



Local Start Sequence with Automatic Synchronizing & Paralleling

OPERATOR ACTION		SYSTEM RESPONSE	COMMENTS
1.	Set Synchronizing switch to Auto position.		This is the preferred mode of operation. The switch settings are required for automatic voltage, frequency, and phase matching. This permits automatic synchronizing and paralleling of the applicable breaker.
2.	Set Voltage Regulator excitation mode switch to Auto position; and set Voltage Regulator On-Off switch to On position.	On the CRT, AVR In Auto message appears on the Generator Data portion of the display. If manual voltage regulation has been selected, the AVR In Manual message replaces AVR In Auto.	
3.	Select Start from the Unit Control screen.	Compartment vent fans toggle, and vent fan airflow is verified. The hydraulic start pump is energized.	
		The generator auxiliary lube oil pump energizes. Pump discharge pressure is verified.	
		10 sec later, the starter is engaged, and cranks the gas generator.	The GTG set undergoes crank.



OPERATOR ACTION		SYSTEM RESPONSE	COMMENTS
3.	Select Start from the Unit Control screen. (Cont)	The purge ends after 2 min (standard configuration) and approximately 7-8 min (HRSG). The solenoid valve de-strokes the starter swash plate to min position, and the gas generator speed decreases to 0%.	
		When gas generator speed drops below 1700 rpm for gas/1200 rpm for liquid, the solenoid valve positions starter swash plate angle to max (100%).	
4.	On the CRT system, observe the rpm indicated by GG Speed Reference display.	The starter ramps to 100% and begins to accelerate the gas generator.	If the gas generator speed fails to exceed 1700 rpm within 10 sec, the <i>Fail To Crank</i> shutdown is tripped.
5.	Observe power turbine inlet T48 Temp and GG Speed Reference displays.	Fuel flow and ignition start at 1700 rpm for gas or 1200 rpm for liquid.	Light-off speed.
		Light-off occurs. T4.8 should exceed 400°F (204°C).	If T4.8 temperature fails to exceed 400 °F within 10 sec (or 25 sec for liquid fuel) after gas generator speed reaches 1700 rpm, the <i>Fail To Ignite</i> shutdown is tripped..



OPERATOR ACTION		SYSTEM RESPONSE	COMMENTS
5.	Observe power turbine inlet T48 Temp and GG Speed Reference displays. (Cont)	The fuel system start ramp begins increasing fuel flow to accelerate the gas generator to idle (starter disconnect) speed.	<p>If gas generator speed fails to exceed 4500 rpm within 60 sec after T48 temperature reaches 400 °F (204°C), the <i>Fail To Accelerate</i> shutdown is tripped</p> <p>Gas turbine has reached its minimum self-sustaining (idle) speed (app. 6800 rpm).</p>
		<p>When gas generator speed exceeds 4500 rpm,</p> <ul style="list-style-type: none">- starter disengages- igniters shut off- <i>Starting Cycle</i> message terminates- <i>Turbine Running</i> message appears- <i>Fired Starts Counter</i> advances by one increment- <i>Turbine Run Time</i> meter initializes	<p>As generator shaft speed reaches 2500 rpm, the electronic control system deenergizes the auxiliary pump and the generator-driven pump assumes lubrication load.</p> <p>If oil pressure is outside pre-set limits, the control system reenergizes the auxiliary pump, activates an alarm, and displays the <i>Aux Pump On Unsched</i> message. The AC pump remains energized until the problem is corrected.</p>

