AVEVAWORLD

ACCELERATE INDUSTRIAL INTELLIGENCE

Baker Hughes adoption of ETAP as pre-FEED software to assess electrical stability of power generation plants serving Data Centers

Baker Hughes
Rewriting The Energy Equation™

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21-May-26

Baker Hughes: our portfolio meets the demands of The Energy Equation

One portfolio.
Two segments.
Unrivaled potential.

We build and deploy solutions to the world's greatest energy challenges

Baker Hughes
Rewriting The Energy Equation™

Agenda

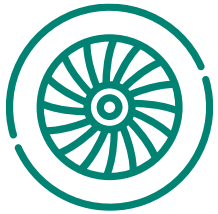
- The Value of power system study
- From grid connected Data Centers to captive power plants: ETAP as a key pre-FEED software
- A case study: power system supplying data center with highly variable
  - Conclusions
  - Q&A

The Value of power system study

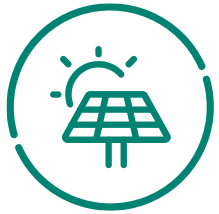
Modern power systems are experiencing a continuous increase in power demand, primarily driven by electrification trends and the rapid expansion of energy-intensive infrastructures, including data centers.

Power systems studies play a Key role to evaluate electrical systems power quality and reliability

(Synchronous condenser)



(Industrial gas turbine)



(Inverter-Based Renewables)

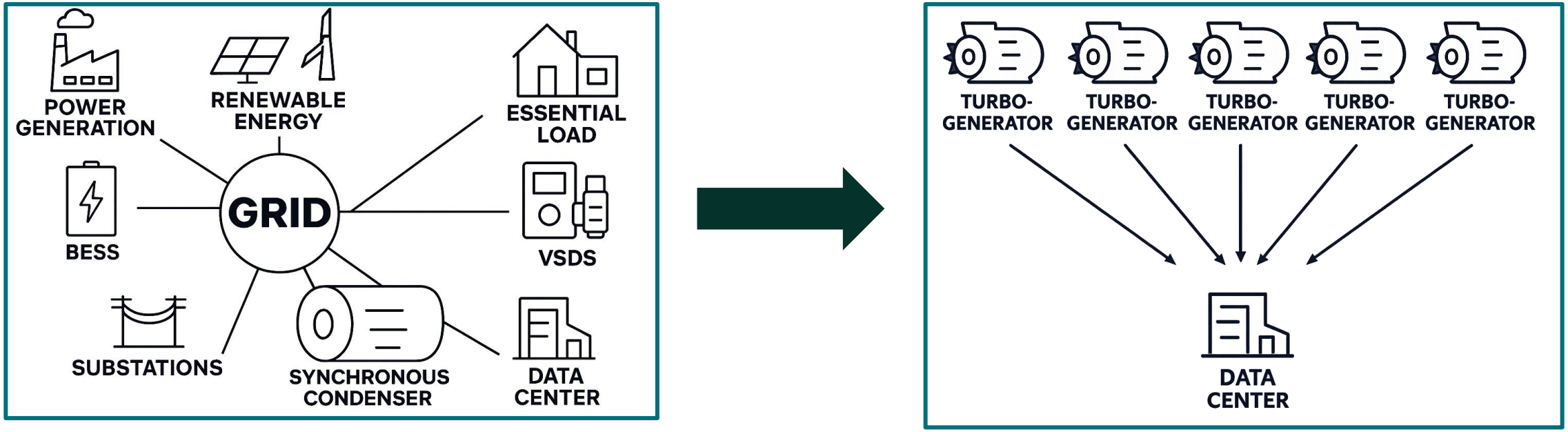
etap®

(Battery Energy Storage System)

From grid connected Data Centers to captive power plants: ETAP as a key software

Ongoing transformation of data center power supply models poses new challenges:

- ❖ Guarantee plant reliability transitioning from grid-connected architectures to captive power generation plants.
- ❖ Guarantee electrical stability with highly dynamic load profiles



