

LOG ENTRY: SOL 38

I'm still cowering in the rover, but I've had time to think. And I know how to deal with the hydrogen.

I thought about the atmospheric regulator. It pays attention to what's in the air and balances it. That's how the excess O₂ I've been importing ends up in the tanks. Problem is, it's just not built to pull hydrogen out of the air.

The regulator uses freeze-separation to sort out the gasses. When it decides there's too much oxygen, it starts collecting air in a tank and cooling it to 90 kelvin. That makes the oxygen turn to liquid, but leaves the nitrogen (condensation point: 77K) still gaseous. Then it stores the O₂.

But I can't get it to do that for hydrogen, because hydrogen needs to be below 21K to turn liquid. And the regulator just can't get temperatures that low. Dead end.

Here's the solution:

Hydrogen is dangerous because it can blow up. But it can only blow up if there's oxygen around. Hydrogen without oxygen is harmless. And the regulator is all about pulling oxygen out of the air.

There are four different safety interlocks that prevent the regulator from letting the Hab's oxygen content get too low. But they're designed to work against technical faults, not deliberate sabotage (bwa ha ha!).

Long story short, I can trick the regulator into pulling all the oxygen out of the Hab. Then I can wear a space suit (so I can breathe) and do whatever I want without fear of blowing up.

I'll use an O₂ tank to spray short bursts of oxygen at the hydrogen, and make a spark with a couple of wires and a

battery. It'll set the hydrogen on fire, but only until the small bit of oxygen is used up.

I'll just do that over and over, in controlled bursts, until I've burned off all the hydrogen.

One tiny flaw with that plan: It'll kill my dirt.

The dirt is only viable soil because of the bacteria growing in it. If I get rid of all the oxygen, the bacteria will die. I don't have 100 billion little space suits handy.

It's half a solution anyway.

Time to take a break from thinking.

Commander Lewis was the last one to use this rover. She was scheduled to use it again on Sol 7, but she went home instead. Her personal travel kit's still in the back. Rifling through it, I found a protein bar and a personal USB, probably full of music to listen to on the drive.

Time to chow down and see what the good commander brought along for music.

LOG ENTRY SOL 38 (2)

Disco. God damn it, Lewis.

LOG ENTRY: SOL 39

I think I've got it.

Soil bacteria are used to winters. They get less active, and require less oxygen to survive. I can lower the Hab temperature to 1°C, and they'll nearly hibernate. This sort of thing happens on Earth all the time. They can survive a couple of days this way. If you're wondering how bacteria on Earth survive longer periods of cold, the answer is they don't. Bacteria from further underground where it is warmer breed upward to replace the dead ones.

They'll still need some oxygen, but not much. I think a 1 percent content will do the trick. That leaves a little in the air

for the bacteria to breathe, but not enough to maintain a fire. So the hydrogen won't blow up.

But that leads to yet another problem. The potato plants won't like the plan.

They don't mind the lack of oxygen, but the cold will kill them. So I'll have to pot them (bag them, actually) and move them to a rover. They haven't even sprouted yet, so it's not like they need light.

It was surprisingly annoying to find a way to make the heat stay on when the rover's unoccupied. But I figured it out. After all, I've got nothing but time in here.

So that's the plan. First, bag the potato plants and bring them to the rover (make sure it keeps the damn heater on). Then drop the Hab temperature to 1°C. Then reduce the O₂ content to 1 percent. Then burn off the hydrogen with a battery, some wires, and a tank of O₂.

Yeah. This all sounds like a great idea with no chance of catastrophic failure.

That was sarcasm, by the way.

Well, off I go.

LOG ENTRY: SOL 40

Things weren't 100 percent successful.

They say no plan survives first contact with implementation. I'd have to agree. Here's what happened:

I summoned up the courage to return to the Hab. Once I got there, I felt a little more confident. Everything was how I'd left it. (What did I expect? Martians looting my stuff?)

It would take a while to let the Hab cool, so I started that right away by turning the temperature down to 1°C.

