

JPC Lessons Learned Forum

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Propellant and Purge System Contamination “2007: A Summer of Fun”

Randy Galloway, Director
SSC Engineering and Test



RELEASED - Printed documents may be obsolete; validate prior to use.





“Summer of Fun”



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- Summer 2007 will be remembered at SSC for a long time
 - Multiple propellant/pressurant system contamination events
 - Two liquid hydrogen (LH₂) tanks contaminated with Nitrogen (N₂)
 - Other problems found while investigating the LH failure
 - » Gaseous Hydrogen (GH₂) contaminated with Helium (He)
 - » Helium contaminated with air (at one stand)
 - Numerous other mishaps within a 2 month period
- RS-68 and Space Shuttle Main Engine (SSME) test programs were suspended from late May until mid-July
- Pressure was on!
 - Investigation was anything but straightforward
 - Additional mishaps left us with “snakebit” feeling



SSC Overview



A-1 Test Stand

B Test Stands

A-2 Test Stand

A-3 Test Stand

E-Complex



SSC Test Stands



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A-1



A-2



E-1



E-2



E-3



B-1

B-2



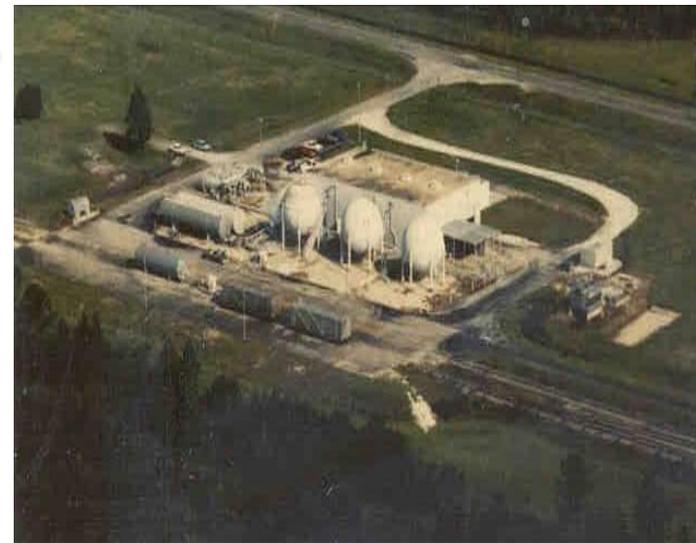
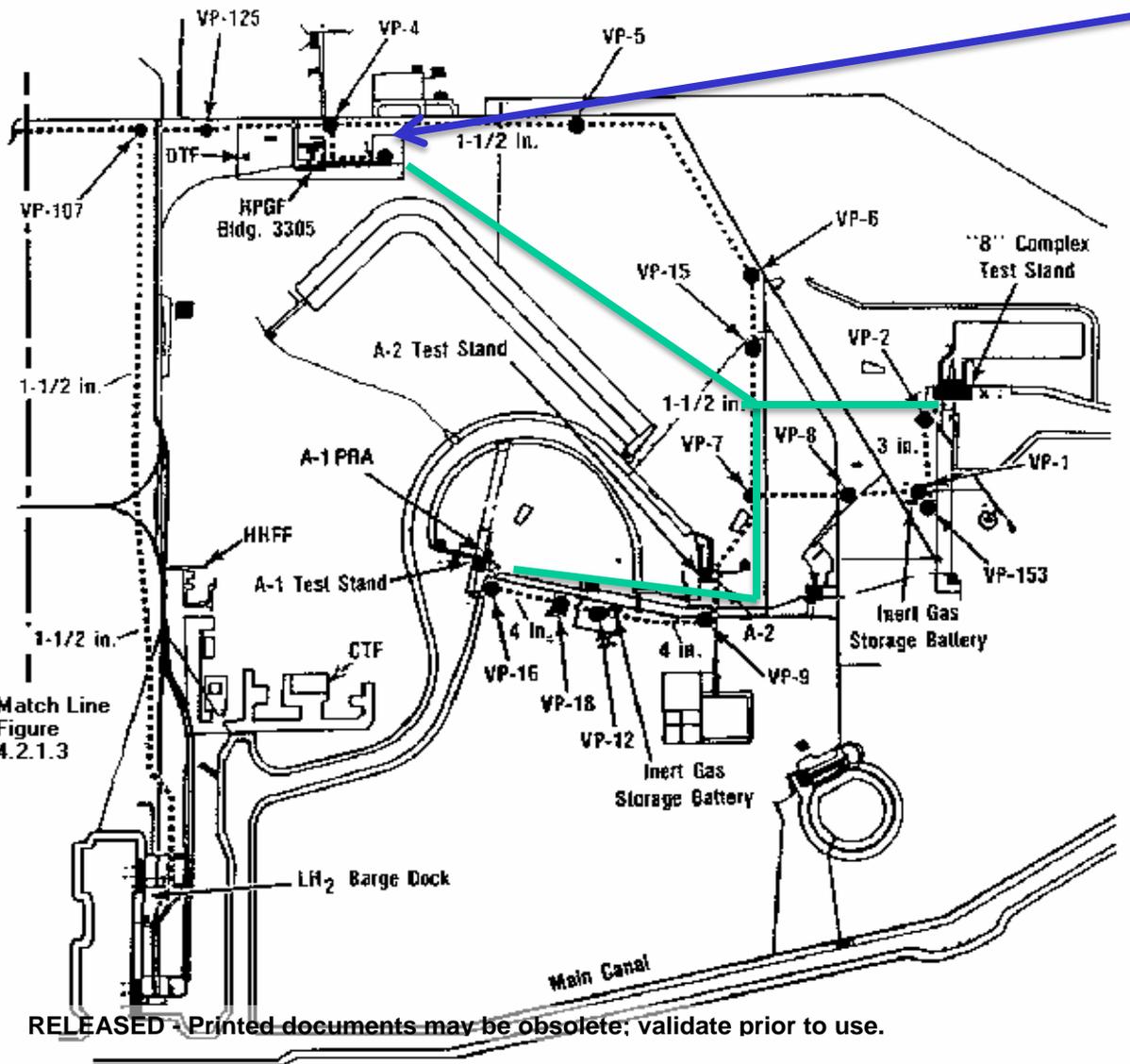
Engine & Component Test Stands



