# CHAPTER 11 : Nuclear Missile Launcher



**Mid Game**

Cycle 0 — Cycle 500 — Cycle 570 — Cycle ∞
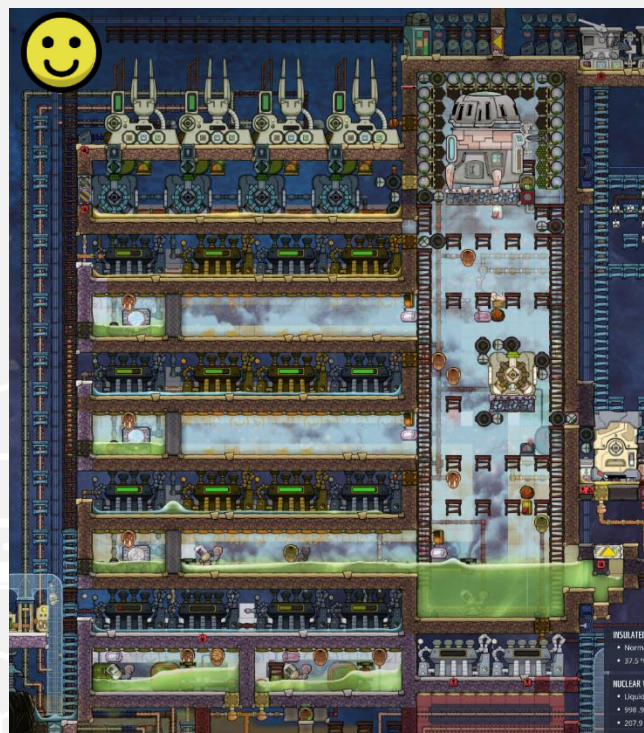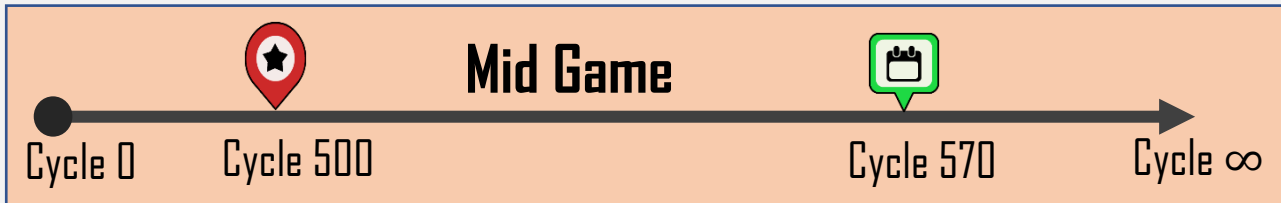


A power source and a transporter, all in one

Sending materials between planets is impossible without rockets. Or is it?

**Highlights :**

- ☢ We build a nuclear reactor
- ☢ We build an interplanetary launcher setup
- ☢ We have a major food storage crisis on Neo Terra
- ☢ At the verge of an electricity grid crisis on Neo Terra

# PROJECT SHATTERSTAR
## ☢ CH 11: Nuclear Missile Launcher

## Disclaimer-

Oxygen Not Included is a sandbox game limited only by the player's imagination. I can assure you that no player (including me) has figured out the 'right' way to play the game…. No matter how many hours they may have put into the game.

**That's because there is no right way.** What you do depends on what you want to achieve. Some love building ridiculous and elaborate builds, while others are more efficient and practical. Both are perfectly acceptable ways to play. What matters is that you enjoy what you do.

The following document is a guide and not a gospel. Like every other player, I have my unique style of play. What I intend to do is to share my playstyle and start a conversation with the community. This document will take you through a real and typical game, showcasing my approach to things. The playthrough will not be perfect. But it will be enlightening and entertaining. I hope my readers will use this series to modify their own unique style rather than copy mine.

Feel free to skip, ignore or modify any of the recommendations given in the series.

All Game art has been taken from the game files and is the property of Klei (if that wasn't obvious enough). I've used them only to make the document more engaging.

While this guide is quite simple, It's not meant to spoon-feed you. You may have to do a bit of additional research if you are a new player, and I'm happy to answer any specific questions.

The easiest way to find me is on Reddit. My handle u/Storm-Father. Please feel free to drop me a message or tag me in a post.

## The series will use the following mods. These are quality-of-life mods and do not affect core gameplay

- ☢ Wounded go to Med bed
- ☢ Per-planetoid materials (Obsolete)
- ☢ Blueprints fixed
- ☢ Bigger Building Menu
- ☢ No 'Long Commutes'
- ☢ Suppress Notifications
- ☢ Geyser Calculated Average Output tooltip
- ☢ Critter Inventory
- ☢ Queue for Sinks
- ☢ FreeCamera
- ☢ MaterialColor
- ☢ Show industrial Machinery Tag

**Game Coordinates – 'SNDST-C-360860549-0'**

**OXYGEN NOT INCLUDED**

**SPACED OUT!**

## The Starmap



The layout of the introduction has been changed to accommodate the increase in information that comes from having multiple planets. If you have any suggestions on alternate layouts or additional information, feel free to let me know on Reddit.
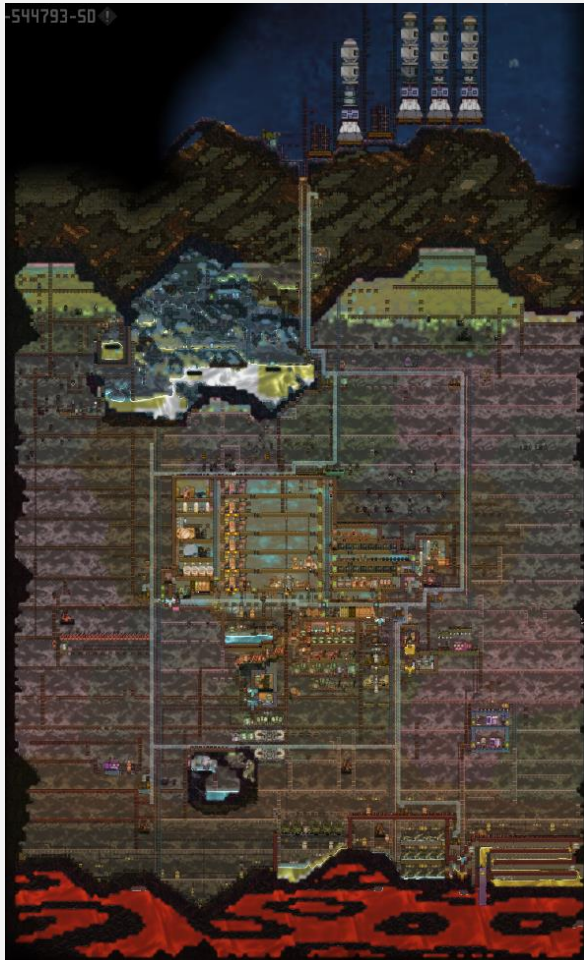
**Neo Terra**

