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CAPITAL REGION PETROLEUM
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SUBJECT: PHYSICAL/LOGICAL MACHINE AND CONTROL SYSTEM CONFIGURATIONS, AND METHODS FOR PRODUCING ROCKET FUEL

Promulgated on [UNRELEASED]

Director, CRHI

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Rocket Fuel is a renewable, high energy density liquid fuel provided by the Ender IO mod. Rocket Fuel is used as fuel in some liquid burning generators such as the Combustion Generator from Ender IO, and the Gas Turbine Generator from Advanced Generators.

The production of Rocket Fuel is done in two primary stages, which is defined as follows: A set of Vats (Ender IO) take Water, Sugar, and Potatoes to produce Hootch (alcohol). Hootch is then pumped into another set of Vats along with Redstone and Gunpowder, which then produce Rocket Fuel, as shown in Figure 1-1.

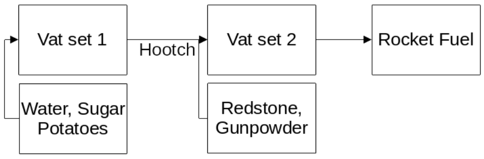


Figure 1-1. The basic rocket fuel production process.

0. Requirements Notation

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119. In addition to the key words and definitions described in RFC 2119, this document adds the following key word(s):

1 **WHEN REQUIRED** This phrase means that an item is used only when the functionality provided by the item is required. The item MUST NOT be used if it is not required, while the item MUST be used if it is required. This phrase helps to more accurately describe the requirements of independent, but similar systems, which have varying requirements because of their purpose (such as those systems described in Section 2.).

1. Production Design Overview

There are a total of twenty two (22) stages of production to produce rocket fuel. These production stages can be as simple as gathering cobblestone, or as complex as a fully automated mob farm, some production stages require specialized systems to ensure continuous operation, while others require multiple materials from previous production stages.

In order to minimize the complexity of the production process, a system for isolating production stages from one another has been designed. When a production stage is "isolated" it means items/fluids going into or coming out of the production stage are only the items/fluids that production stage requires or produces. To put it another way, an isolated production stage is not able to access any other items/fluids from any other production stages, except for the items/fluids that have been explicitly shared with it. This allows each production stage, and consequently rocket fuel production as a whole to scale easily with demand. The method for isolation is defined in Section 2.

As stated earlier, the production of rocket fuel consists of twenty two (22) stages of production. This standardization truncates that number down to seventeen (17) stages of production because some stages can be combined into a single production stage. A production stage typically produces one (1) item or fluid that can be used in another production stage (an exception to this is the mob farm which produces redstone and gunpowder, and the production stage that produces sugarcane and potatoes). Production stages are named after the item(s)/fluid(s) they produce. The following seventeen (17) stages of production defined by this standardization are as follows:

1 Pulverized Charcoal
2 Cobblestone
3 Sand
4 Sandstone
5 Niter
6 Slag
7 Phyto-Gro
8 Water
9 Sugarcane and Potatoes
10 Sugar
11 Sap
12 Rich Phyto-Gro
13 Fluxed Phyto-Gro
14 Redstone (produced by Phytogenic Insolators)
15 Redstone and Gunpowder (produced by the mob farm)
16 Hootch
17 Rocket Fuel

1.1. Operating States of Production Systems

Operating States describe the modes of operation common to the production systems defined within this document. Only one Operating State may be used to describe the operation of a production system at any point in time. Production systems can change Operating States at anytime due to (1) human/automated action, or (2) adventitiously. Operating States apply a reason to why a production system is behaving in a certain manner, at a particular point in time. Operating States do not define a physical or electronic system, nor does it enforce any requirements on production systems (or any other type of system) defined within this document.

The following seven Operating States are:

- ACTIVE - The production system is currently processing material.
- INACTIVE - The production system is configured and ready for use, however it is currently not being supplied power.
- STALL - The production system cannot meet the supply demands of other production systems.
- REDUCED - The production system, as an attempt to avoid being put into the STALL Operation State, has partially or entirely disabled one or more of its subsystems (while not negatively effecting its ability to process material). The production system will continue to process material during this time.
- STANDBY - The production system has reached maximum storage capacity, processing will resume when enough storage becomes available. The production system has most likely entered this state because it was able to produce more than the demand.
- MAINTENANCE - A physical/logical reconfiguration of the production system is taking place, production may be halted entirely or degraded during this time.
- DESTROYED/DAMAGED - The production system has been rendered inoperable or production is severely degraded due to hostile action (e.g., griefing).

1.2. Expectations for a Defined Production Stage

1.2.1. Preceding Description

Each stage of the production process will have a dedicated section, the section will be titled with the end product(s) of that production stage. The first sentence will state the sequence of the production stage (ex: 'The first stage of the production process involves producing Pulverized Charcoal'). Next, an ordered list is provided with all the involved processes ordered from first-to-last. Then, an alphabetically-ordered list provides which other stages receive the product(s) produced by this production stage, each stage is named the same as its sub-section. Lastly, another alphabetically-ordered list provides all the involved machinery during this production stage, along with the mod each machine is from.

1.2.2. The Description Section

A sub-section will follow titled 'Description', this section will describe the systems/methods used in the production stage.

1.2.3. The Operating State Advisory Section

If required, following the Description section a sub-section titled 'Operating State Advisory' may appear. This section is used for production systems which modify some aspect of their physical/logical behavior when put into different Operating States via human/automated action.

The purpose of the Operating State Advisory section is to: (1) address the specific actions the production system will take when put into different Operating States, and (2) to help identify the current Operating State of the production system.

The reason behind requiring this section for production systems which are able to change their Operating State through human/automated means, is because production systems which are capable of doing so, do so for a specific purpose and thus will exhibit unique behavior when put into different Operating States (e.g., such as an automated system disabling certain machines when the buffer chest becomes full). As such, that unique behavior must be clearly defined.

The Operating State Advisory section will contain an alphabetically-ordered list of one or more Operation States of concern. Each listed Operation State will specify the specific systems that are affected, and their modified behavior.

Lastly, Operating States that can appear as part of the Operating State Advisory are: (1) REDUCED, and (2) STANDBY. These two Operating States (aside from the ACTIVE Operating State) are the only ones that can be controlled using human/automated action (however production systems may enter these states adventitiously). As the ACTIVE Operation State is the normal, base-line of production systems, there is no need to include it into the Operating State Advisory. Only when the production system can change Operation States via human/automated action, and changing the Operation State immediately effects some aspect of the production system (e.g., enabling/disabling machinery) is an Operating State Advisory provided for that production system.

1.2.4. The Flow Charts Section

Following the Description section, or Operating State Advisory section (if present), another sub-section titled 'Flow Charts' will provide one or more flow charts which describe the logical layout of the production stage.

1.2.5. The Setup Photos Section

Lastly, a sub-section titled 'Setup Photos' will provide in-game pictures relevant to the setup.

1.3. Common Energy and Transport Systems

1.3.1. Forge Energy

You MUST power all machinery defined within this document with Forge Energy (FE). All machinery defined within this document is compatible with the Forge Energy system. You may generate Forge Energy using any methods you see fit.

1.3.2. Ender IO Conduits

The common transport system when connecting to machines, buffer chests/buffer drums are the various conduits provided by Ender IO. The following four (4) types of conduits are used: (1) Item Conduits, (2) Ender Fluid Conduits, (3) Ender Energy Conduits, and (4) Redstone Conduits. Ender IO conduits are used because of their superior transport and configuration capabilities when compared to other types of transport systems. Ender IO conduits are only used to transport materials within the boundaries of a production stage, in that Ender IO conduits from one production stage MUST NOT connect to Ender IO conduits from other production stages. The exception to this rule is the Redstone Conduit which carries a signal from the: Redstone and Gunpowder, and Redstone-Growing production stages to the Rocket Fuel production stage, see Section 20.1.1.

Within a production stage you: MUST transfer all energy using Ender Energy Conduits, MUST transfer all items using Item Conduits, MUST transfer all fluids using Ender Fluid Conduits, MUST transfer all redstone signals using Redstone Conduits.

2. Applied Energistics 2 Physical/Logical Infrastructure

The AE2 infrastructure consists of multiple independent AE2 networks (hereafter referred to as 'production networks'), an AE2 transport network, and multiple isolation subnetworks called 'handoff-zones'. A production network is an assortment of AE2 devices which are configured to meet the requirements of a specific stage of the production process. The transport network is the medium through which material to/from production networks flow. A production network will share one or more products with one or more production networks, and may receive one or more resources from one or more production networks. Transfer of materials between production networks are facilitated by small subnetworks called 'handoff-zones', which functions as an isolation layer between the transport network and production networks.

By configuring the Applied Energistics 2 infrastructure in this manner, we gain the following two (2) advantages:

1 Resource Isolation: No production network has access to all the materials used in the production process. A production network only has access to the materials which are required to perform its part of the production process.

2 Monitoring Capabilities: By separating each stage of the process, monitoring the I/O of materials and energy usage of a specific stage within the production process is now possible.

2.1. Components of the Applied Energistics 2 Infrastructure

The following subsections will clearly define the physical/logical requirements and configurations of the various AE2 networks used in the production process. Specifically, these sections will discus the (1) handoff-zones, (2) production networks, and (3) the transport network.

2.1.1. Handoff-Zone Network

The handoff-zone is a network which exists between the production network and the transport network which serves to isolate the production networks from each other, and to isolate the production networks from the transport network. The handoff-zone is comprised of three components: (1) an ME Storage Bus or ME Fluid Storage Bus, (2) an ME Interface or ME Fluid Interface, and (3) a P2P Tunnel configured for ME, the default. A handoff-zone can be configured in two ways: (1) to receive resources, or (2) to share products. These configurations are described in Section 2.1.1.1. and Section 2.1.1.2. respectively. For examples, refer to Photograph 2-1-1, Photograph 2-1-2, Photograph 2-2-1, Photograph 2-2-2, and Photograph 2-2-3. Additionally, all Photograph N-2 photos who's captions are prefixed with the words 'Resource Provision Systems' depict a handoff-zone which is configured to receive resources.

2.1.1.1. Handoff-Zone: Receiving Resources

In order for a production network to receive shared resources, one or more P2P Tunnels connect to an ME Interface on the P2P Tunnel side of the connection. Then an ME Storage Bus on the production network's side of the connection attaches to the ME Interface, as shown in Photograph 2-1-1. If fluids are being received you MUST use ME Fluid Storage Buses and ME Fluid Interfaces.

When there is a handoff-zone providing items and a handoff-zone providing fluids, you MUST separate the two with cable anchors, as shown in Photograph 2-1-2. This is because you are unable to receive fluids through a handoff-zone which can only accept items, because that handoff-zone is not using ME Fluid Storage Buses and ME Fluid Interfaces, and vise versa.

Additionally, you MUST NOT use the same P2P Tunnel pair more than once on a production network when receiving resources.

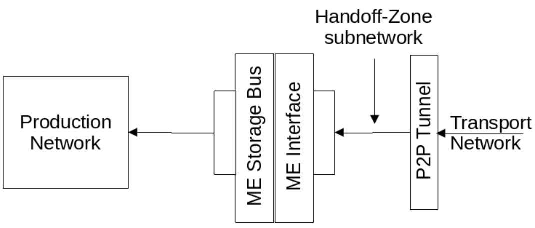


Figure 2-1. Logical diagram of a handoff-zone configured to receive resources.

Photograph 2-1-1. An ME Storage Bus (left) is connected to an ME Interface (middle), a P2P Tunnel (right) makes available resources from another production network; a typical setup for an AE production network receiving resources from another production network.

Photograph 2-1-2. A production network receiving items and fluids.

2.1.1.2. Handoff-Zone: Sharing Products

When a production network shares its product(s) with other production networks it does so by providing an ME Interface on the production network's side of the connection, which is configured to only provide one specific item/fluid. Next, an ME Storage Bus on the handoff-zone side of the connection attaches to the ME Interface, as shown in Photograph 2-2-1. The ME Storage Bus is configured for the same item/fluid as the ME Interface, additionally the ME Storage Bus Input/Output Mode setting is set to 'Extract Only'. If fluids are being shared you MUST use ME Fluid Storage Buses and ME Fluid Interfaces.

You MUST share a single type of item/fluid through a P2P Tunnel. Multiple different types of items/fluids MUST NOT be shared through one P2P Tunnel. Each shared product MUST have a dedicated: P2P Tunnel pair, ME Interface, and ME Storage Bus, for an example see Photograph 2-2-2.

You MAY have multiple end-points for one P2P Tunnel which is sharing a product to multiple (different) production networks. You MAY share the same product to another production network multiple times, but when doing so you MUST use a different P2P Tunnel pair, ME Interface, and ME Storage Bus, as shown in Photograph 2-2-3. This is because, as stated in Section 2.2., you MUST NOT use the same P2P Tunnel pair more than once on the receiving resources handoff-zone.

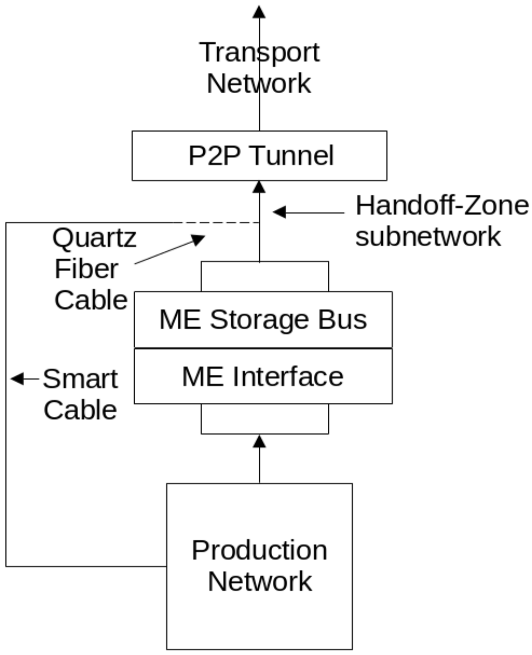
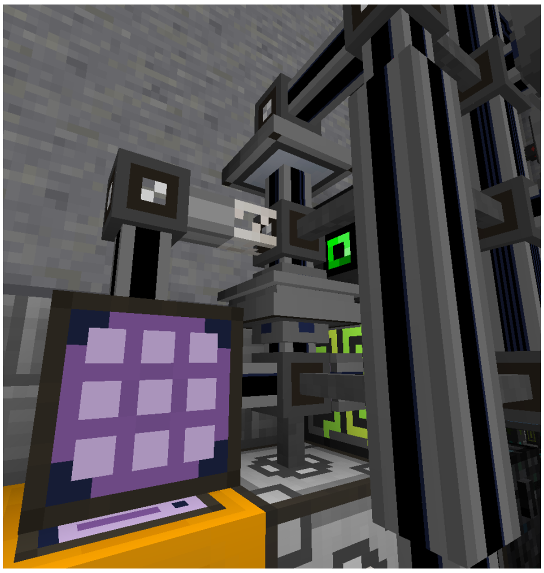
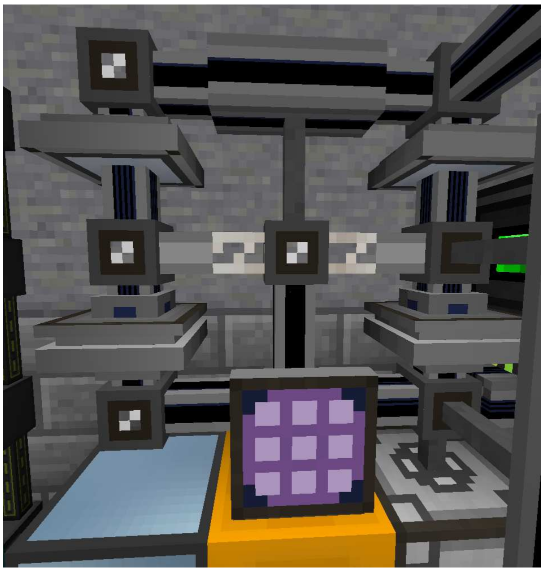


Figure 2-2. Logical diagram of a handoff-zone configured to share products.



Photograph 2-2-1. A P2P Tunnel (top) makes available products to other production networks, an ME Storage Bus (middle) is connected to an ME Interface (bottom); a typical setup for an AE production network sharing its products.



Photograph 2-2-2. When sharing multiple products, you MUST dedicate one P2P Tunnel per item/fluid.

Photograph 2-2-3. The Water production stage shares water multiple times to the Redstone-Growing production stage. Each time it shares water it uses a different P2P Tunnel pair.

2.1.2. Production Networks

As stated in Section 2., production networks are an assortment of AE2 devices which are configured to meet the requirements of a specific stage of the production process. A production network is present at every stage of the production process to support the operation of machines associated with that production stage. To accomplish this, a production network provides the following eight (8) capabilities:

1 Accept Resources: [WHEN REQUIRED] A production network accepts one or more items/fluids that are required for the current stage of production.

2 Interfaces: A production network will provide an ME Terminal for accessing items within the production network. If preferred, an ME Crafting Terminal may take the place of an ME Terminal. [WHEN REQUIRED] A production network will provide an ME Fluid Terminal for viewing the fluids within the production network.

3 Network Security: A production network is equipped with an ME Security Terminal to limit access to only authorized individuals.

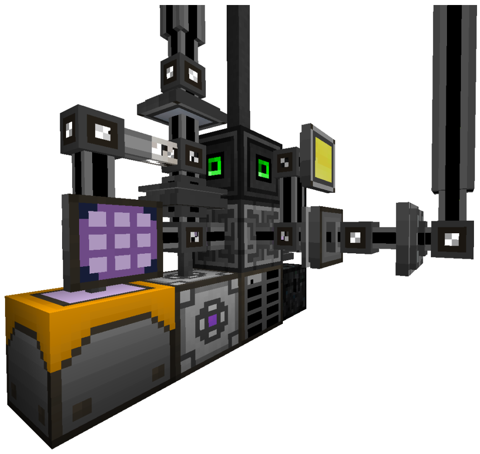
4 Process Control: [WHEN REQUIRED] A production network will provide one or more ME Level Emitters and/or ME Fluid Level Emitters for the purpose of providing an input signal to a subsystem apart of the same production stage. This subsystem will then perform some type of action, such as enabling/disabling machines.

5 Process Monitoring: [Method 1, REQUIRED] Utilizing an Adapter from OpenComputers, we are able to acquire telemetry data from the production networks, such as: current stored items, average/idle power usage of the production network, and the power usage of non-Applied Energistics 2 machines, see Section 2.2.
[Method 2, OPTIONAL] Utilizing one or more ME Level Emitters and/or ME Fluid Level Emitters, we are able to output a signal to some type of device, such as a Redstone Transmitter, for the purpose of process monitoring.

6 Provide Energy: [WHEN REQUIRED] A production network provides one or more P2P Tunnel pairs to accept and output energy to machinery. By routing energy through the production network, the approximate amount of energy used by non-Applied Energistics 2 devices can be calculated, see Section 2.2.

7 Share Products: A production network exposes one or more items/fluids to one or more production networks to be used in later stages of production.

8 Storage: A production network is able to store the product(s) it produces.



Photograph 2-3. An example of an AE2 production network.

An exhaustive list of all possible components that may appear in a production network are as follows:

Device	Always Used (required)	Quantity
1k ME Storage Cell and/or 1k ME Fluid Storage Cell	Yes	1 ≥
ME Controller	Yes	1
ME Drive	Yes	1
ME Energy Acceptor	Yes	1
ME Export Bus and/or ME Fluid Export Bus	No	1 ≥
ME Import Bus and/or ME Fluid Import Bus	Yes	1 ≥
ME Interface and/or ME Fluid Interface	Yes	1 ≥
ME Level Emitter and/or ME Fluid Level Emitter	No	1 ≥
ME P2P Tunnel - FE	No	2 ≥
ME Security Terminal	Yes	1
ME Storage Bus and/or ME Fluid Storage Bus	No	1 ≥
ME Terminal and/or ME Fluid Terminal	Yes	≤ 1
OpenComputers Adapter	Yes	1

Table 2-1. Exhaustive list of network components that can comprise a production network.

Due to the highly configurable nature of production networks, and the lack of requirements on the scale (size) of each production stage, production networks do not have strict physical setup requirements. You are allowed to configure production networks in anyway you see fit, with the following two (2) exceptions:

1 All required devices listed in Table 2-1 (column 2) MUST be present on the production network.

2 The quantities listed in Table 2-1 (column 3) are respected, e.g. you do NOT use more than one (1) ME Controller.

Even though production networks do not have strict configuration requirements, there are some design characteristics you MUST adhere to:

1 The amount of AE network devices remains minimal. This means that the I/O operations are "centralized" to buffer chests/drums. Which is a practice you will find common for all production stages. Less AE network devices increases the accuracy of the value returned from the formula in Section 2.2.

2.1.2.1. Storage Requirements

As stated in Table 2-1, production networks MUST have at least one (1) 1K ME Storage Cell and/or at least one (1) 1K ME Fluid Storage Cell. The true amount of storage cells, and the specific type of storage cells used, depends upon the production stage. Each storage cell MUST be configured to store a single type of item or fluid (storage cells can be configured to store specific items/fluids in a Cell Workbench). That is, for every product produced by a production stage, there are an equal number of storage cells, each dedicated to a single product. For example, if a production stage shares redstone and gunpowder (its products), then there are two (2) storage cells total, one dedicated to redstone, and the other dedicated to gunpowder. There MUST NOT be more than one (1) storage cell dedicated to the same product.

The reason for using the lowest capacity (1K) storage cells, is because (almost) all production stages produce their product(s) faster than those products are consumed. This is to say that large storage capacities for production networks are useless, because the production stage will never be in a situation where it cannot produce its product(s) quick enough. The one exception to this are the production stages that produce redstone, i.e. Redstone-Growing, Redstone and Gunpowder production stages. In these two production stages, use a 64K ME Storage Cell to store redstone.

2.1.3. Transport Network

The transport network acts as the backbone of the production process. It provides the transport medium for all material flowing to/from production stages, as well as providing power to all production networks.

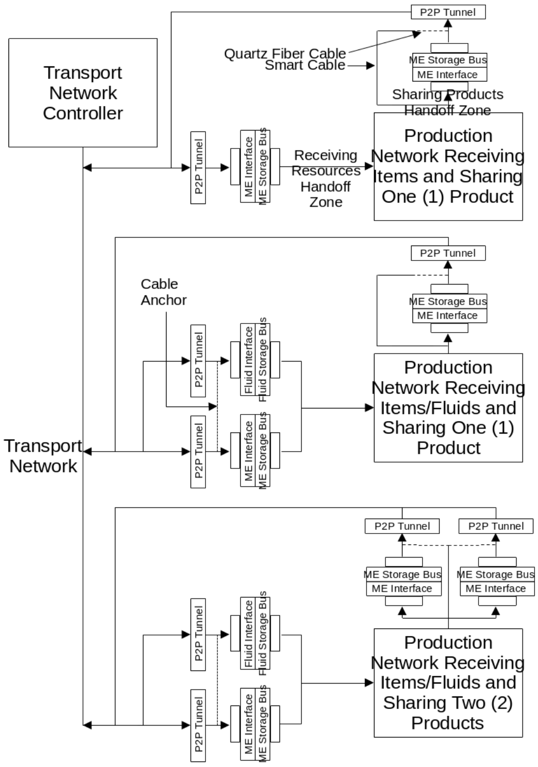


Figure 2-3. Logical topology of the transport network.

An exhaustive list of all components that MUST appear on the transport network are as follows:

Device	Quantity
Energy Acceptor	1
ME Controller	1
ME Security Terminal	1
P2P Tunnel (ME)	17 ≥ (approx.)

Table 2-2. Exhaustive list of network components that comprise the transport network.

2.2. Interfacing with OpenComputers

Every production network, including the transport network, have an Adapter from OpenComputers placed on the ME Controller. This allows OpenComputers to access the ME Controller as a component, which provides the methods of the OpenComputers Applied Energistics 2 API (payonel, 2018)[1]. The purpose of which is to facilitate monitoring of the production process.

When in context to the Rocket Fuel production process, the following six (6) types of data is of concern:

1. The Universally Unique Identifier (UUID) of the ME Controller.
2. The average power usage of the production network, in AE units of energy.
3. The idle power usage of the production network, in AE units of energy.
4. *The average power usage of non-Applied Energistics 2 machines in the production stage, in FE units of energy.
5. The type and quantity of item(s) stored within the production network.
6. The type and quantity of fluid(s) stored within the production network.

*To calculate the amount of FE used by the production network, use the following formula:

$$\left(\frac{(avgAEPwrUsage\ -\ idleAEPwrUsage)}{0.05}\right)\times 2$$

The above formula will output the current power usage of the production network in FE units of energy. In-order to calculate this value, two pieces of data must be collected from the production network, being the average power usage (avgAEPwrUsage) and idle power usage (idleAEPwrUsage). Almost every Applied Energistics 2 device uses power both passively and while performing an operation, which is reported in the idle power usage and average power usage data values respectively. Because of this, it is difficult to determine the actual amount of power used by only non-Applied Energistics 2 machines. As such, the value returned by the formula should be taken only as an approximation. To increase the accuracy of this output, follow the recommendations made at the end of Section 2.1.2. Additionally, when transferring power through FE configured P2P Tunnels, there is a 5% tax on power. That is, the network itself will use 5% of however much power you are attempting to send through it (yueh, 2015)[2]. This however, does not mean the power you are tunneling through the network is consumed, rather the power usage of the Applied Energistics network itself will merely increase.

2.2.1. Industrial Monitoring System

The Industrial Monitoring System (IMS) is the collective name of all OpenComputers components that are used to facilitate monitoring of the production networks.

There are two configurations for the IMS, the configurations are defined by where you are viewing the collected data (e.g. on-site, or off-site). You MAY configure the IMS to perform on-site and off-site monitoring, however this is not covered.

The two configurations for the IMS are covered in the following subsections.

2.2.1.1. On-Site

When monitoring from on-site, the following network architecture is used:

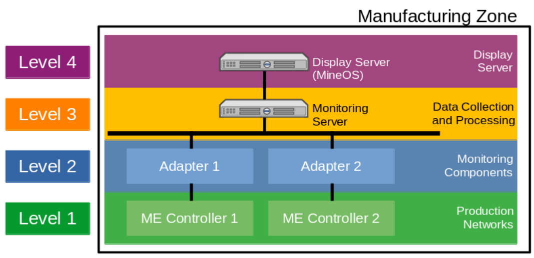


Figure 2-4. Network architecture of the IMS when electing to keep all monitoring capabilities on-site.

