OpFlex*
ADVANCED CONTROL SOLUTIONS

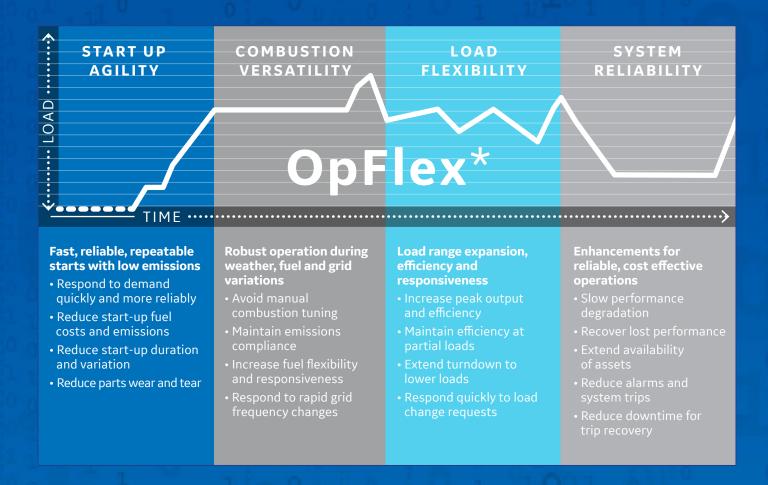| START UP AGILITY	COMBUSTION VERSATILITY	LOAD FLEXIBILITY	SYSTEM RELIABILITY
Fast, reliable, repeatable starts with low emissions	**Robust operation during weather, fuel and grid variations**	**Load range expansion, efficiency and responsiveness**	**Enhancements for reliable, cost effective operations**
• Respond to demand quickly and more reliably	• Avoid manual combustion tuning	• Increase peak output and efficiency	• Slow performance degradation
• Reduce start-up fuel costs and emissions	• Maintain emissions compliance	• Maintain efficiency at partial loads	• Recover lost performance
• Reduce start-up duration and variation	• Increase fuel flexibility and responsiveness	• Extend turndown to lower loads	• Extend availability of assets
• Reduce parts wear and tear	• Respond to rapid grid frequency changes	• Respond quickly to load change requests	• Reduce alarms and system trips
			• Reduce downtime for trip recovery

Technology that helps you flex your operational muscle

YOUR PLANT.
UNDER YOUR CONTROL.

Uncertain fuel costs. Fluctuating industry conditions. Emerging renewables. Fast-changing environmental regulations. With so many things out of your control these days, it just makes good economic sense to get a firmer grip on those things you can control. That's where GE's OpFlex* Advanced Control Solutions come in. This suite of advanced technologies gives you unprecedented control over your power plant—from start-up to balancing to turndown. It's an intelligent way to better manage grid stability, fuel variability, emissions, compliance, and all those other challenges that impact your ability to reduce costs and increase revenue. With OpFlex* Solutions, it's all about giving you more control to respond in real time to real challenges.