Cycle 500

Temporary food storage

Cycle 570

**Petra**
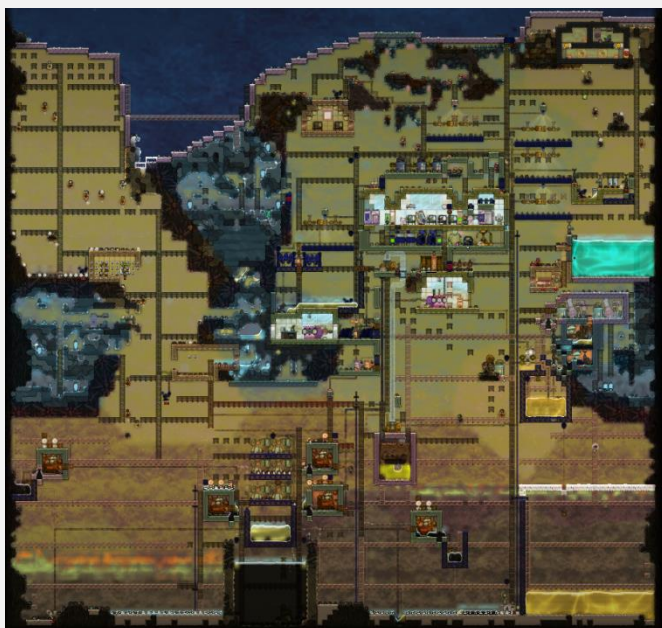
Cycle 500

Cycle 570

**Chernobyl**
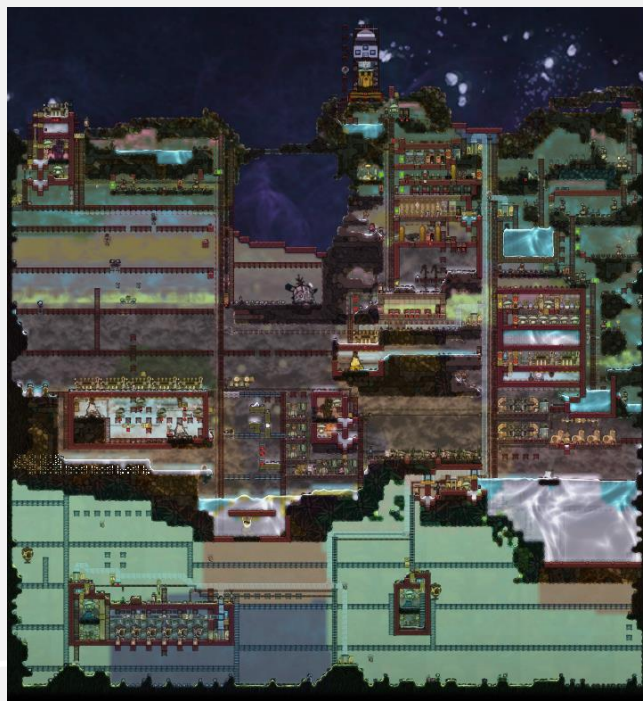


Cycle 500



Cycle 570

**Svalbard**
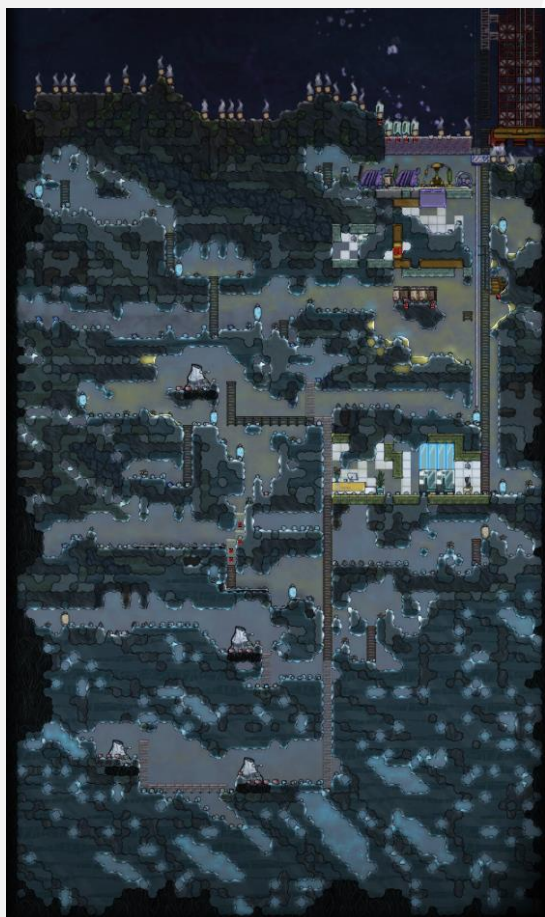


Cycle 570

**Numenor**
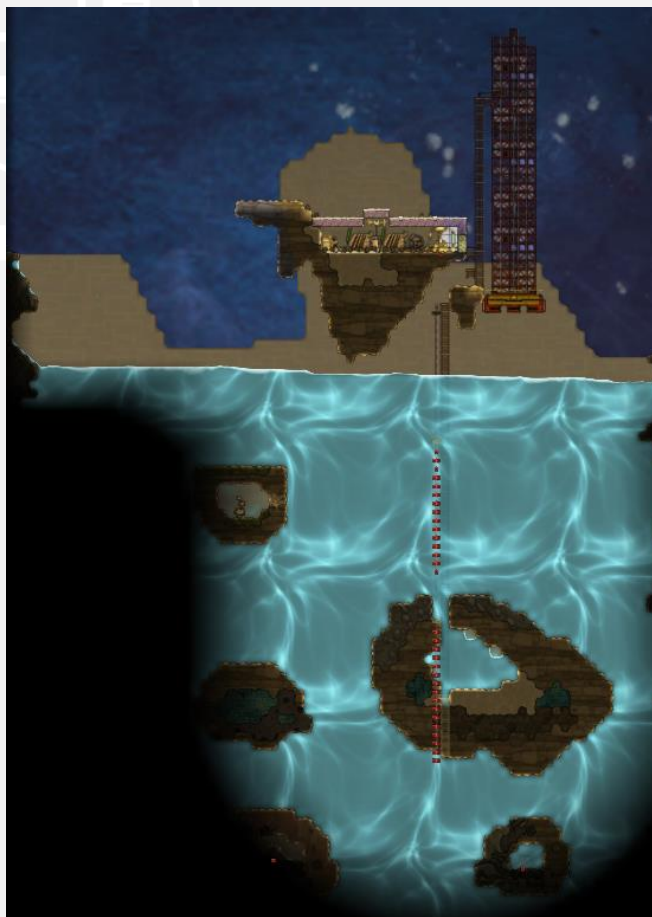


Cycle 570

## 1) <u>Famine on Neo Terra</u>

I think I'd gotten a bit cocky about how good my food production system was…. And the ONI gods heard me. I received a notification for rotten food inside my food storage chamber.

