

Stephen Coester added 6 new photos.

· March 20 at 7:46am ·

I had posted this on a Space Shuttle site but putting it here for anyone interested. Particularly my son, Dean, and Phil Hampton the SSME manager at KSC while I was MPS supervisor.

This shot of the SSME schematic was just posted the other day but I'm posting it again because I want to discuss the SSME start which even though I worked Main Propulsion for nineteen years has always blown my mind. The SSME must go from zero to 100% thrust in 3 seconds.

At SSME start command, the ET LH2 and LO2 tanks have been pressurized providing a head pressure of 41 psi and 100 psia respectively at the SSME low pressure pump inlets. The SSME has been temperature conditioned and the MPS recirculation pumps shut off and the LH2 pre valves opened at T-10 seconds. LO2 bleed has been terminated.

So this powerful beast is sitting there with just a low inlet pressure and no pumps turning. The start command is given and all it takes to get the engine roaring is to open a few valves and turn on the augmented spark igniters.

The propellants flow through the inactive low and high pressure pumps and the also inactive LO2 preburner pump. In short order the propellants make it to the hydrogen and oxygen preburner injectors where they are mixed in a fuel rich mixture and ignited. Some of the H2 detours to the nozzle and thrust chamber for cooling before heading to the preburner.

Now things start happening quickly. The preburned gas drives the turbines that in turn drive the high pressure H2 and O2 pumps which quickly ramp up to 33000 and 22000 rpm. The H2 low pressure pump is driven by thrust chamber H2 coolant flow which exits to the preburner. The low pressure LO2 pump gets driven by some of the outlet of the High pressure O2 pump and the returns to the main flow.

The pressures and temperatures start rising extremely rapidly until they reach 3000 to 7000 psi and 6000 degrees.

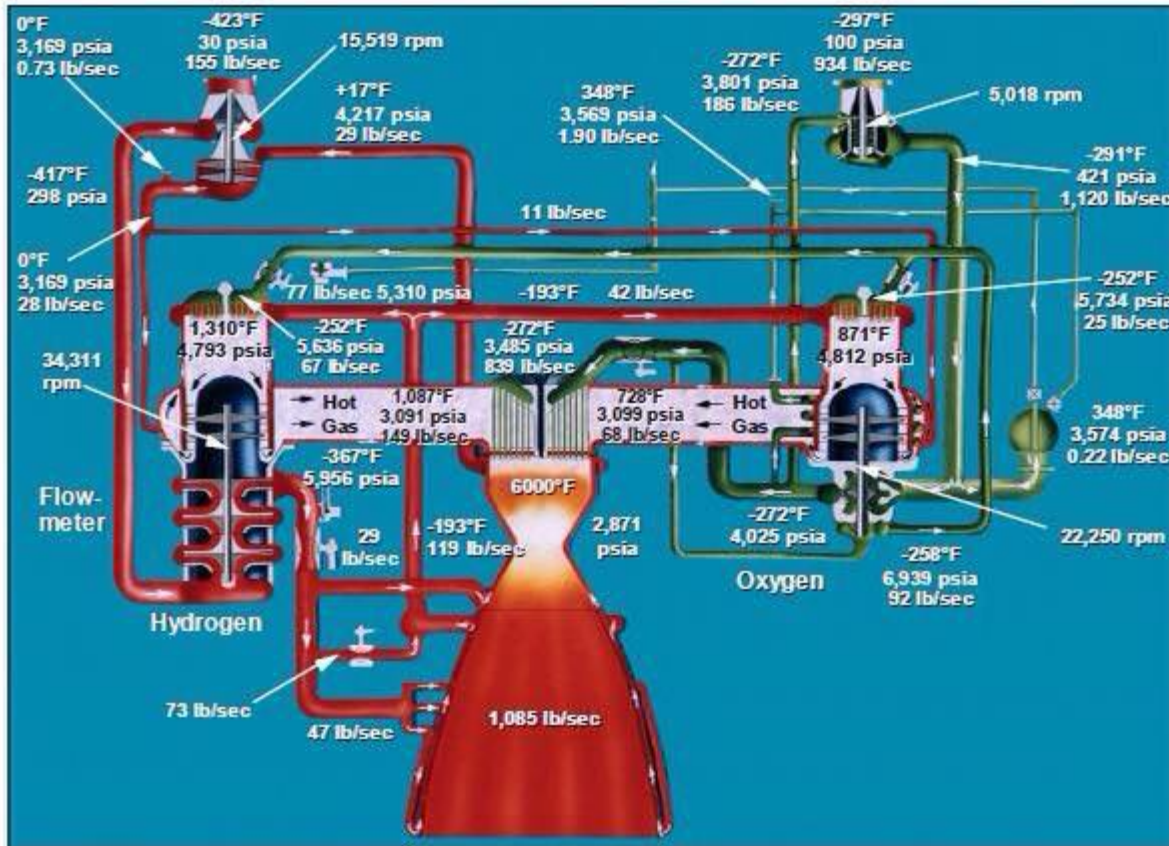
All of that preburned high pressure hydrogen rich gas plus a bit of H2 coolant flow then enters the main injector at the thrust chamber where it is mixed with six pounds of high pressure O2 for each pound of H2 and ignited by another igniter resulting in 450000 pound of thrust and 25000 gallons of propellant being consumed every minute.