In this configuration, the network is contained within one zone with four levels:

- Manufacting Zone:
  - Level 4: Display Server
  - Level 3: Data Collection and Processing
  - Level 2: Monitoring Components
  - Level 1: Production Networks

The Monitoring Server (MS) gathers data using a daemon. The data is then transmitted to the Display Server (DS). The DS then displays the data on a graphical interface. Additionally, the DS uses the MineOS operating system because of its well-developed and featureful graphical API (IgorTimofeev, 2021)[3].

2.2.1.2. Off-Site

When monitoring from off-site, the following network architecture is used:

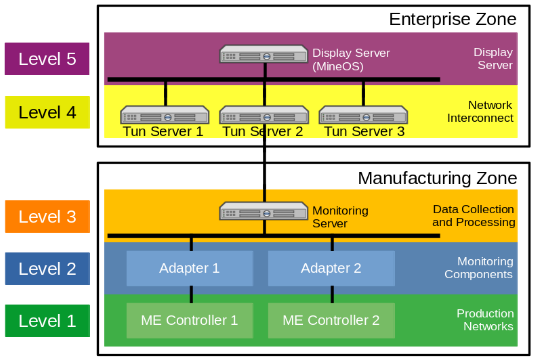


Figure 2-5. Network architecture of the IMS when sending all data off-site.

In this configuration, the network is contained within two zones with five levels:

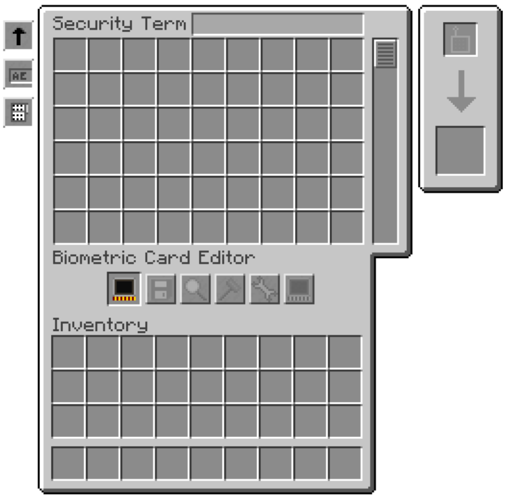
- Enterprise Zone:
  - Level 5: Display Server
  - Level 4: Network Interconnect
- Manufacturing Zone:
  - Level 3: Data Collection and Processing
  - Level 2: Monitoring Components
  - Level 1: Production Networks

The MS and DS are separated geographically from each other. To facilitate data transfer between the two, an intermediary system is introduced. This system is called the Tun Server (TS) ('tun' as in tunnel). The TS contains a Linked Card, while the MS contains the corresponding Linked Card. By doing this, both the TS and MS can send network messages back and forth. The TS receives data from the MS, then the TS sends that data to the DS.

2.3. Network Security Requirements

Every Applied Energistics network within this document, be it production networks, the transport network, but excluding handoff-zones, MUST comply to the requirements defined within this section.

In Applied Energistics 2, network security is provided by the ME Security Terminal (thatsIch, 2014)[4]. At a minimum, the ME Security Terminal MUST contain a (single) Biometric Card, which is not bound to any player, and has been configured to provide NO PERMISSIONS. This results in all players having no permissions on the network. Permissions MAY be delegated on a player-by-player basis, where each player will have their own Biometric Card stored within the ME Security Terminal. Remember the principle of least privilege when delegating permissions to players. That is, players SHOULD only be assigned the Deposit and Withdraw permissions. It is NOT RECOMMENDED to delegate any other permissions other than Deposit and Withdraw to a player.



Configuration 2-1. Configuration of the Biometric Card within the ME Security Terminal. Take notice, all the security permissions for this card are greyed out, indicating those permissions are not applied to the card.

3. Pulverized Charcoal

The first stage of the production process involves producing Pulverized Charcoal. The following is an outline of the production process:

1. Oak trees are harvested using Ender IO Farming Stations.
2. Harvested materials travel through a Nullifier, with a black-list filter for Oak Wood.
3. Oak Wood is prioritized to be inserted into an Ender IO Crafter first. If required, the Crafter will then craft four (4) Oak Wood Planks.
4. Oak Wood Planks pass into a Crafter to be turned into Sticks.
5. Oak Wood Planks and Sticks pass into a Crafter to be turned into Wooden Axes.
6. Oak Wood Planks and Sticks pass into a Crafter to be turned into Wooden Hoes.
7. The remaining Oak Wood is then inserted into the Oak Wood buffer chest.
8. An ME Storage Bus is attached to the Oak Wood buffer chest to expose the

contents of said chest to the local production network.

9 An ME Interface is configured to provide Oak Wood. Attached to this ME Interface is an Item Conduit which extracts the Oak Wood. The Oak Wood is then inserted via Item Conduits into the Redstone Furnaces.

10 Redstone Furnaces smelt Oak Wood into Charcoal. Charcoal is then inserted into adjacent Pulverizers.

11 Pulverizers then pulverize Charcoal into Pulverized Charcoal.

12 Pulverized Charcoal is then extracted from the Pulverizers and inserted into the Pulverized Charcoal buffer chest using Item Conduits.

13 Pulverized Charcoal is then imported into the local production network from the Pulverized Charcoal buffer chest using an ME Import Bus.

14 Pulverized Charcoal is then stored on the local production network.

Pulverized Charcoal is used in the following production stage(s):

- Phyto-Gro

The following machinery is used during this production stage:

- Crafter - Ender IO
- Farming Station - Ender IO
- Nullifier - Thermal Expansion
- Pulverizer - Thermal Expansion
- Redstone Furnace - Thermal Expansion

3.1. Description

The production stage of Pulverized Charcoal uses Farming Stations to harvest Oak Wood. A large part of this production stage is the crafting of tools to provide to the Farming Stations. The following is done to accomplish this. An Item Conduit attached to a Nullifier is configured with a filter card which black-lists Oak Wood, allowing for unwanted products from harvesting to be removed from the process. Then, Oak Wood is inserted into the first of four Crafters using an insert priority of zero (0), here Oak Wood is crafted into Oak Wood Planks. The second of these Crafters uses Oak Wood Planks to craft into Sticks, which are used to craft the tools. The third Crafter uses Oak Wood Planks and Sticks to craft Wooden Axes. The fourth and final Crafter uses Oak Wood Planks and Sticks to craft Wooden Hoes. Both tools are then extracted from the third and fourth Crafters and then inserted into the Farming Stations using Item Conduits.

After the tools are crafted, the remaining Oak Wood is inserted into the Oak Wood buffer chest with an insertion priority of negative one (-1). An ME Storage Bus is connected to the Oak Wood buffer chest which exposes the chest's contents to the local production network. Because the Oak Wood buffer chest is now effectively network storage, we use an ME Interface to access Oak Wood. Attached to this ME Interface is an Item Conduit which extracts Oak Wood from the local production network, and into the Redstone Furnaces. The Redstone Furnaces then smelt the Oak Wood into Charcoal. Then, taking advantage of a feature in Thermal Expansion machines, Charcoal is exported into adjacent Pulverizers. The Pulverizers then pulverize Charcoal into Pulverized Charcoal, which is then extracted into the Pulverized Charcoal buffer chest. The local production network when imports the contents of said chest using an ME Import Bus.

3.2. Flow Charts

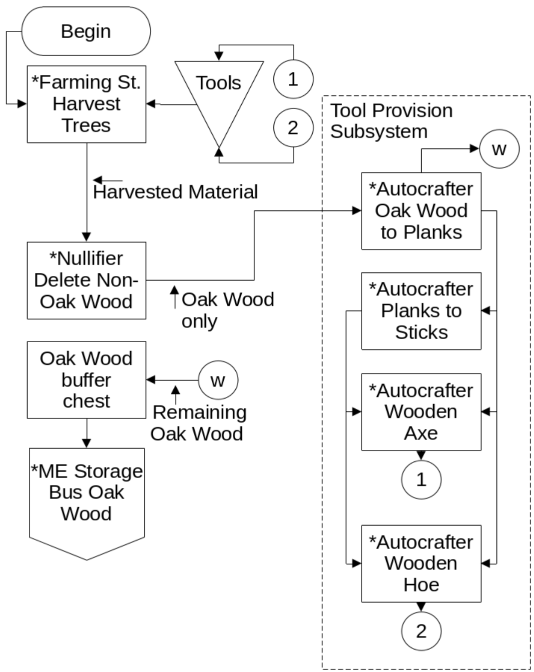


Figure 3-1. Pulverized Charcoal production diagram

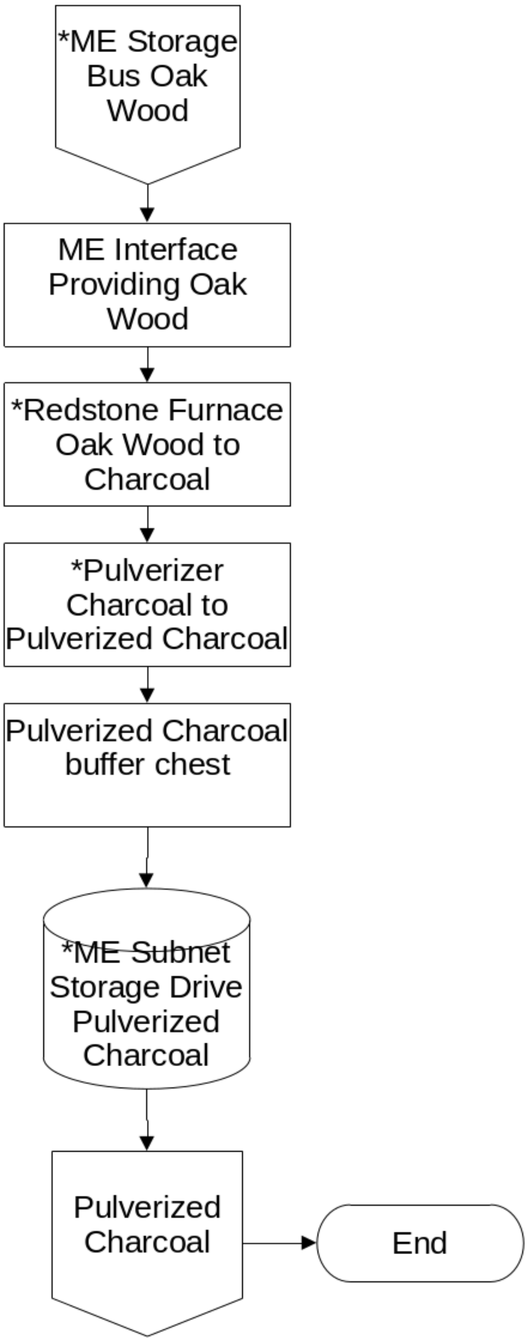
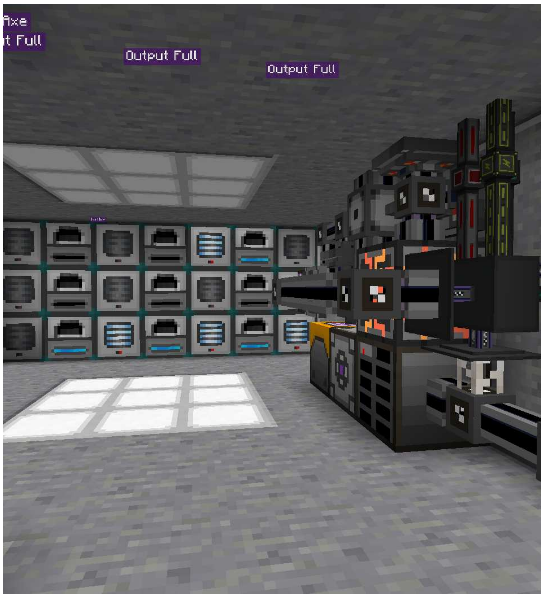
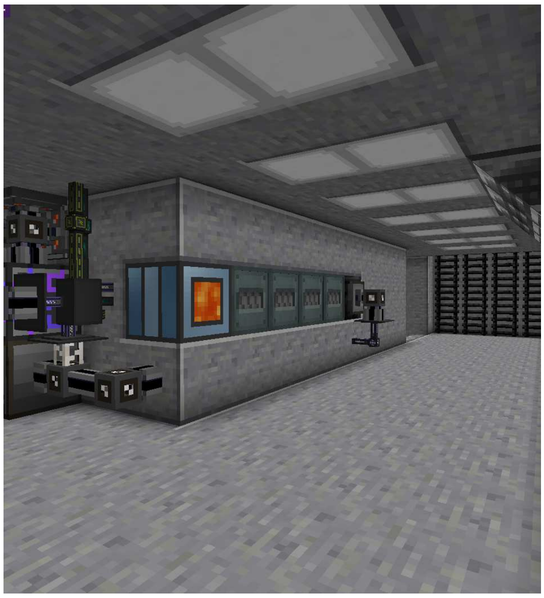


Figure 3-2. Pulverized Charcoal production diagram continued

3.3. Setup Photos

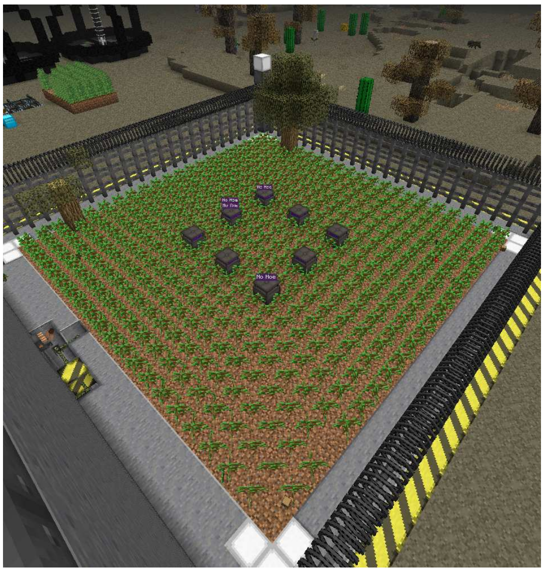


Photograph 3-1. Pulverized Charcoal production systems

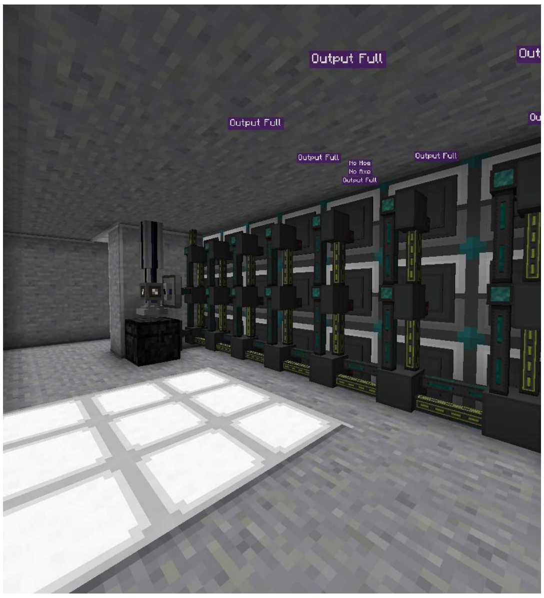


Photograph 3-2. Tool Provision Subsystem

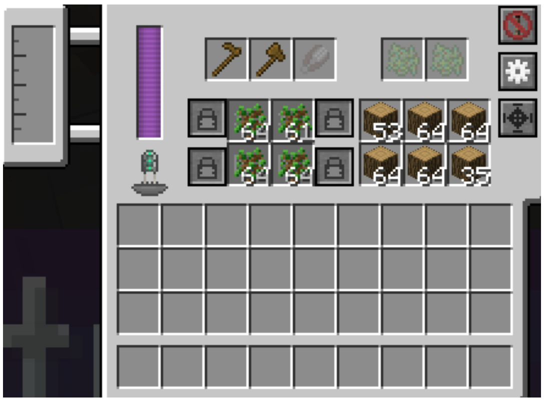
Photograph 3-3. The chest (bottom) contains Pulverized Charcoal. The ME Interface (middle-right) provides Oak Logs.



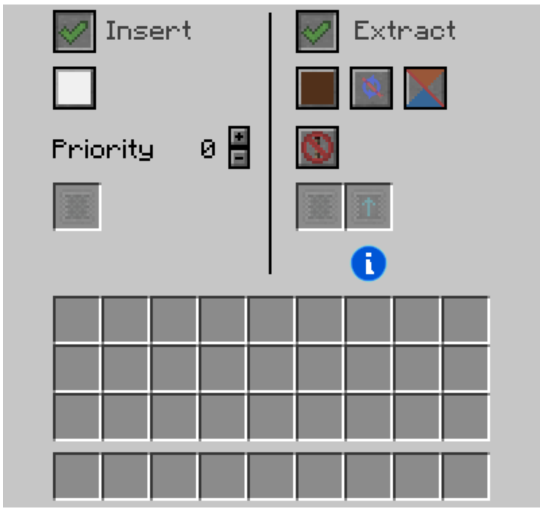
Photograph 3-4. The ideal size of the tree farm (21x21).



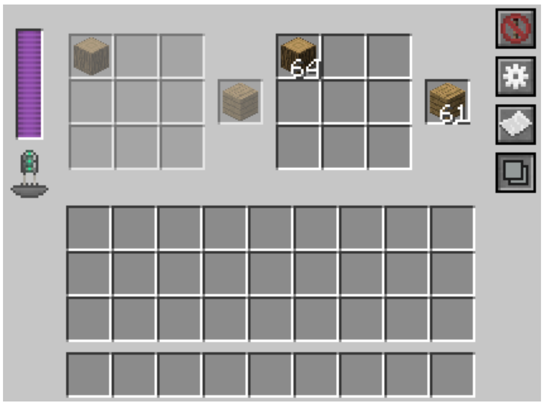
Photograph 3-5. Rear of the furnaces and pulverizers depicting the Item and Energy Conduits.



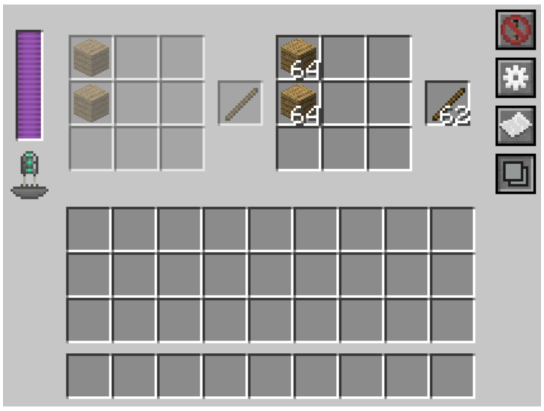
Configuration 3-1-1. Farming Station configuration.



Configuration 3-1-2. Item Conduit configuration for the Farming Stations.

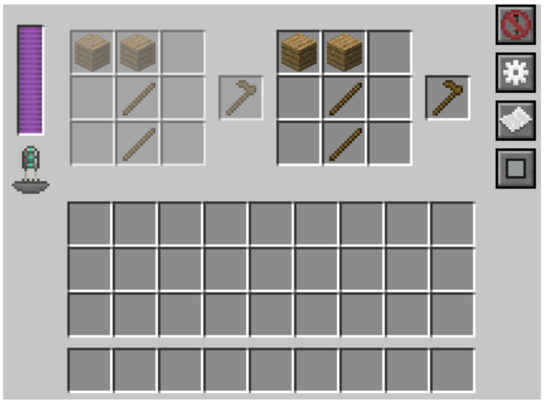


Configuration 3-2-1. Crafter - Oak Wood to Oak Wood Planks



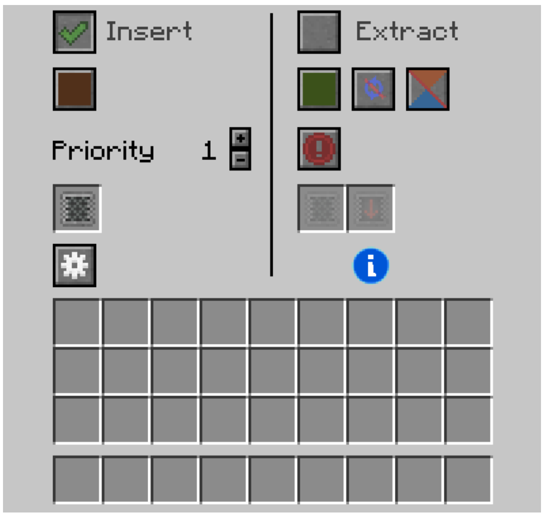
Configuration 3-2-2. Crafter - Oak Wood Planks to Sticks

Configuration 3-2-3. Crafter - Wood Axe



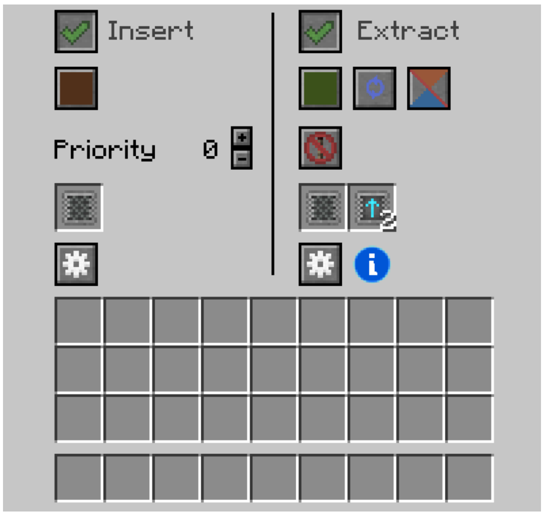
Configuration 3-2-4. Crafter - Wood Hoe

Configuration 3-3. Configuration for Oak Wood buffer chest ME Storage Bus.



Configuration 3-4-1. Item Conduit configuration for Nullifier.

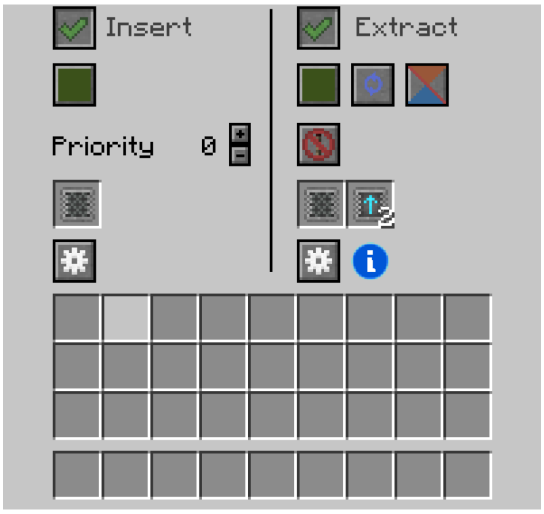
Configuration 3-4-2. Item Conduit filter configuration for Nullifier.



Configuration 3-5-1. Item Conduit configuration for Oak Wood to Oak Planks Crafter.

Configuration 3-5-2. Item Conduit Insert filter configuration for Oak Wood to Oak Planks Crafter.

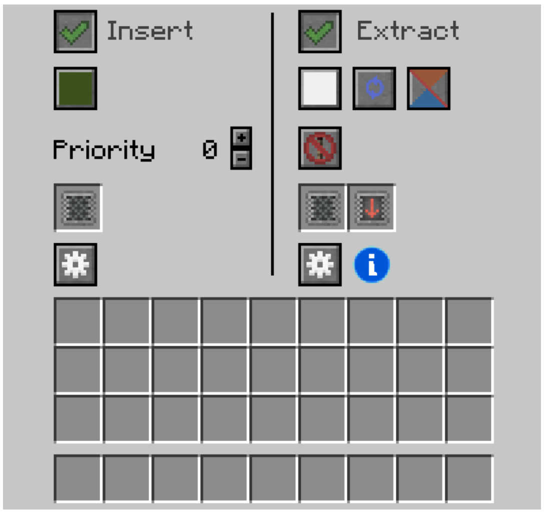
Configuration 3-5-3. Item Conduit Extract filter configuration for Oak Wood to Oak Planks Crafter.



Configuration 3-6-1. Item Conduit configuration for Oak Planks to Sticks Crafter.

Configuration 3-6-2. Item Conduit Insert filter configuration for Oak Planks to Sticks Crafter.

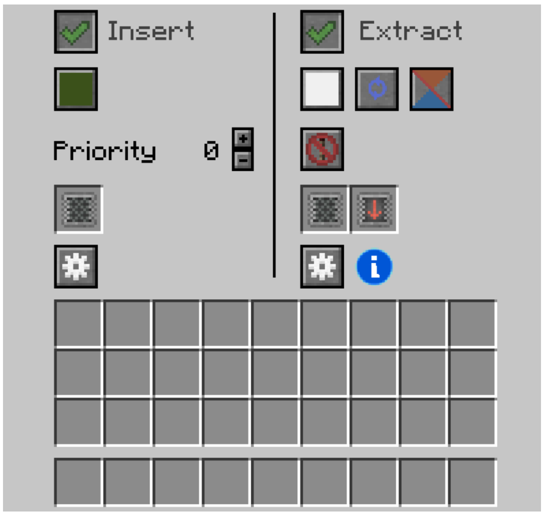
Configuration 3-6-3. Item Conduit Extract filter configuration for Oak Planks to Sticks Crafter.



Configuration 3-7-1. Item Conduit configuration for Wood Axe Crafter.

Configuration 3-7-2. Item Conduit Insert filter configuration for Wood Axe Crafter.

Configuration 3-7-3. Item Conduit Extract filter configuration for Wood Axe Crafter.



Configuration 3-8-1. Item Conduit configuration for Wood Hoe Crafter.

Configuration 3-8-2. Item Conduit Insert filter configuration for Wood Hoe Crafter.

Configuration 3-8-3. Item Conduit Extract filter configuration for Wood Hoe Crafter.