On closer inspection, I found a patch of polluted oxygen which was slowly rotting away the food over time. I have no idea how it got there. My theory is that maybe my cooling loop was not running cool enough. Since this $CO_2$ pit was made very early in the game, I could only fill it with 1.5kg of $CO_2$ per tile, which is not a lot and does not prevent off-gassing. And since $CO_2$ does have a low condensation point, the gas could easily become a liquid if I cooled it too much, and this would spoil the food anyway.

Anyhow, root cause analysis later. First, we have to find a way to preserve the food we have left. I'm not quite sure of how much I've lost already, but If I lose the whole batch, that will be a disaster and I have no backup food source.

When In crisis, your solution doesn't have to be pretty, it just has to work. The pre-space biome of Neo Terra is super cold, and there is plenty of $CO_2$ around. So instead of wasting time building a new cooling setup, I just sent up a conveyer rail to move all my food to where it was already cold. This way, I was able to save my hard-earned food from rotting.

Of course, this is only temporary, giving me enough time to rebuild the current cooler. I broke open the wall to let the polluted oxygen bubble out and the ambient bubble in. The temperature of the ambient $CO_2$ was quite hot, but the existing cooling loop is enough to bring it back to a reasonable temperature. More so, once we resealed the pit, the volume of $CO_2$ was around 20kg per tile, which would be a lot harder to liquefy, meaning we could run our cooling loop a lot colder and not worry about losing the gas. In the long term, this solves a lot of problems for us.

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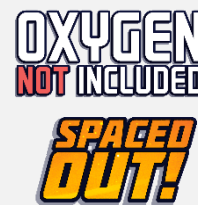
I left the food out in the open in the icy pre-space biome, till the food pit went back to the required temperature, at which point I moved it back in. We were back to normal in a dozen cycles or so. Crisis averted
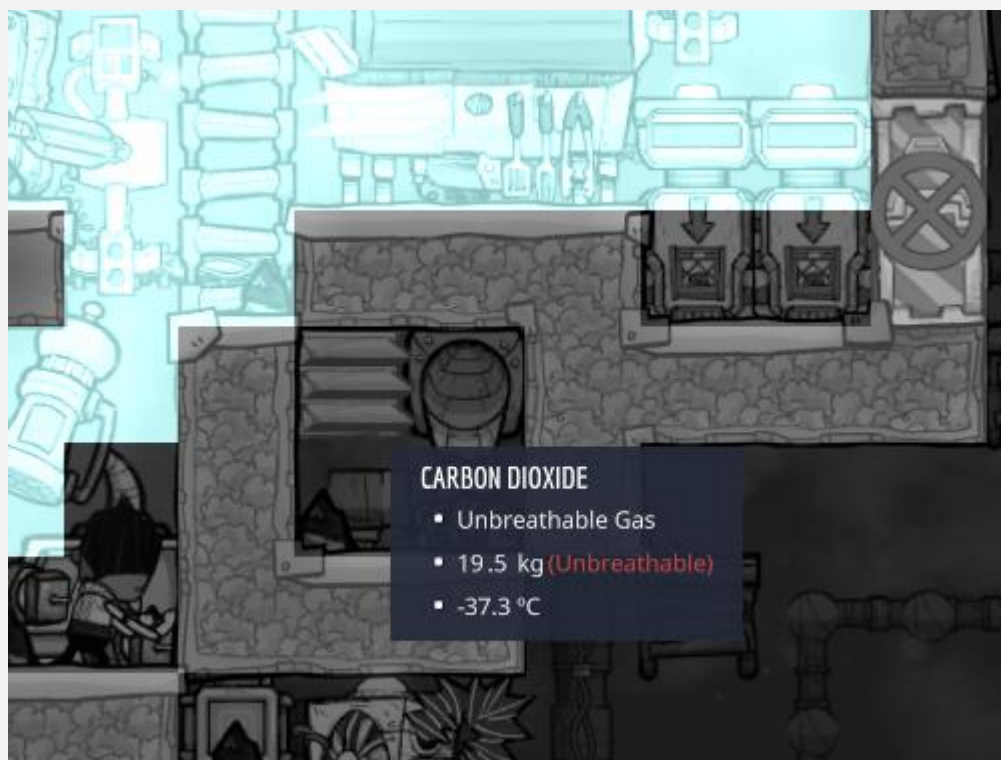


CARBON DIOXIDE
• Unbreathable Gas
• 19.5 kg (Unbreathable)
• -37.3 °C

## 2) <u>**Power Grid is Obsolete -**</u>

The power grid, on the other hand, is a different problem. We had 2 problems, one immediate and critical. The other is more long-term but equally critical.
The immediate problem was that we are short on power, and we need power to produce power. Let me explain.

While our petroleum and natural gas generators produce power for us, they have to be fed fuel by pipes. And these pipes are operated by pumps. As long as there is some extra power in the batteries. It's all good. The minute you start consuming more power than you can consume, only some buildings get power while others don't. When it comes to an electric grid, power first goes to buildings directly connected to the grid rather than any transformers on it (Or so I've observed, though I could be wrong). Since both pumps for natural gas and petroleum are connected via transformers, they will be the first to fail. Once they fail, the generators will eventually fail too, as they have no fuel to burn. And so, your whole grid just dies.

This is pretty much what happened to me here. Before I know it, I was out of power. Oxygen and all that. Fortunately, there was some petroleum in a pipe that I was able to divert. I also used the pliers to cut the grid of everything except the pumps and the generators. Once I had them up and running, I connected the grid again but left the oxylite refineries out, thinking they were the reason I was running out of power.