And that's about it.....and it all happens in that three seconds.

It is fascinating from the charts how in that short three seconds the five valves are throttled up and down to attain a smooth thrust buildup under constantly changing pressure and propellant flow conditions. Must have been a lot of trial and error at NSTL before they got it right.

Details of the start sequence are shown in the pictures

Block IIA SSME Propellant Flow Schematic 104.5% of RPL



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(IGNITION PHASE - NOMINAL DURATION: 2.3 SECONDS)

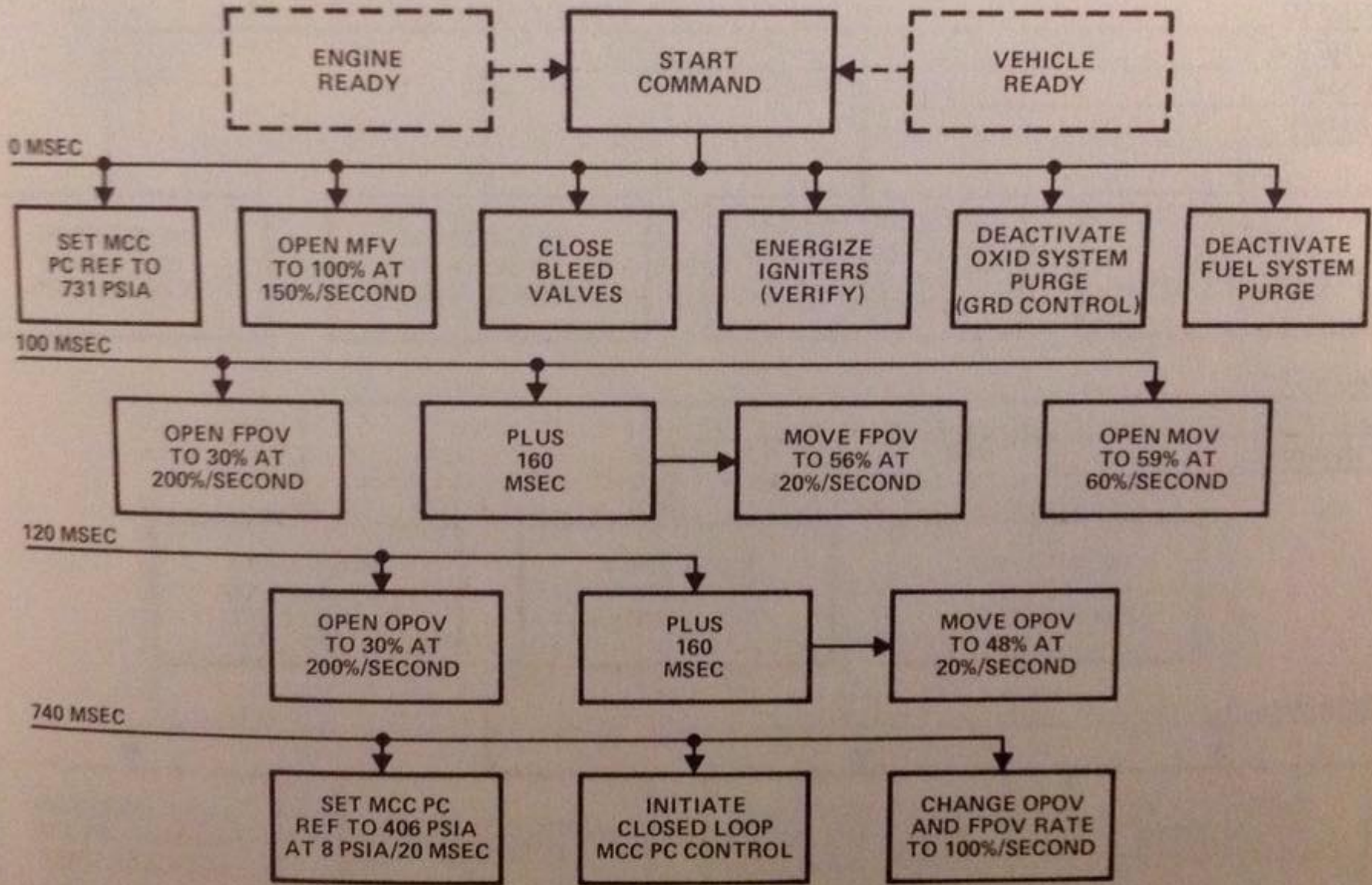


FIGURE 1-14. SSME OPERATIONAL PHASE/MODES (SHEET 9 OF 19)

(IGNITION PHASE CONTINUED - NOMINAL DURATION: 2.3 SECONDS)

