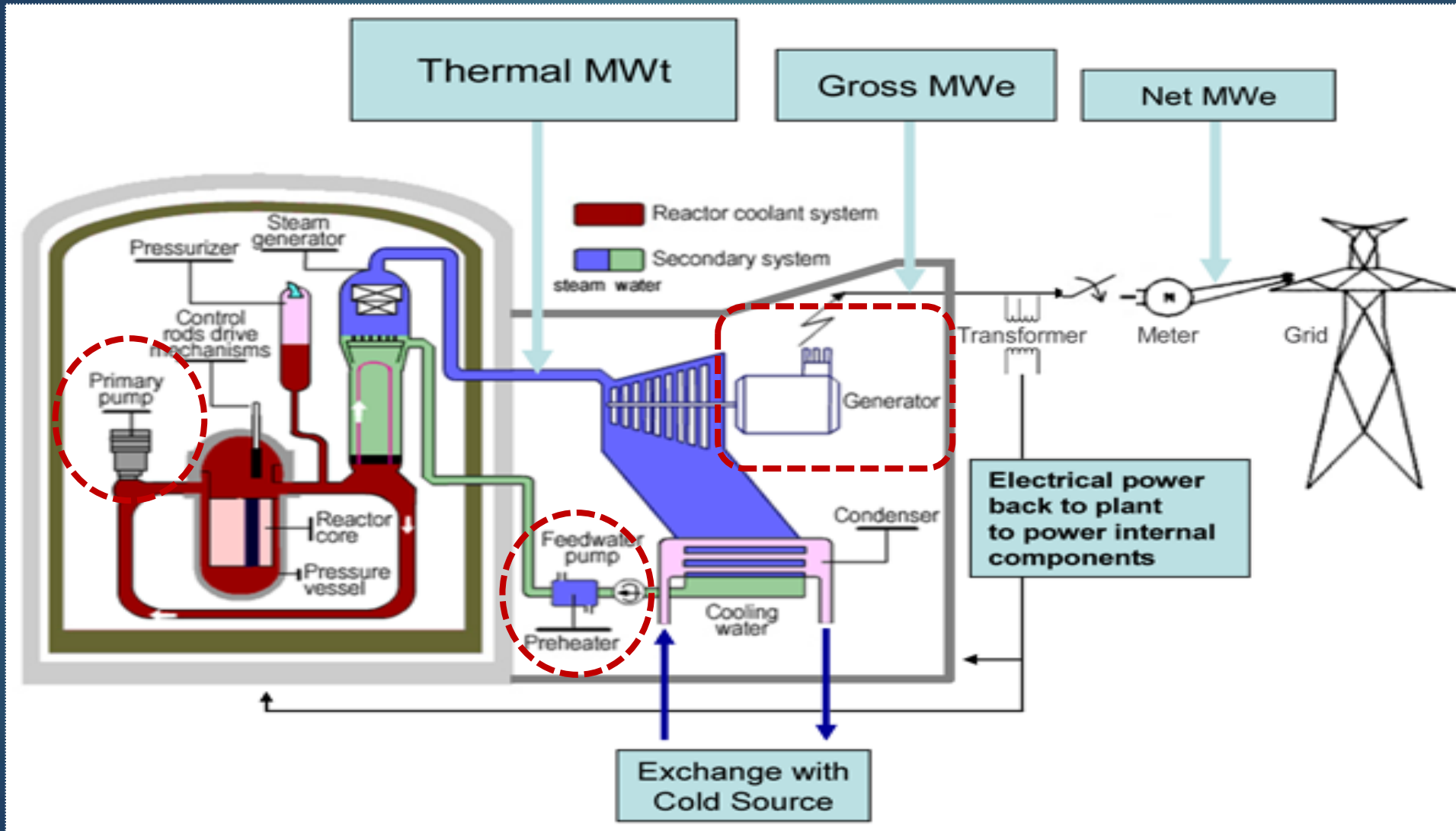
Martin Szemkus, Magdeburg-stendal University of Applied Sciences