Turns out I ran out of power because I was constructing the nuclear reactor at the time, and I had built a bunch of radbolt generators, which I connected to the grid by mistake. Got to be careful.



The long-term issue is that the heavy-watt wire can hold only 20,000 kW, and we are getting dangerously close to that level. The only remedy for this is to upgrade the entire wiring to conductive heavy-watt wire, which will need a lot of refined metal and is going to be more of a long-term concern.

## 3) **The Manhatten Project –**

Last chapter we used our bees to start making some refined uranium. Now we will use that to produce power for the base.

At the moment, refined uranium is not a renewable resource because we have no constant flow of uranium coming in from anywhere. But, a closer look at the star map shows me that there are space POIs (Points Of Interest) that have uranium in them and I can probably harvest them later in the game.

Right now we have enough uranium ore to make about 22 tons of Enriched Uranium total, which can run a single nuclear reactor for 2200 cycles. While that may sound like a lot, this number crashes quickly if you build more reactors than you can support. Also,

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I've never messed around much in mining POIs before. So I know it might take me a while to set up a proper mining operation.

Let's talk a bit about the nuclear reactor itself before we get into the nuclear plant design. The reactor takes in water and enriched uranium to give out superheated water that flashes to steam on contact with a surface, and liquid nuclear waste. The basic stands and details are given in the ONI wiki, so I'm not going to repeat them, but the point is that A nuclear reactor simply converts fuel into heat, just like a real nuclear reactor. We can just use that steam to produce electricity.



Also, like a real nuclear reactor, this one can explode if used incorrectly. The following things must be kept in mind –

☢   Lack of water can cause the reactor to explode
☢   Too much heat can cause a reactor to explode
☢   Too much pressure can cause a reactor to explode
☢   The build-up of nuclear waste is a long-term issue

The first one is the biggest concern. You have to create a system such that the nuclear reactor always has a constant flow of fresh water, no matter what happens to the reactor.

For the second one, as long as your steam turbines are running fine, you should be good. Just make sure your turbines are cool and they are not prevented from running because of automation or something.

For the third one, as long as you're running in a closed water system, you're good. By closed water system, I mean that the water collected from the steam turbines is the water that is being pushed back into the reactor, and no additional water is added from outside. If you achieve this, the pressure inside the reactor will remain stable.

For the fourth one, you need to have a pump inside the plant that will pump out the nuclear waste and dispose of it. Simple enough to set up with a little automation.

As expected, the reactor also puts out a large amount of radiation, which can be harnessed. I will be using the radiation to generate radbolts, to power payload launchers and diamond presses.

## 4) <u>Reactor then and now  –</u>



**First Design at cycle 570**

This was my 2nd attempt at a nuclear reactor, the first being some work I had done on my previous guide SGG.

Even so, I had not decided on a 'final design' and was still experimenting. In general, I am not a fan of debug mode and like testing things out in game, and making modifications as needed.

So here I'll show you what I made originally, and then go into the future to show you the modifications I ended up making.

The first design I made covered all the main requirements –

- ☢ 12 steam turbines to keep the reactor cool and the power output high
- ☢ Pipes set up to ensure uninterrupted water supply to the reactor
- ☢ 2 cooling loops with aquatuners to keep the turbines cool
- ☢ Built out in space, so no risk of thermal leakage because of the vacuum
- ☢ Plenty of thermal shift plates in the background, with drywall to ensure no exposure to space inside the power plant.
- ☢ Perfect amount of space to fit in 4 payload launchers (We'll get into why 4)
- ☢ I use water as the coolant because it's only temporary

**But as I used the thing I realized a lot of things had to change, and I ended up with the following design. Changes were made in increments over hundreds of cycles. <u>The screenshots below are from cycle 1800</u> (yep, the colony has been going strong! Stay tuned)**

Though Screenshots are from Cycle 1800, I have not made any changes to the core powerplant for the last few hundred cycles or so. And this design does not use any special materials, so nothing will stop you from making something similar to the below design at the very beginning of your nuclear journey.

11

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**Cycle 1800**

I.   You'll notice that all the turbines have some liquid on them. This is to cool them off. See, heat cannot be transferred in a vacuum, so having a water pipe going on the turbine isn't enough you also need a medium to transfer the heat. You could seal the full chamber and fill it with gas, but this is a much easier solution. A major change here is that I extended the cooling setup to cool the radbolt chambers as well. If not cooled, the radbolt chambers will not overheat, but will literally melt into nothing at some point.

II.    I changed the way the cooling loops worked. Having the aquatuners in the center was not helping. Steam was not being carried all the way to the $4^{th}$ steam turbine, as it was too far away from the heat source. Because of this, the $4^{th}$ turbine was running very poorly in all 3 levels. By shifting the aquatuners to the $4^{th}$ turbine and adding a metal wall to separate them from the other 3, they can more evenly distribute heat across all 12 turbines and give better outputs. I also switch to nuclear waste as the coolant in place of water. It has a better temperature range and is a better choice for the use case. I will switch it out for supercoolant at some point.