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A case study: power generation system supplying data center with highly variable load demand

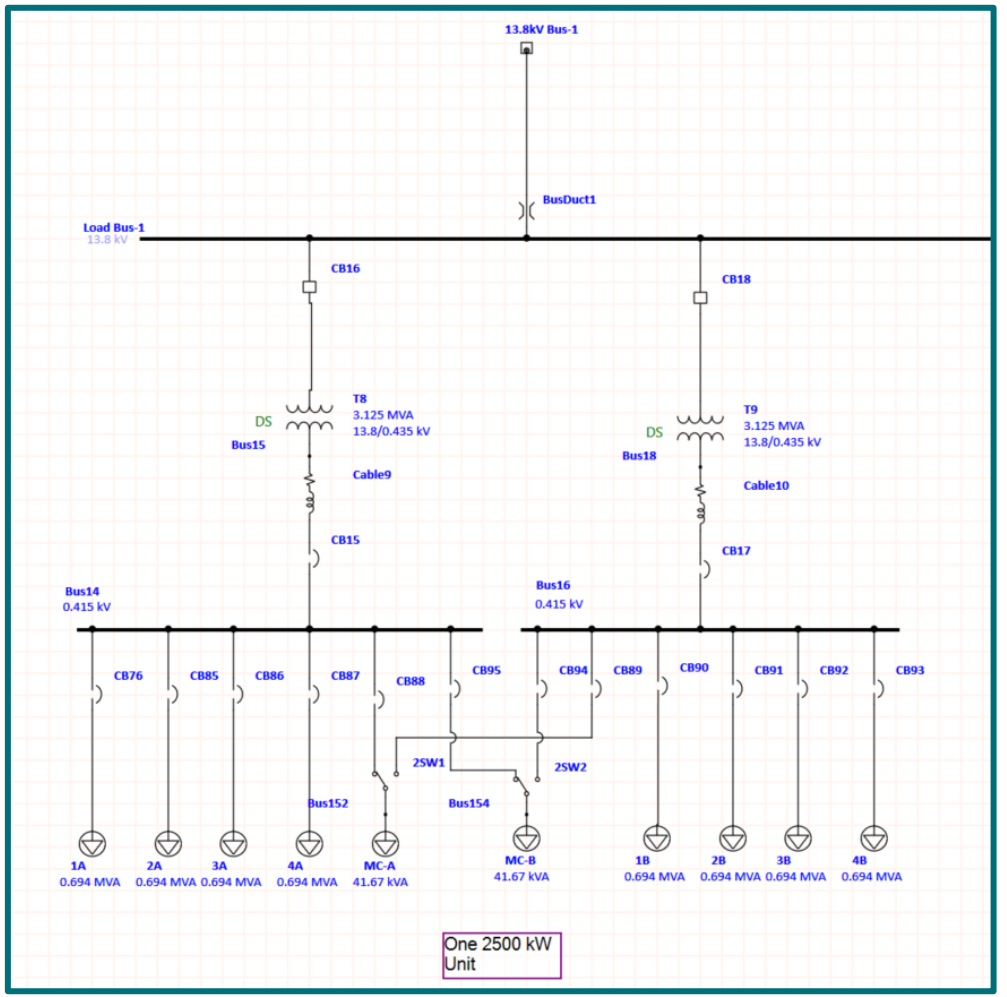
Case study: power generation system plant intended to supply a data center hosting 40 IT units (100MW) characterized by highly dynamic load profiles.

Expected guarantees:

1. Continuity of service
2. Maximum frequency variation below 2%.

Peculiarities:

Integration of BESS and Synchronous condensers to stabilize the plant grid.