OpFlex* ADVANCED CONTROL SOLUTIONS
B–E CLASS

OpFlex* Solution Suite	Category	OpFlex* Product Offering	Description	6B		7EA		9E		Compatible Mark* Controls / Notes
				STD	DLN 1/1+	STD	DLN 1/1+	STD	DLN 1/1+	
Start-Up Agility — Fast, reliable, repeatable starts with low emissions	Start Time and Fuel	Fast Start	Shortened start-up time to full speed-full load to reduce fuel cost, reduce emissions and capture additional revenue. Enables 10-15 minute simple cycle start times.	●	●	●	●	●	●	VI, VIe
	Start Reliability	Start-up Assurance	Simplified start permissives, automated system pre-start checks (various pumps, fans, valves), and HMI start-up sequence screens to reduce the number of failed starts.	●	●	●	●	●	●	VI, VIe
Combustion Versatility — Robust operation during weather, fuel, and grid variations	Automated Tuning	AutoTune DX/DF	AutoTune LT plus closed-loop DLN control module using emissions feedback from CEMS (AutoTune DX) and/or combustion dynamics feedback from CDM (AutoTune DF).		●		●		●	VI, VIe
		AutoTune LT	Automated tuning of DLN fuel splits based on Corrected Parameter Control (CPC) logic to manage combustor emissions, dynamics, and flame stability across all operating conditions.		●		●		●	VI, VIe
		Ambient Select	Dual DLN fuel split schedules within the control system to accommodate basic seasonal DLN tuning needs.		●		●		●	V, VI, VIe
	Reliability	AutoRecover	Automated detection of and recovery from DLN1/1+ Primary Re-Ignition (PRI) events, providing fast restoration of premixed mode with no interruption of high/baseload operation. Compatible with transfer and transferless DLN systems.		●		●		●	VI, VIe
Load Flexibility — Load range expansion, efficiency and responsiveness	Output	Variable Peak Fire	Operator or AGC adjustable peak fire for additional output, subject to user defined MW or emissions limitations. Peak maintenance factor applies.	●	●	●	●	●	●	V, VI, VIe
		Variable Airflow	Operator adjustable max IGV setting for better baseload output or better CC heat rate.	●	●	●	●	●	●	V, VI, VIe
	Turndown	Extended Turndown	Combustion control software to extend the emissions compliant load range to 5% - 10% lower load levels (requires AutoTune LT).		●		●		●	VI, VIe
		Smart IGV Control	Enables improved turndown for units without IBH through the use of enhanced IGV control in warm ambient conditions where icing risk is low.	●	●	●	●	●	●	V, VI, VIe
	Efficiency	Smart Inlet Bleed Heat (IBH)	Replaces static IBH schedule logic with online models to better manage IBH use, enabling improved part load efficiency and turndown in select situations (requires AutoTune DX).		●		●		●	VI, VIe
		Cold Load Path	Enables improved part load efficiency for simple cycle units by improving the GT fuel and air control logic while maintaining CO emissions compliance (requires AutoTune LT).		●		●		●	VI, VIe
System Reliability — Enhancements for reliable, cost effective operations	Operational Packages	Trip Avoidance	Improved protection logic to avoid unnecessary gas turbine trips. Instrument fault accommodation, flame detection errors, valve mis-operation detection, creative redundancies, etc.	●	●	●	●	●	●	VI, VIe
		Sliding Fuel Pressure Control	Reduces gas fuel supply pressure (P2) requirements during start-up and operation to better accommodate low or fluctuating pressure, and possibly enable reduced gas compressor usage.	●	●	●	●	●	●	VI, VIe
		Gas Turbine Outage Odometer	Provides automated calculation and HMI display of factored fired hours (FFH) and starts (FFS) per GER-3620 to simplify maintenance planning.	●	●	●	●	●	●	VI, VIe (Edge-based)
		Diagnostics and Productivity	Software enhancements that improve operator's capability to quickly diagnose and resolve system issues and efficiently execute system tests and procedures		●		●		●	VI, VIe
	Fuels Packages	Heavy Fuel Oil (HFO) Package	Model-Based Control of GT operation to better compensate for hot gas path fouling due to HFO operation, plus a smart cooldown process and optional automated wash system to shorten offline water wash cycles to recover performance.	●		●		●		VI, VIe

DLN = Dry Low NOx combustor
Mark* V applicability subject to unit specific evaluation