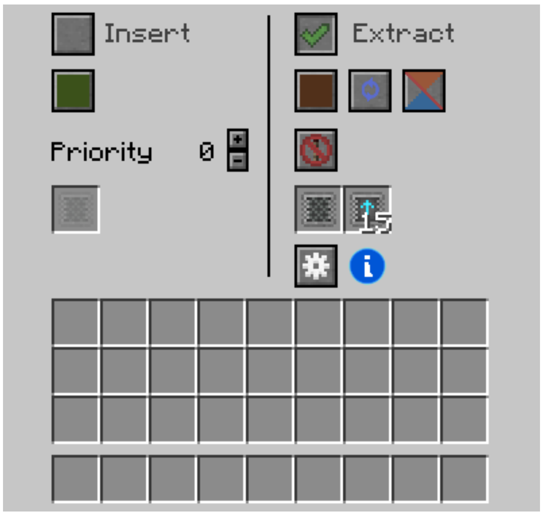
Configuration 3-9-2. Item Conduit Insert filter configuration for Oak Wood buffer chest.

Configuration 3-9-1. Item Conduit configuration for Oak Wood buffer chest.

Configuration 3-10-1. Redstone Furnace augment configuration.

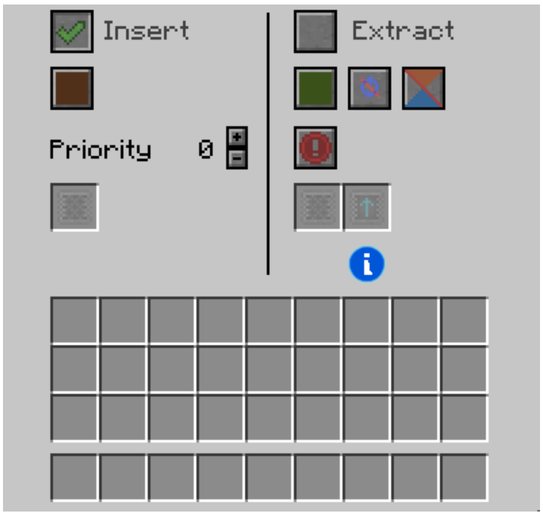
Configuration 3-10-2. Redstone Furnace IO configuration.

Configuration 3-10-3. ME Interface configured to expose Oak Wood from the production network so that the attached Item Conduit can extract the Oak Wood and transfer it to the Redstone Furnaces.



Configuration 3-10-4. Item Conduit configuration for extracting Oak Wood from the ME Interface for processing in the Redstone Furnaces.

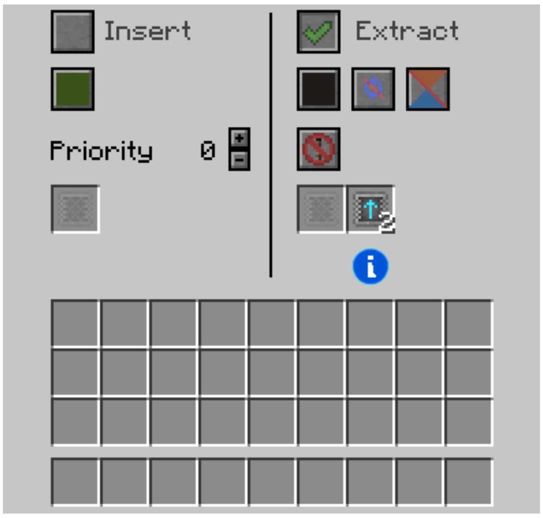
Configuration 3-10-5. Item Conduit filter configuration for extracting Oak Wood from the ME Interface for processing in the Redstone Furnaces.



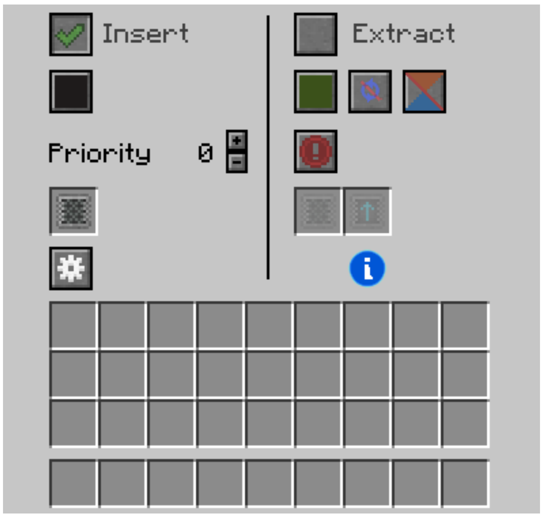
Configuration 3-10-6. Item Conduit configuration for inserting Oak Wood into the Redstone Furnaces.

Configuration 3-11-1. Pulverizer augment configuration.

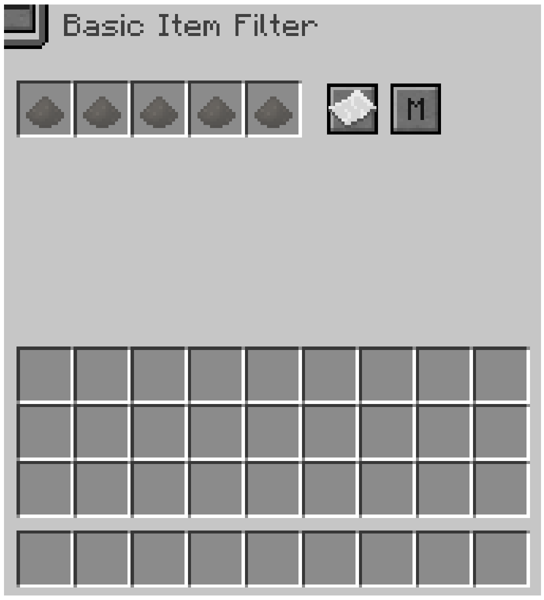
Configuration 3-11-2. Pulverizer IO configuration.



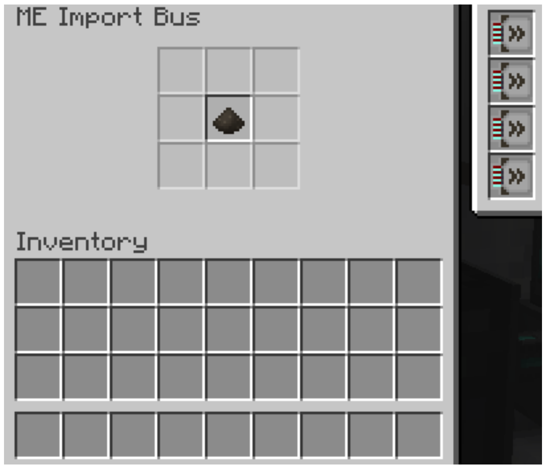
Configuration 3-11-3. Item Conduit configuration for extracting Pulverized Charcoal from the Pulverizers.



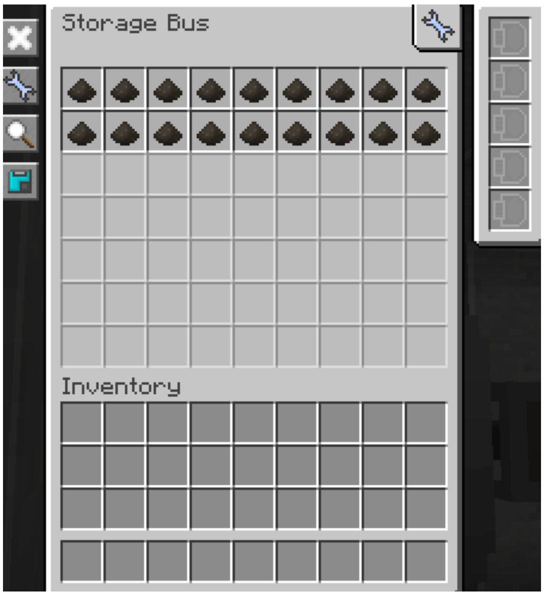
Configuration 3-11-4. Item Conduit configuration for inserting Pulverized Charcoal into the Pulverized Charcoal buffer chest.



Configuration 3-11-5. Item Conduit filter configuration for inserting Pulverized Charcoal into the Pulverized Charcoal buffer chest.



Configuration 3-11-6. ME Import Bus configuration for the Pulverized Charcoal buffer chest.



Configuration 3-12-1. Product - Pulverized Charcoal - ME Storage Bus

Configuration 3-12-2. Product - Pulverized Charcoal - ME Interface

4. Cobblestone

The second stage of the production process involves producing Cobblestone. The following is an outline of the production process:

1 Lava/Water placed in a checker-board pattern separated by one (1) Cobblestone block.

2 Extra Utilities 2 Transfer Nodes (Items) are placed on the top face of each Cobblestone block.

3 Transfer Nodes (Items) create Cobblestone blocks, then insert them into a Cobblestone buffer chest.

4 Cobblestone within the Cobblestone buffer chest is imported and stored in the AE production network.

Cobblestone is used in the following production stage(s):

- Sand
- Slag

The following machinery is used during this production stage:

- Transfer Node (Items) - Extra Utilities 2

4.1. Description

A Cobblestone generator is used in this production stage, which uses lava/water in a checker board pattern separated by one (1) block of Cobblestone. Extra Utilities Transfer Nodes (Items) are placed on the top face of each Cobblestone block. The Extra Utilities Transfer Nodes (Items) are able to generate Cobblestone using the 'Upgrade Mining' upgrade, plus several 'Upgrade Speed' upgrades. Transfer Nodes (Items) then feed into the Cobblestone buffer chest, Cobblestone from this chest are then imported into the AE production network for storage.

Note that Extra Utilities 2 uses its own energy system: Global Power (GP), which is bound to the player and is accessible from anywhere in-game. Because of this the generators used to produce GP are not required to be on site. Additionally, if the consumption of GP is greater than the production of GP, every Extra Utilities 2 machine that consumes GP will not function. This can be fixed by adding additional GP generators. Make sure you have enough GP available to power the Transfer Nodes.

4.2. Flow Charts

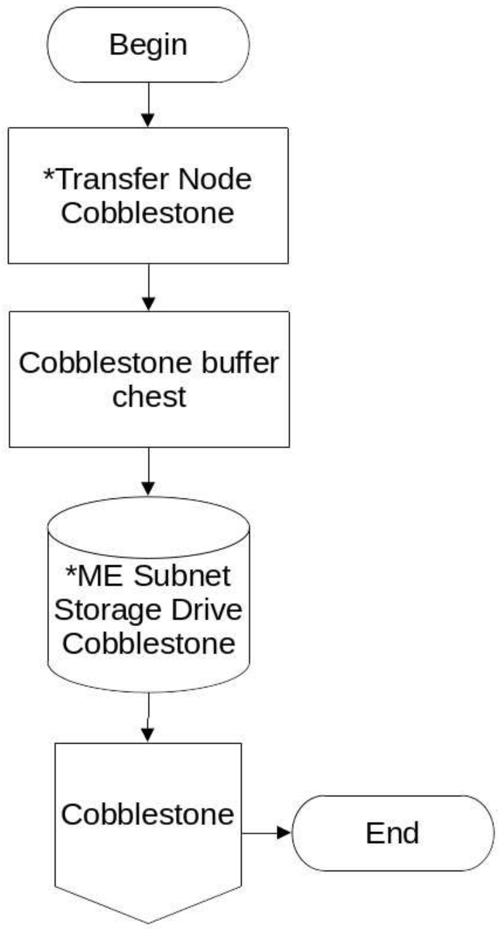
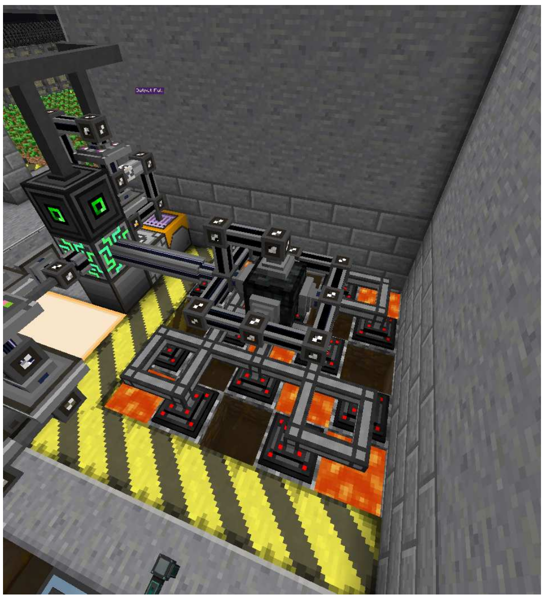


Figure 4-1. Cobblestone Production Diagram

4.3. Setup Photos



Photograph 4-1. Cobblestone production system.

Transfer Nodes generate Cobblestone then insert it into the chest.

Configuration 4-1. Transfer Nodes (Items) configuration.

Configuration 4-2. Cobblestone buffer chest ME Import Bus configuration.

Configuration 4-3-1. Product - Cobblestone - ME Storage Bus

Configuration 4-3-2. Product - Cobblestone - ME Interface

5. Sand

The third stage of the production process involves producing Sand. The following is an outline of the production process:

1. Cobblestone is pulverized into Gravel in Pulverizers, a by-product of this process is Sand.
2. The Sand by-product from the previous stage is inserted into a Sand by-product buffer chest. This buffer chest feeds into the Main Sand buffer chest.
3. Gravel is inserted into another set of Pulverizers, Gravel is then pulverized into Sand. A by-product of this process is Flint.
4. The Flint by-product from the previous stage is inserted into a Nullifier.
5. The Sand from step 3 is inserted into the Main Sand buffer chest.
6. Sand within the Main Sand buffer chest is imported and stored in the AE production network.

Sand is used in the following production stage(s):

- Sandstone

The following machinery is used during this production stage:

- Nullifier - Thermal Expansion
- Pulverizer - Thermal Expansion

5.1. Description

In this production stage, two sets of Pulverizers are stacked on top of each other in alternating rows. The first set pulverises Cobblestone into Gravel, the second set pulverises Gravel into Sand. During the first set, Sand is produced as a by-product which is then extracted and inserted into the Sand by-product buffer chest. The second set produces Flint as a by-product, which is then inserted into a Nullifier. The first set feeds Gravel into the second set, Sand is extracted from the second set and inserted into the Main Sand buffer chest.

5.2. Flow Charts

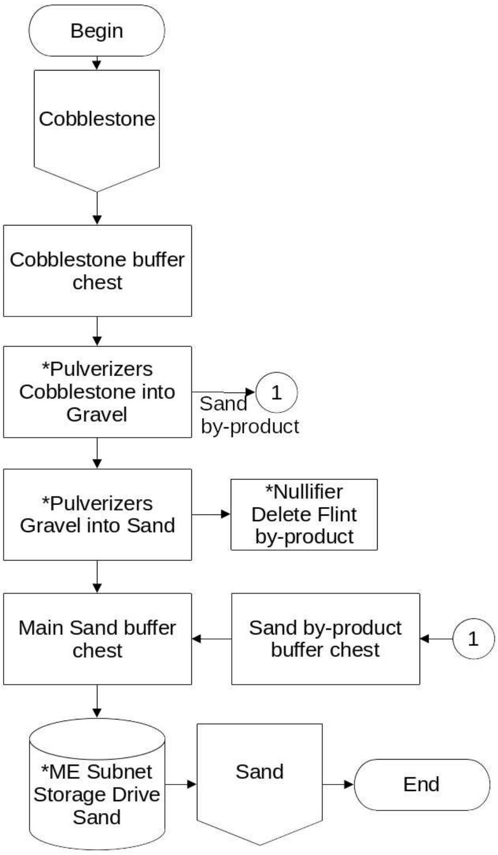
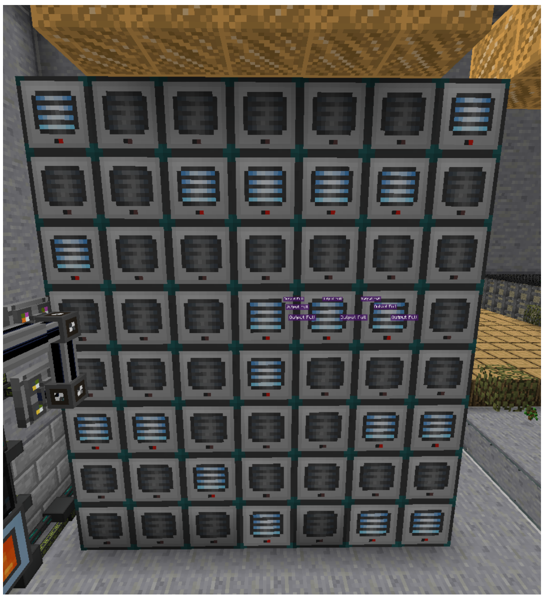
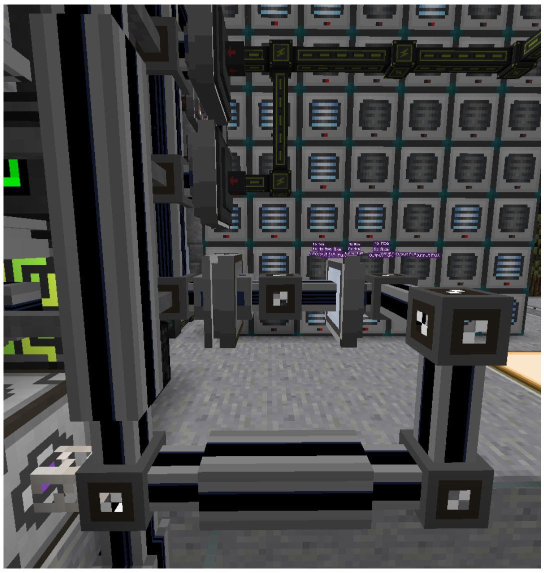


Figure 5-1. Sand Production Diagram

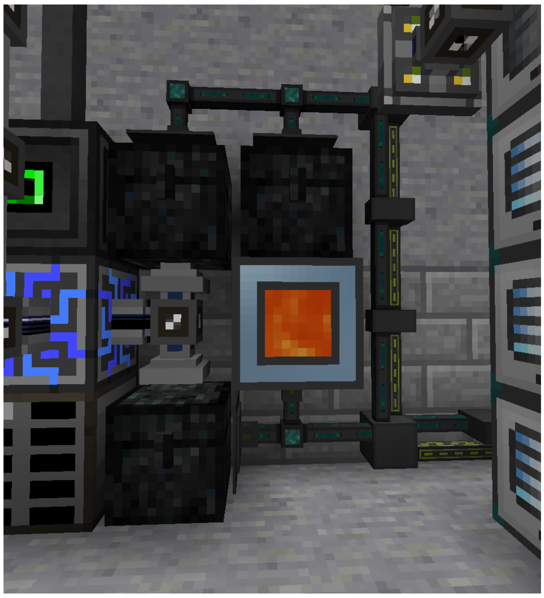
5.3. Setup Photos



Photograph 5-1. Sand production systems

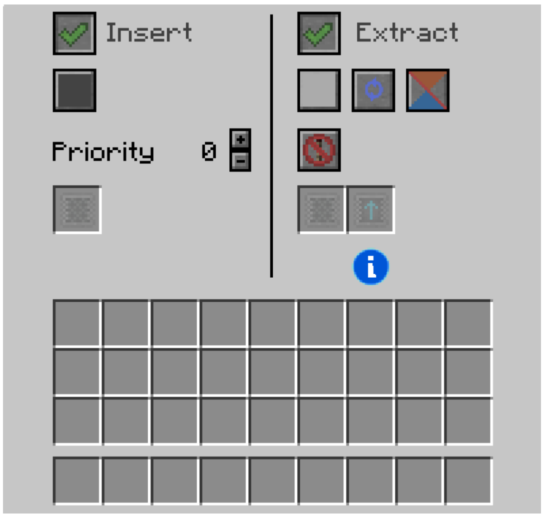


Photograph 5-2. Resource Provision Systems; P2P Tunnel (right) provides Cobblestone.

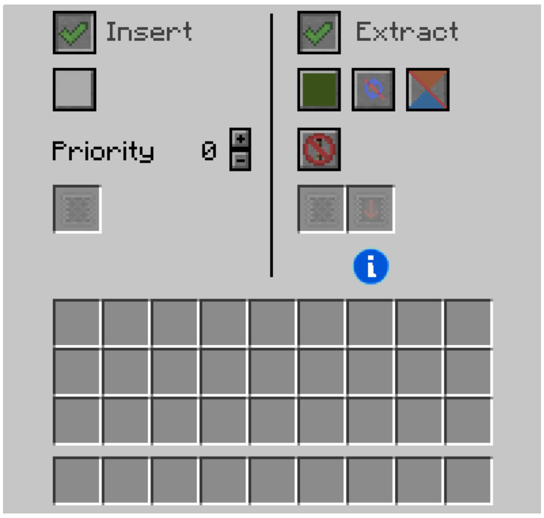


Photograph 5-3. Cobblestone buffer chest (top-left), sand by-product buffer chest (top-right), Nullifier (middle-right), and Main Sand buffer chest (bottom-left).

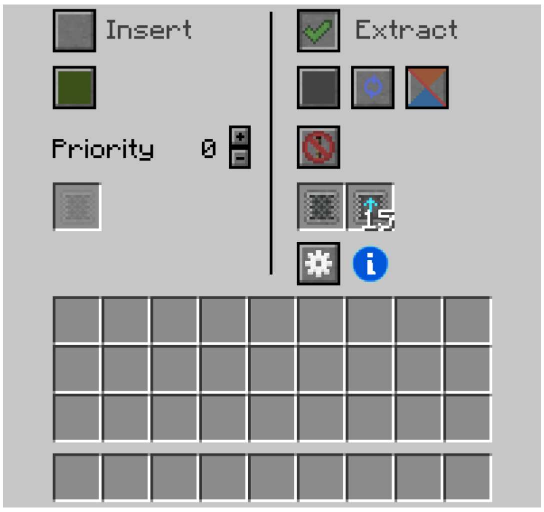
Configuration 5-1. Pulverizers augment configuration.



Configuration 5-2. Item Conduit configuration for Cobblestone-to-Gravel Pulverizers.

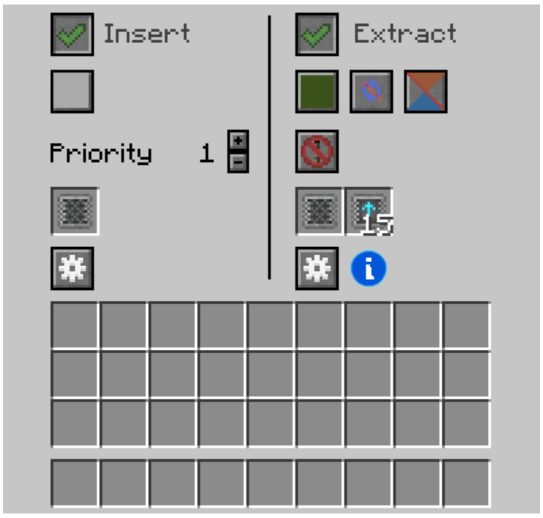


Configuration 5-3. Item Conduit configuration for Gravel-to-Sand Pulverizers.



Configuration 5-4-1. Item Conduit configuration for Cobblestone buffer chest.

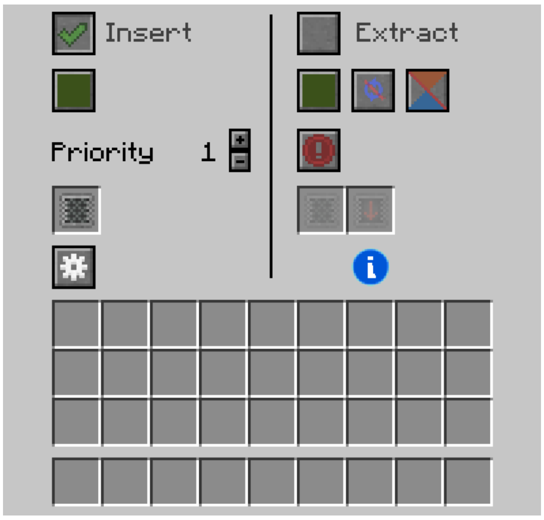
Configuration 5-4-2. Item Conduit extract filter configuration for Cobblestone buffer chest.



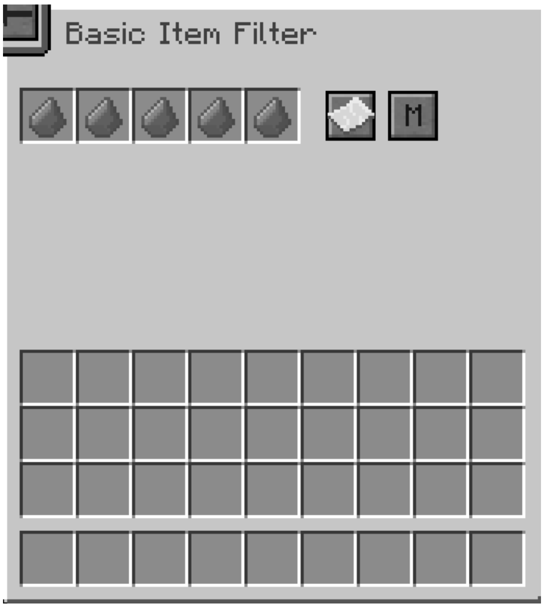
Configuration 5-5-1. Item Conduit configuration for Sand By-product buffer chest.

Configuration 5-5-2. Item Conduit insert filter configuration for Sand By-product buffer chest.

Configuration 5-5-3. Item Conduit extract filter configuration for Sand By-product buffer chest.

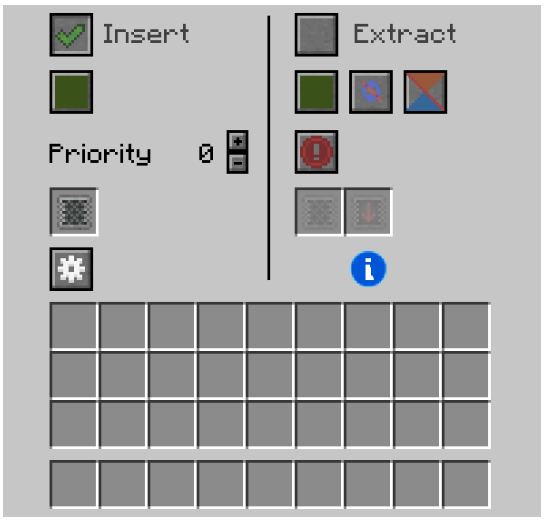


Configuration 5-6-1. Item Conduit configuration for Nullifier.



Configuration 5-6-2. Item Conduit insert filter configuration for Nullifier.