Electrical Schematic of one 2500kW IT module

A case study: power generation system supplying data center with highly variable load demand

Plants configuration

(100MW Data Center)

(10 Generator Gas Turbine 16 MW)

(77 MW Battery Energy Storage System)

[Studies and sizing ongoing]

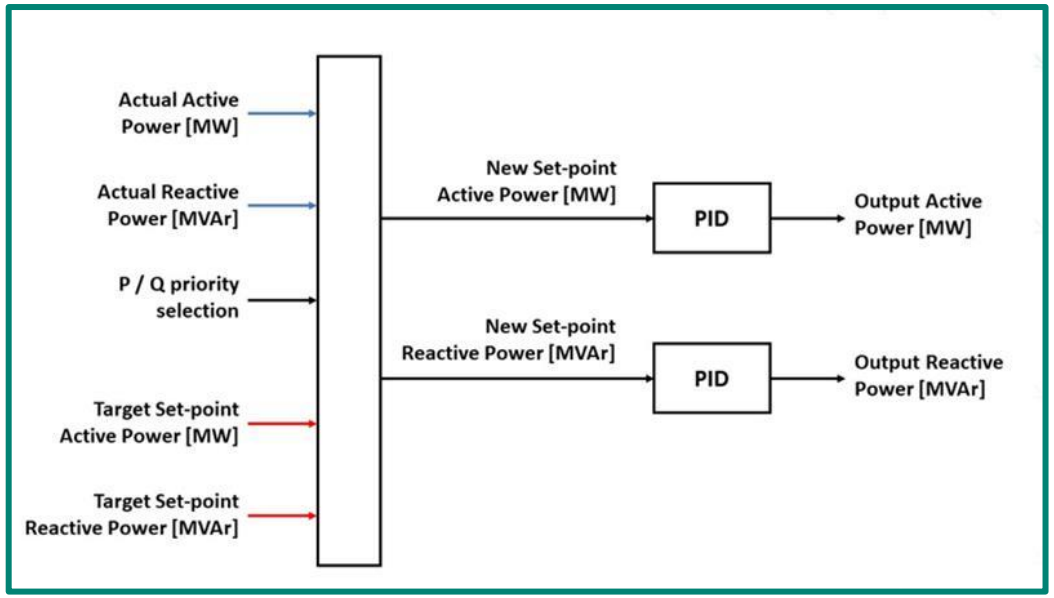
(Synchronous Condenser)

A case study: power generation system supplying data center with highly variable load demand

Equipment supporting (micro)grid stability: Battery Energy Storage System (BESS)

Battery Energy Storage Systems (BESS) play a critical role in maintaining power system stability in data center load profiles.

- Grid-following BESS model suitable for RMS analysis.
- The BESS is able to provide active power to fast recover the grid stability.



BESS UDM

A case study: power generation system supplying data center with highly variable load demand

Transient stability analysis

PROJECT GOAL

Evaluation of the power generation system response to a demanding load change.