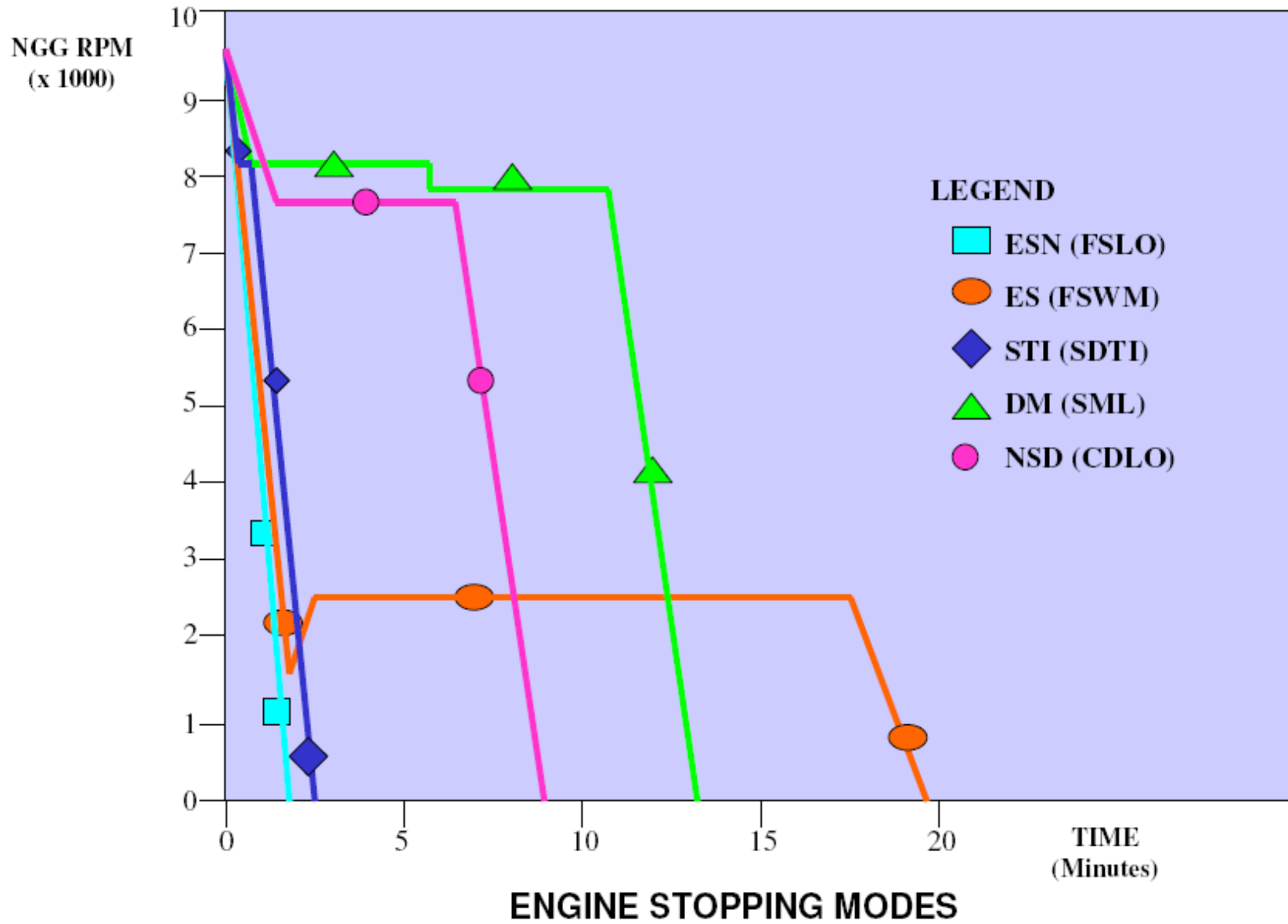


OPERATOR ACTION		SYSTEM RESPONSE	COMMENTS
6.	On the CRT display, observe that gas generator speed stabilizes at approx. 6800 rpm and that power turbine speed increases.	Gas generator speed reaches 6800 rpm, starting 1 min warm-up timer.	If power turbine speed fails to exceed 350 rpm within the 1 min warm-up period, the <i>PT Fail To Accelerate</i> shutdown activates.
		After 1 min warm up complete, GG ramps up to accelerate power turbine to 3600 rpm.	Excitation increases as the unit accelerates to synch idle speed
7.	On the CRT's <i>Gen Power Data</i> screen, observe <i>Generator Voltage</i> data, <i>Exciter Field Voltage</i> data, and <i>Exciter Field Current</i> ampere data.	After an approximate 60 sec delay for voltage to stabilize, paralleling devices are enabled.	
8.	Observe the red and green lamps used to indicate the status of the circuit breaker.	When paralleling devices match generator frequency, phase angle, and output voltage with those on the other bus, the circuit breaker closes and <i>Ready To Load</i> appears.	The MGTG set is ready to assume its proportional share of the load. The red (breaker closed) lamp illuminates and the green (breaker open) lamp extinguishes.



OPERATOR ACTION		SYSTEM RESPONSE	COMMENTS
9.	On CRT's <i>Gen Power Data</i> screen, check generator ammeter, varmeter, and wattmeter readings.		
10.	On the CRT, check <i>T48 Temp</i> , <i>GG Speed</i> , and <i>PT Speed</i> displays.		
11.	Use the <i>Governor Raise-Lower</i> switch to increase the loading on the generator.	The unit assumes new load setting by increasing fuel flow. Loading is limited by T48 maximum temperature.	

END OF SEQUENCE





Engine Stopping Modes

Shutdown may be initiated by operator selection or caused by engine operational conditions at any time during startup or running operational modes. The LM2500 software code lists more than 200 engine, generator, and subsystem conditions that can cause a shutdown.

The five programmed shutdown sequences that can occur once shutdown is initiated are:

- 1) Emergency Stop – No motoring (**ESN**)
- 2) Emergency Stop with motoring (**ES**)
- 3) Step To Idle (**STI**)
- 4) Decelerate to Minimum load (**DM**)
- 5) Normal Shut Down (**NSD**)



ESN (FSLO) - Emergency Stop No motoring (Fast Stop Lock-Out)

- Immediately shutdown the unit by shutting off fuel, water / steam and trip the breaker.
- When NGG (HP shaft) coasts down below 300 RPM and if the T48 temperature is above 1150 degrees F (621 degrees C) then a 4-hour lockout will be initiated after a 10 minute delay.
- A 15 minute crank cycle must complete to reset the 10 minute delay timer.
- If the crank cycle is interrupted, causing N25 to coast below 300 RPM, and if the high T48 temperature persists, then a 4-hour lockout period is initiated

ES (FSWM) - Emergency Stop (Fast Stop With Motoring)

- Immediately shutdown the unit by shutting off fuel, water / steam and trip the breaker.
- When N25 (HP shaft) coasts down to 1700 RPM, engage starter and crank for 15 minutes.



STI (SDTI) - Step to Idle (Step Decel To Idle)

- Immediately step the megawatt load to minimum. The breaker remains closed.
- If the SI condition cannot be reset within 10 seconds then an ESN occurs.

DM (SML) - Decelerate to Minimum load (Slow to Minimum Load)

- Fast load shed within 20 seconds. If the DM condition cannot be reset within 5 minutes then an NSD occurs.

NSD (CDLO) - Normal ShutDown (CoolDown LockOut)

- Shed load and water / steam at the normal stop rate of 0.19 MW/Sec. Open breaker when minimum load is achieved.
- Idle at synchronous speed for 5 minutes maximum to cool down unit and then shut off fuel, water / steam.
- If the NSD condition can be reset within the shutdown period, then the NSD shutdown is aborted.
- Fans & lube oil pumps remain on for a 30 minute cool-down cycle