I bagged the potato plants, and got a chance to check up on them while I was at it. They're rooting nicely and about to

sprout. One thing I hadn't accounted for was how to bring them from the Hab to the rovers.

The answer was pretty easy. I put all of them in Martinez's space suit. Then I dragged it out with me to the rover I'd set up as a temporary nursery.

Making sure to jimmy the heater to stay on, I headed back to the Hab.

By the time I got back, it was already chilly. Down to 5°C already. Shivering and watching my breath condense in front of me, I threw on extra layers of clothes. Fortunately I'm not a very big man. Martinez's clothes fit over mine, and Vogel's fit over Martinez's. These shitty clothes were designed to be worn in a temperature-controlled environment. Even with three layers, I was still cold. I climbed into my bunk and under the covers for more warmth.

Once the temperature got to 1°C, I waited another hour, just to make sure the bacteria in the dirt got the memo that it was time to take it slow.

The next problem I ran into was the regulator. Despite my swaggering confidence, I wasn't able to outwit it. It *really* does not want to pull too much O₂ out of the air. The lowest I could get it to was 15 percent. After that, it flatly refused to go lower, and nothing I did mattered. I had all these plans about getting in and reprogramming it. But the safety protocols turned out to be in ROMs.

I can't blame it. Its whole purpose is to *prevent* the atmosphere from becoming lethal. Nobody at NASA thought, "Hey, let's allow a fatal lack of oxygen that will make everyone drop dead!"

So I had to use a more primitive plan.

The regulator uses a different set of vents for air sampling than it does for main air separation. The air that gets freeze-separated comes in through a single large vent on the main unit. But it samples the air from nine small vents that pipe

back to the main unit. That way it gets a good average of the Hab, and one localized imbalance won't throw it off.

I taped up eight of the intakes, leaving only one of them active. Then I taped the mouth of a Hefty-sized bag over the neck-hole of a spacesuit (Johanssen's this time). In the back of the bag, I poked a small hole and taped it over the remaining intake.

Then I inflated the bag with pure O₂ from the suit's tanks. "Holy shit!" the regulator thought, "I better pull O₂ out right away!"

Worked great!

I decided not to wear a space suit after all. The atmospheric pressure was going to be fine. All I needed was oxygen. So I grabbed an O₂ canister and breather mask from the medical bay. That way, I had a hell of a lot more freedom of motion. It even had a rubber band to keep it on my face!

Though I did need a space suit to monitor the actual Hab oxygen level, now that the Hab's main computer was convinced it was 100 percent O₂. Let's see...Martinez's space suit was in the rover. Johanssen's was outwitting the regulator. Lewis's was serving as a water tank. I didn't want to mess with mine (hey, it's custom-fitted!). That left me two space suits to work with.

I grabbed Vogel's suit and activated the internal air sensors while leaving the helmet off. Once the oxygen dropped to 12 percent, I put the breather mask on. I watched it fall further and further. When it reached 1 percent, I cut power to the regulator.

I may not be able to reprogram the regulator, but I can turn the bastard off completely.

The Hab has emergency flashlights in many locations in case of critical power failure. I tore the LED bulbs out of one and left the two frayed power wires very close together. Now, when I turned it on, I got a small spark.

Taking a canister of O₂ from Vogel's suit, I attached a strap to both ends and slung it over my shoulder. Then I attached an air line to the tank and crimped it with my thumb. I turned on a very slow trickle of O₂; small enough that it couldn't overpower the crimp.

Standing on the table with a sparker in one hand and my oxygen line in the other, I reached up and gave it a try.

And holy hell, it worked! Blowing the O₂ over the sparker, I flicked the switch on the flashlight and a wonderful jet of flame fired out of the tube. The fire alarm went off, of course. But I'd heard it so much lately, I barely noticed it anymore.

Then I did it again. And again. Short bursts. Nothing flashy. I was happy to take my time.

I was elated! This was the best plan ever! Not only was I clearing out the hydrogen, I was making more water!

Everything went great right up to the explosion.

