

DA8-85-04 (FT)

DA8/Chairman, STS Flight Techniques
Special Topics

Special Topics Flight Techniques Meeting #1 - Addition/Use of Sixth GpC -
Minutes

The first meeting of Special Topics Flight Techniques was held on December 18, 1984, at the Johnson Space Center. Rockwell, Downey, Draper Laboratories and NASA Headquarters participated via teleconference.

Summary

The following points were made on addition of a sixth GPC concerning hardware versus software failure during each flight phase, training requirements, power requirements, MCC requirements, IP bus requirements, location and string configuration.

a. Prelaunch

(1) PASS

(a) If the GPC stops processing; assume hardware failed, move the string and continue countdown.

(b) If there is a fail to sync and the GPC is still running, an analysis is required (~2 hours) to verify a hardware versus a software failure.

(2) BFS

(a) If failure occurs prior to T-20, IPL new GPC and continue if BFS functions properly, else scrub.

(b) If failure occurs between T-20 to T-9; recycle PASS to T-20 (OPS 9) and IPL new BFS GPC; do another 1-shot transfer and continue if BFS functions properly, else scrub.

NOTE: Currently KSC requires BFS dump and verify before proceeding.

(3) Reconfigure to sixth GPC as late as T-9 minutes.

(a) The T-9 hold is a good time for PASS GPC restring/reconfiguration. The general consensus of the panel is we can safely reconfigure and go on.

(b) The T-5 mInijtes f1PU start is probably too late to reconfigure; CB is not in favor of GPC reconfiguration at this late time in the countdown.

(c) For any late reconfiguration/restringing we would not launch on time, but spend some time in the T-9 hold to be completely sure of our launch GPC status.

b. Ascent Options

(1) Run 5 GPC RS through ascent.

(a) Requires expensive analysis of 5 GPC RS (with unbalanced strings, more time in error loops, all abort modes).

(2) Take fifth GPC to halt at T-9 and run 4 GPC RS.

(a) This option requires a capability (software modification) to allow adding GPC to RS in OPS 101 prior to T-9.

(b) Less analysis/software verification is required since latest reconfiguration time is well known.

(c) CB requires a sixth GPC installed in the SMS for training for either option.

c. Entry Options

(1) The ascent/entry configuration to be run the same whichever option is picked.

(2) Modify software to allow GPC's to be added to RS in MM 101, 302, and 303, and run 4 GP RS.

d. Orbit

(1) Use GPC 5 to functionally replace failed GPC's.

(2) Used as dedicated payload GPC vice processor dedicated to payload.

(a) Open areas to be resolved:

1 If the GPC is used, redefine the priorities for a GPC failure.

-2-

2 The Payload bus assignment (SM versus PL MF) is mutually exclusive today. SM must have payload busses. What are the new bus requirements? Which busses apply to which GPC's? What are the LB's

requirements?

- 3 CRT usage conflict, If any?
- 4 New software development required?
- 5 More power requirements on orbit? Payload required
2 GNC, 1 SM, 1 PL.

e. SMS Training

(1) CB believes we require at least one base updated to 6 GPC's; STS 51-D rewiring required on present projected schedule.

(2) Time required for implementation estimated between 10 months and 18 months. CB would not want to use a sixth GPC during a mission until training is available.

(3) EH4/G. K. Aaines says no GPC's available. They would have to be scavenged from GNS.

(a) There will be schedule conflict for development.

(b) There will be schedule conflict for training on a certain SMS base.

(4) Issues to be resolved.

(a) Mission requires new controls/displays.

(b) EPS/cooling model update.

(c) IP busses

f. Ascent Power Requirement

(1) No problems are anticipated.

g. Sixth GPC MCC Requirements

(1) No problems anticipated with downlist.

(2) Require (desirable) new OI data.

(a) RPC status

(b) I - fail

h. IP Bus Requirements

(1) Initial reviewing effort indicates the IP bus requirements can be accomplished.

(2) We will work with the MG/C. T. Dawson working group to insure the requirements are met.

(3) BFS - 2 IP's

(4) SM GPC - 2 IP's (Use GPC 1 - Change FDF)

(5) GNC (1) - 2 IP's

(6) GNC (Secondary) - 1 IP to PCMMU 1

i. Location of sixth GPC

(1) DF7 is working with Rockwell to minimize IFM impacts.

(2) Locate under Bay 3A.

j. BFC

(1) Already has one set extra (for sixth GPC).

(2) Interface wiring all that is required.

1. Sixth GPC Usage/Configuration - DF2/A. F. Algate

Mr. Algate's presentation covered the proposed sixth GPC configurations for prelaunch, ascent/entry and orbit. The objective of adding another GPC is to preclude double string for entry and significantly improve the STS vehicle launch probability.

Prelaunch

During the prelaunch phase the issue is to accurately differentiate between a hardware and software failure. In PASS, the panel decided if the GPC stops processing, a hardware failure is assumed, move the string and continue countdown operations. A dump is desired, but analysis is not required. However, if a GPC fails to sync and is still running, then a dump and an analysis of approximately 2 hours is required to verify the failure was not in the software.

