

2.4 Apollo 7 Oxidizer Spill (Or The Day We Leaked on Ike's Rocket - Our first Integrated Incident)

(A story "borrowed" from Ted Sasseen's autobiography. Ted was the NASA Chief Spacecraft Engineer during the Apollo Program and subsequently the NASA Shuttle Chief Engineer at KSC. Ike was Ike Rigell, the NASA Director of Launch Vehicle operations. Ted had written up this story himself originally but had made many errors so he had me "rewrite" it using his format.

Setting the Scene

This is a story told by the two perpetrators, Horace Lamberth and John Tribe, and concurred in by the injured party, Ike Rigell. Thanks to Frank Bryan, who found the original incident report in his garage. It was not like most of us had remembered.

Folks at The Kennedy Space Center were in the rocket launching business. Rockets had payloads. A Manned Spacecraft was a new thing. We had always been "Those people up there--The Nose Cone"

It was April 1968, over a year since the fire. With Apollo 7 we were going to try again to man-rate the spacecraft. A Saturn 1B (two stages plus an IU) was erected on LC-34 with command and service module (CSM) BP-30 on top. Our flight SLA (LM adapter) and CSM 101 were over two months late.

We had finally gotten our "real" reaction control system (RCS) Servicing equipment- temperature conditioning and pumping units at the base of the service structure. Fluid was to be pumped up to valve boxes and then through flex hoses to twenty small RCS tanks in the CSM. Operations were to be conducted from our ACE control room in the O&C building. The system engineer could operate each valve, and also control the thermal and pumping units. Servicing was completely manual. A pair of technicians in SCAPE (self contained atmospheric protection ensemble) was stationed at each area. Suits were needed because you couldn't breathe the vapors. Oxidizer (nitrogen tetroxide, N₂O₄) was especially nasty since it is highly corrosive, becomes nitric acid in your lungs, and also tends to distort seals, binding up and blocking quick disconnects, QD's. The Fuel, MMH, wasn't much better. It was carcinogenic, and also very flammable.

Servicing was to be exactly like that we would use later with the flight vehicle. RCS test tanks, with teflon bladders for zero-G, were placed at the same level on the gantry as the actual vehicle tanks. Most service module (SM) tanks were vertically oriented and could be filled by overflow. Command module (CM) tanks were horizontally oriented and required a vacuum, collapsing the bladders around the standpipe before filling.

The Crime

It was Sunday morning, 21 April 1968. SM loading had been completed. We were getting ready to fill a CM tank. The test tanks had been emptied after the initial load, or so we thought. However, because of a QD blockage, the horizontal tank was still partially filled with nitrogen tetroxide. As the preparations for reload continued, the evacuation of this partially filled tank was begun. Almost immediately, as the vacuum pump sucked in the fluid, the oil sump vent spewed a stream of oxidizer several feet into the air.

The SCAPE technicians reported the spill, and found they could stop flow just by placing a gloved thumb over the hole. As engineers tried to understand what was happening, the oxidizer flow continued. The techs addressed the increasing puddle on the deck with the standard, approved procedure; dilute with copious amounts of water.

Flow was quickly terminated and the group supervisor, John Tribe, was called. He quickly headed in to work. The techs completed their enthusiastic cleanup with a fire hose, washing what was now dilute nitric acid from the upper levels, later estimated to be some 400 gallons. The dilute acid, mixed with pump-oil, flowed through numerous openings in the decks, down the side of the SM and empty SLA. It found leaking hatches and panels, and lots of little holes. Down to the IU, SIVB and SIB stages, spreading into joint interfaces and finally down to the launch platform.

Recovery

The stage people quickly showed up in the next few hours. Everything seemed wet. Quickie sampling showed mostly water, slightly acidic with a little nitrate. Clean up and mapping began immediately with a 1% sodium bicarbonate solution. Bosun's chairs were used to wipe the outside. The S-IVB people had to remove the Forward Skirt to get to their crotch and dome. Inside the IU there was a lot of fluid. It went to its hanger, the skirt to the VAB. The other interfaces were de-mated and neutralized. The lab analyzed

many hundreds of wipes. It took several weeks.

The big MSFC worry was long-term corrosion. They started a bunch of tests to evaluate the conditions. Most of the IU cabling came out and was wiped. Four cables were replaced, five connectors re-terminated. All boxes were OK. Three outside antennas were changed. The S-IVB required only extensive cleaning. On the S-IB, fin #4 and the lox bay 3 door were replaced due to staining. Everything else was cleaned.

There was major re-write of the servicing procedures. Everything except the incident report was complete by 10 May. The incident report took until mid June, and was an inch and a half thick.

The Trial

There wasn't even a semblance of "presumed innocence". It was a lynching. Presiding, the Honorable Rocco Petrone, Launch Director.

Bright and early Monday morning we all assembled in Rocco's office. Everybody involved was there, from the Base Managers on down; IBM, Douglas, Chrysler and, of course, North American - all with their NASA counterparts.

Rocco was a big man, dominating the room. While at West Point he had played tackle for Army. He believed in the old fashioned virtues, Brains, and an old fashioned incentive - fear. At least every other month he made sure I knew I could be fired. Charlie Mars had told me: "I just picture him putting on his underwear!"

He dearly loved a big audience and could talk for hours. This time he spent the entire morning "chewing". John Tribe sat in the spotlight. It was his first experience with Rocco. He learned to listen. We could only plead Nolo Contendere. We hadn't been very smart. It damn well wasn't going to happen again.

The Fix

While this regrettable incident caused a significant amount of clean up, it did establish a much needed new philosophy, and a much better appreciation/sensitivity for working with hypergolic propellants. Both by us and the booster folks below.

The North American materials people came up with a cloth called Velostat, graphite impregnated, teflon coated, totally inert. We used many yards to make an enclosed tub of each deck, and little scuppers under every joint. We also developed 'aspirators', a venturi in a pot, run on facility GN2 that could suck up any fluid. We could now contain small spills without the need to 'fire hose' it and, in a major spill, wash down everything and it still wouldn't go anywhere.

Further, after use, each QD would be disassembled, cleaned, and the seals replaced. If we ever again ran a hypergolic GSE test, we would use non-hazardous referee fluids such as freon and alcohol.

The Rocket people were equally determined to protect themselves. They made special curtains, and wrote procedures to tape all interface joints and all other invasive leak paths, all to be removed before flight. Also, 'What to do if ...' procedures.

Aftermath

Some time after 'The Incident', Ike and Frank Bryan were walking down the newly stacked vehicle, starting at the IU. They needed the elevator to go down to the S-IV B level. Next to the door were two identical buttons in little explosion proof boxes, neither labeled. Frank pushed one. Soon there was a hissing sound and orange fluid began to drip all around them. Instant panic. 'They're leaking on us again'. Sanity returned shortly. It was just rusty water. The gantry firex system had not been flushed in a long time. They couldn't turn it off. Finally the Test Conductor did.

In late September, Ike and I walked down the entire stack, and gave a GO to Rocco. Spacecraft CSM 101 was successfully serviced for flight, without incident or leaks. It had taken two days to make each deck 'spill proof' and to tape up the rocket. You could just barely see the spacecraft under all that black plastic sheeting.

On 11 October 1968 it lifted off to complete a 10-day mission with astronauts Wally Schirra, Walt Cunningham, and Don Eisele. The first manned CSM. We were on our way to the Moon.