Cycle 1800
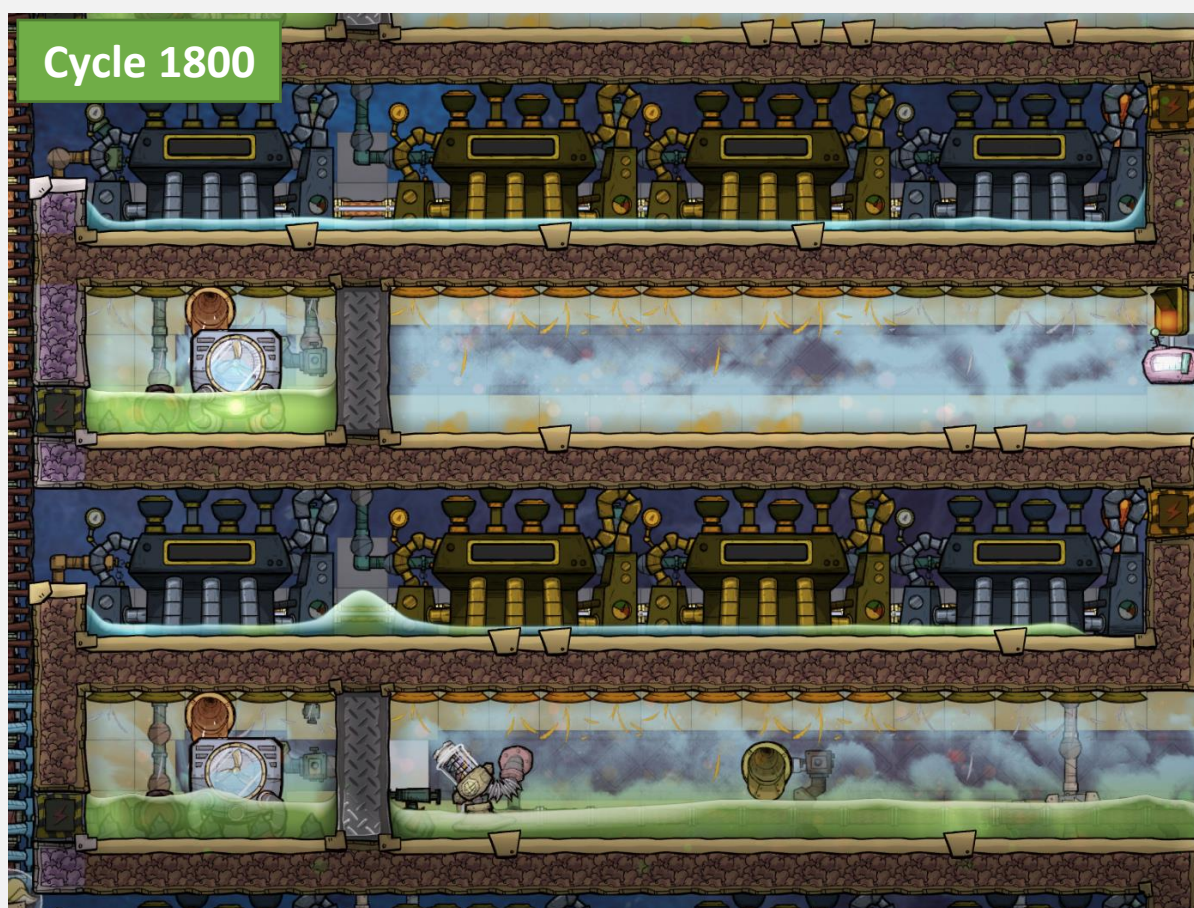
III.   Removing nuclear waste is a priority, or the turbines in the bottom will not have any steam to work with, and eventually, the whole system will overheat. I found over time that having a single pump in the waste pit was not enough and sometimes waste would form pools at the edge of the wall. So I ended up adding a second pump there with some automation to turn on if the waste pressure goes over 400 kg, the same setting I've kept for the pump in the pit.

IV. I had initially added a metal platform here, which I had hoped would distribute the heat move evenly in the power plant because it was in the center. This turned out to be a complete disaster with the middle row of turbines running too hot and the bottom row not having enough hot steam to run well. I ultimately ended up removing it and letting the nuclear waste pit be a single source of heat for the full system. Now, the lowest row of turbines does run a bit hotter than the other two, but overall it works out well. The radbolt chamber in its place is used to power the diamond press, but this is not essential to the core reactor, so I will discuss that another time.

V. The nuclear waste pit is the hottest point in the whole build, and as the quantity of waste increases, it has to be pumped out. I also modified the entrance into the chamber in such a way that the waste pit is part of the airlock that prevents the escape of steam into the outer world.

VI. When excess nuclear waste is pumped out of the system, it is typically at 210 degrees or so. Just pumping this liquid into space felt like a massive waste of heat energy. The two chambers under the main nuclear power plant are 'waste heat recovery' chambers. They basically take in the excess nuclear waste from the nuclear waste pit, use the hot liquid to produce steam (and thus electricity), and once the nuclear waste hits 130 degrees, we pump it out into space. This whole thing is managed by automation, which I will not get into details today. I'll revisit it when I actually build it in the game.

VII. I had initially used a radbolt joint plate to extract radbolts from inside the chamber and use them to power my payload launchers (will get into the specifics in a bit).



Cycle 1800

But this led to issues because of the heat. I had tried cooling the joint plate with a cooling loop but it was proving to be inadequate. So I ended up using the diagonal radbolt exploit to get it through the wall. What this exploit means is that while radbolts cannot travel through a wall, they can move diagonally through the corner of a wall. A useful trick to know.

14

## 5) <u>Nuclear power plant basics -</u>

Initially, I wanted to make a separate guide on how to make the power plant, but then I realized I'll probably never do it so here go some basics

☢ The construction-

Fairly simple. Build out the overall frame using insulated tiles, using conductive joint plates where required to fit in your power cables. Do not bother trying to use transformers and all that jazz, just go with heavy-watt wire all the way. Just remember that joint plates conduct heat, so make sure at least one side of the joint plate is in a vacuum or you will have heat leakage.

After which fill in the chamber with thermal shift plates to even out the temperature. And if you're building the reactor out in space (which I recommend) fill in the entire area with drywall (except the parts that have the thermal shift plates, obviously.

☢ The liquid pipes-

The build has 2 types of liquid loops, one for cooling the turbines and one for putting water back into the reactor. Here the green and the blue dots make this pretty clear.

We have 3 loops of nuclear waste to cool the turbines (ignore the 2 loops on the right side, not our problem right now), but the water piping is a bit more complicated.
This is because we've used bridges to give water 2 paths – a primary and a secondary one. If you want to get into the basics of pipe priority, look up academy not included on Reddit.