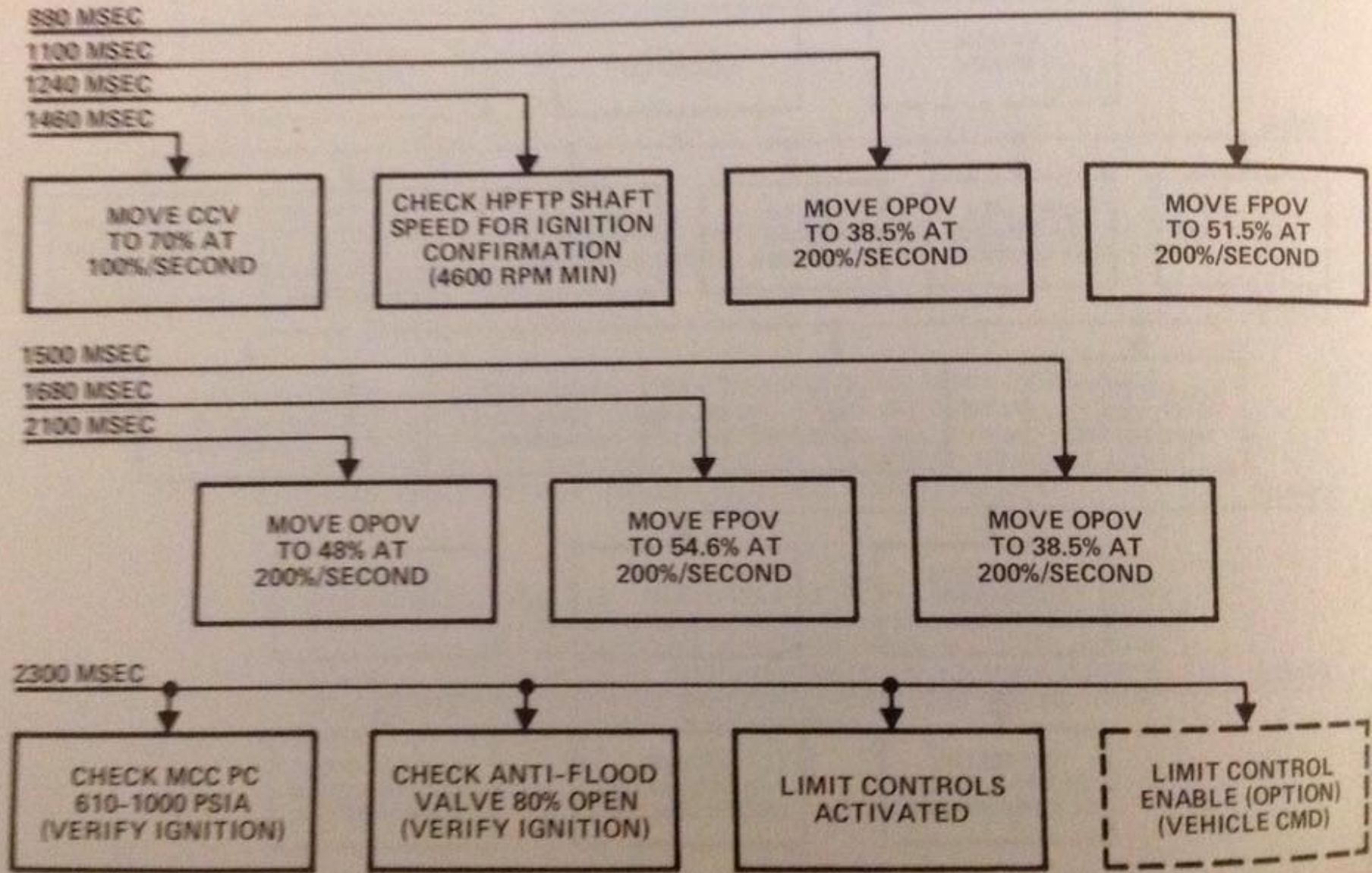


FIGURE 1-14. SSME OPERATIONAL PHASE/MODES (SHEET 10 OF 19)

