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Sally K. Ride Papers - STS-51L Mission Operations Manual

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Three SRB chamber pressures from each SRB are displayed at 1 sample/sec in the MCC. The data are used to relay to the crew whether a delayed SRB separation can be expected because of instrumentation failures.

System design does allow Orbiter separation from the ET while SRB's are thrusting. However, SRB separation from the ET does not occur. From ET separation initiation the system was designed to take 3.4 seconds until the Orbiter physically separated from the ET to allow main engine shutdown, engine prevalve closure, and disconnect valve closure. Past studies indicate that the Orbiter would not structurally survive an attempted Orbiter separation from the ET while the SRB's are thrusting. These studies show the Orbiter would rotate about the aft attach points and wing structural failure would occur. Additionally, disconnect valve rupture could allow explosive mixing of cryogenic propellants with spraying into the aft Orbiter structure and probable disintegration of the ET. Current use of this capability is limited to after SRB burnout for multiple main engine failures. Thus, for the mission STS 51-L failure, no survivable abort options were available.

After SRB separation, at approximately 120 seconds after lift-off, several intact abort modes were available to STS 51-L. An intact abort consists of a controlled landing on a runway. The first abort mode available would have been a Return to Launch Site (RTLS) abort. In this abort mode, flight is continued downrange in order to burn excess main engine propellant until the Orbiter and the ET can be turned around and flown back to a point near the Florida coast where the engines can be shut down and the Orbiter, after separating from the empty ET, can glide back to the Shuttle Landing Facility (SLF) at KSC. At 231 seconds after lift-off, the downrange velocity of the Orbiter would have been too great to enable flyback to KSC; and the next mode to be used, if needed, would have been a TAL abort. This mode covers the period when RTLS is no longer available, but there is not enough performance to make it either once around to Edwards or to continue on to a low orbit.

A TAL abort allows an intact landing at the TAL site chosen. For STS 51-L, the TAL site was Dakar, Senegal, with a single SSME failure prior to the "single engine" call, and with two engine failures after the call. The TAL and RTLS abort modes overlap for a brief period of time. The current ascent Flight Rules normally would have the crew perform RTLS rather than TAL during the period they overlap.

At 320 seconds after liftoff, STS 51-L would have achieved enough performance to be able to continue on to main engine cutoff (MECO) targets with a single engine failure and have at least enough performance to accomplish an abort-once-around (AOA). An AOA would have had STS 51-L deorbit on its first orbit and land at Edwards Air Force Base. At 427 seconds into the flight, STS 51-L would have been able to sustain two SSME failures and still make an AOA. Again, the abort modes overlap, this time between TAL and AOA. The current Flight Rules favor AOA over TAL. Once enough performance existed to enable

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