Cycle 1800

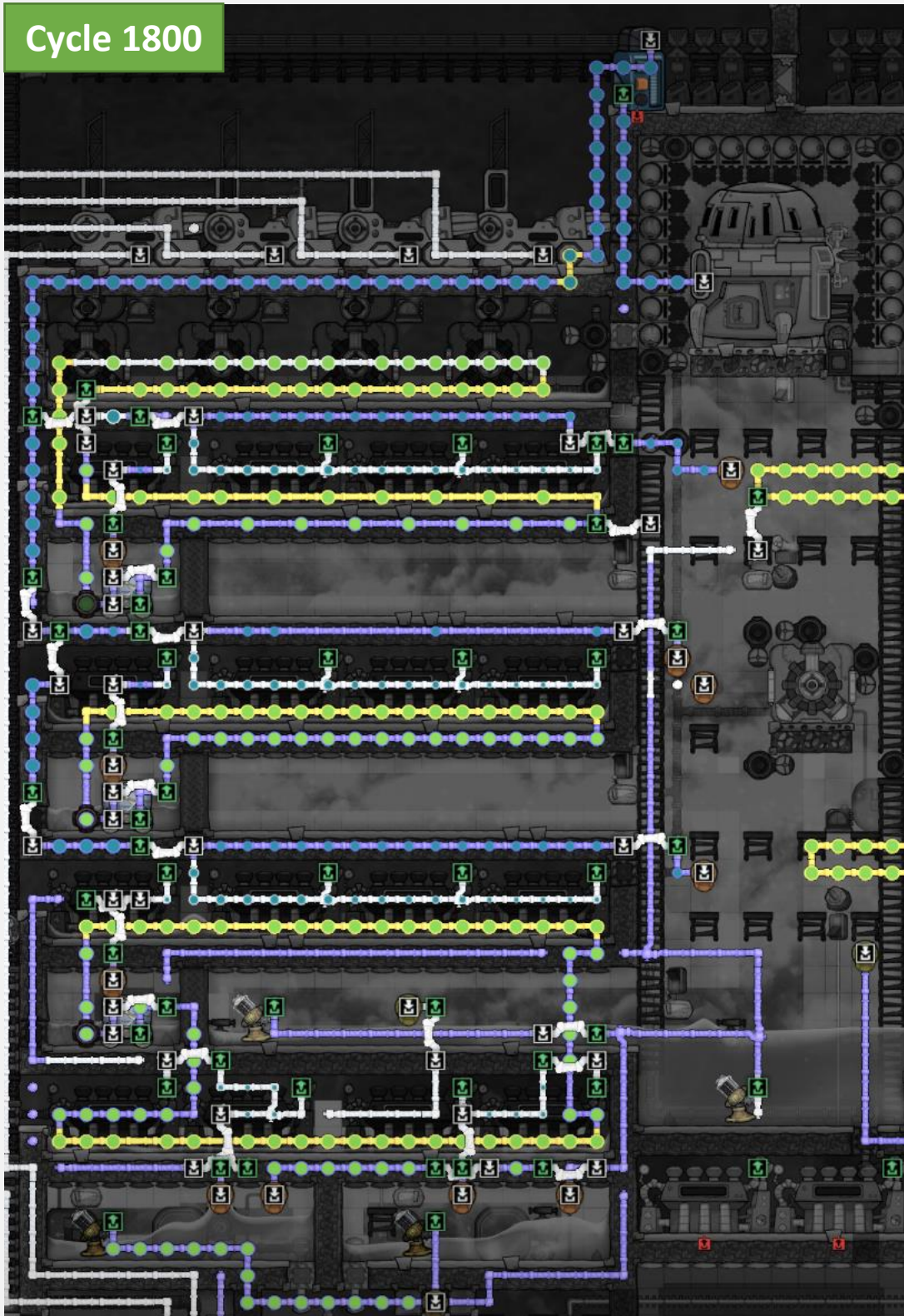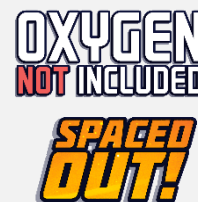In short, we can use bridges to dictate where the liquid will go first if it has 2 options available. Here, water will always try to go first towards the central pipe that feeds the nuclear reactor, and if that pipe is already full, it will pump its water into the power plant chamber, where it will fall into the nuclear waste pit and

convert to steam. This way, there will always be enough water to fuel the reactor ( we've also added a water reservoir just in case). And, any water that leaves the system via the steam turbines will go back into it, leaving the overall steam pressure inside the chamber at a steady level.

Note that the 4th turbines in all 3 rows are not part of this water loop, as they have their own closed-off chambers.

## Automation –

If I'm being honest, automation is unnecessary if you're just using this reactor for power. I have a small setup that raises an alarm if the temperature is too high or the pressure is too low, but that's all this build needs (apart from the usual aquatuner automation for a cooling loop). The automation on the turbines was just experimental and is completely unnecessary. We do use automation to manage our radbolts, but that's a separate discussion.

## Fuelling the reactor –

While I eventually built an automated delivery system to supply fuel, for a very long time I just used a storage bin with some fuel that I would refill periodically. The autosweeper will use that stored uranium and feed the reactor when it needs it. Make sure you change your door permissions to only allow duplicants in when absolutely necessary, or you will have a lot of radiation sickness to deal with.

## Radiation –

It's a NUCLEAR reactor, what else were you expecting? You can mess with radiation suits and rad pills and all that, but frankly, it's unnecessary. Repairs can be carried out in a live reactor with very little damage to your dupes. Sure, they'll spend a few cycles puking their guts out, but a few mop commands and some time will fix everything. Just make sure you have some med bays set up, just in case.

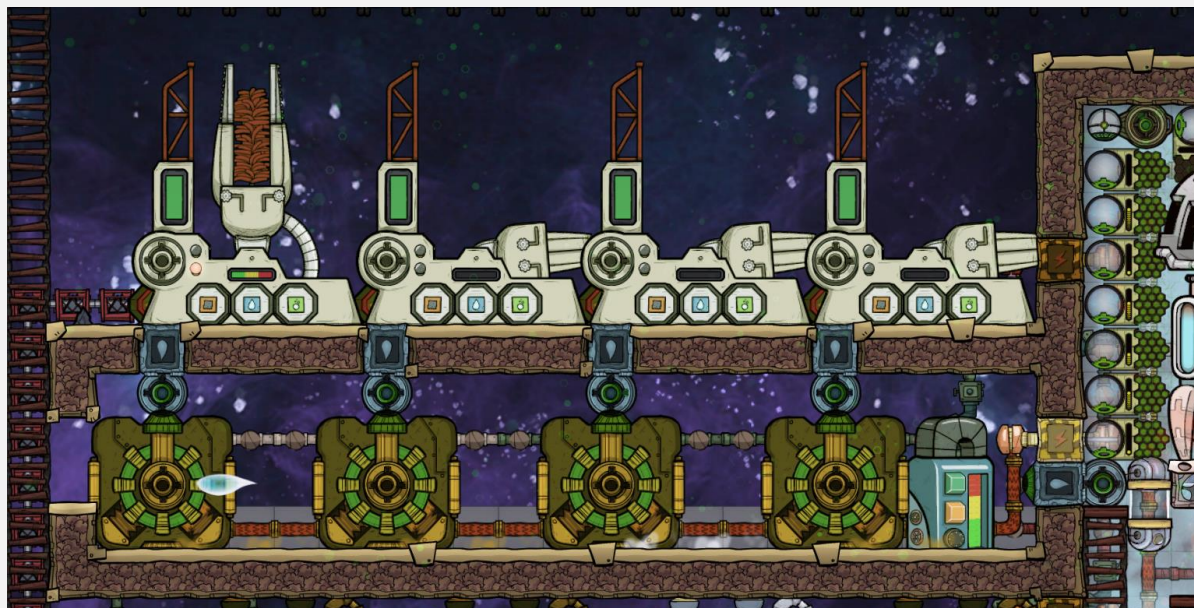And make sure you disable any radbolt generators when your dupes are in the chamber.