Karl Waedt, Framatome Gmbh

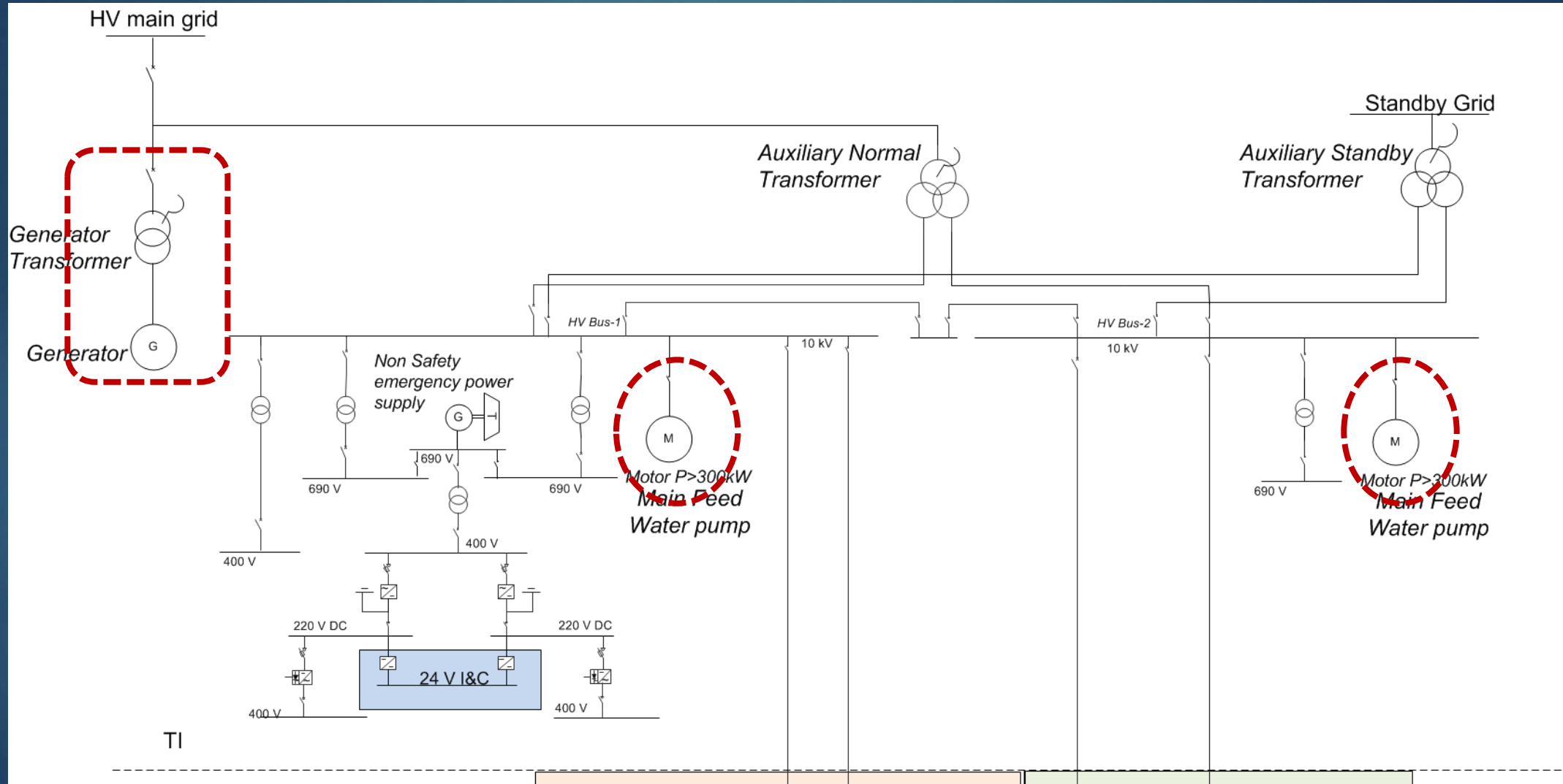
Outline

- 1 Targeted EPS of an NPP
- 2 Tailored Matlab/ Simulink Model for EPS
- 3 Network Diagram for Attack Implementation
- 4 Example of a Simulated Cyber-Attack

