System Configuration & LDDL Workload Model Parameter Values

System Configuration

System configuration and parameters are given in Table I. The turbine generators and multi-mass synchronous generators' shafts are given in Table II.

LDDL Workload Model Parameter Values

Table 3: Workload Model Parameters for LDDL Facilities

Parameter	LDDL1 (Bus 9)	LDDL2 (Bus 36)	LDDL3 (Bus 37)
Workload type	AI Inference	ML Training	Batch Jobs
Rated capacity (MW)	57.5	51.7	46.0
Number of racks N	500	450	400
Servers per rack M	40	40	40
Idle power P_{idle} (kW/server)	0.15	0.15	0.15
Peak power P_{peak} (kW/server)	0.50	0.50	0.50
Poisson arrival rate η (jobs/s)	12.0	—	—
Job duration γ (s)	0.08	—	—
Job duration spread γ_1 (s)	0.02	—	—
Training epoch period (s)	—	1.5	—
Epoch amplitude (LF variation)	—	0.15	—
Batch step interval (s)	—	—	0.8
Batch step size (LF change)	—	—	0.10
Cooling ratio α_1	0.15	0.15	0.15
Cooling response rate α_2	0.05	0.05	0.05
Power supply time const τ_s (s)	0.01	0.01	0.01
Mean load factor (pu)	0.775	0.829	0.840
Std. dev. load factor (pu)	0.107	0.103	0.090

Table 1: IEEE 68-Bus System Configuration and Simulation Parameters

Parameter	**Value**	**Unit**
System base power	100	MVA
System base frequency	60	Hz
Total generation capacity	184.08	pu
Total load demand	184.08	pu
Series Compensation		
Transmission line reactance	0.50	pu
Compensation level	50	%
Capacitor reactance	0.25	pu
Electrical resonance frequency	42.43	Hz
Subsynchronous frequency	17.57	Hz
Simulation Settings		
Simulation duration	5.0	s
Integration time step	0.1	ms
Integration method	RK45 adaptive	
Relative tolerance	10^{-6}	
Absolute tolerance	10^{-9}	

Table 2: Multi-Mass Shaft Model Parameters for Torsional Dynamics

Mass Section	**Inertia H (s)**	**Shaft Stiffness K (pu)**	**Damping D (pu)**
High Pressure (HP)	0.0929	—	0.0
HP-IP coupling	—	19.303	—
Intermediate Pressure (IP)	0.1556	—	0.0
IP-LPA coupling	—	34.929	—
Low Pressure A (LPA)	0.8587	—	0.0
LPA-LPB coupling	—	52.038	—
Low Pressure B (LPB)	0.8842	—	0.0
LPB-GEN coupling	—	70.858	—
Generator (GEN)	0.8685	—	0.5
GEN-EXC coupling	—	2.822	—
Exciter (EXC)	0.0342	—	0.0
Total system inertia: $H_{total} = 2.894\ s$			