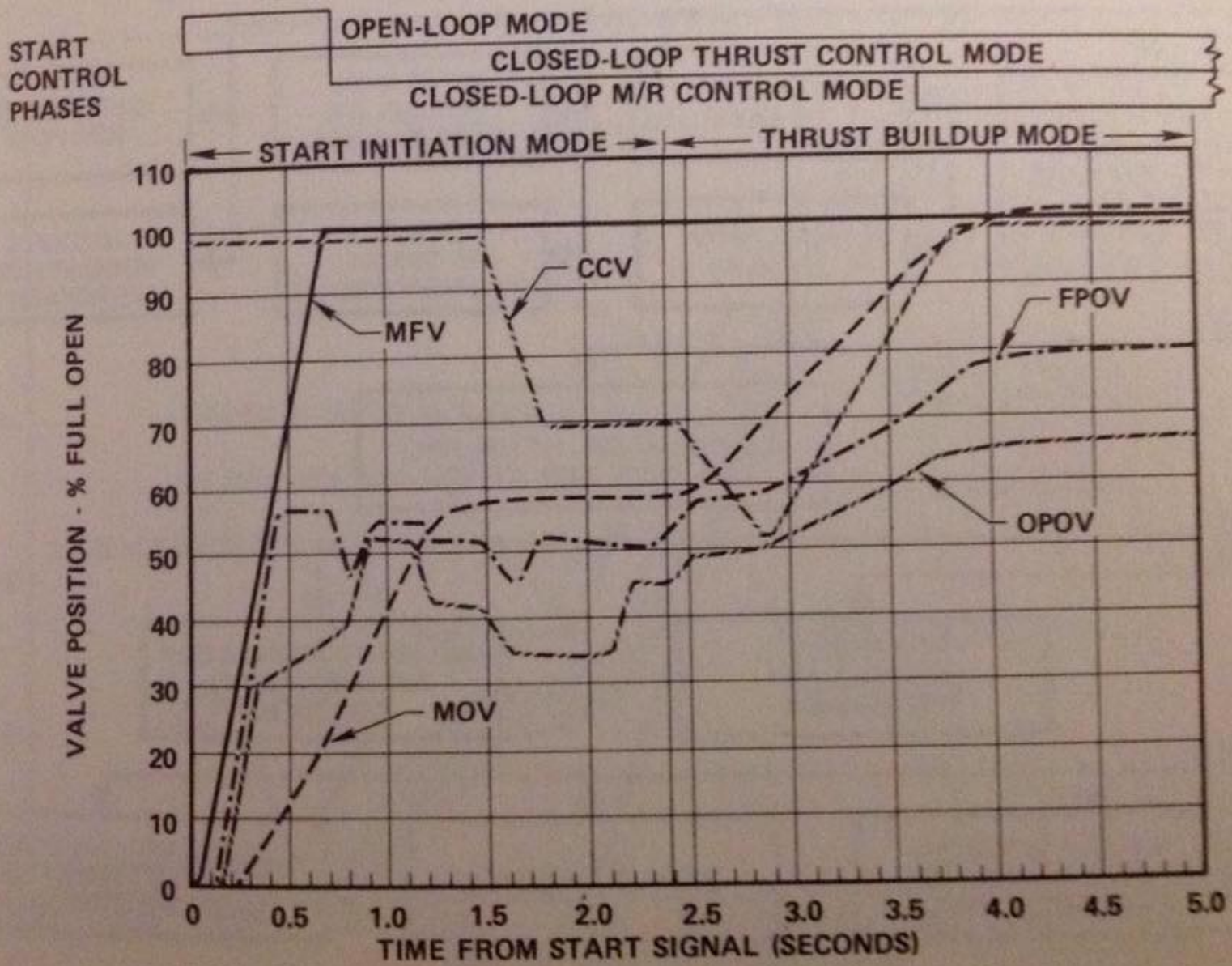


FIGURE 1-14. SSME OPERATIONAL PHASE/MODES (SHEET 11 OF 19)