Targeted Systems of a Nuclear Plant

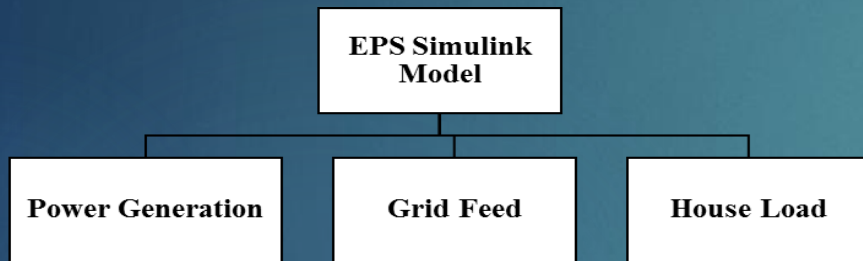


Single Line Electrical Diagram

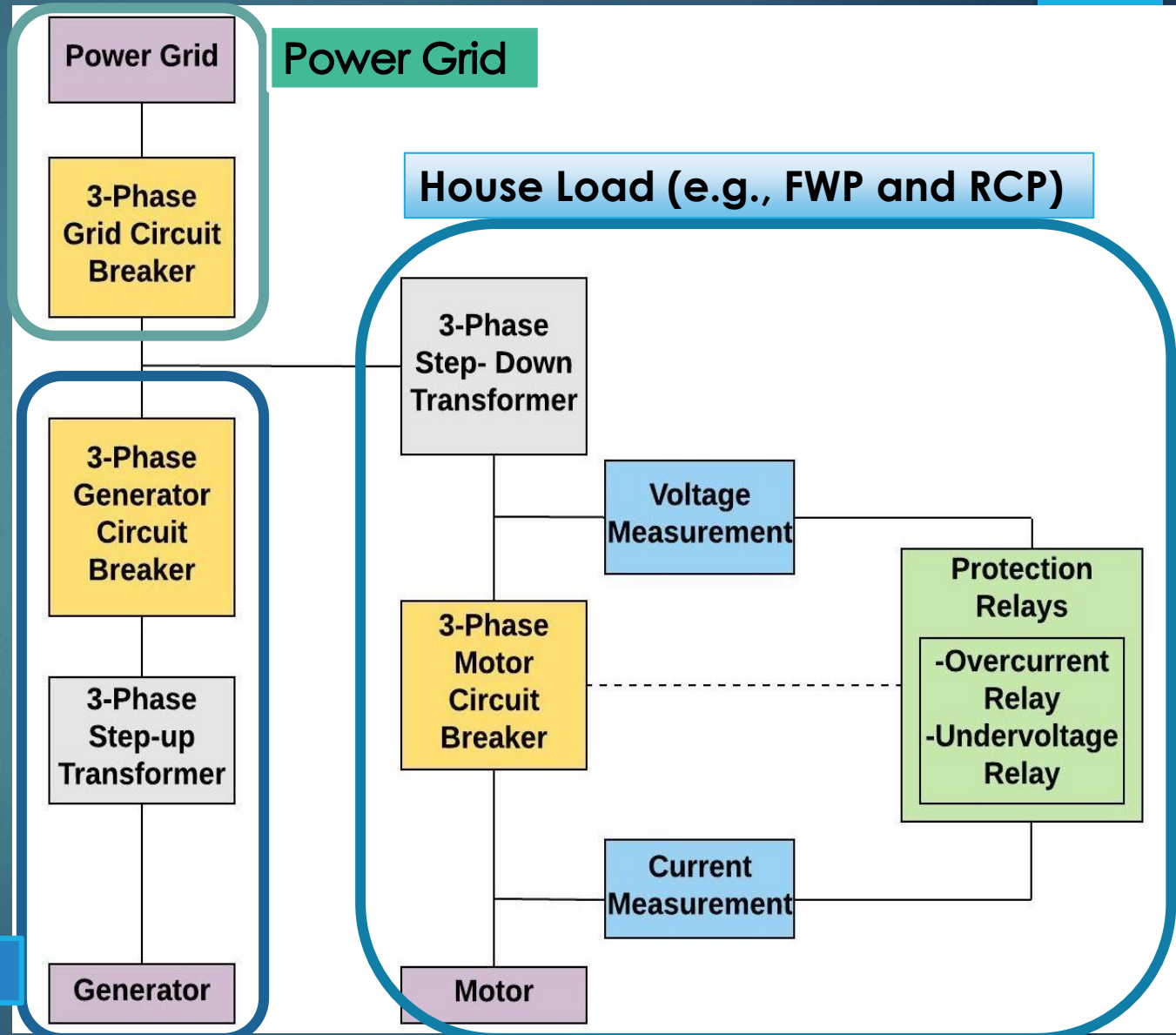


Block Diagram of Simulink Model

Design



Power Generation





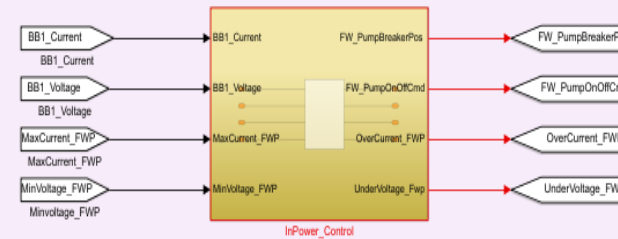
Overview of MATLAB/ Simulink Model

Communication

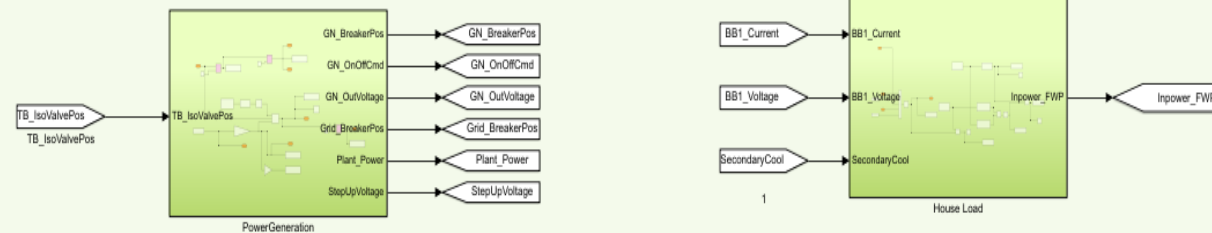


OPC Comm Module

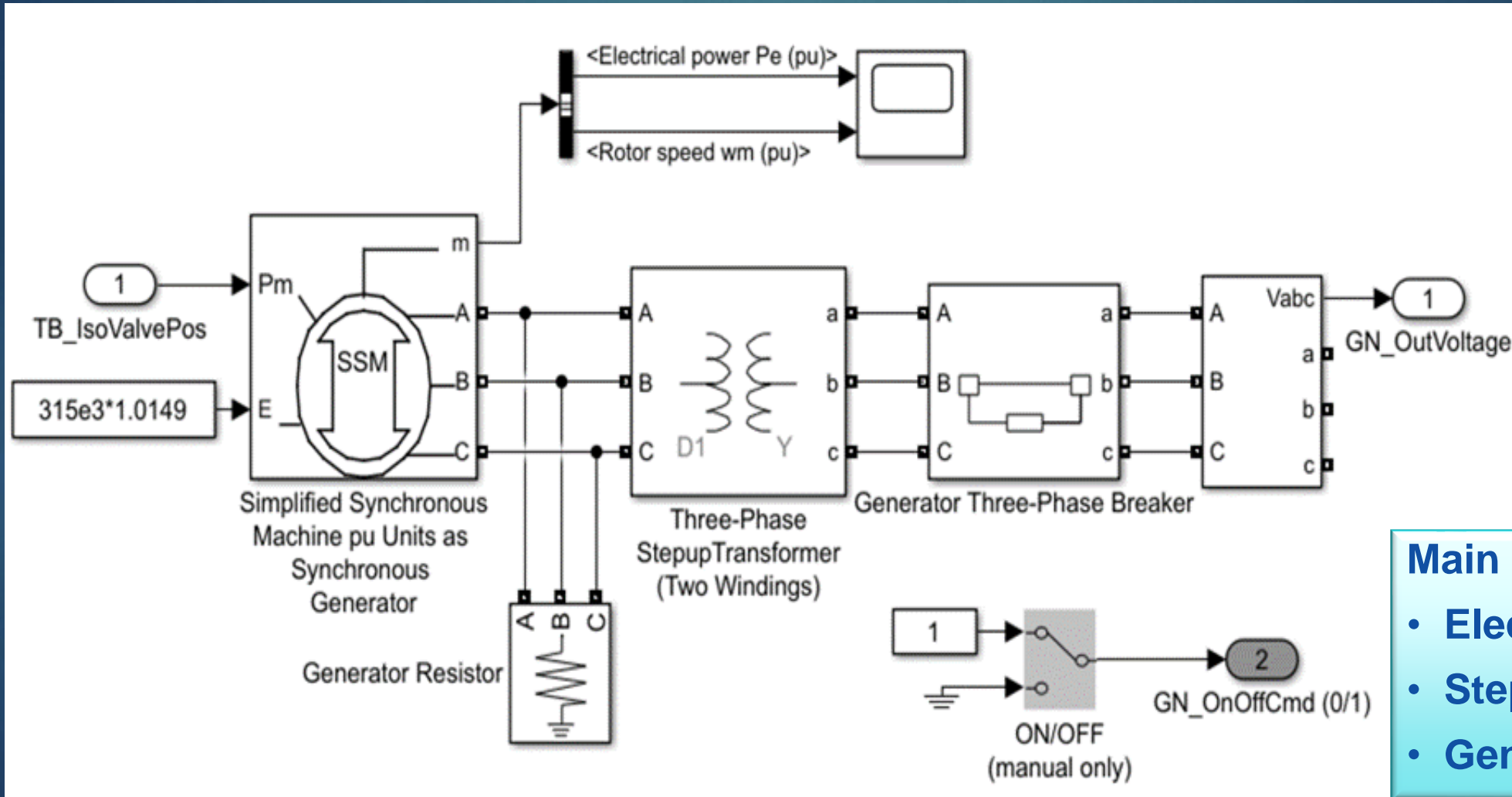
Control



Power Operation



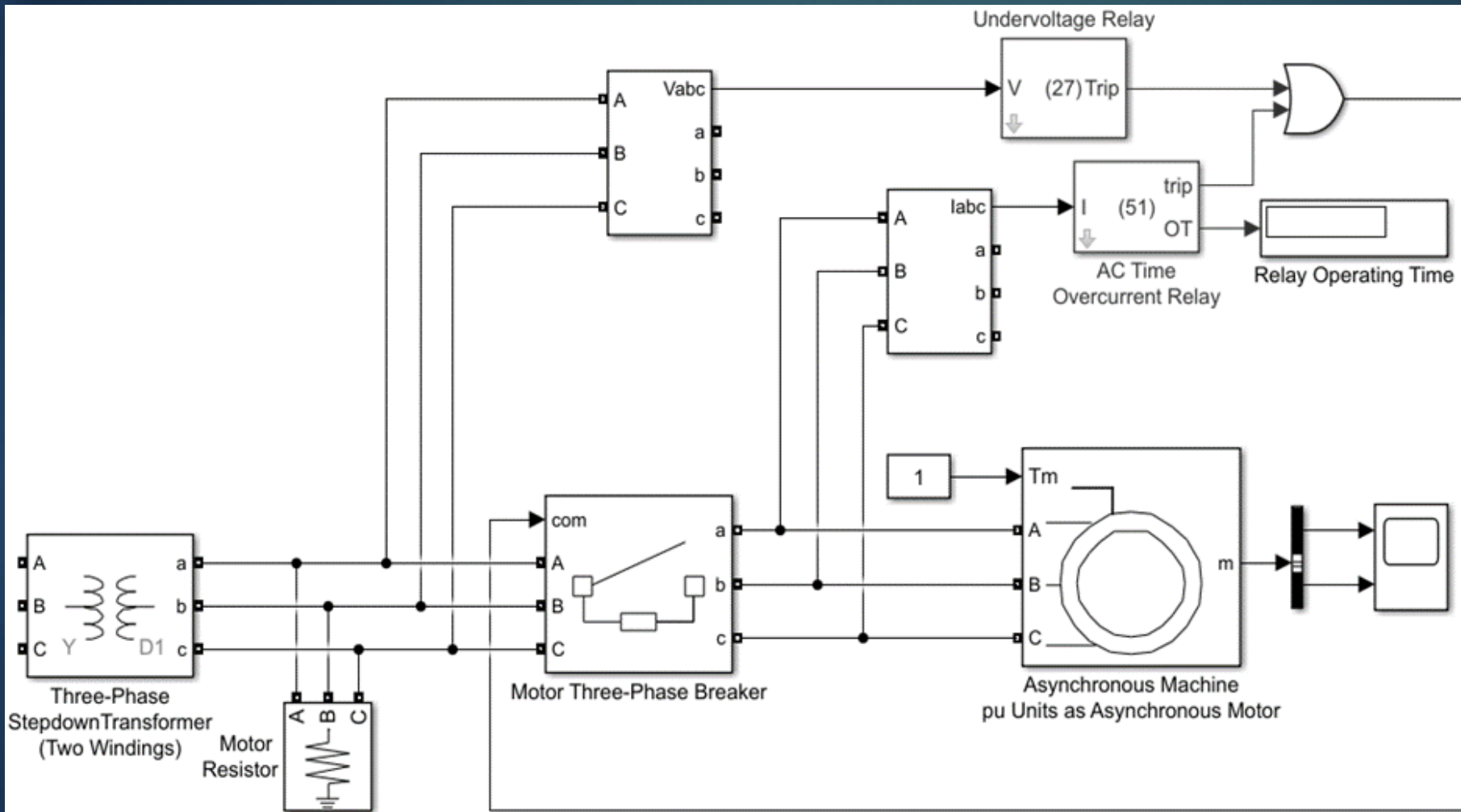
Power Generation



Main components:

- Electric Generator
- Step-up Transformer
- Generator Breaker

House Load Control



Main components:

- Step-down Transformer