S Standard
● Available
O Coming Soon

OpFlex* Solution Suite	Category	OpFlex* Product Offering	Description	6FA.01/.03 DLN2.6 Non-MBC	6FA.01/.03/.04 DLN2.6 MBC	6FA.03/.04 DLN2.6+ MBC	7FA.03 DLN2.6 Non-MBC	7FA.03/.04 DLN2.6 MBC	7FA.03/.04 DLN2.6+ MBC	7FA.05 DLN2.6 MBC	7FA.04-200/.05 DLN2.6+ MBC	9FA.01/.03 DLN2.0+ Non-MBC	9FA.01/.03 DLN2.6+ Non-MBC	9FA.01/.03/.04 & 9FB.05 DLN2.6+ MBC	Comments
Start-Up Agility Fast, reliable, repeatable starts with low emissions	Start Time and Fuel	Variable Load Path (VLP)	Independent GT load and exhaust temperature control to customize startup and operational load paths, enabling lower fuel burn and faster combined cycle starts (requires AutoTune MX).	N/A	N/A	○	N/A	N/A	●	N/A	○	N/A	N/A	●	Requires AutoTune MX
		Fast Start	Shortened start-up time to full speed-full load to reduce fuel cost, reduce emissions and capture additional revenue. Enables 10-15 minute simple cycle start times.	●	●	●	●	●	●	●	●	N/A	●	●	Includes Start Assurance
	Start Time	Purge Credit	Combined control software and valve hardware system to enable purge to be conducted during prior shutdown, followed by isolation of the fuel manifold with a valve system, such that purge can be skipped on start-up, enabling 15+ min. combined cycle start time savings (NFPA- 85 compliant).	●	●	●	●	●	●	●	●	N/A	●	●	Includes Start Assurance, Pre Start Checks
	Start Emissions	Start-up NOx	Advanced combustion control to enable low visible emissions above full speed no load and reduced cumulative start-up NOx emissions.	●	●	N/A	●	N/A	●	S	N/A	●	●	●	
Combustion Versatility Robust operation during weather, fuel, and grid variations	Automated Tuning	AutoTune MX	Full automated DLN tuning at all loads; extends AutoTune DX technology to all combustion modes (requires ETS).	N/A	N/A	○	N/A	N/A	●	N/A	○	N/A	N/A	●	
		AutoTune DX	ETS plus closed-loop DLN control module using combustion dynamics feedback for Mode 6 automated tuning.	●	● (.01/.03); S (.04)	S	N/A	S	S	S	S	N/A	N/A	S	
	Grid Stability	Enhanced Transient Stability (ETS)	Advanced Model-Based Control (MBC) architecture for GT operation plus grid stability software package to help ensure reliable transient operation.	●	S	S	●	S	S	S	S	●	●	S	
Load Flexibility Load range expansion, efficiency and responsiveness	Output	Variable Peak	Online user or AGC adjustable peak fire for additional output, subject to user defined MW or emissions limitations. Peak maintenance factor applies. Operational above 45°F ambient with AutoTune DX, otherwise above 59°F ambient temperature.	●	●	●	●	●	●	●	●	●	●	●	
		Robust Extended Peak	Provides variable, emissions-compliant peak-fire without ambient temperature restriction, up to max equipment capability.	N/A	○	○	N/A	●	●	●	●	N/A	N/A	●	Requires ETS and AutoTune DX
		Variable Airflow	Online, user adjustable max IGV setting for better baseload output or better CC heat rate (requires AutoTune DX); onetime fixed adjustment possible for Mark* V and VI controller, non-AutoTune configurations.	●†	●	●	●†	●	●	●	●	●†	●†	●	†Non-Variable Airflow (Max IGV increase) available for non-ETS/AutoTune units, if not already maxed out
		Cold-Day Performance	Utilizes AutoTune DX technology to allow removal of legacy cold weather firing temperature suppression, enabling higher output (+5 MW at 0°C).	N/A	●	●	N/A	●	●	N/A	N/A	N/A	N/A	●	
	Responsive-ness	Fast Ramp	Enables faster up/down load ramping at up to 2.5x the nominal rate while in emissions compliant operation (Mode 6); (requires ETS).	N/A	○	○	N/A	●	●	●	●	N/A	N/A	●	
		Grid Services Package	Advanced load control software to enable compliance to global grid codes and grid testing requirements, and enable participation in grid support ancillary services (some features require ETS).	●	●	●	●	●	●	●	●	●	●	●	
	Turndown	Extended Turndown	Combustion control software to extend the emissionscompliant load range to 5% – 10% lower load levels.	S	S	N/A	●	N/A	N/A	N/A	N/A	N/A	●	● (.01/.03); S (.04/FB/.05)	
	Efficiency	Variable Inlet Bleed Heat (IBH)	Replaces static IBH schedule logic with online models to enable part load heat rate benefit of 1% or more (requires AutoTune DX).	N/A	●	S	N/A	S	●	S	●	N/A	N/A	●	
System Reliability Enhancements for reliable, cost effective operations	Operational Packages	Trip Avoidance	Enhanced protection logic to avoid gas turbine trips related to problematic exhaust conditions (spreads, over temp., over press.), IBH control, fuel pressure, GCV calibration, etc.	●	S	S	●	S	S	S	S	●	●	S	
		Variable Exhaust Isotherm	Online, user adjustable max part load exhaust temperature (isotherm) to address combined cycle plant HRSG operability, flexibility, and/or life considerations (requires AutoTune DX).	N/A	●	○	N/A	●	○	●	○	N/A	N/A	○	
		Sliding Fuel Pressure Control	Uses closed loop control to reduce gas fuel supply pressure (P2) requirements during start-up and operation to better accommodate low or fluctuating pressure, and possible enable reduced gas compressor usage. Improves protective actions to reduce likelihood of trips or runbacks with low gas pressure.	●	●	●	●	●	S	S	●	●	●	●	
		Gas Turbine Outage Odometer	Provides automated calculation and HMI display of factored fired hours (FFH) and starts (FFS) per GER-3620 to simplify maintenance planning.	●	●	●	●	●	●	●	●	●	●	●	
		Diagnostics and Productivity	Software enhancements that improve operator's capability to quickly diagnose and resolve system issues and efficiently execute system tests and procedures.	●	S	S	●	S	S	S	S	●	●	S	
		Non-Optical Flame Detector	Uses combustion dynamics signals to reliably detect the presence of flame, avoiding the need for dedicated optical flame sensors. Requires Combustion Dynamics Monitoring (CDM) system	N/A	○	○	N/A	○	○	○	○	N/A	○	○	