Configuration 5-7-2. Item Conduit configuration for Main Sand buffer chest.



Configuration 5-7-1. Item Conduit configuration for Main Sand buffer chest.

Configuration 5-8-1. Product - Sand - ME Storage Bus

Configuration 5-8-2. Product - Sand - ME Interface

6. Sandstone

The fourth stage of the production process involves crafting Sandstone. The following is an outline of the production process:

1. Sand is inserted into Ender IO Crafters.
2. Ender IO Crafters craft 4 Sand into Sandstone.
3. Sandstone from the Ender IO Crafters is inserted into the Sandstone buffer chest.
4. Sandstone within the Sandstone buffer chest is imported and stored in the AE production network.

Sandstone is used in the following production stage(s):

- Niter

The following machinery is used during this production stage:

- Crafter - Ender IO

6.1. Description

This stage of production uses Crafters, which take four (4) Sand and craft it into Sandstone, which is then inserted into the Sandstone buffer chest.

6.2. Flow Charts

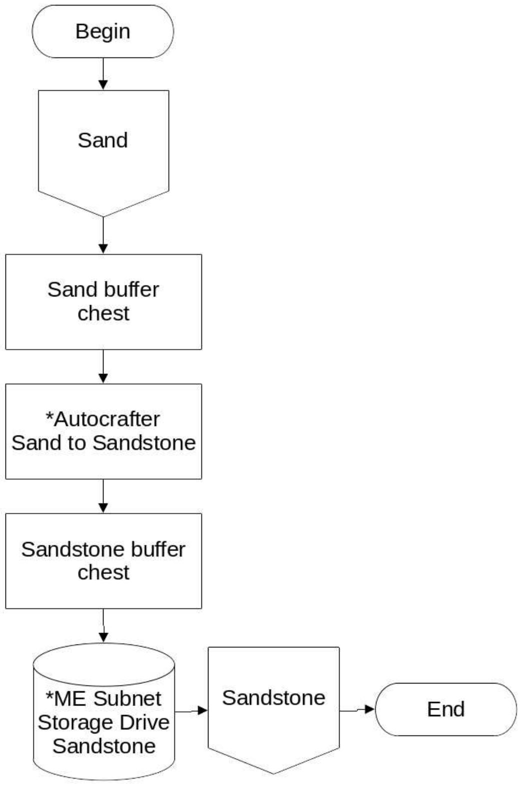
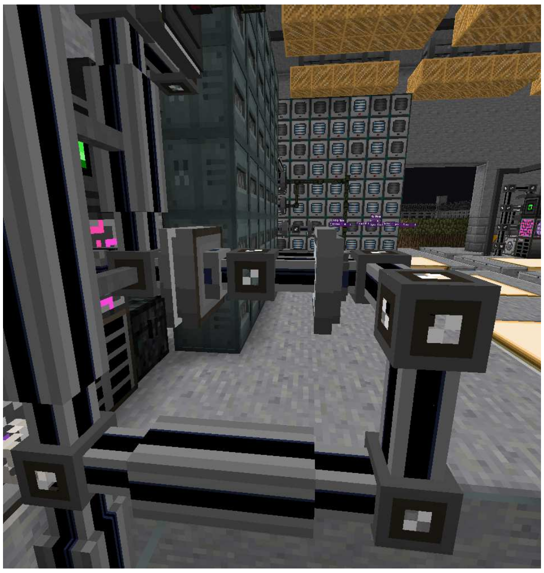


Figure 6-1. Sandstone Production Diagram

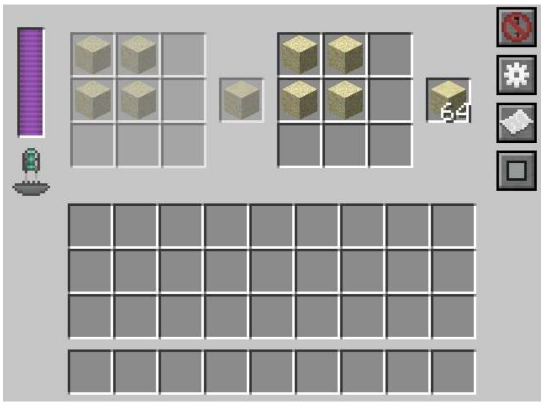
6.3. Setup Photos

Photograph 6-1. Sandstone production systems

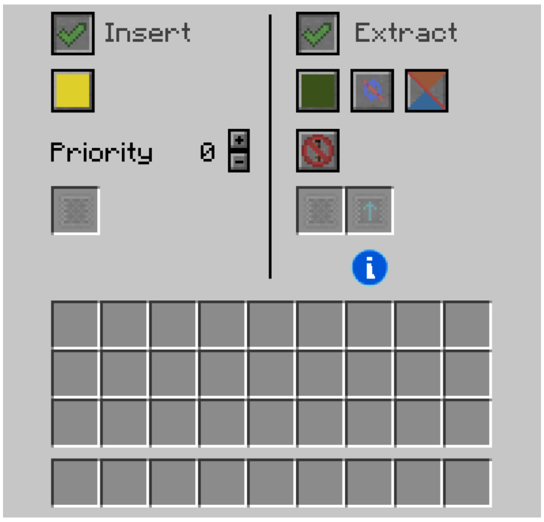


Photograph 6-2. Resource Provision Systems; P2P Tunnel (right) provides Sand.

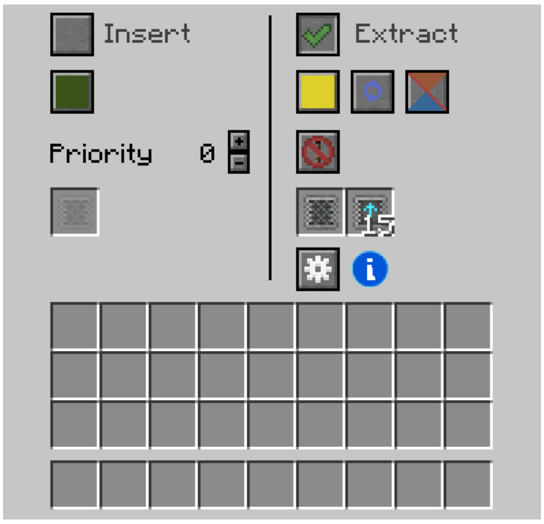
Photograph 6-3. Sand buffer chest (top), and Sandstone buffer chest (bottom).



Configuration 6-1. Crafters - Sandstone



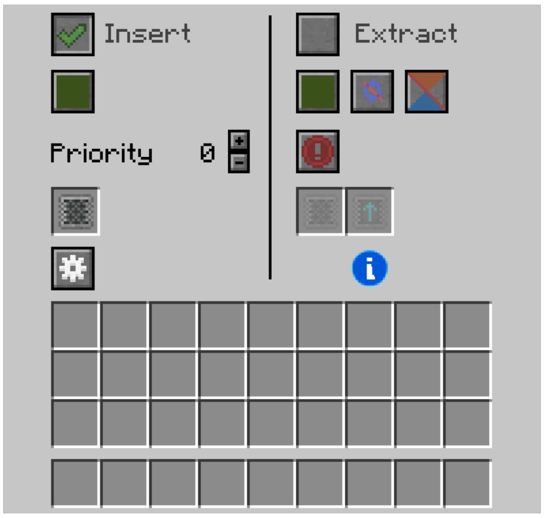
Configuration 6-2. Item Conduit configuration for Crafters.



Configuration 6-3-1. Item Conduit configuration for Sand buffer chest.

Configuration 6-3-2. Item Conduit extract filter configuration for Sand buffer chest.

Configuration 6-4-2. Item Conduit insert filter configuration for Sandstone buffer chest.



Configuration 6-4-1. Item Conduit configuration for Sandstone buffer chest.

Configuration 6-5-1. Product - Sandstone - ME Storage Bus

Configuration 6-5-2. Product - Sandstone - ME Interface

7. Niter

The fifth stage of the production process involves producing Niter. The following is an outline of the production process:

1 Sandstone is Pulverized into Sand, the by-product of this process is Niter.

2 Sand from the previous stage is inserted into the Sand buffer chest, this chest is connected to an XNet Controller which reads the amount of Sand in the chest. If the amount of Sand is greater-than or equal to the capacity of the chest then 64 Sand from the first inventory slot is inserted into a Nullifier. If there is space in the AE production network to store the excess Sand, it will be imported into the AE production network using an ME Import Bus.

3 The Niter from step 1 is inserted into the Niter buffer chest.

4 Niter within the Niter buffer chest is imported and stored in the AE production network.

Niter is used in the following production stage(s):

- Phyto-Gro

Sand is used in the following production stage(s):

- Slag

The following machinery is used during this production stage:

- Controller - XNet
- Nullifier - Thermal Expansion
- Pulverizer - Thermal Expansion

7.1. Description

This production stage makes use of Pulverizers and XNet. When a Pulverizer pulverises Sandstone it has a base chance of 40% to produce Niter as a by-product. To increase the chance of producing Niter each of the Pulverizers use three (3) Auxiliary Sieve augments, raising the chance to produce Niter to 72% (Team CoFH, 2021)[5].

Since Sand is the main product of the Sandstone-pulverizing process (two (2) Sand per Sandstone) it is stored in the Sand buffer chest. To ensure the Sand within the Pulverizers will always be removed an XNet Controller reads the contents of the Sand buffer chest. When the Sand buffer chest reaches capacity the XNet controller enables the Nullifier, extracts 64 Sand from the first inventory slot in the Sand buffer chest, and inserts that Sand into the Nullifier. Of course, if there is room in the AE production network to import Sand, it will do so.

7.2. Flow Charts

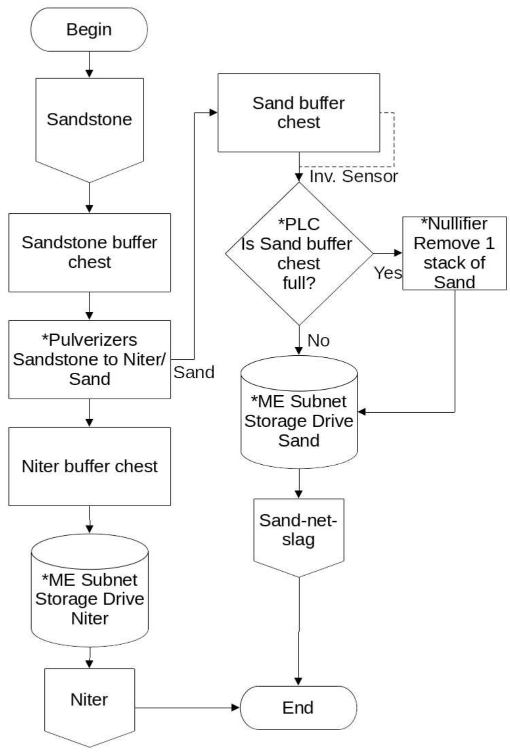
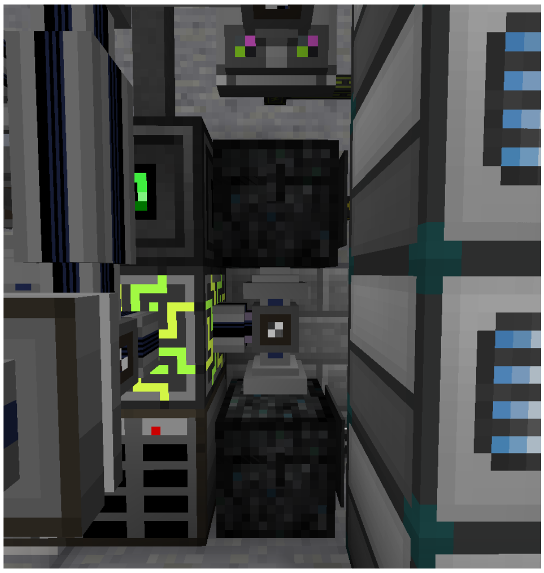


Figure 7-1. Niter Production Diagram

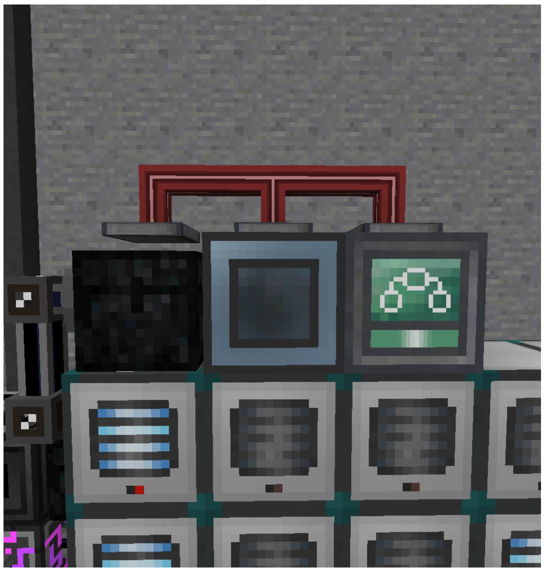
7.3. Setup Photos

Photograph 7-1. Niter production systems

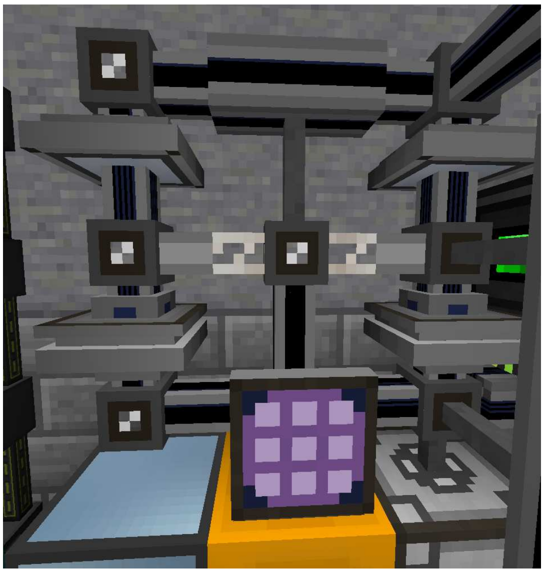


Photograph 7-3. Sandstone buffer chest (top), and Niter buffer chest (bottom).

Photograph 7-2. Resource Provision Systems; P2P Tunnel (right) provides Sandstone.

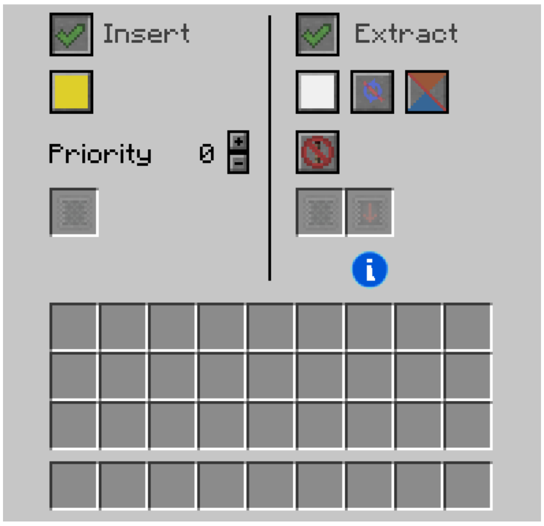


Photograph 7-4. Sand buffer chest (left), Nullifier (middle), Controller (right).

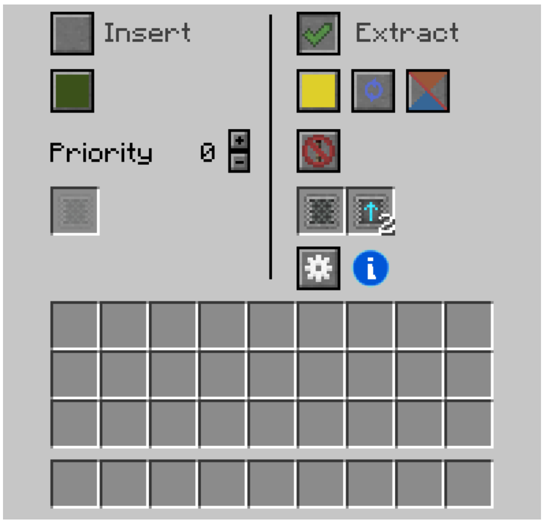


Photograph 7-5. Left-side: Sand product export systems, Right-side: Niter product export systems.

Configuration 7-1-1. Pulverizers augment configuration.

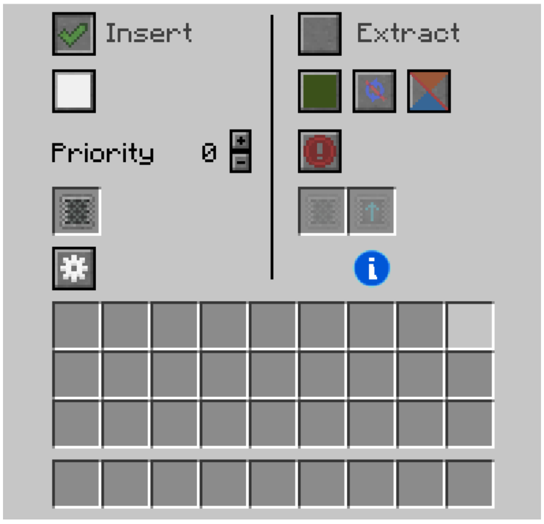


Configuration 7-1-2. Item Conduit configuration for Pulverizers.

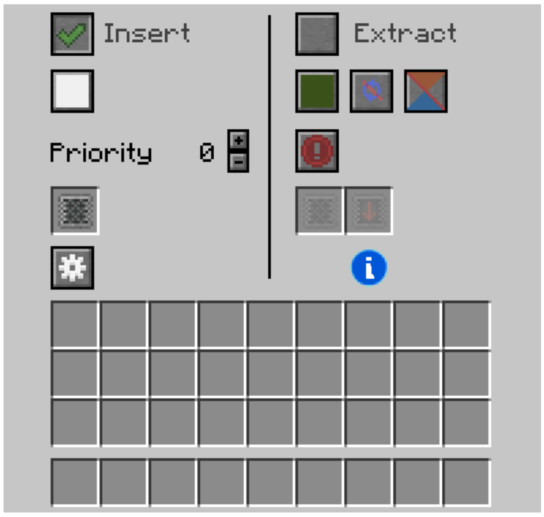


Configuration 7-2-1. Item Conduit configuration for Sandstone buffer chest.

Configuration 7-2-2. Item Conduit extract filter configuration for Sandstone buffer chest.



Configuration 7-3-1. Item Conduit configuration for Niter buffer chest.



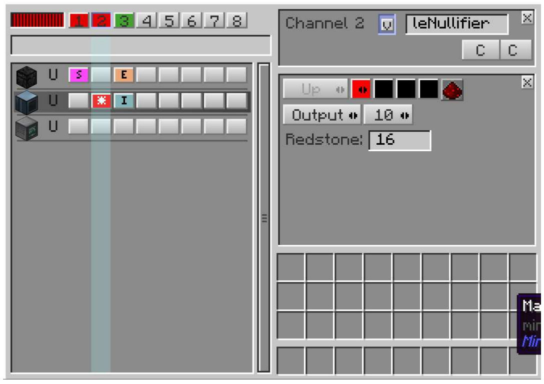
Configuration 7-4-1. Item Conduit configuration for Sand buffer chest.

Configuration 7-3-2. Item Conduit insert filter configuration for Niter buffer chest.

Configuration 7-4-2. Item Conduit insert filter configuration for Sand buffer chest.

Configuration 7-5-1. Controller inventory sensor configuration for Sand buffer chest.

Configuration 7-5-2. Controller inventory extraction configuration for Sand buffer chest.



Configuration 7-5-3. Controller redstone output configuration.

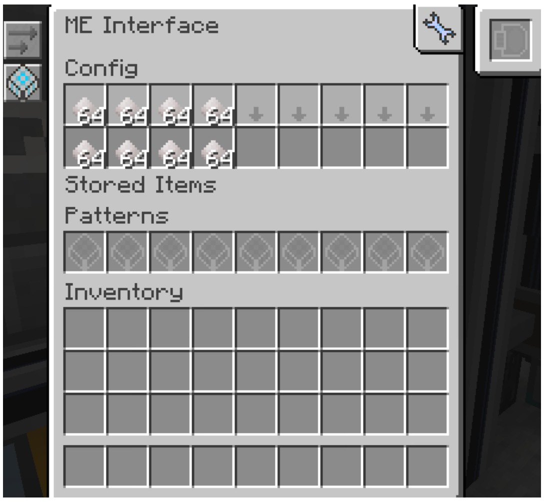
Configuration 7-5-4. Controller inventory insertion configuration for Nullifier.

Configuration 7-6-1. Nullifier redstone control configuration.

Configuration 7-6-2. Nullifier I/O configuration.

Configuration 7-7. Sand buffer chest ME Import Bus configuration.

Configuration 7-8-1. Product - Niter - ME Storage Bus.



Configuration 7-8-2. Product - Niter - ME Interface.

Configuration 7-9-1. Product - Sand - ME Storage Bus

Configuration 7-9-2. Product - Sand - ME Interface

8. Slag

The sixth stage of the production process involves producing Slag. The following is an outline of the production process:

1 Induction Smelters take Sand and Cobblestone to produce Stone Bricks, the by-product of this process is Slag.

2 Stone Bricks are inserted into a Nullifier.

3 Slag from step 1 is inserted into the Slag buffer chest.

4 Slag within the Slag buffer chest is imported and stored in the AE production network.

Slag is used in the following production stage(s):

- Phyto-Gro

The following machinery is used during this production stage:

- Induction Smelter - Thermal Expansion
- Nullifier - Thermal Expansion

8.1. Description

Induction Smelters are used in the production of Slag. Induction Smelters take Sand and Cobblestone to produce Stonebricks and Slag. Stonebricks are inserted into a Nullifier and Slag is inserted into the Slag buffer chest. Even though Slag is a by-product of this process, it has a 100% chance to be produced.

8.2. Flow Charts

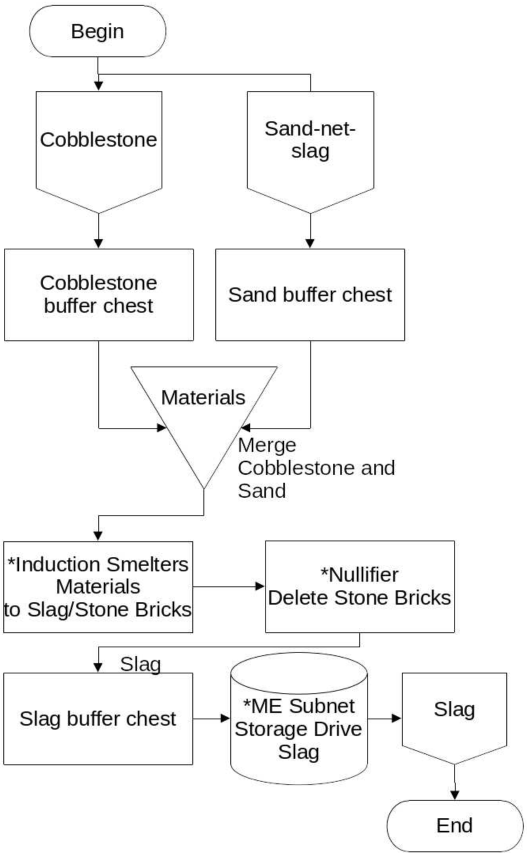
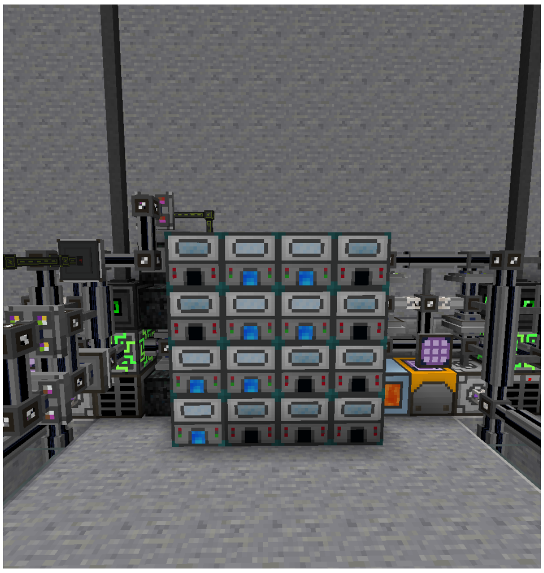


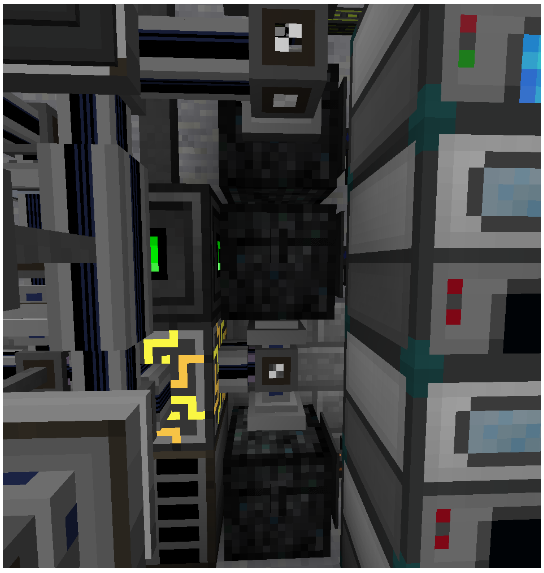
Figure 8-1. Slag Production Diagram

8.3. Setup Photos



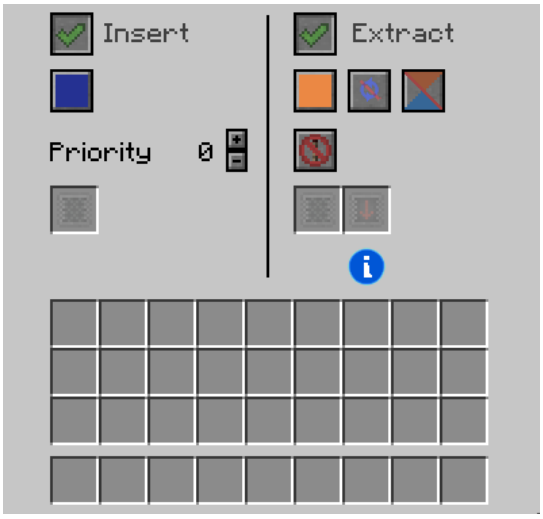
Photograph 8-1. Slag production systems

Photograph 8-2. Resource Provision Systems; P2P Tunnel (right-bottom) provides Cobblestone, P2P Tunnel (right-top) provides Sand.