One minute I was happily burning hydrogen; the next I was on the other side of the Hab, and a lot of stuff was knocked over. I stumbled to my feet and saw the Hab in disarray.

My first thought was: "My ears hurt like hell!"

Then I thought, "I'm dizzy," and fell to my knees. Then I fell prone. I was *that* dizzy. I groped my head with both hands, looking for a head wound I desperately hoped would not be there. Nothing seemed to be amiss.

But feeling all over my head and face revealed the true problem. My oxygen mask had been ripped off in the blast. I was breathing nearly pure nitrogen.

The floor was covered in junk from all over the Hab. No hope of finding the medical O₂ tank. No hope of finding anything in this mess before I passed out.

Then I saw Lewis's suit hanging right where it belonged. It hadn't moved in the blast. It was heavy to start with and had 70 liters of water in it.

I rushed over, quickly cranked on the O₂, and stuck my head into the neck hole (I'd removed the helmet long ago, for easy access to the water). I breathed a bit until the dizziness faded, then took a deep breath and held it.

Still holding my breath, I glanced over to the space suit and Hefty bag I'd used to outsmart the regulator. The bad news is I'd never removed them. The good news is the explosion removed them. Eight of the nine intakes for the regulator were still bagged, but this one would at least tell the truth.

Stumbling over to the regulator, I turned it back on.

After a two-second boot process (it was made to start up fast for obvious reasons), it immediately identified the problem.

The shrill low-oxygen alarm blared throughout the Hab as the regulator dumped pure oxygen into the atmosphere as fast as it safely could. *Separating* oxygen from the atmosphere is difficult and time-consuming, but *adding* it is as simple as opening a valve.

I clambered over debris back to Lewis's space suit and put my head back in for more good air. Within three minutes, the regulator had brought the Hab oxygen back up to par.

I noticed for the first time how burned my clothing was. It was a good time to be wearing three layers of clothes. Mostly the damage was on my sleeves. The outer layer was gone. The middle layer was singed and burned clean through in places. The inner layer, my own uniform, was in reasonably good shape. Looks like I lucked out again.

Also, glancing at the Hab's main computer, I saw the temperature had gone up to 15°C. Something very hot and very explodey had happened, and I wasn't sure what. Or how.

And that's where I am now. Wondering what the hell happened.

After all that work and getting blown up, I'm exhausted. Tomorrow I'll have to do a million equipment checks and try to figure out what exploded, but for now I just want to sleep.

I'm in the rover again tonight. Even with the hydrogen gone, I'm reluctant to hang out in a Hab that has a history of exploding for no reason. Plus, I can't be sure there isn't a leak.

This time, I brought a proper meal, and something to listen to that isn't disco.

LOG ENTRY: SOL 41

I spent the day running full diagnostics on every system in the Hab. It was incredibly boring, but my survival depends on these machines, so it had to be done. I can't just assume an explosion did no long-term damage.

I did the most critical tests first. Number one was the integrity of the Hab canvas. I felt pretty confident it was in good shape, because I'd spent a few hours asleep in the rover before returning to the Hab, and the pressure was still good. The computer reported no change in pressure over that time, other than a minor fluctuation based on temperature.

Then I checked the oxygenator. If that stops working and I can't fix it, I'm a dead man. No problems.

Then the atmospheric regulator. Again, no problem.

Heating unit, primary battery array, O₂ and N₂ storage tanks, water reclaimer, all three airlocks, lighting systems, main computer...on and on I went, feeling better and better as each system proved to be in perfect working order.

Got to hand it to NASA. They don't screw around when making this stuff.

Then came the critical part...checking the dirt. I took a few samples from all over the Hab (remember, it's all dirt flooring now) and made slides.

With shaking hands, I put a slide into the microscope and brought the image up on-screen. There they were! Healthy, active bacteria doing their thing! Looks like I won't be starving to death on Sol 400 after all. I plopped down in a chair and let my breathing return to normal.

Then I set about cleaning up the mess. And I had a lot of time to think about what had happened.