## 6) **Pew Pew**

I absolutely love the interplanetary launchers (Or payload launchers as I usually end up calling them), and I love the way I've been able to set them up here.



The logic here is that a nuclear reactor gives out both heat and radiation, so it's best to use them both optimally. So while the turbines produce power, radbolt generators will convert some of that power and radiation to radbolts, which will power my interplanetary launchers.

Why launchers? Because the movement of materials from one planet to another is the key to colonizing the galaxy. Not the highest priority right now, but we have to set the foundation of the system early in the game. We have a total of 8 planets apart from Neo Terra, meaning that at some point, I will need at least 7 launchers (because Petra can be supplied with the teleporters and a launcher is not strictly necessary). However, 8 is a nice even number and having double the capacity for Petra is a good thing, one I can use at some point. Right now I have built a nuclear reactor with 4 launchers on its left side. If I build a symmetrical reactor on the right side, I will be able to reach all 8 planets quite easily.

Setting up a launcher is very simple. It requires no cooling or anything (Assuming it's in a vacuum, otherwise you MAY need some light cooling). All it needs is a source of radbolts. I could have rigged them to use radbolts from the generators directly, but that would either lead to an excess, or a shortage of radbolts depending on the situation.

The radbolts that come from the radbolts generators are stored in the radbolt chambers under the launchers, which act as a buffer and allow the system to function more smoothly. The automation for the launcher is pretty simple as well. If any of the radbolt chambers is not full, the generators are activated and the chambers are refilled. Once they are full, the generators are disabled.





Cycle 1800
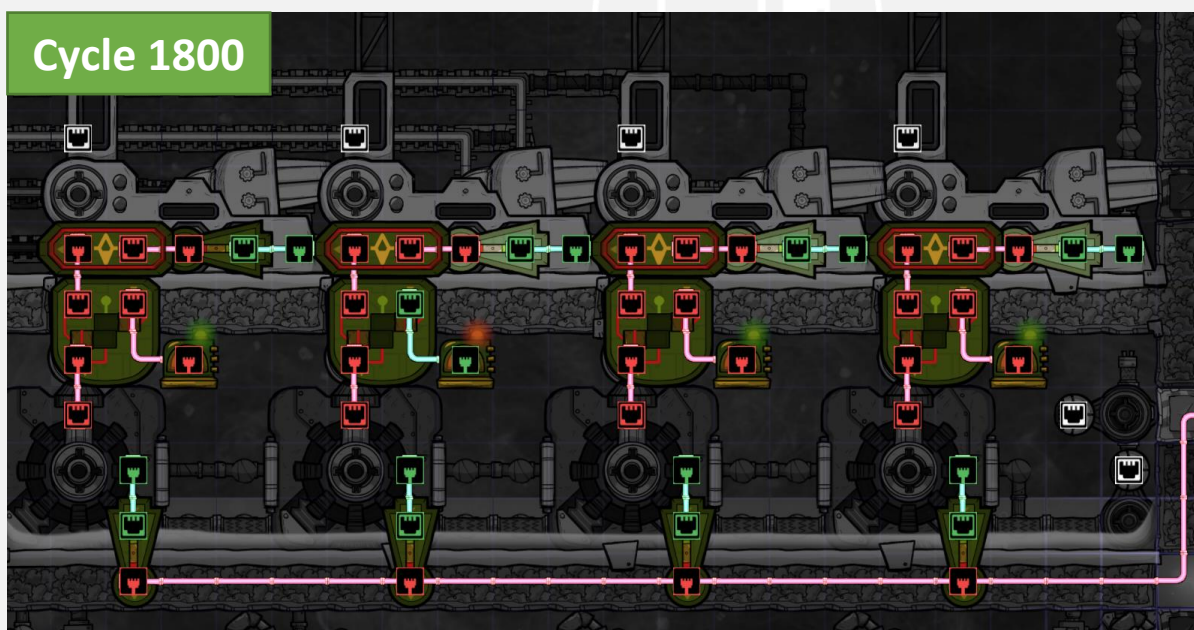
Similarly, if any of the interplanetary launchers do not have a full tank of radbolts, they trigger the automation to release radbolts from the chamber below it. If they are full, the chamber is disabled. The timer automation and the AND gate are just to make sure that too many radbolts are not released. The system still works without the AND gate and timer, but more radbolts are wasted.
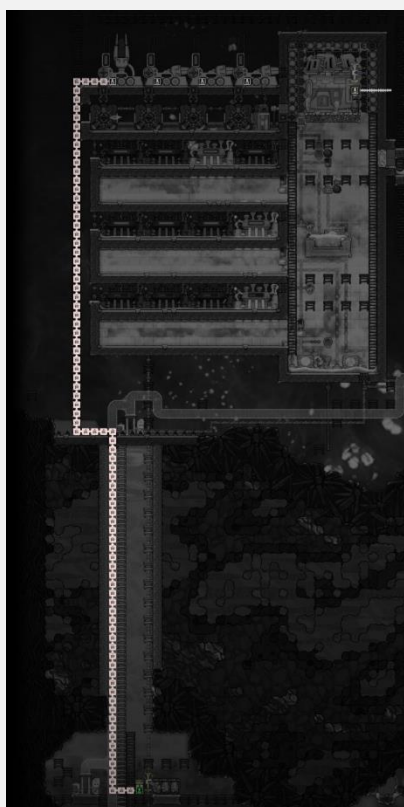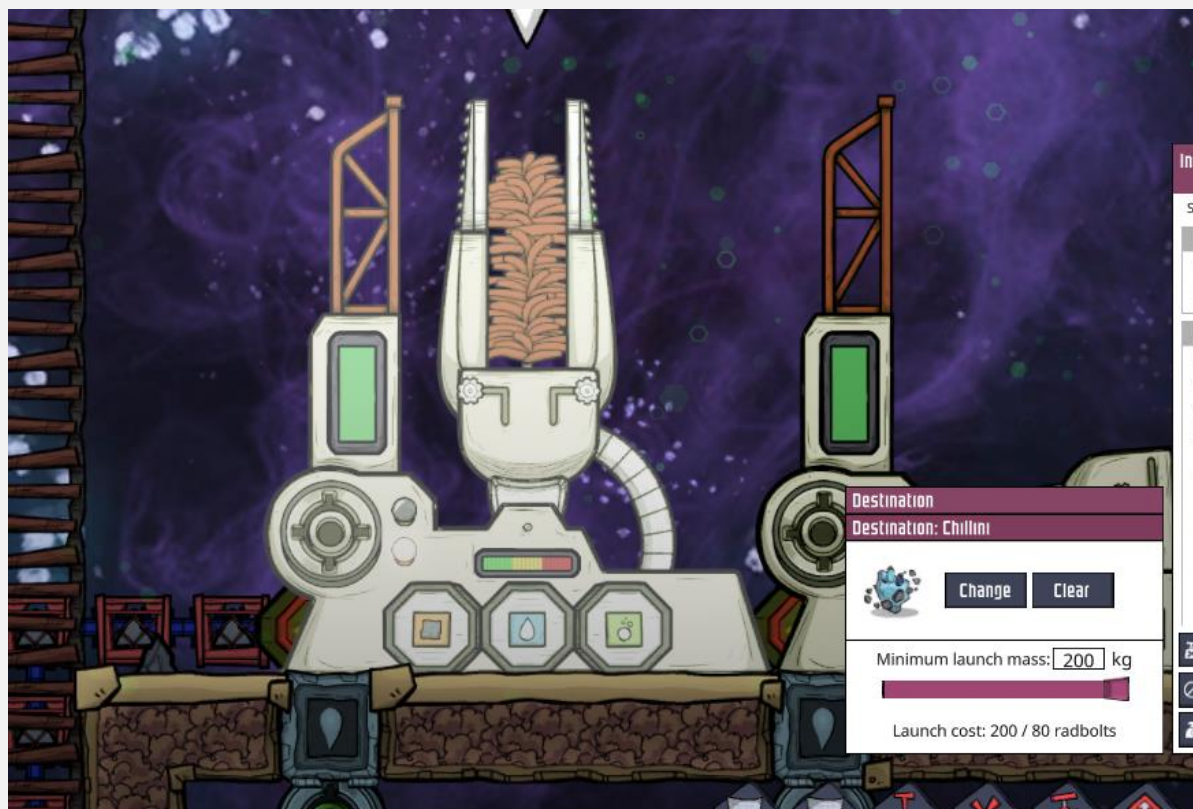
You can also set the radbolt chambers to expel a certain amount of radbolts, based on the requirement. The cost of launch depends on the target planet, and I always set the threshold as launch cost +1.