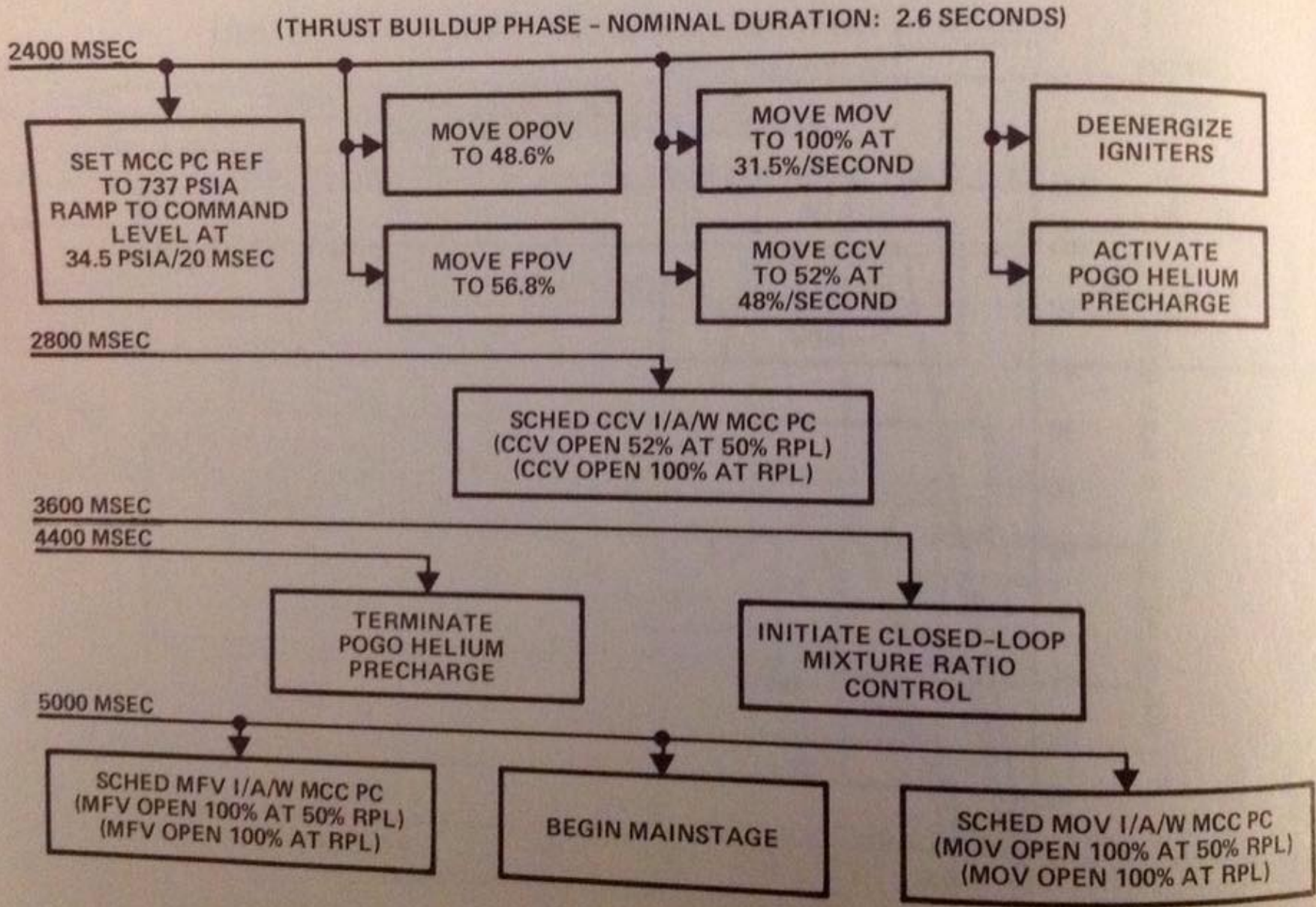


FIGURE 1-14. SSME OPERATIONAL PHASE/MODES (SHEET 12 OF 19)