So what happened? Well, I have a theory.

According to the main computer, during the blast, the internal pressure spiked to 1.4 atmospheres, and the temperature rose to 15°C in under a second. But the pressure quickly subsided back to 1 atm. This would make sense if the atmospheric regulator were on, but I'd cut power to it.

The temperature remained at 15°C for some time afterward, so any heat expansion should still have been present. But the pressure dropped down again, so where did that extra pressure go? Raising the temperature and keeping the same number of atoms inside should permanently raise the pressure. But it didn't.

I quickly realized the answer. The hydrogen (the only available thing to burn) combined with oxygen (hence combustion) and became water. Water is a thousand times as dense as a gas. So the heat added to the pressure, and the transformation of hydrogen and oxygen into water brought it back down again.

The million dollar question is, where the hell did the oxygen come from? The whole plan was to limit oxygen and keep an explosion from happening. And it was working for quite a while before blowing up.

I think I have my answer. And it comes down to me brain-farting. Remember when I decided not to wear a space suit? That decision almost killed me.

The medical O₂ tank mixes pure oxygen with surrounding air, then feeds it to you through a mask. The mask stays on your face with a little rubber band that goes around the back of your neck. Not an airtight seal.

I know what you're thinking. The mask leaked oxygen. But no. I was breathing the oxygen. When I was inhaling, I made a nearly airtight seal with the mask by sucking it to my face.

The problem was *exhaling*. Do you know how much oxygen you absorb out of the air when you take a normal breath? I don't know either, but it's not 100 percent. Every time I exhaled, I added more oxygen to the system.

It just didn't occur to me. But it should have. If your lungs grabbed up all the oxygen, mouth-to-mouth resuscitation wouldn't work. I'm such a dumb-ass for not thinking of it! And my dumb-assery almost got me killed!

I'm really going to have to be more careful.

It's a good thing I burned off most of the hydrogen before the explosion. Otherwise that would have been the end. As it is, the explosion wasn't strong enough to pop the Hab. Though it was strong enough to almost blast my eardrums in.

This all started with me noticing a 60-liter shortfall in water production. Between deliberate burn-off and a bit of unexpected explosion, I'm back on track. The water reclaimer did its job last night and pulled 50 liters of the newly created water out of the air. It's storing it in Lewis's spacesuit, which I'll call "The Cistern" from now on, because it sounds cooler. The other 10 liters of water was directly absorbed by the dry soil.

Lots of physical labor today. I've earned a full meal. And to celebrate my first night back in the Hab, I'll kick back and watch some shitty twentieth-century TV courtesy of Commander Lewis.

The Dukes of Hazzard, eh? Let's give it a whirl.

LOG ENTRY: SOL 42

I slept in late today. I deserved it. After four nights of awful sleep in the rover, my bunk felt like the softest, most profoundly beautiful feather bed ever made.

Eventually, I dragged my ass out of bed and finished some post-explosion cleanup.

I moved the potato plants back in today. And just in time, too. They're sprouting. They look healthy and happy. This isn't chemistry, medicine, bacteriology, nutrition analysis, explosion dynamics, or any other shit I've been doing lately. This is *botany*. I'm sure I can at least grow some plants without screwing up.

Right?

You know what really sucks? I've only made 130 liters of water. I have another 470 liters to go. You'd think after almost killing myself *twice*, I'd be able to stop screwing around with hydrazine. But nope. I'll be reducing hydrazine and burning hydrogen in the Hab, every ten hours, for another ten days. I'll do a better job of it from now on. Instead of counting on a clean reaction, I'll do frequent "hydrogen cleanings" with a small flame. It'll burn off gradually instead of building up to kill-Mark levels.

I'll have a lot of dead time. Ten hours for each tank of CO₂ to finish filling. It only takes twenty minutes to reduce the hydrazine and burn the hydrogen. I'll spend the rest of the time watching TV.

And seriously...It's clear that General Lee can outrun a police cruiser. Why doesn't Rosco just go to the Duke farm and arrest them when they're *not* in the car?