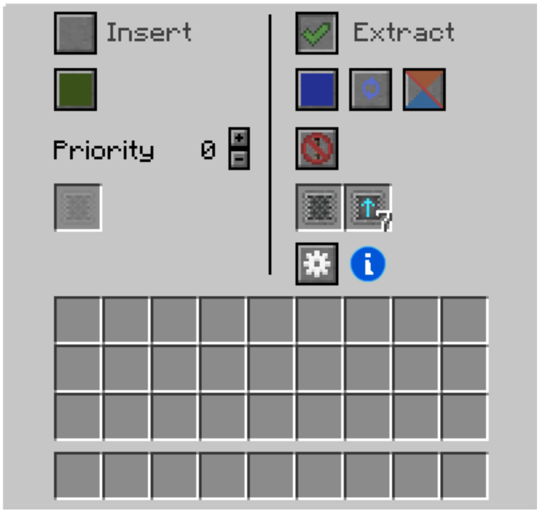


Photograph 8-3. Sand buffer chest (top), Cobblestone buffer chest (middle), and Slag buffer chest (bottom).

Configuration 8-1-1. Induction Smelters augment configuration.

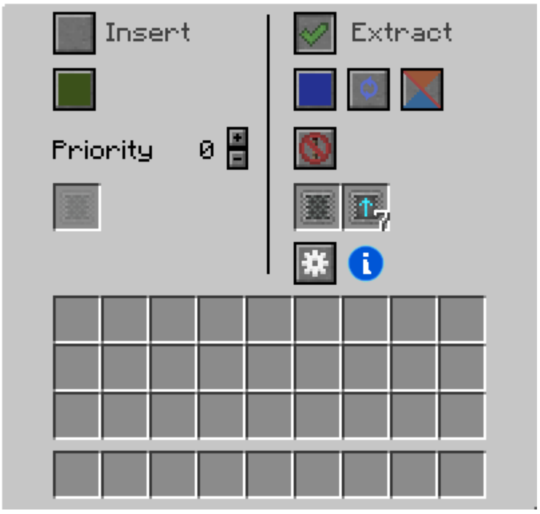


Configuration 8-1-2. Item Conduit configuration for Induction Smelters.

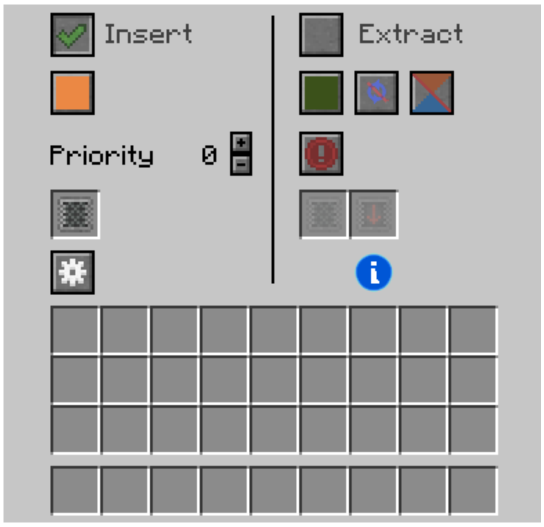


Configuration 8-2-1. Item Conduit configuration for Sand buffer chest.

Configuration 8-2-2. Item Conduit extract filter configuration for Sand buffer chest.



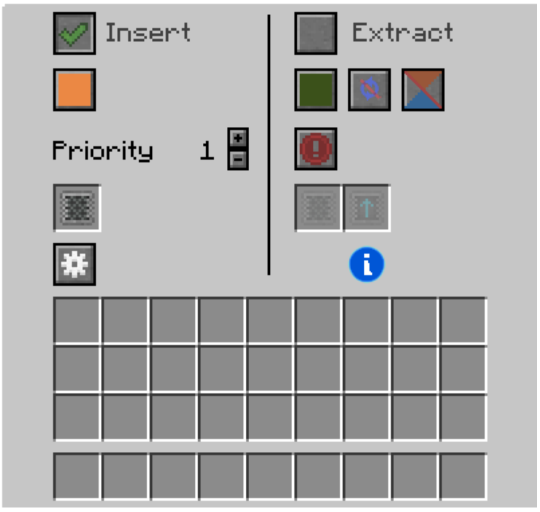
Configuration 8-3-1. Item Conduit configuration for Cobblestone buffer chest.



Configuration 8-4-1. Item Conduit configuration for Slag buffer chest.

Configuration 8-3-2. Item Conduit extract filter configuration for Cobblestone buffer chest.

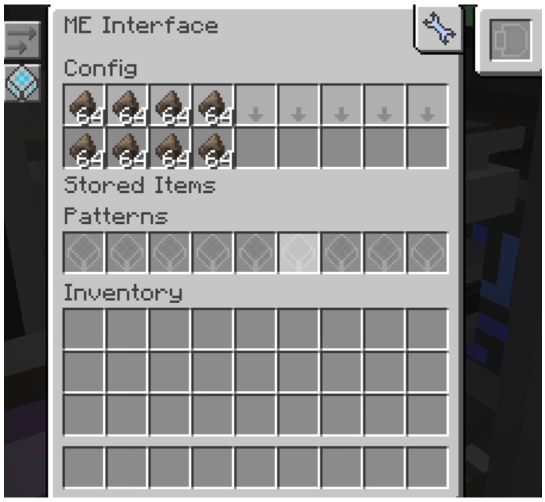
Configuration 8-4-2. Item Conduit insert filter configuration for Slag buffer chest.



Configuration 8-5-1. Item Conduit configuration for Nullifier.

Configuration 8-5-2. Item Conduit insert filter configuration for Nullifier.

Configuration 8-6-1. Product - Slag - ME Storage Bus



Configuration 8-6-2. Product - Slag - ME Interface

9. Phyto-Gro

The seventh stage of the production process involves producing Phyto-Gro. The following is an outline of the production process:

1. Crafters take Pulverized Charcoal, Niter, and Slag to produce Phyto-Gro.
2. Phyto-Gro is extracted from the Crafters and inserted into the Phyto-Gro buffer chest.
3. Phyto-Gro within the Phyto-Gro buffer chest is imported and stored in the AE production network.

Phyto-Gro is used in the following production stage(s):

- Rich Phyto-Gro
- Sap
- Sugar Cane/Potatoes

The following machinery is used during this production stage:

- Crafter - Ender IO

9.1. Description

Crafters are used to craft Phyto-Gro. Material is inserted directly into the Crafters using ME Export Buses with Capacity Card upgrades. This eliminates the need for three separate buffer chests to store the exporting materials.

9.2. Flow Charts

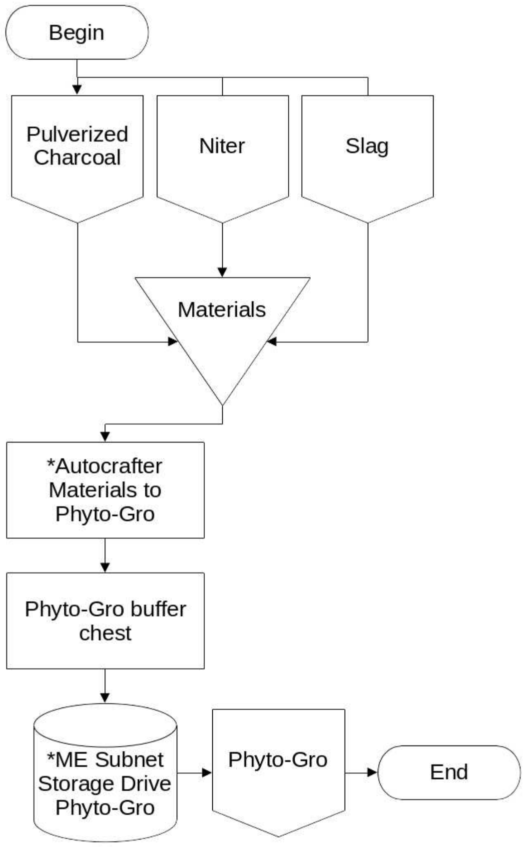
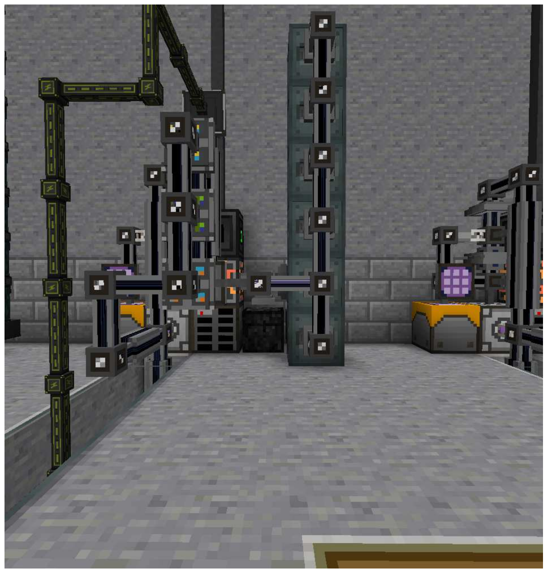


Figure 9-1. Phyto-Gro Production Diagram

9.3. Setup Photos

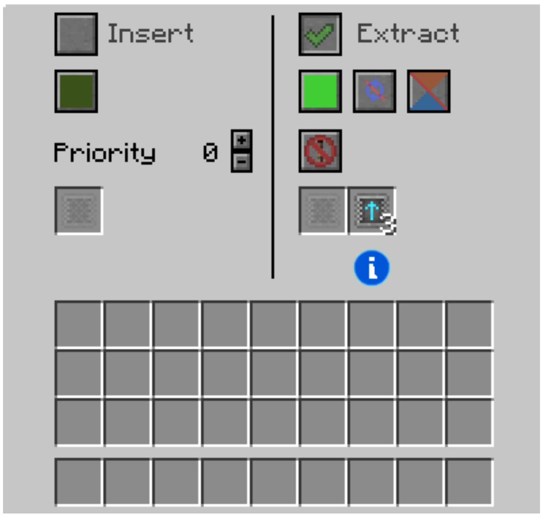


Photograph 9-1. Phyto-Gro production systems

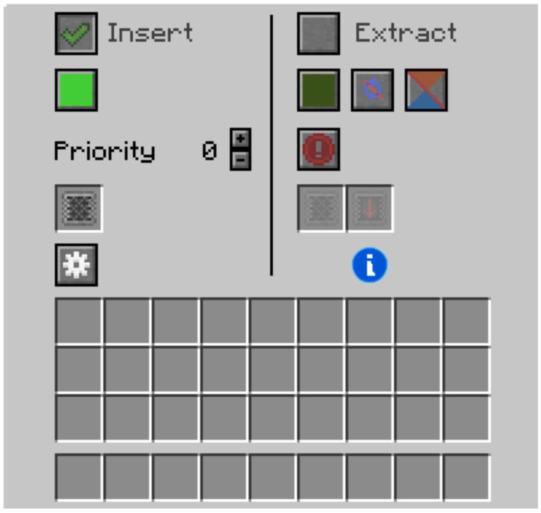
Photograph 9-2. Resource Provision Systems;P2P Tunnel (top) provides Pulverized Charcoal, P2P Tunnel (middle) provides Niter, P2P Tunnel (bottom) provides Slag.

Photograph 9-3. Phyto-Gro buffer chest

Configuration 9-1. Crafters Configuration

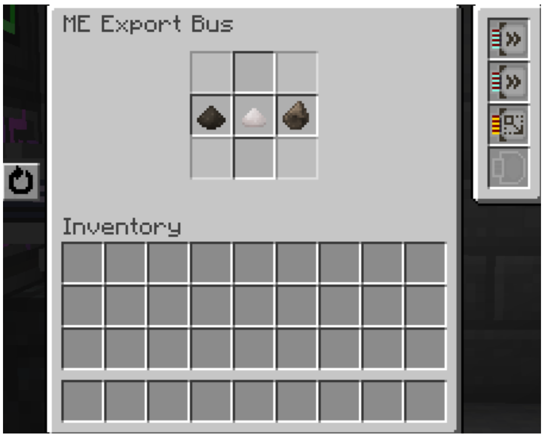


Configuration 9-2. Item Conduit configuration for Crafters.



Configuration 9-3-1. Item Conduit configuration for Phyto-Gro buffer chest.

Configuration 9-3-2. Item Conduit insert filter configuration for Phyto-Gro buffer chest.



Configuration 9-4. Crafters ME Export Bus configuration.

Configuration 9-5-1. Product - Phyto-Gro - ME Storage Bus

Configuration 9-5-2. Product - Phyto-Gro - ME Interface

10. Water

The eighth stage of the production process involves producing Water. The following is an outline of the production process:

1 Aqueous Accumulators pump Water and insert that Water into Water buffer drums.

2 Water in the water buffer drums is imported and stored in the AE production network.

Water is used in the following production stage(s):

- Hootch
- Redstone-Growing
- Sap
- Sugar Cane/Potatoes

The following machinery is used during this production stage:

- Aqueous Accumulator - Thermal Expansion

10.1. Description

Aqueous Accumulators are used to generate Water during this production stage. Water is used for multiple processes throughout the production process, as such it is crucial that enough water be supplied to the various processes. To ensure that a sufficient amount of water is supplied, make sure there is an appropriate amount of: Aqueous

Accumulators to produce the required amount of water, Fluid Import Buses to import the required amount of water into the AE production network, and P2P Tunnel connections and the associated ME Interfaces which will allow for the extraction of water from the AE production network.

Additionally, the AE production network that is apart of this process will need an Energy Cell attached to it. The reason for this is because the network is likely to consume a considerable amount of energy when importing and sending water to other production systems. Without extra energy, the production network is likely to go down intermittently.

10.2. Flow Charts

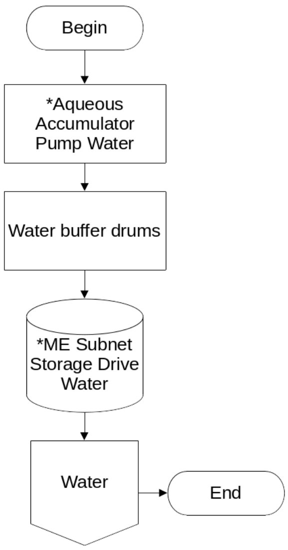
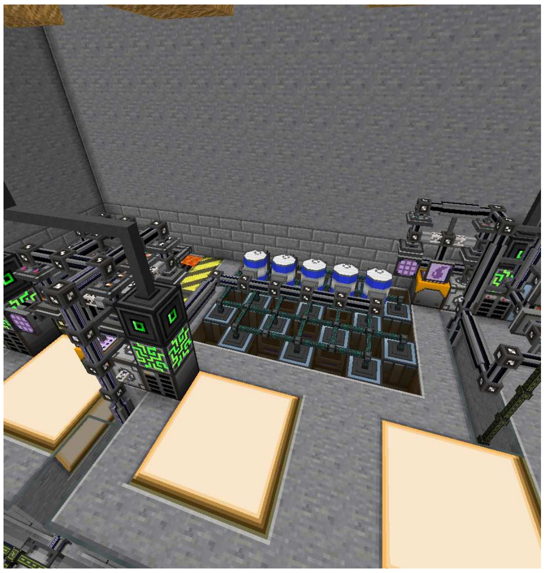
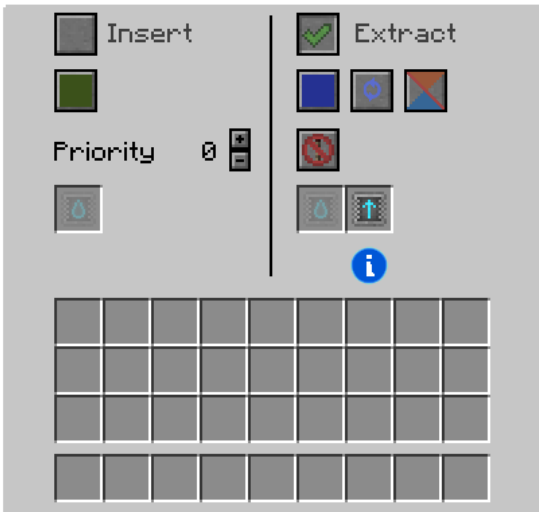


Figure 10-1. Water Production Diagram

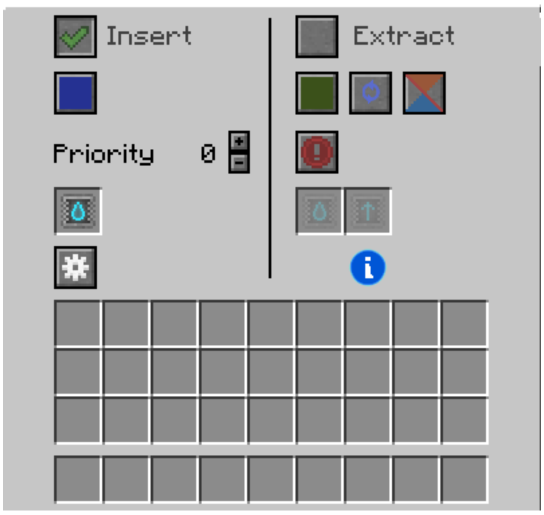
10.3. Setup Photos



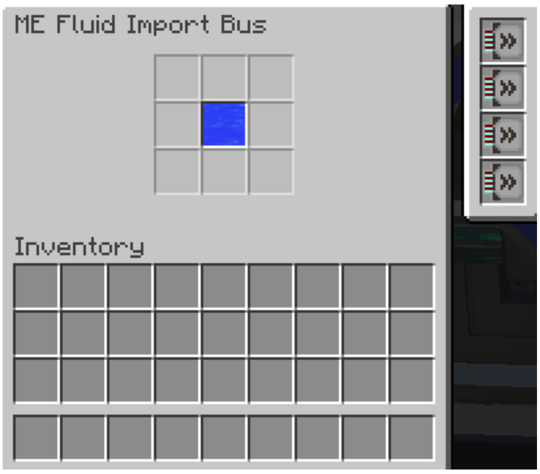
Photograph 10-1. Water production systems



Configuration 10-1. Fluid Conduit configuration for Aqueous Accumulators.

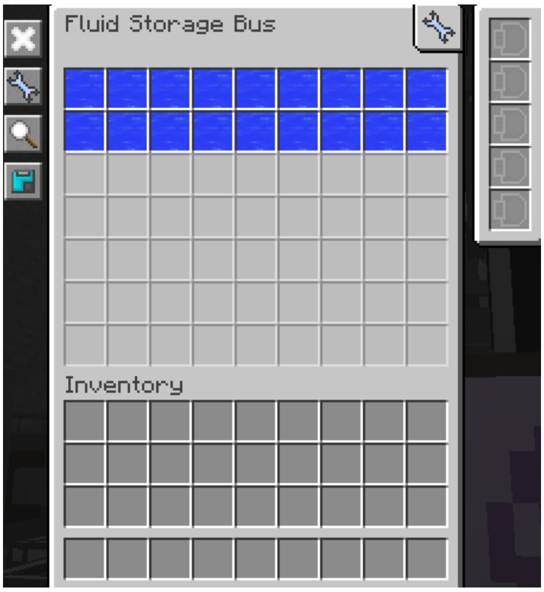


Configuration 10-2-1. Fluid Conduit configuration for Water buffer drums.

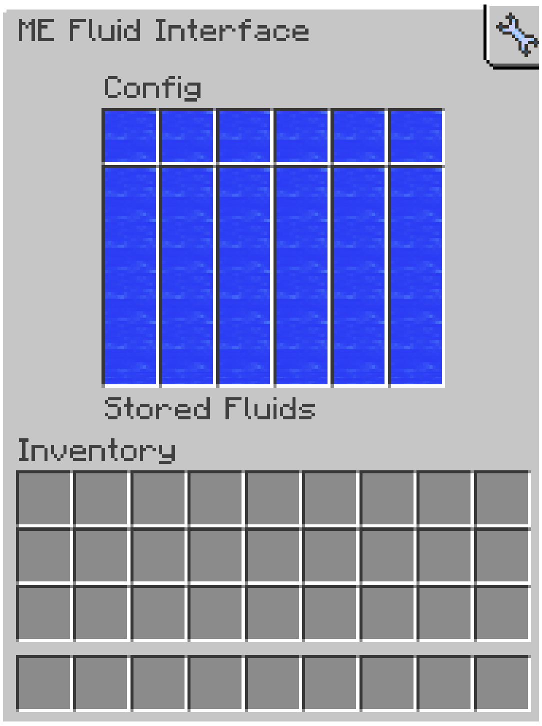


Configuration 10-3. Water ME Import Bus configuration.

Configuration 10-2-2. Fluid Conduit insert filter configuration for Water buffer drums.



Configuration 10-4-1. Product - Water - ME Fluid Storage Bus



Configuration 10-4-2. Product - Water - ME Fluid Interface

11. Sugar Cane and Potatoes

The ninth stage of the production process involves producing Sugar Cane and Potatoes. The following is an outline of the production process:

1 Phytogenic Insolators take Phyto-Gro and Water to produce Sugar Cane and Potatoes, the by-product of Potato production is Poisonous Potatoes. A single Sugar Cane and Potato are placed inside their respective Phytogenic Insolators.

2 Poisonous Potatoes are inserted into a Nullifier.

3 Sugar Cane and Potatoes are inserted into their appropriate buffer chests.

4 Sugar Cane and Potatoes within their buffer chests are imported and stored in the AE production network.

Sugar Cane is used in the following production stage(s):

- Sugar

Potatoes are used in the following production stage(s):

- Hootch

The following machinery is used during this production stage:

- Nullifier - Thermal Expansion
- Phytogenic Insolator - Thermal Expansion

11.1. Description

Sugar Cane and Potatoes are grown using Phytogenic Insolators. These Phytogenic Insolators are separated into two columns, the first column producing Sugar Cane and the second column producing potatoes. Each Phytogenic Insolator is equipped with: the Monoculture Cycle specialization, one (1) Auxiliary Reception Coil, and two (2) Nutrient Recovery augments. These augments ensure there is a balance between speed and efficiency.

11.2. Flow Charts

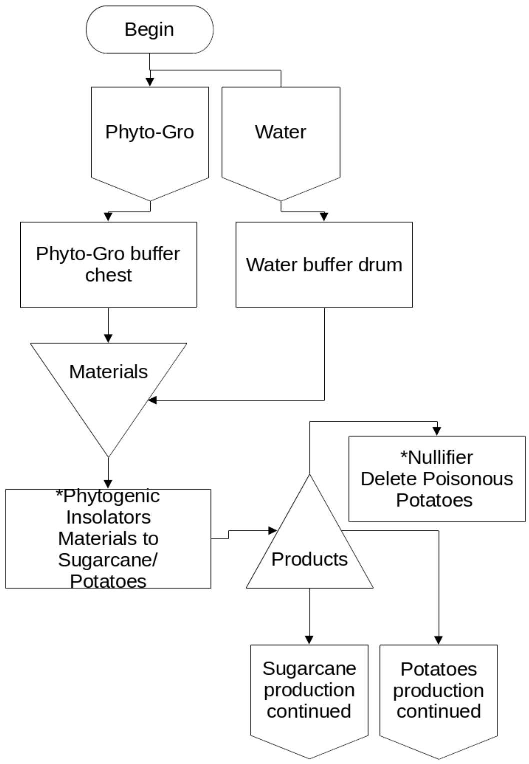


Figure 11-1. Sugar Cane and Potatoes Production Diagram

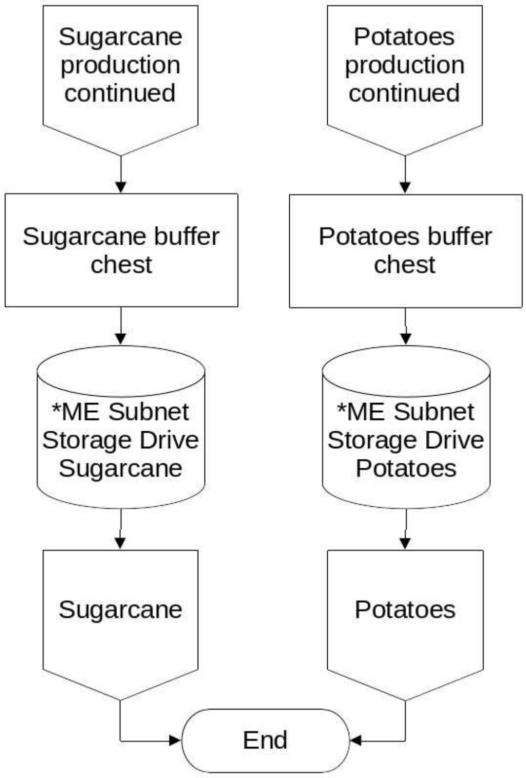
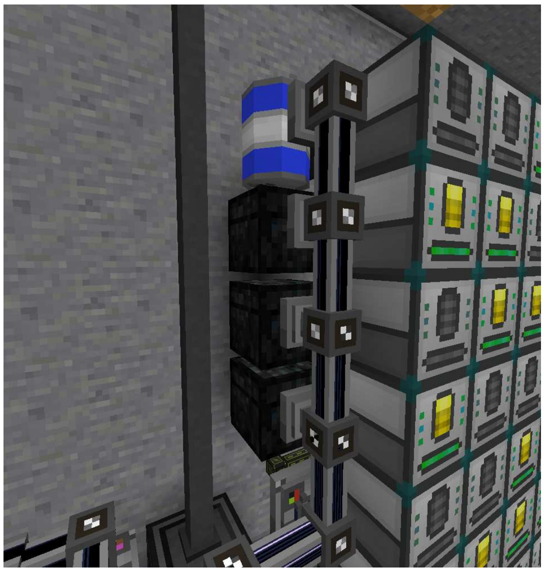


Figure 11-2. Sugar Cane and Potatoes Production Diagram continued

11.3. Setup Photos

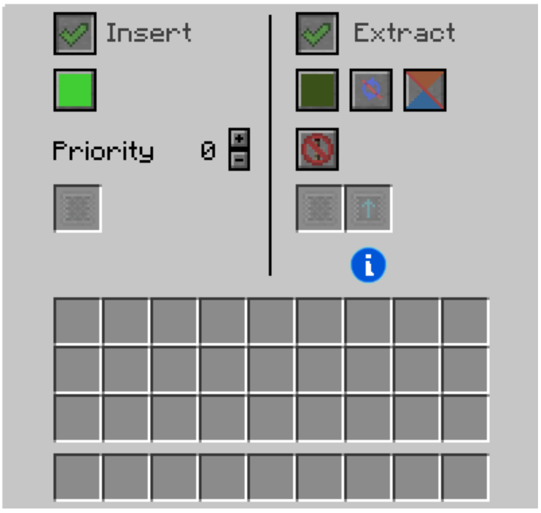
Photograph 11-1. Sugar Cane and Potatoes production systems

Photograph 11-2. Resource Provision Systems; P2P Tunnel (top) provides Water, P2P Tunnel (bottom) provides Phyto-Gro.