In BFS, move the BFS to a different GPC, if the problem is not obviously software, and assume a hardware failure if the BFS functions properly with the new GPC.

In particular, if a failure occurs prior to T-20, IPL the new GPC and continue the countdown if the BFS functions properly otherwise scrub the launch. Between T-20 and T-9 recycle PASS to T-20 via ops 9 and IPL the new BFS, GPC. Perform another 1 shot transfer and continue if the BFS functions

properly otherwise scrub. (The current KSC requirement to do a BFS dump and verification before proceeding needs to be reconciled.)

The general consensus of the panel was down to the T-9 hold we can safely restrIng/reconFIGure PASS GPC. The panel, including CB was not in favor of a reconFIGuratiOn as late as T-5 APU start.

Addition of a sixth GPC for redundancy will not guarantee a launch. In two previous launch slips, a sixth GPC would not have prevented the slip in the case of STS-1 but may have in the case of STS 51-A, although there would have been a 2 hour delay. Upcoming flights like STS 61-F and STS 61-G have tight launch windows for which a 2 hour hold could not be tolerated.

Ascent

Three options were presented for ascent. One was to run a five GPC redundant set through the ascent phase of the mission. This option would require extensive analysis of 5 GpC RS covering unbalanced strings, the additional times required in the error loops and impact on all abort modes before it could be accepted.

The second option is to take the fifth GPC to halt status at 7-9 and run a 4 GPC RS. This one is undesirable because it requires late reconfiguration by the crew.

The third option requires a software change which would allow adding a GPC in major mode 101. The software modification permits leaving the sixth GPC in halt until it is required. An advantage of the option is that less analysis and software verification would be required since latest reconfiguration time is well known.

Entry

The entry configuration should be the same one selected for ascent. The software should be modified to allow GPC to be added to RS in major modes 101, 302, and 303; and, configured to run 4 GPC redundant set if that option is selected.

Orbit

The on-orbit configuration would be to use GpC 5 to functionally replace failed GPC's. This option provides additional GPC flexibility, but there, would be FDF impacts to GPC failure recovery procedures. In addition, it could be used as a dedicated payload GPC vice processor currently dedicated to payloads.

Action: 12/18-001 DF2/A. F. Algate - Assess sixth GPC as dedicated payload GPC and provide recommended orbit configuration for GPC's second bus assignments.

2. SAIL and SMS Training Impacts - DG6/D. D. Beckman

Mr. Beckman's presentation covered SAIL and SMS training requirements and impacts. He proposed pre-launch training could be accomplished at SAIL

provided the sixth GPC would not be used after T-9 minutes. If the GPC is to be used after T-9 then significant Impact on SMS Is anticipated Including installation of a GPC In both of the bases at the SMS. CB believes at least I one base must be upgraded with a sixth GPC and they would not want to fly a mission with the sixth GPC installed in the Orbiter until the SMS is upgraded and subsequent crew training with It Is completed In the SMS. There are no GPC's available except by scavenging from GNS and there would be schedule conflicts to SMS base modification and current training requirements-

Enclosure 1 details the Impacts on the SMS.

3. Ascent Power Loading Concerns for 6 GPC Ons - DF7/P. M. Joyce

Enclosure 2 describes power considerations for the addition of a sixth GPC. No power problems are anticipated during ascent.

4. Sixth GPC Data Requirements - DF2/A. F. Algate

Mr. Algate indicated there are no new requirements for down list data. It is desirable to obtain new OI data for the RPC and I fail status indications.

5. IP Bus Wiring Considerations/Concerns - DF2/J. F. Muratore

Mr. Muratore Presented IP bus wiring consideration and concerns for the sixth GPC. Enclosure 3 is a list of INCO/COMM requirements for essentially no Impact to the current FDF and procedures. Item 5 requirement of the enclosure is a sub requirement resulting from requirementd 1 and 2. The requirements seem straightforward to meet but will be placed on the agenda of a project working group headed by MG/C. T. Dawson convened to insure resolution of problems, and requirements like these are met.

6. Five GPC RS Verification Analysis for Ascent Phase - FR2/W. C. Young

Deferred

7. Sixth GPC Physical Location Effects on IFM's - DF7/R. L. Robbins

Mr. Robbins discussed the physical location and IFM Impacts of the sixth GPC. The probable location will be under AV Bay 3A. DFJ Is working with Rockwell to confirm the location and minimize IFM impacts.

8. (Walk on) On-orbit GPC/String Configuration - DF6/J. Bantle

Mr. Bantle presented the on-orbit GPC/string configuration options available based on which systems redundancy needs to be Protected. The panel decided to continue to fly the current string configuration except during rendezvous/prox ops and in those cases protect translational redundancy. On those days we would restring early for rendezvous/prox ops to a 13/24 configuration and maintain the string through termination of the rendezvous/prox ops then restring to 14/23. The consensus of the panel was to retain the nominal string configuration except for some specific operations for minimum impact to FDF procedures.

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