Site High Pressure Distribution Map



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High Pressure Gas Facility

 New above ground GH supply line route



Investigation



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- Cross organizational team formed
- Began heavy sampling pace at all use points of GH2 and Helium
 - These commodities are the ones which nominally “touch” LH2 tank contents
- Found additional contamination in GH2 (He) and in Helium (air) at one test stand
- Variability in sample results on gas and liquid samples hampered the team’s work



Results of Investigation



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- Definitive root cause for contamination of LH2 tank never found
 - Most likely source of N2 contamination was a “dead leg” of old below grade GH2 system left connected unintentionally; also possible that transfer line inerting procedure was not adequate to prevent contamination
 - Helium contamination with air also did not have definitive root cause, but most likely cause was a rarely used compressor which was found to ingest small amounts of air at start-up
 - Definitive cause found for Helium contamination in GH2
 - Maintenance procedure did not properly verify valve configuration, allowing helium used for inerting the system to migrate to a storage bottle bank



Lessons Learned



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- System configuration control lacking
 - Common theme across other incidents that summer
- Sampling procedures and equipment needed improvement and standardization
- SSC fluids specification did not require sufficient sampling frequency to pinpoint specific windows of possible contamination issues (quarterly/semi-annually)
- **NEVER take anything for granted! Murphy Lives!**



What We Did Afterward



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- SSC instituted a major initiative to improve configuration management processes and procedural integrity
 - An end to end walkdown of purge systems were conducted to verify drawings and procedural details
- SSC and MSFC collaborated to develop a new fluids specification with reduced sampling intervals and clearer requirements
- Implemented common training and improved equipment for sampling
- Heightened attention to system health and aging infrastructure issues

No repeat occurrences since 2007