TRANSIENT STABILITY ANALYSIS

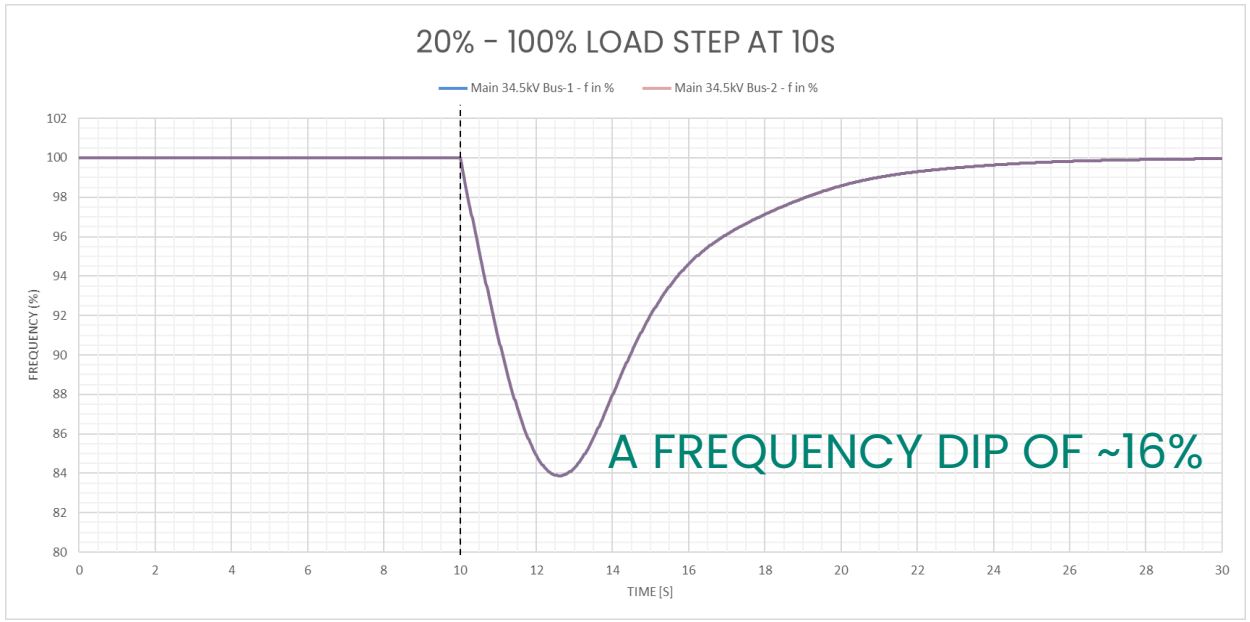
EVENT: Load Step from 20MW (20%) to 100MW (100%)

STUDY CASES (highlights)

- **CASE 1:** Load acceptance event verifies with no BESS neither Synchronous Condenser with 10 GTGs running
- **CASE 2**: Load acceptance event verifies with BESS but no Synchronous Condenser with 10 GTGs running
- **CASE 3**: Load acceptance event verifies with BESS and Synchronous Condenser with 10 GTGs running (ongoing)

Results

CASE 1: 20%–100% LOAD ACCEPTANCE (10 GTGs RUNNING)