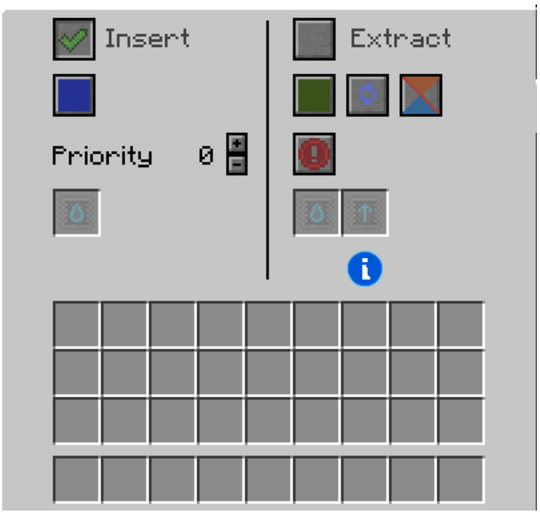


Photograph 11-3. Water buffer drum (top), Phyto-Gro buffer chest (second from top), Potatoes buffer chest (third from top), Sugar Cane buffer chest (fourth from top).

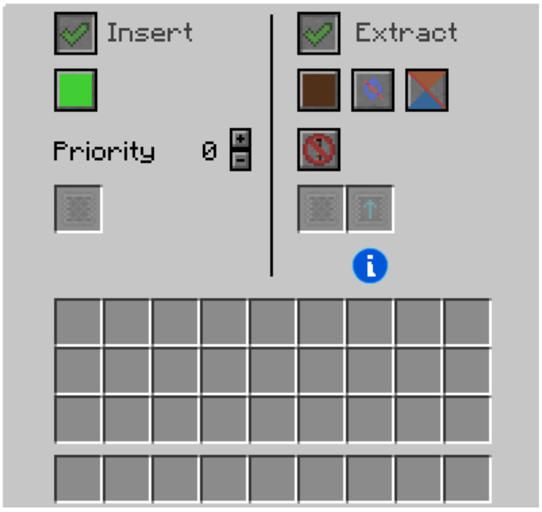
Configuration 11-1. Phytogenic Insolators augment configuration.



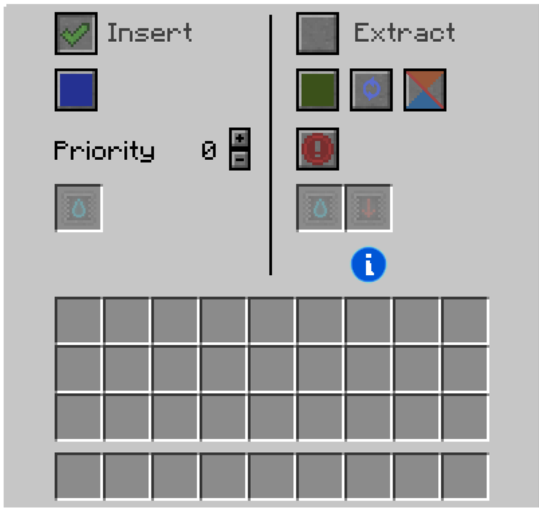
Configuration 11-2-1. Item Conduit configuration for Sugar Cane Phytogenic Insolators.



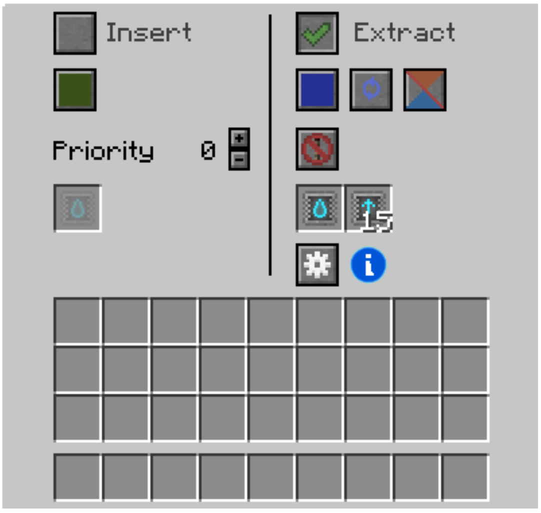
Configuration 11-2-2. Fluid Conduit configuration for Sugar Cane Phytogenic Insolators.



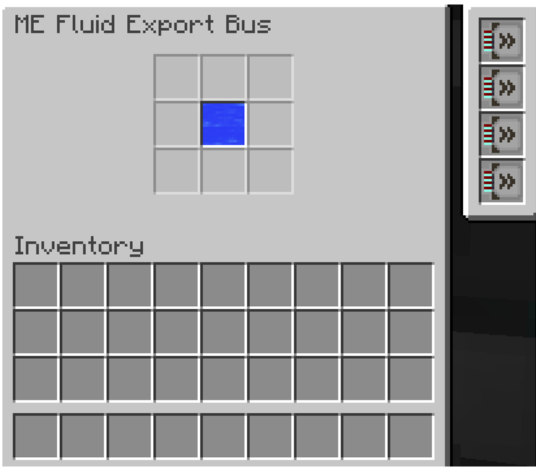
Configuration 11-3-1. Item Conduit configuration for Potatoes Phytogenic Insolators.



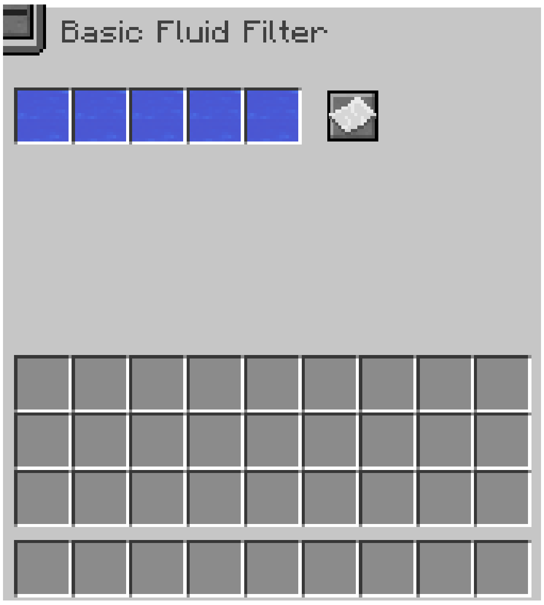
Configuration 11-3-2. Fluid Conduit configuration for Potatoes Phytogenic Insolators.



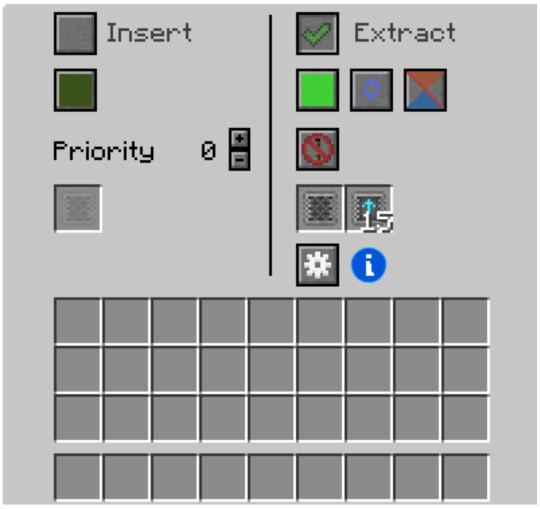
Configuration 11-4-1. Fluid Conduit configuration for Water buffer drum.



Configuration 11-4-3. ME Fluid Export Bus configuration for Water buffer drum.



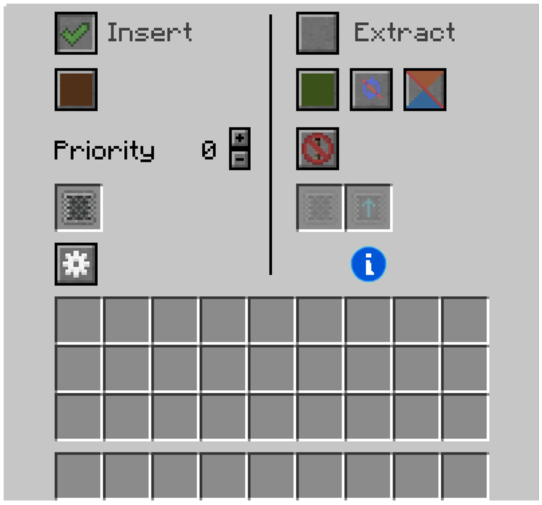
Configuration 11-4-2. Fluid Conduit extract filter configuration for Water buffer drum.



Configuration 11-5-1. Item Conduit configuration for Phyto-Gro buffer chest.

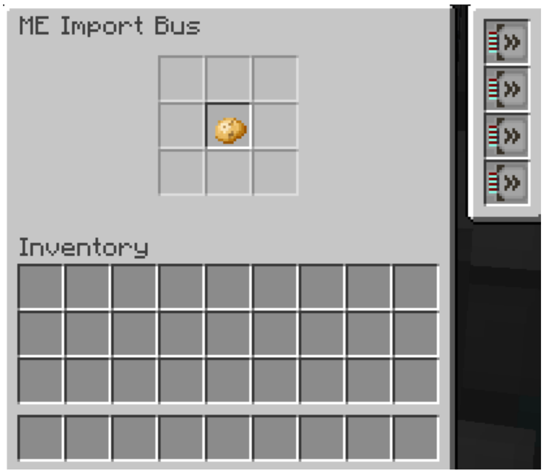
Configuration 11-5-2. Item Conduit extract filter configuration for Phyto-Gro buffer chest.

Configuration 11-5-3. ME Export Bus for Phyto-Gro buffer chest.

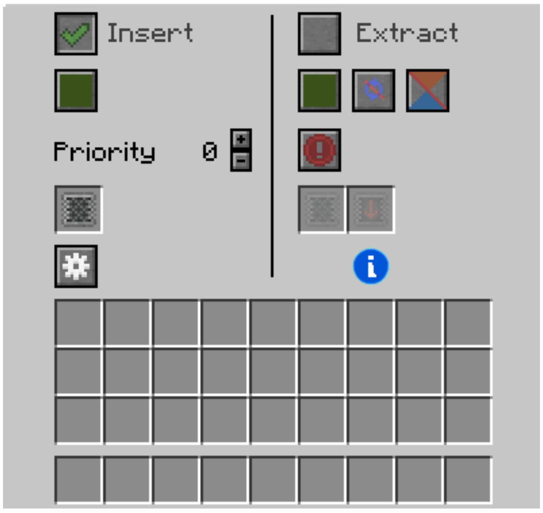


Configuration 11-6-1. Item Conduit configuration for Potatoes buffer chest.

Configuration 11-6-2. Item Conduit insert filter configuration for Potatoes buffer chest.

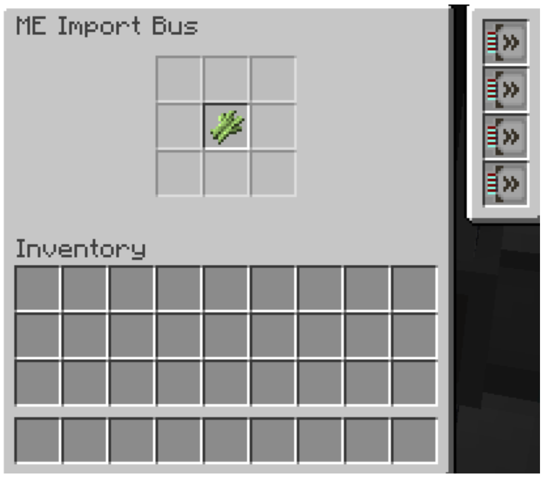


Configuration 11-6-3. ME Import Bus for Potatoes buffer chest.

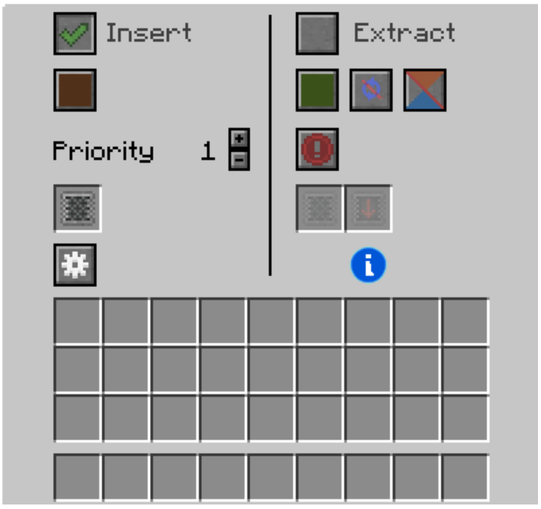


Configuration 11-7-1. Item Conduit configuration for Sugar Cane buffer chest.

Configuration 11-7-2. Item Conduit insert filter configuration for Sugar Cane buffer chest.

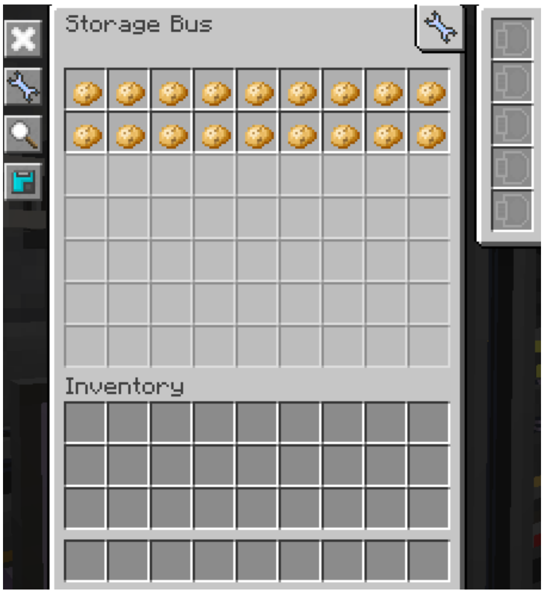


Configuration 11-7-3. ME Import Bus configuration for Sugar Cane buffer chest.

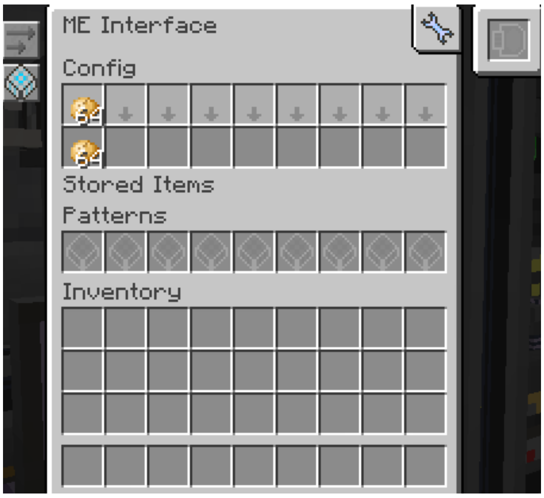


Configuration 11-8-1. Item Conduit configuration for Nullifier.

Configuration 11-8-2. Item Conduit insert filter configuration for Nullifier.

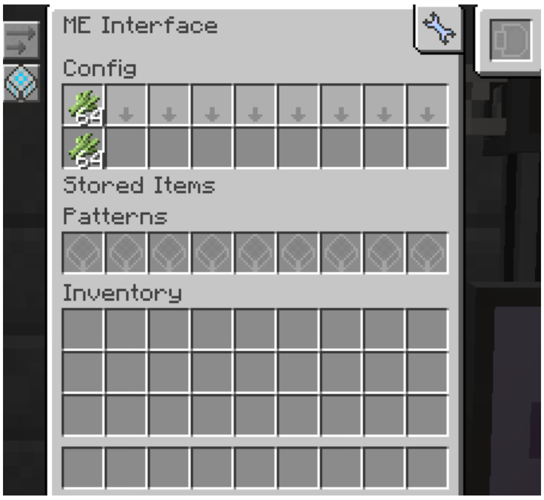


Configuration 11-9-1. Product - Potatoes - ME Storage Bus



Configuration 11-9-2. Product - Potatoes - ME Interface

Configuration 11-10-1. Product - Sugar Cane - ME Storage Bus



Configuration 11-10-2. Product - Sugar Cane - ME Interface

12. Sugar

The tenth stage of the production process involves producing Sugar. The following is an outline of the production process:

1 Centrifugal Separators take Sugar Cane and turn it into Sugar, a by-product of this process is Water.

2 Water is inserted into a Nullifier.

3 Sugar is extracted from the Centrifugal Separators and inserted into the Sugar buffer chest.

4 Sugar within the Sugar buffer chest is imported and stored in the AE production network.

Sugar is used in the following production stage(s):

- Hootch

The following machinery is used during this production stage:

- Centrifugal Separator - Thermal Expansion
- Nullifier - Thermal Foundation

12.1. Description

Centrifugal Separators are used to centrifuge Sugar Cane into Sugar. One (1) Sugar Cane is inserted into the Centrifugal Separators which is turned into two (2) Sugar. During this process Water is produced as a by-product, which is then deleted in a Nullifier.

12.2. Flow Charts

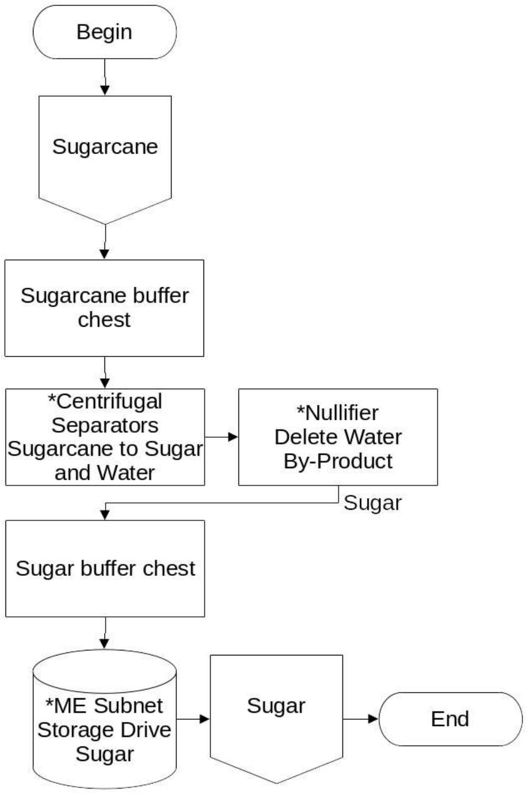
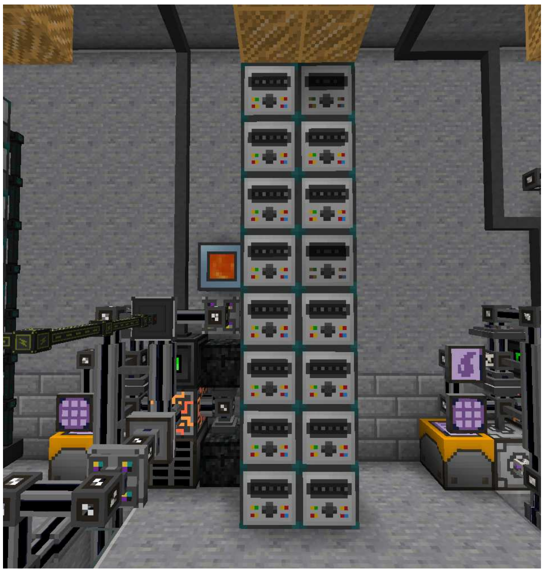


Figure 12-1. Sugar Production Diagram

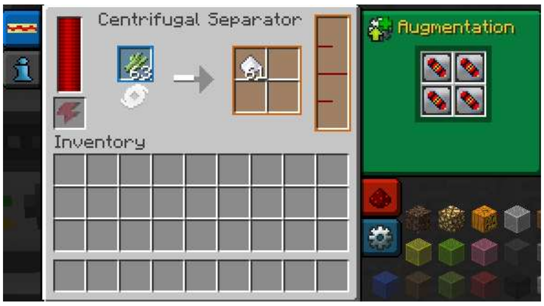
12.3. Setup Photos



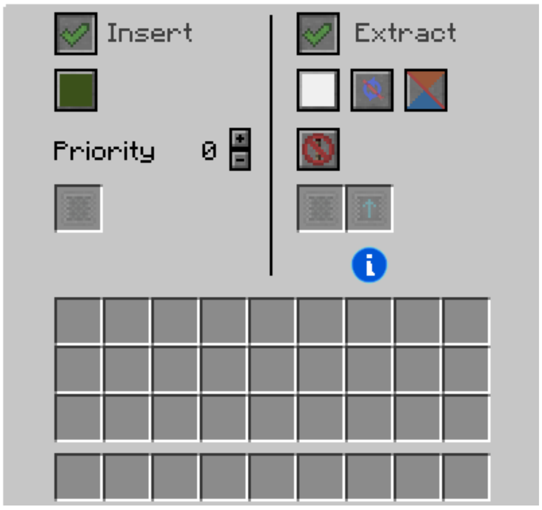
Photograph 12-1. Sugar production systems

Photograph 12-2. Resource Provision Systems; P2P Tunnel (right) provides Sugar Cane.

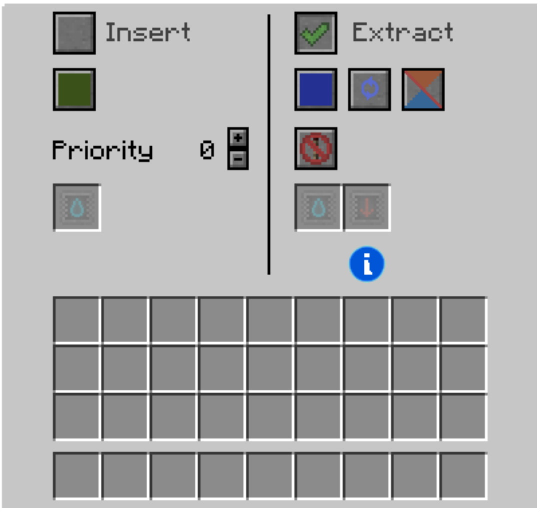
Photograph 12-3. Sugar Cane buffer chest (top), and Sugar buffer chest (bottom).



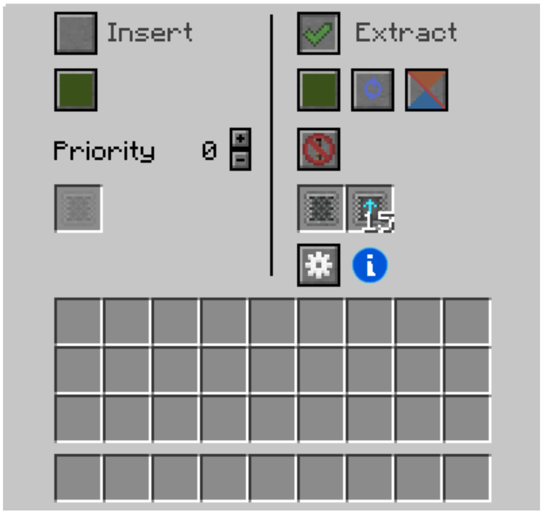
Configuration 12-1-1. Centrifugal Separators augment configuration.



Configuration 12-2-1. Item Conduit configuration for Centrifugal Separators.



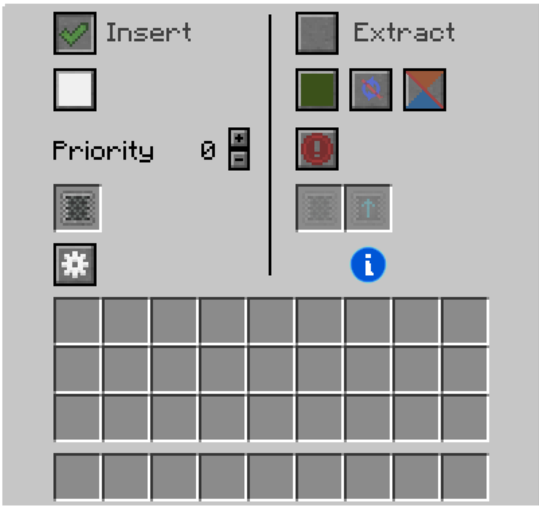
Configuration 12-2-2. Fluid Conduit configuration for Centrifugal Separators.



Configuration 12-3-1. Item Conduit configuration for Sugar Cane buffer chest.

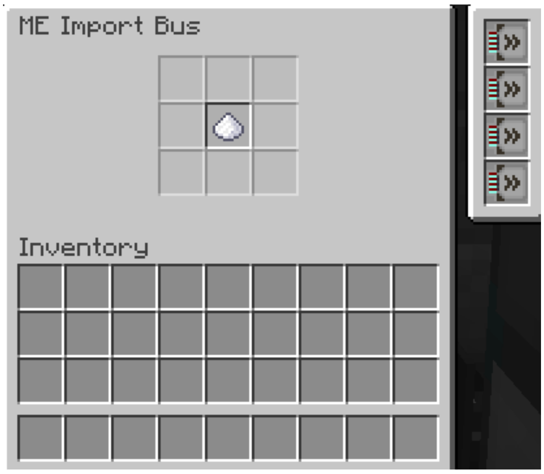
Configuration 12-3-2. Item Conduit extract filter configuration for Sugar Cane buffer chest.

Configuration 12-3-3. ME Export Bus configuration for Sugar Cane buffer chest.