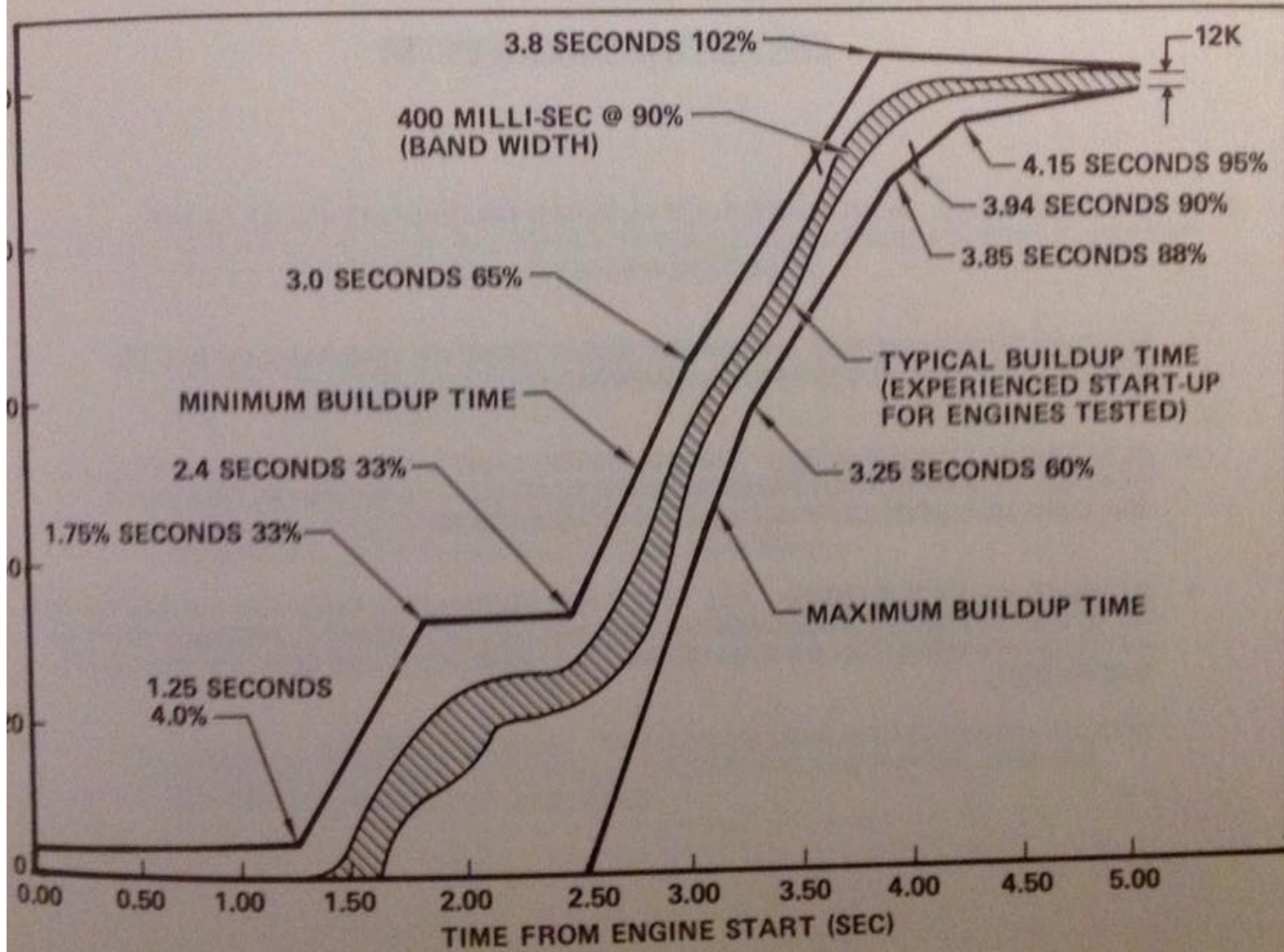


FIGURE 1-14. SSME OPERATIONAL PHASE/MODES (SHEET 13 OF 19)