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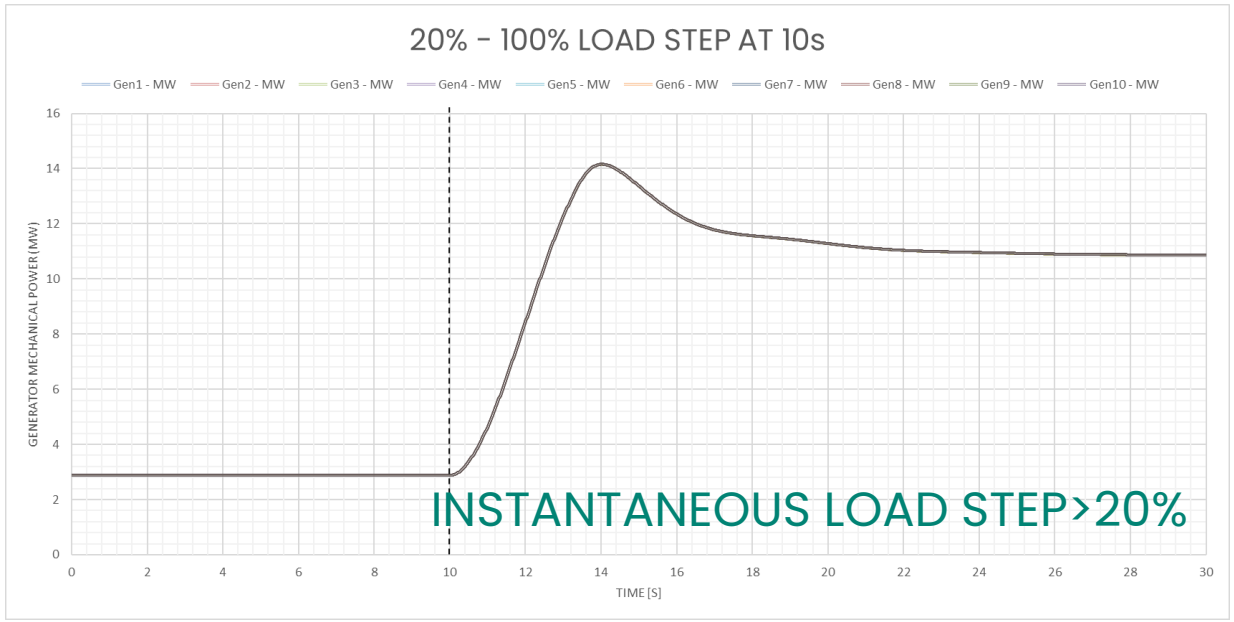
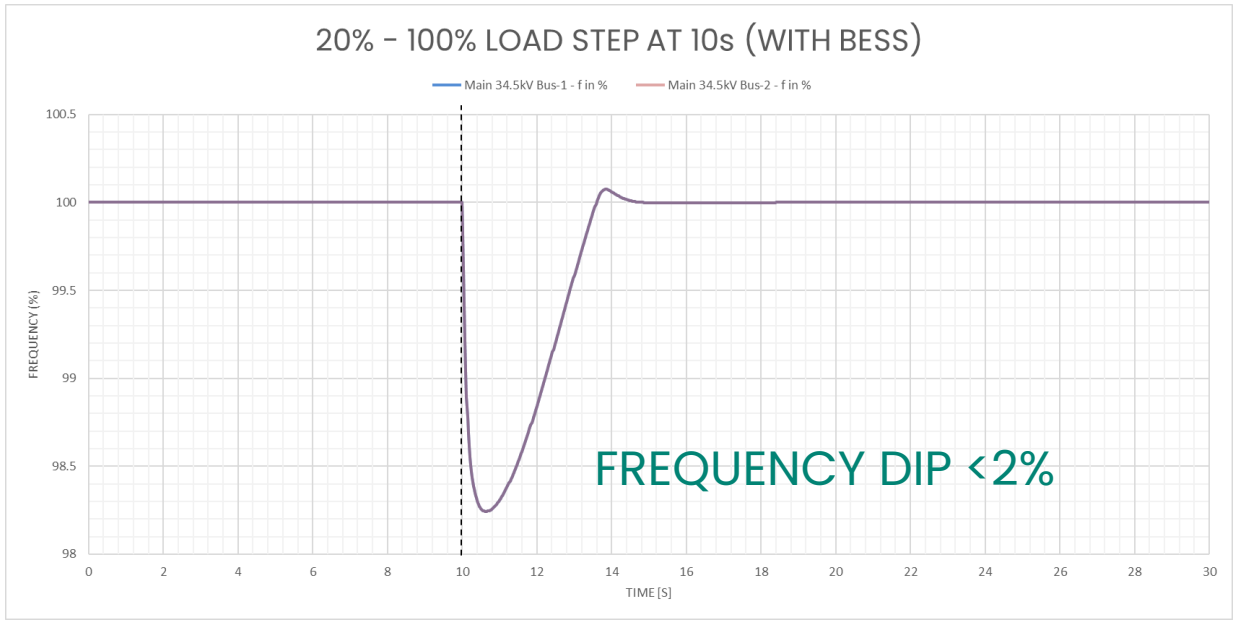


GENERATOR MECHANICAL POWER

Results

CASE 2: 20%-100% LOAD ACCEPTANCE WITH BESS (10 GTGs RUNNING)