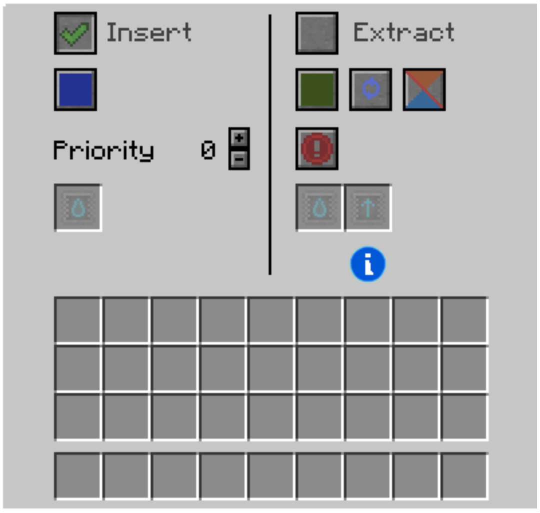


Configuration 12-4-1. Item Conduit configuration for Sugar buffer chest.

Configuration 12-4-2. Item Conduit insert filter configuration for Sugar buffer chest.



Configuration 12-4-3. ME Import Bus configuration for Sugar buffer chest.



Configuration 12-5. Fluid Conduit configuration for Nullifier.

Configuration 12-6-1. Product - Sugar - ME Storage Bus

Configuration 12-6-2. Product - Sugar - ME Interface

13. Sap

The eleventh stage of the production process involves producing Sap. The following is an outline of the production process:

1 Phytogenic Insolators grow Dark Oak Logs using Water and Phyto-Gro. A single Dark Oak Sapling is present within each Phytogenic Insolator.

2 Dark Oak Logs are extracted from the Phytogenic Insolators and inserted into the Dark Oak Logs buffer chest.

3 Dark Oak Logs from the Dark Oak Logs buffer chest are inserted into Sawmills.

4 An ME Fluid Level Emitter checks the level of Sap currently stored within the AE production network. If the amount of Sap is less-than 520,192,000 Millibuckets (mB), then a redstone signal is emitted. A Redstone Conduit transports this signal into a Processor on the purple redstone channel.

5 The Processor checks for a redstone input signal (provided by the Redstone Conduit on the purple redstone channel) every 600 ticks (30 seconds). If a signal is present, the Processor emits a redstone signal on the red redstone channel, if no signal is present no signal is emitted.

6 The redstone signal on the red redstone channel enables/disables the Sawmills. If a signal is present the Sawmills are disabled, if no redstone signal the Sawmills are enabled.

7 Sawmills create Sap along with other by-products (Dark Oak Planks, Sawdust).

8 By-products from the previous step are inserted into a Nullifier.

9 Sap from step 7 is inserted into the Sap buffer drum.

10 Sap in the Sap buffer drum is imported and stored in the AE production network.

Sap is used in the following production stage(s):

- Rich Phyto-Gro

The following machinery is used during this production stage:

- Nullifier - Thermal Expansion
- Phytogenic Insolator - Thermal Expansion
- Processor - RFTools Control
- Sawmill - Thermal Expansion

13.1. Description

Sap is produced by the Sawmills at 20mb per-operation when using Dark Oak Logs (may vary depending on modpack configuration). To do this, each Sawmill uses: one (1) Resin Funnel, and three (3) Auxiliary Reception Coil augments, as shown in Configuration 13-4-1.

Because of the speed of the Sawmills, twice the amount of Phytogenic Insolators will need to be used to balance the Dark Oak Wood consumption/production. Each Phytogenic Insolator uses: one (1) Sapling Infuser, one (1) Monoculture Cycle, and two (2) Auxiliary Reception Coil augments, as shown in Configuration 13-3-1.

13.1.1. Sap Sawmills PLC

The Sap production stage uses a Processor to toggle on/off the Sawmills by providing a redstone signal on the Red redstone channel which outputs to the Sawmills. This redstone signal is transferred using Redstone Conduits, as shown in Photograph 13-4. The processor takes a redstone signal on the purple redstone channel as input. This input redstone signal is created by an ME Fluid Level Emitter which reads the level of Sap currently stored in the AE Network, if the amount of Sap falls below 520,192,000 mB then a redstone signal is emitted. The processor is programmed to check the redstone signal on the South side of the Processor every 600 ticks (30 seconds). If a redstone signal is present, then the Processor will enable the Sawmills, else the Sawmills will be disabled. To facilitate redstone control by the Processor, all of the Sawmills will have their Redstone Control setting set to 'Low' (active without signal). When the Processor disables the Sawmills, the Sap production stage is put into the STANDBY Operation State. The Processor uses the following components: CPU Core B500 (x1), and RAM Chip 8E (x1).

The reason why the STANDBY Operation State is used and not the REDUCED Operation State is because the Sawmills are only disabled when the AE production network has reached its maximum capacity of Sap. By disabling the Sawmills, the Phytogenic Insolators will fill up their internal inventories with Dark Oak Wood then cease processing until the Sawmills are re-enabled.

13.2. Operating State Advisory

What follows is a list of one or more Operation States that modify this production system's physical/logical behavior, along with the specific systems modified:

- STANDBY - When this production system is put into this state: all of the Sawmills are disabled via a redstone signal.

13.3. Flow Charts

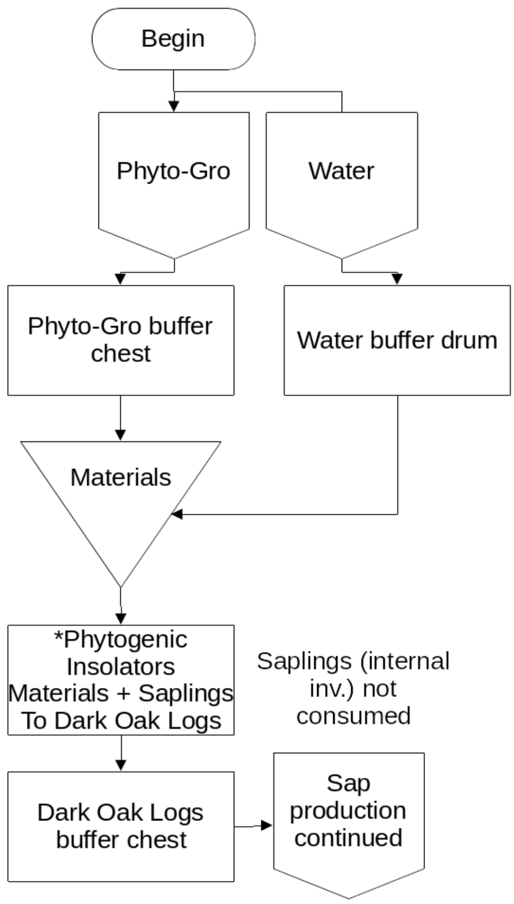


Figure 13-1. Sap Production Diagram

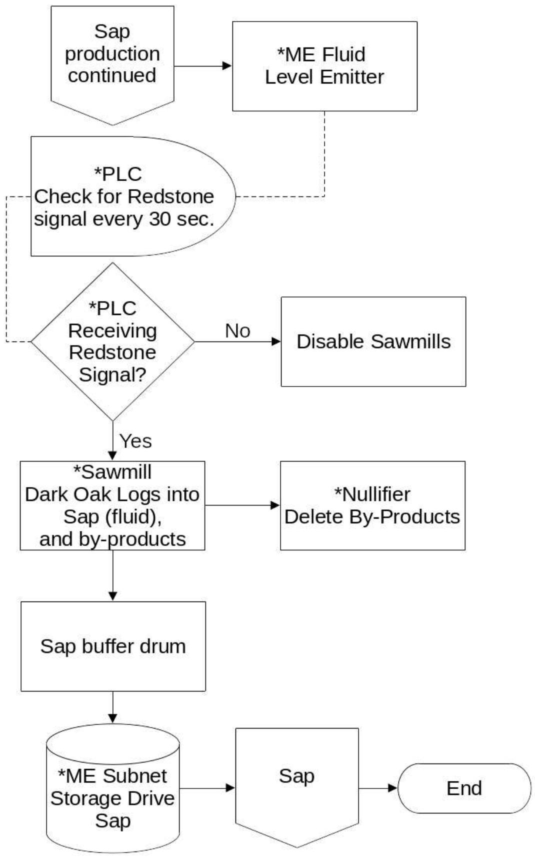
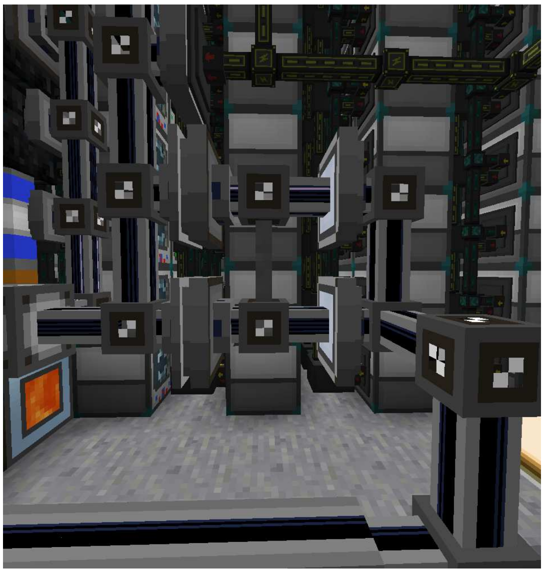


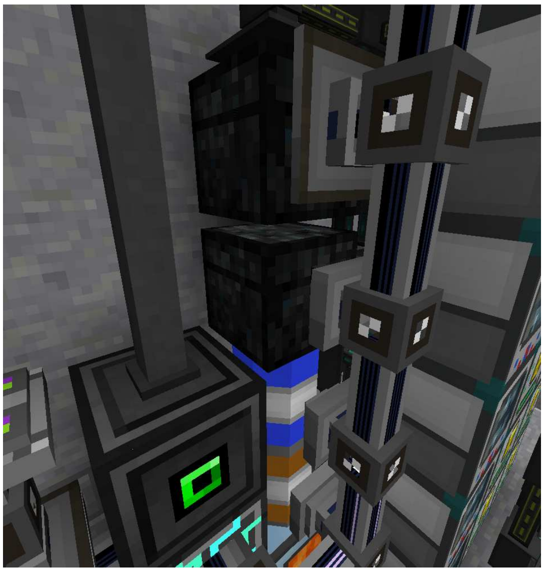
Figure 13-2. Sap Production Diagram continued

13.4. Setup Photos

Photograph 13-1. Sap Production Systems

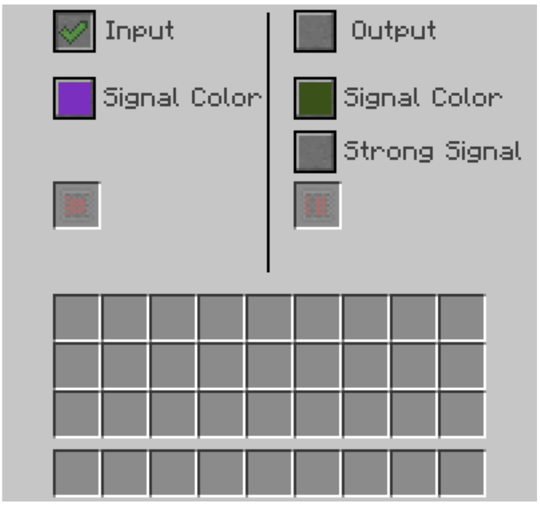


Photograph 13-2. Resource Provision Systems; P2P Tunnel (top) provides Water, P2P Tunnel (bottom) provides Phyto-Gro.

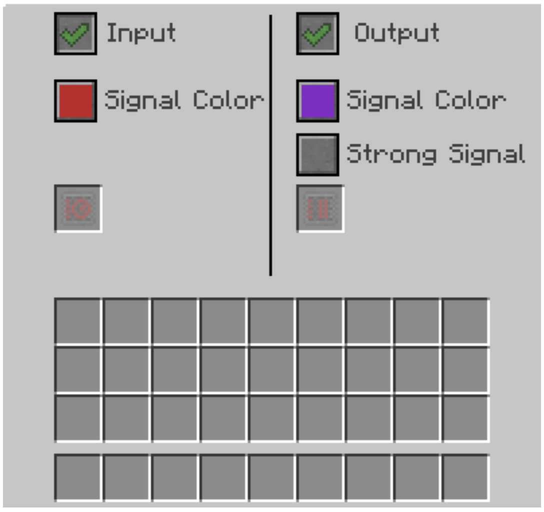


Photograph 13-3. Dark Oak Wood buffer chest (top), Phyto-Gro buffer chest (second from top), Water buffer drum (third from top), Sap buffer drum (fourth from top).

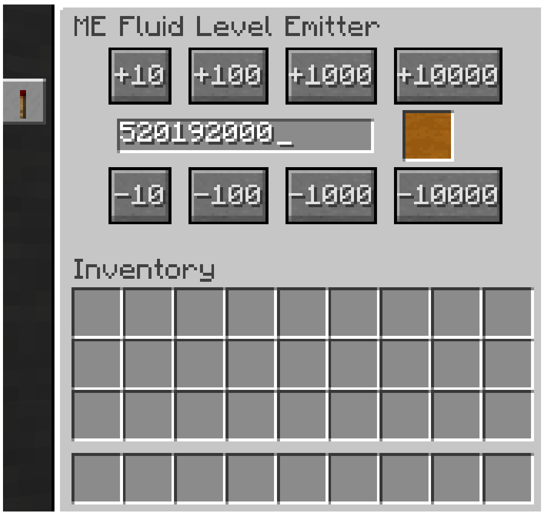
Photograph 13-4. Processor which controls the Sawmills (middle-right), and ME Level Emitter which provides a control signal for the Processor (middle).



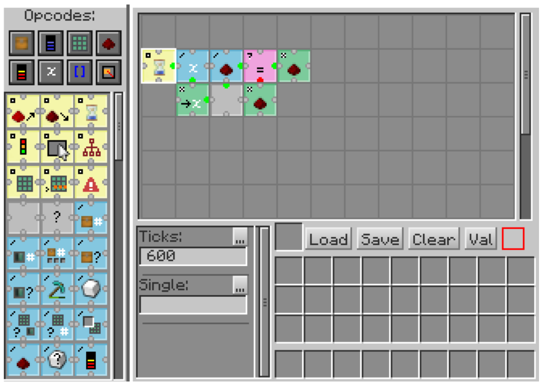
Configuration 13-1-1. Configuration for the Redstone Conduit which connects to the ME Fluid Level Emitter.



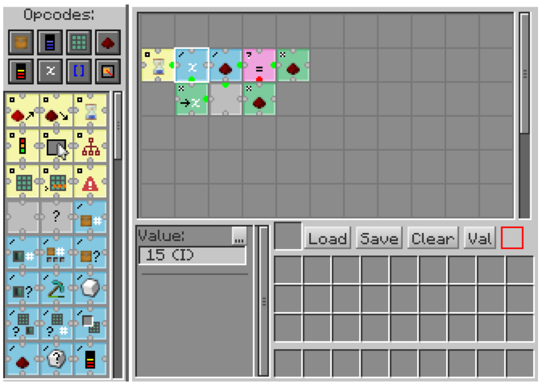
Configuration 13-1-2. Redstone Conduit configuration for the input/output Redstone Conduit connector on the Processor.



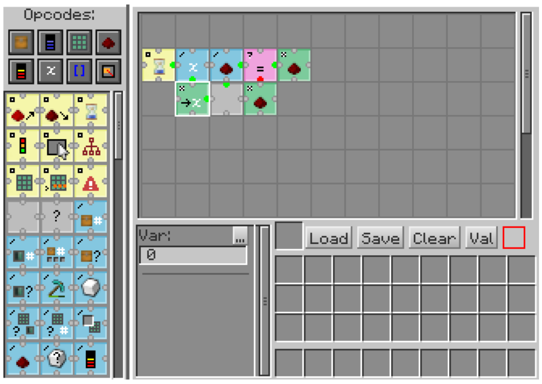
Configuration 13-1-3. ME Fluid Level Emitter configuration for Sap.



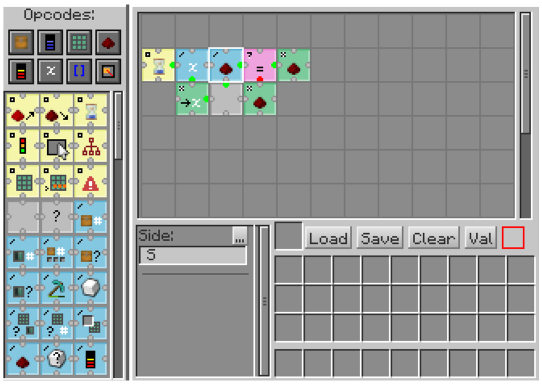
Configuration 13-2-1. Event: repeat, configured for 600 ticks (30 seconds).



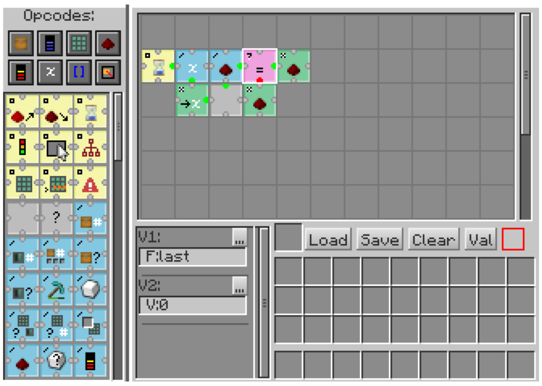
Configuration 13-2-2. Eval: number, configured for ’15’ (integer).



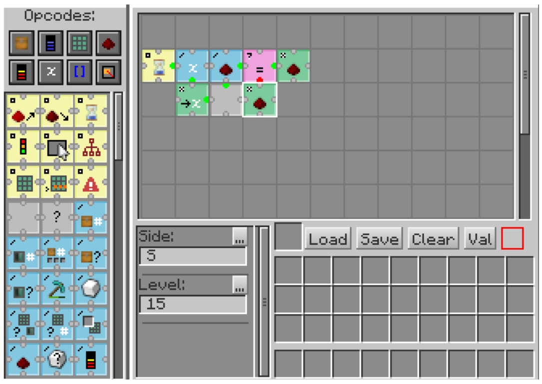
Configuration 13-2-3. Operation: set variable, configured for the previous Eval Opcode.



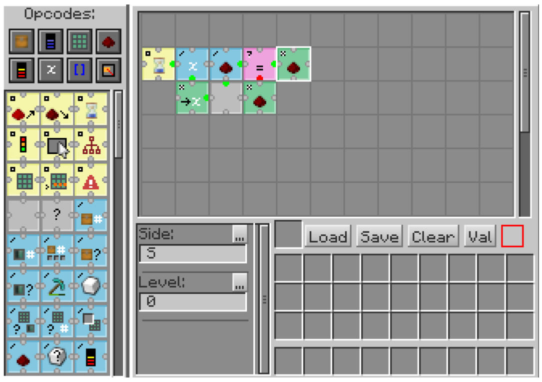
Configuration 13-2-4. Eval: read redstone, read redstone signal on South side of the Processor.



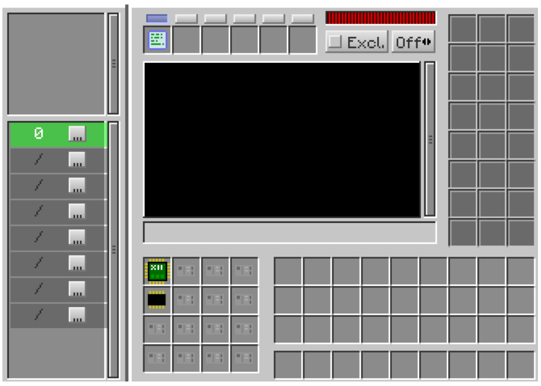
Configuration 13-2-5. Test: equality, if the last redstone signal read equals the value in variable 0 (V:0) set redstone signal output to ’0’ on South side, else set redstone signal output to ’15’ on South side.



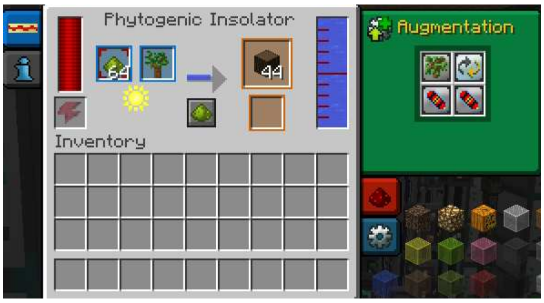
Configuration 13-2-6. Operation: set redstone, redstone signal output to ’15’ on South side if the ’Test: equality’ statement is false.



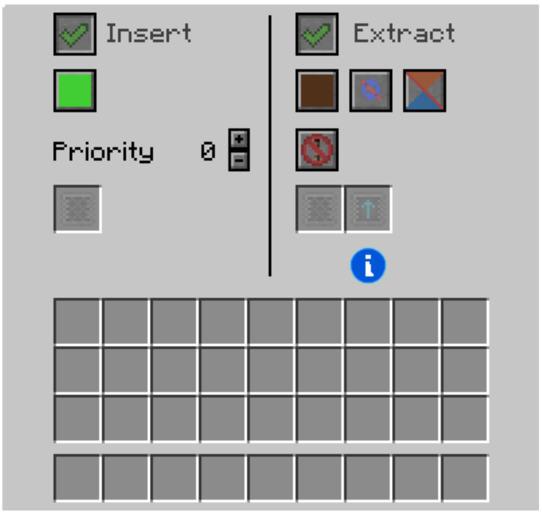
Configuration 13-2-7. Operation: set redstone, redstone signal output to ’0’ on South side if the ’Test: equality’ statement is true.



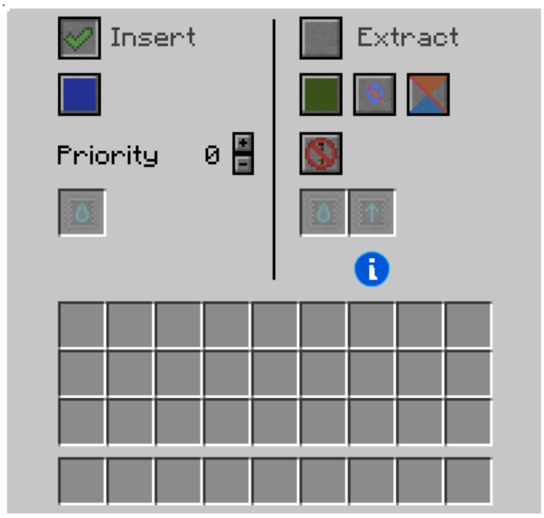
Configuration 13-2-8. As stated previously, the Processor is equipped with: CPU Core B500 (x1), and RAM Chip 8E (x1). Variable 0 is allocated to program card.



Configuration 13-3-1. Phytogenic Insolators augment configuration.



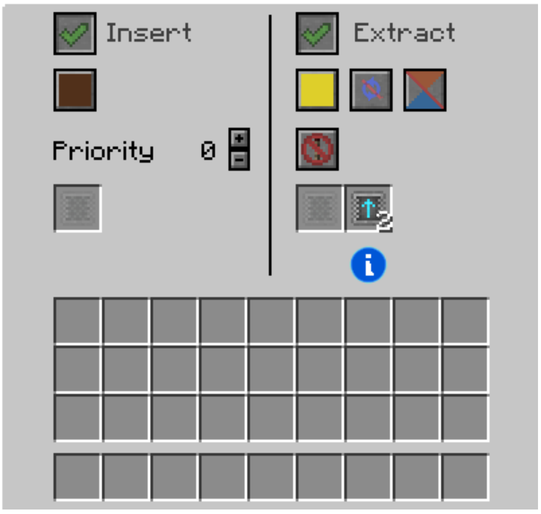
Configuration 13-3-2. Item Conduit configuration for Phytogenic Insolators.



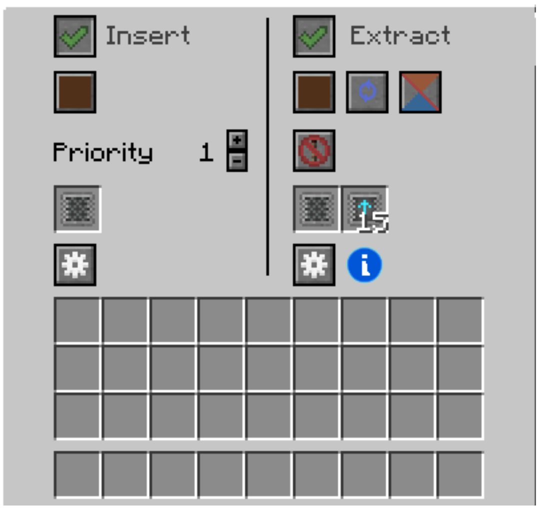
Configuration 13-3-3. Fluid Conduit configuration for Phytogenic Insolators.

Configuration 13-4-1. Sawmills augment configuration.

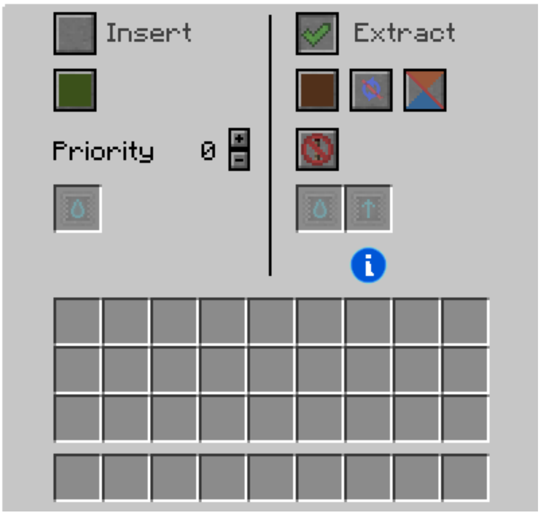
Configuration 13-4-2. Sawmills Redstone Control configuration.



Configuration 13-4-3. Item Conduit configuration for Sawmills.



Configuration 13-5-1. Item Conduit configuration for Dark Oak Wood buffer chest.