DLN = Dry Low NOx combustor
Mark* V applicability subject to unit specific evaluation
MBC = Model Based Control (standard with Enhanced Transient Stability, ETS);
  requires Mark* VIe controls

S Standard
● Available
○ Coming Soon

OpFlex* ADVANCED CONTROL SOLUTIONS
PLANT

OpFlex* Solution Suite	Category	OpFlex* Product Offering	Description	Steam Tubine A/D-Class	HRSG All OEM	Compatible Mark* Controls / Notes
Start-Up Agility Fast, reliable, repeatable starts with low emissions	**Steam Turbine**	Steam Turbine Agility	Automated start-up control, revised permissives, and rotor stress management using Model-Based Control to enable fast, repeatable steam turbine start times.	●		VI, VIe; GE or non-GE DCS
		Steam Turbine Fast Cooldown	Automated fast cooldown process using temperature matching logic in reverse, or HRSG terminal attemperators, if available, to safely reduce ST cooldown times by 50% or more, enabling critical path maintenance activities to begin 24 to 36 hours sooner. Emissions compliant cooldown possible using terminal attemperators.	O		VI, VIe; GE or non-GE DCS
	HRSG	Attemperator Control	Model-Based Control of attemperation flow to better regulate steam temperature during start-up and transients, enabling more stable operation, fewer trips, and improved efficiency.		●	VI, VIe; GE or non-GE DCS
		SCR Control	Model-Based Control of Selective Catalytic Reduction (SCR) system ammonia flow to enable enhanced operation during start-up and transients, resulting in less ammonia slip and lower overall NOx emissions.		●	VI, VIe; GE or non-GE DCS
		AutoBlend	Automation of the HRSG blending process to better manage steam temperature and flow when bringing additional gas turbines online in combined cycle plants. This enables more stable operation, fewer trips, and more energy production for the lead gas turbine.		●	VI, VIe; GE or non-GE DCS
		HRSG Boiler Response	Improved setpoint management and tuning of HRSG drum level control to enable more stable operation during starts and transients, and fewer trips.		●	VI, VIe; GE or non-GE DCS
Load Flexibility Load range expansion, efficiency and responsiveness	**Turndown**	Steam Turbine Turndown	Enables extended Combined Cycle plant load turndown by operating the steam turbine outside of inlet pressure control (IPC) at as low a load as possible while maintaining forward HP flow and bypassing excess steam flow to the condenser. Potentially up to 5-10% reduction in minimum Combined Cycle load possible.	O		VI, VIe; GE or non-GE DCS

DLN = Dry Low NOx combustor
Mark* V applicability subject to unit specific evaluation

S Standard
● Available
O Coming Soon

For more information,
please contact your
GE Gas Power
account manager,
or visit our Website

gepower.com

GEA19566D (03/2021)