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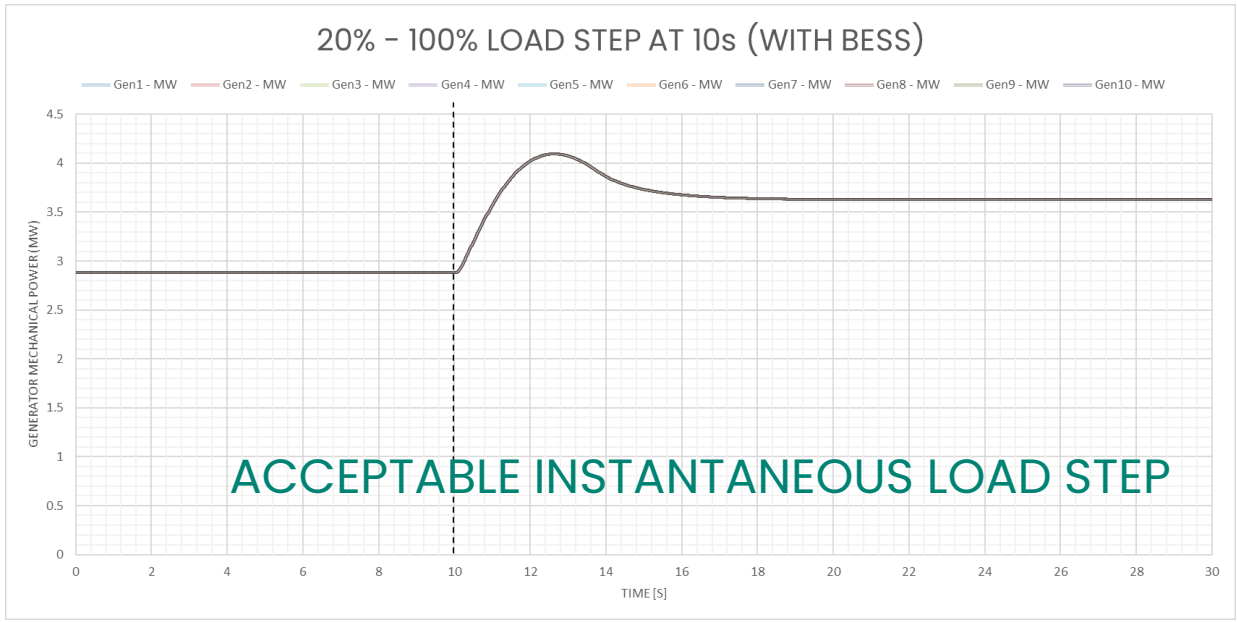

GENERATOR MECHANICAL POWER

Conclusions

Impact of Battery Energy Storage System (BESS) :

- Frequency deviations maintained within ±2% across all scenarios.
- System stable during load acceptance.

The integration of the synchronous condenser (SC) into the overall system configuration remains the subject of ongoing studies.

STUDY CASE	Synchronous Condenser (sc)	BESS	Δf	ΔV	BESS Size
CASE-1	No SC	No BESS	16%	4.6%	-
CASE-2	No SC	BESS	1.8%	4.71%	77.6 MW
CASE-3	SC	BESS	ongoing	ongoing	ongoing

Electrical Digital Twin Foundation for Digitalization, Electrification & Decarbonization

Open Architecture

OEM Agnostic

Cloud Enabled

Single Database

Design to Build

Feasibility to Design

Built to Operate

Operate to Maintain

Multi-Dimensional

Unified Model

Situational Awareness & Sustainability Management	Compliance and safety checks, enterprise view, Work Orders, Analytical Intelligence, What-if scenarios, etc.
3D Insight Reality APM	Asset status, Protection relay settings, Real-Time 3D operational and maintenance Management, etc.
Predictive Simulation	PSMS, Operational Planning, Simulation Before Operation, Switching Sequence, Operator Training, Power Reservations.
Operation & Control	Advanced visualization, controls, SCADA, intelligent monitoring, analytic alarms, PMS, EMS, Microgrid and historian, etc
3D Design & PLM	Asset Information Management, 3D model, wire routing, wire duct, CNC connectivity, drilling and punching, bus bars, etc.
Schematics	Schematics, Bill of Material, Wire list, Cable list, Terminal row plan, Implementation, Labels, BOQ etc.
Power Analysis	Unified AC-DC: Power flow, short-circuit, dynamics, protection coordination, arc flash, harmonics, renewables, etc
iSLD	Network model, native components, wide library, configurations, revisions, rulebooks, AI native.

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