- Circuit Breaker
- Electric Motor
- Protection Relays
- Measurement devices

OPC UA Tags Utilized in Simulink Model

Tag Type	Tag Name	Significance
Analog Input	BB1_Current	Value of current in Bus Bar 1
	BB1_Voltage	Value of voltage in Bus Bar 1
	MaxCurrent_FWP	Maximum permissible current to FWP
	MinVoltage_FWP	Minimum allowed voltage to FWP
Digital Input	SecondaryCool	State [On/Off (1/0)] of secondary cooling
	TB_IsoValvePos	Position [Open/Close (0/1)] of turbine isolation valve
Analog Output	GN_OutVoltage	Value of generator Voltage
	Inpower_FWP	Value of consumed power by FWP
	OverCurrent_FWP	Overcurrent set-point of FWP
	Plant_Power	Calculated power of a virtual NPP
	StepUpVoltage	Value of voltage of step-up transformer
	UnderVoltage_FWP	Undervoltage set-point of FWP
Digital Output	FW_PumpBreakerPos	Breaker position [Open/Close (0/1)] of FWP
	FW_PumpOnOffCmd	Status [On/Off (1/0)] of FWP
	GN_BreakerPos	Breaker position [Open/Close (0/1)] of generator
	GN_OnOffCmd	Status [On/Off (1/0)] of generator
	Grid_BreakerPos	Breaker position [Open/Close (0/1)] of main grid

Summary

- ▶ A Need to implement cybersecurity analysis for EPS of NPP in generation stage
- ▶ Customized Matlab/ Simulink model was used to model the physical model of EPS
- ▶ Network Diagram for Attack Implementation and Network Monitoring
- ▶ Implementation of OPC UA Protocol helps to simulate cyber-attacks for future critical infrastructures.

Simulation Model for Threat and Impact Analysis on Modern Electrical Power Systems

5TH GI/ACM I4.0 Workshop on Standardization of Automation
and Control Systems (IACS)

28 September 2020

Deeksha Gupta, TU Dresden

Yongjian Ding, Magdeburg-stendal University Of Applied Sciences

Dharini Govindaraj, Hochschule Darmstadt

Mathias Lange, Magdeburg-stendal University Of Applied Sciences

Martin Szemkus, Magdeburg-stendal University Of Applied Sciences

Karl Waedt, Framatome Gmbh

Thank You!!