So here it's set to 81.

Each launcher has an input for a solid, liquid and gas, all of which can be loaded simultaneously, with the launcher only being limited by radbolt supply and how often it can launch (with a maintenance period every 6 shots).

The main reason I built this right now is so that I could send material to Svalbard, which I was easily able to do (you can see all the payloads on the planet's surface at the start of the chapter). We do not have any fancy automatic logistics system yet, so right now it's just a conveyer rail with a loader in place.

## 7) <u>Updates and upgrades –</u>

We've also made a few general changes in the base that I would like to quickly go over.

The food source for the hatches has been changed to granite, due to a shortage of sedimentary rock, and an abundance of granite. This granite will not last forever though… will need to come up with a different solution in the long term.

I set up some oxylite refining on Chernobyl but doesn't look like I have the power for it. In any case, there isn't much for me to do there, so I just packed up and left. I'll come back when I need to.

We add some lights around Neo Terra. Lights help some things up by giving us a speed bonus.

Finally, we now have a dedicated critter pit. It's not a closed room, so the dupes don't get overcrowded, but no non-flying critter can escape. All non-hatch eggs are automatically swept up and loaded into the critter pit, where they hatch and live.
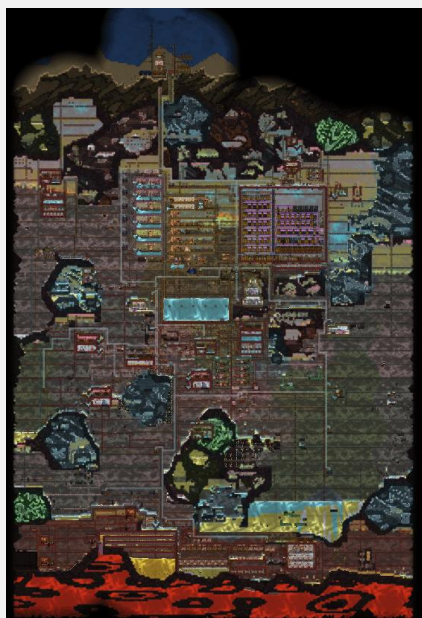
## 8) <u>Base Check-</u>

**The following tech was researched**

☢ Cryofuel propulsion technology

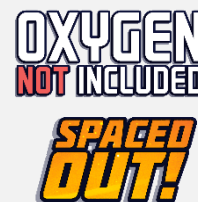## 9) <u>Comparison To The StormFather's Guide to the Galaxy-</u>

I think I took a different philosophical approach in SGG, where by cycle 550 I had begun work on décor for my dupes, and building new places for them to live and such. While I hesitate to call it a 'waste of time', this time around I'm a lot more focused on practical things, like nuclear reactors, which I was nowhere close to building in SGG.

**OXYGEN NOT INCLUDED**

**SPACED OUT!**

## Author's Note –

Thank you for taking the time to check out Project Shatterstar. I hope this helps you to up your game. Each episode will be updated when necessary, so do keep an eye on the change history.

This series is a labour of love and an attempt to create quality written content. It does take up a lot of effort, though, so If you do like the work, please share and recommend it actively. You can also support me directly if you are willing and able.

There is always scope for improvement and new perspectives, so I encourage you to reach out to me if you have any specific thoughts on the work, be it good, bad or ugly. Reddit is the best way to get a hold of me. Do follow me there to keep up to date with the latest on what I do.

Check out the 'Stormfather's Guide to the Galaxy' and 'Academy Not Included', both of which are series that I built on Reddit. SGG is now scrapped, thanks to some complications when Spaced Out came out of Beta. But ANI will continue in some form or another.

Reddit is also the perfect place to point out any errors in the file. Due credit will be given to those who find errors or provide feedback that is incorporated into the file.

To check out any past or future work, or to support or follow me, do check out the following link-
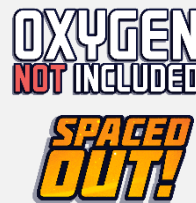
**https://linktr.ee/Stormfather**

Until next time

## Change History –

| Date | Version | Change | Credits |
|------|---------|--------|---------|
| 10th April '23 | 0 | New Release | - |
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