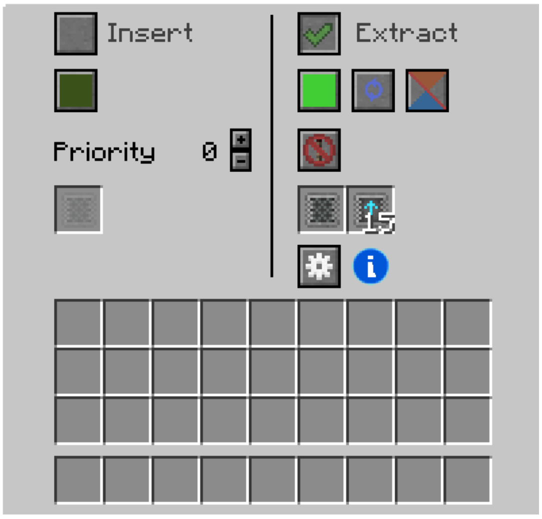


Configuration 13-4-4. Fluid Conduit configuration for Sawmills.

Configuration 13-5-2. Item Conduit insert filter configuration for Dark Oak Wood buffer chest.

Configuration 13-5-3. Item Conduit extract filter configuration for Dark Oak Wood buffer chest.

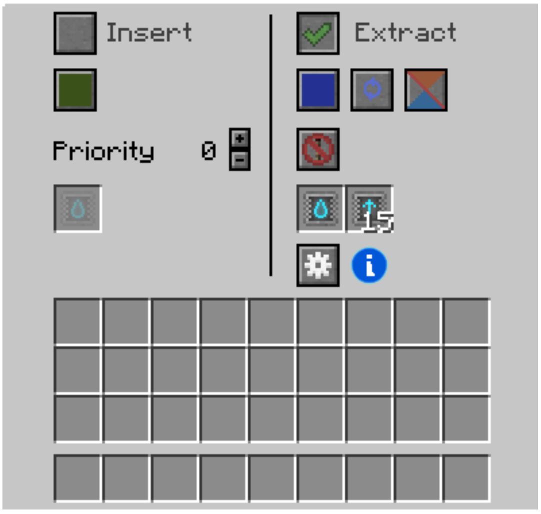
Configuration 13-5-4. ME Storage Bus configuration for Dark Oak Wood buffer chest.



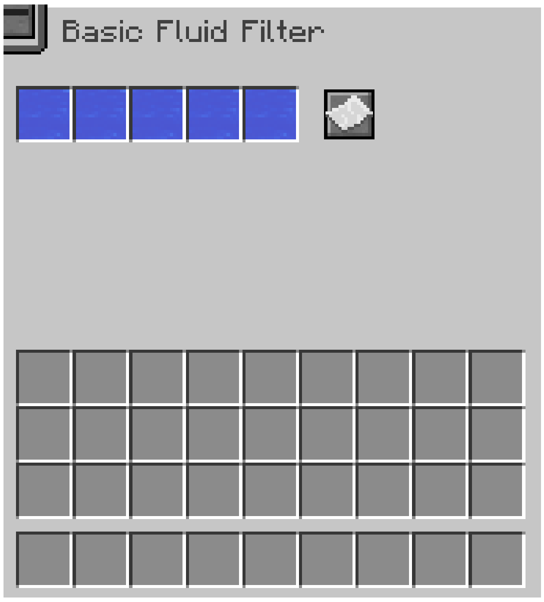
Configuration 13-6-1. Item Conduit configuration for Phyto-Gro buffer chest.

Configuration 13-6-2. Item Conduit extract filter configuration for Phyto-Gro buffer chest.

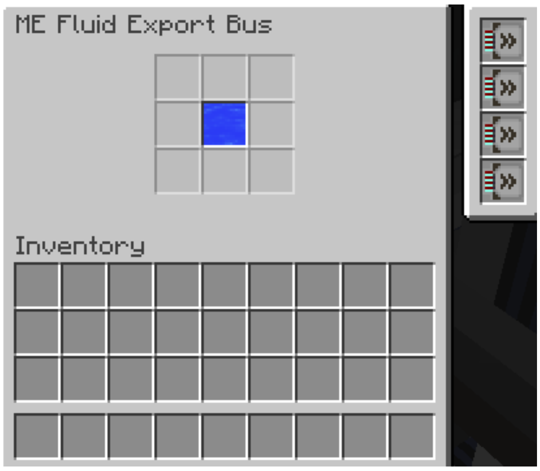
Configuration 13-6-3. ME Export Bus configuration for Phyto-Gro buffer chest.



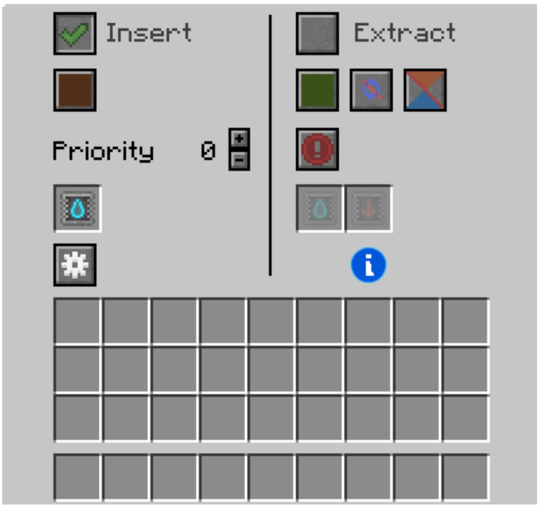
Configuration 13-7-1. Fluid Conduit configuration for Water buffer drum.



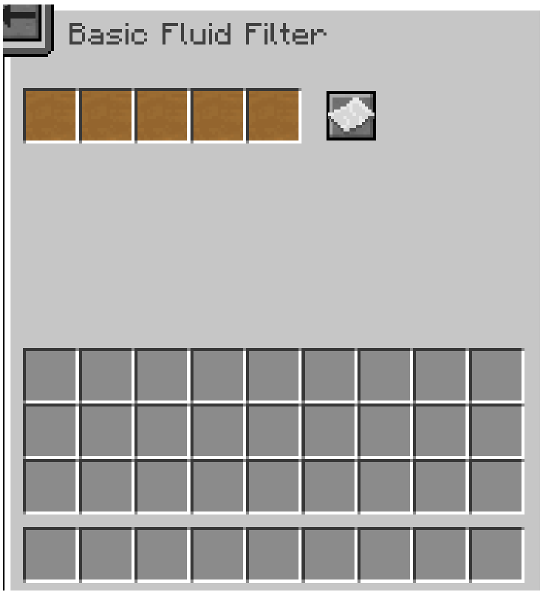
Configuration 13-7-2. Fluid Conduit extract filter configuration for Water buffer drum.



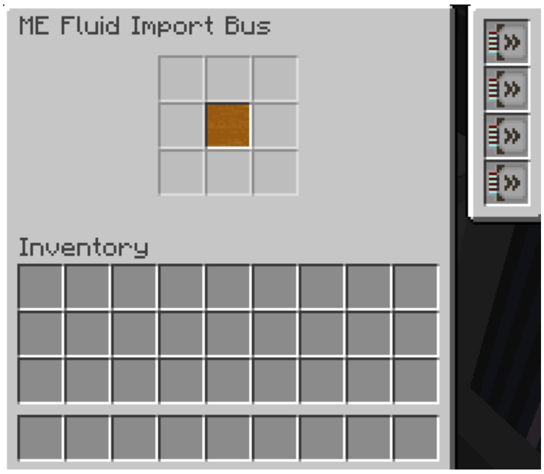
Configuration 13-7-3. ME Fluid Export Bus configuration for Water buffer drum.



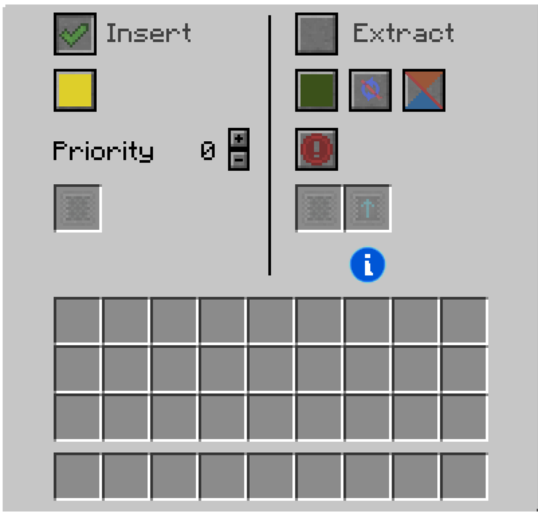
Configuration 13-8-1. Fluid Conduit configuration for Sap buffer drum.



Configuration 13-8-2. Fluid Conduit insert filter configuration for Sap buffer drum.

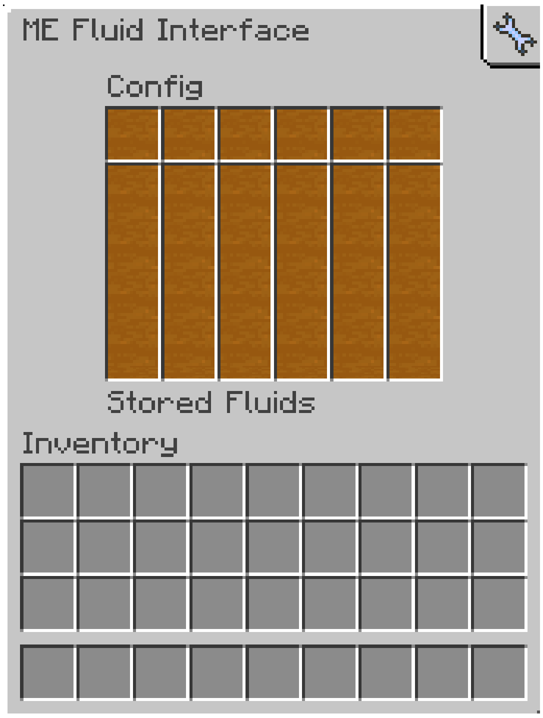


Configuration 13-8-3. ME Fluid Import Bus configuration for Sap buffer drum.



Configuration 13-9. Item Conduit configuration for Nullifier

Configuration 13-10-1. Product - Sap - ME Fluid Storage Bus



Configuration 13-10-2. Product - Sap - ME Fluid Interface

14. Rich Phyto-Gro

The twelfth stage of the production process involves producing Rich Phyto-Gro. The following is an outline of the production process:

1 Fluid Transposers take in Phyto-Gro and Sap to produce Rich Phyto-Gro.

2 Rich Phyto-Gro is inserted into the Rich Phyto-Gro buffer chest.

3 Rich Phyto-Gro within the Rich Phyto-Gro buffer chest is imported and stored in the AE production network.

Rich Phyto-Gro is used in the following production stage(s):

- Fluxed Phyto-Gro

The following machinery is used during this production stage:

- Fluid Transposer - Thermal Expansion

14.1. Description

Phyto-Gro and Sap are inserted into Fluid Transposers which then produce Rich Phyto-Gro using one (1) Phyto-Gro and 200mb of Sap. Each of the Fluid Transposers will use four (4) Auxiliary Reception Coil augments to increase processing speed.

14.2. Flow Charts

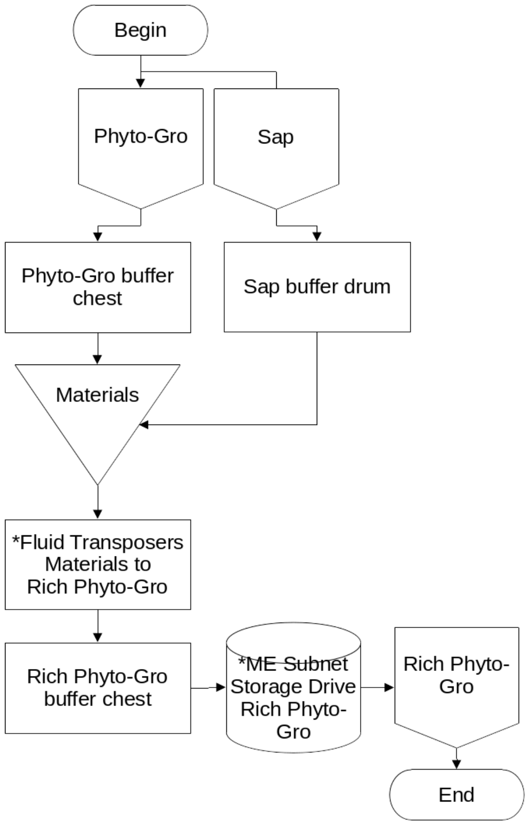
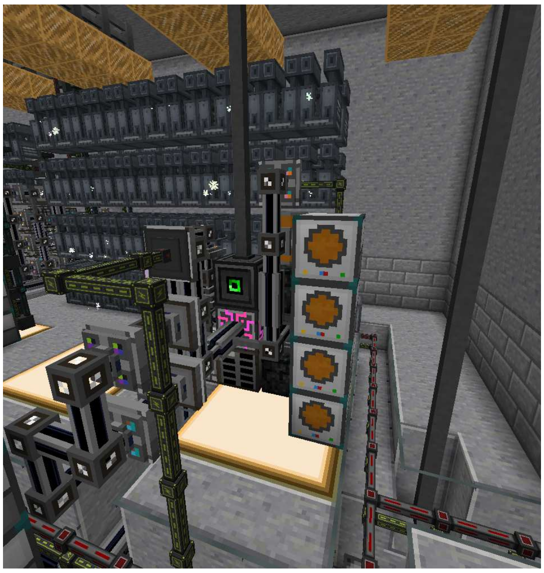
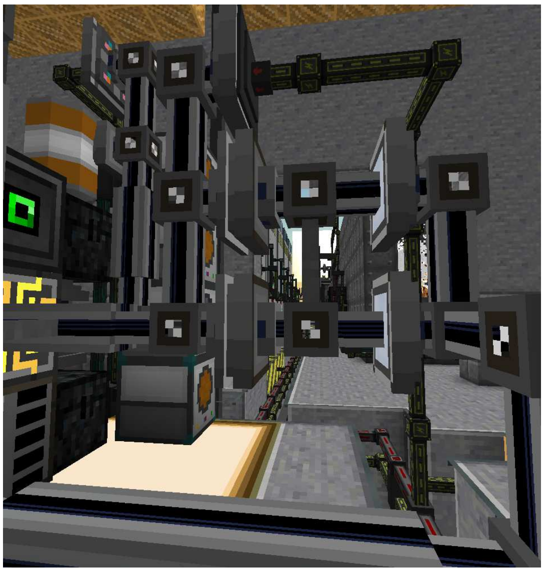


Figure 14-1. Rich Phyto-Gro Production Diagram

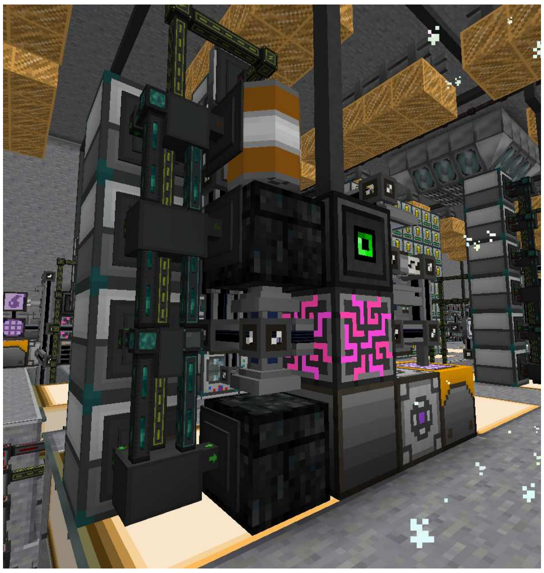
14.3. Setup Photos



Photograph 14-1. Rich Phyto-Gro production systems

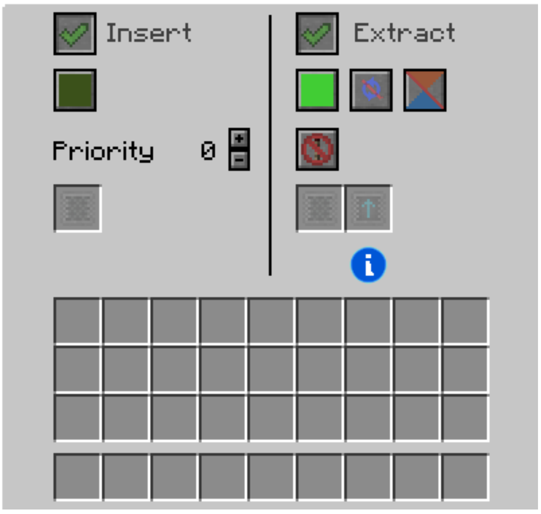


Photograph 14-2. Resource Provision Systems; P2P Tunnel (top) provides Sap, and P2P Tunnel (bottom) provides Phyto-Gro.

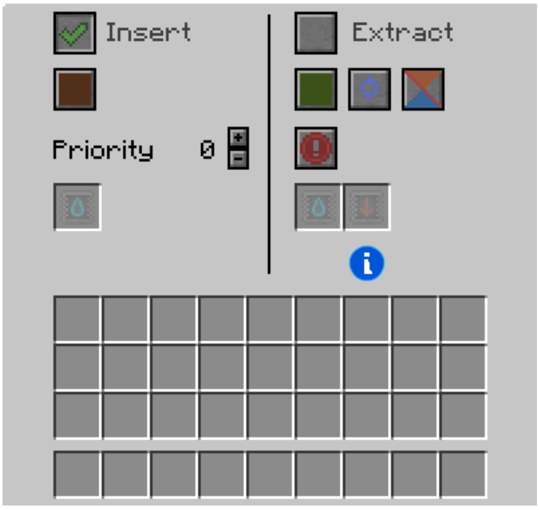


Photograph 14-3. Sap buffer drum (top), Phyto-Gro buffer chest (middle), and Rich Phyto-Gro buffer chest (bottom).

Configuration 14-1-1. Fluid Transposers augment configuration.

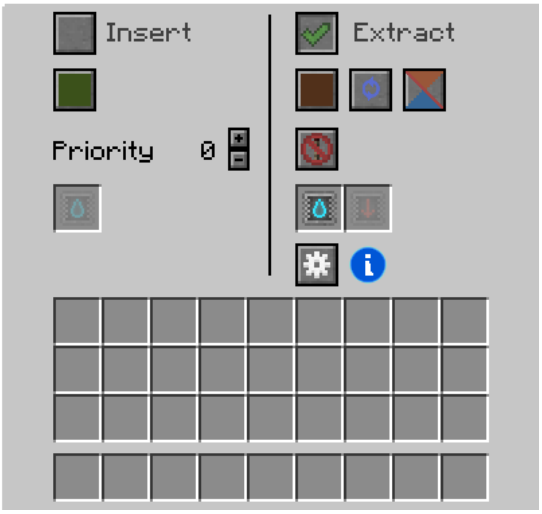


Configuration 14-1-2. Item Conduit configuration for Fluid Transposers.

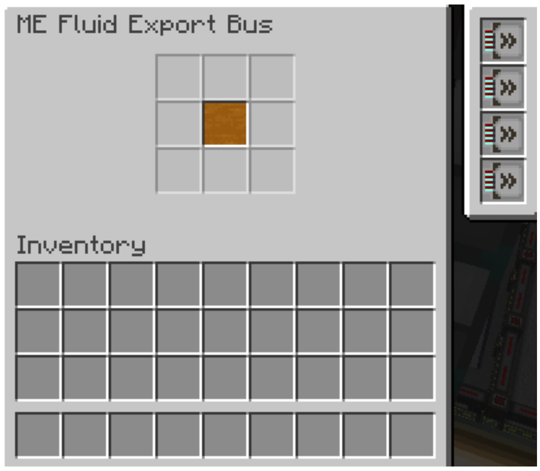


Configuration 14-1-3. Fluid Conduit configuration for Fluid Transposers.

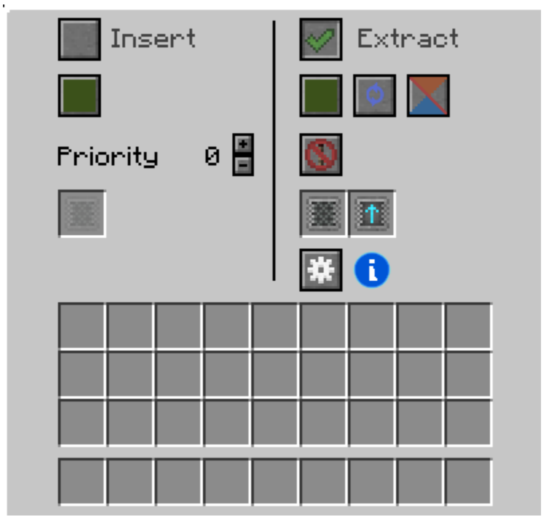
Configuration 14-2-2. Fluid Conduit extract filter configuration for Sap buffer drum.



Configuration 14-2-1. Fluid Conduit configuration for Sap buffer drum.



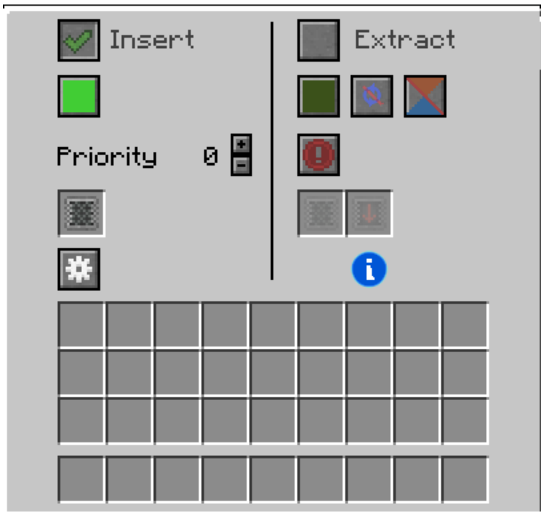
Configuration 14-2-3. ME Fluid Export Bus configuration for Sap buffer drum.



Configuration 14-3-1. Item Conduit configuration for Phyto-Gro buffer chest.

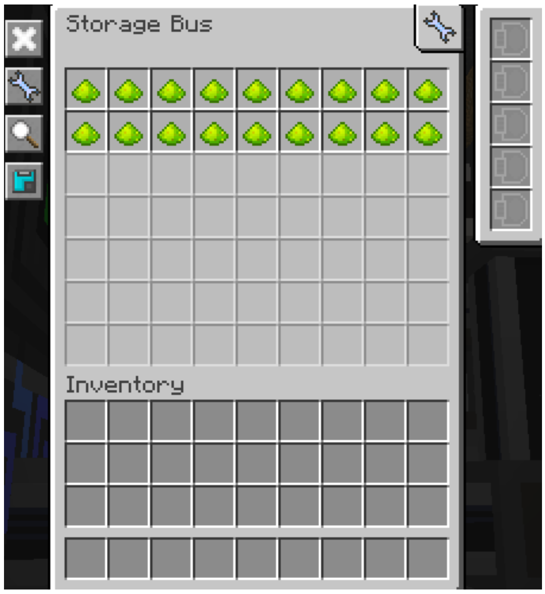
Configuration 14-3-2. Item Conduit extract filter configuration for Phyto-Gro buffer chest.

Configuration 14-3-3. ME Export Bus configuration for Phyto-Gro buffer chest.

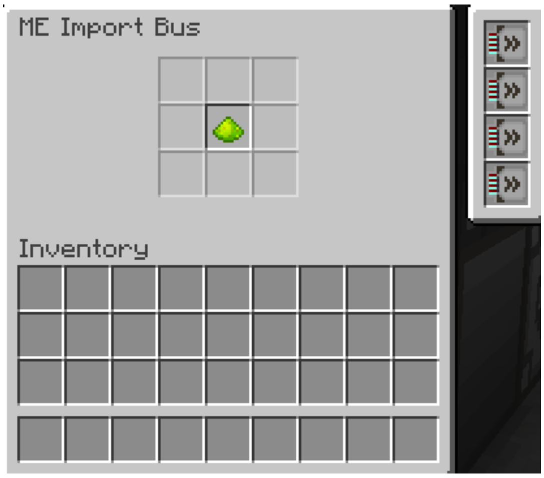


Configuration 14-4-1. Item Conduit configuration for Rich Phyto-Gro buffer chest.

Configuration 14-4-2. Item Conduit insert filter configuration for Rich Phyto-Gro buffer chest.



Configuration 14-5-1. Product - Rich Phyto-Gro - ME Storage Bus.



Configuration 14-4-3. ME Import Bus configuration for Rich Phyto-Gro buffer chest.

Configuration 14-5-2. Product - Rich Phyto-Gro - ME Interface.

15. Fluxed Phyto-Gro

The thirteenth stage of the production process involves producing Fluxed Phyto-Gro. The following is an outline of the production process:

1 Energetic Infusers take Rich Phyto-Gro and energize it into Fluxed Phyto-Gro.

2 Fluxed Phyto-Gro is inserted into the Fluxed Phyto-Gro buffer chest.

3 Fluxed Phyto-Gro within the Fluxed Phyto-Gro buffer chest is imported and stored in the AE production network.

Fluxed Phyto-Gro is used in the following production stage(s):

- Redstone-Growing

The following machinery is used during this production stage:

- Energetic Infuser - Thermal Expansion

15.1. Description

Energetic Infusers take Rich Phyto-Gro and energize it to produce Fluxed Phyto-Gro. Each Energetic Infuser uses four (4) Auxiliary Reception Coil augments to increase production speed.

15.2. Flow Charts

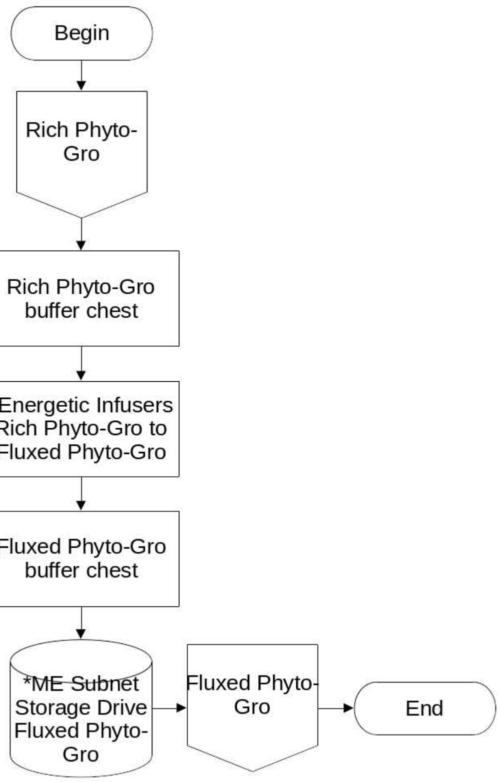
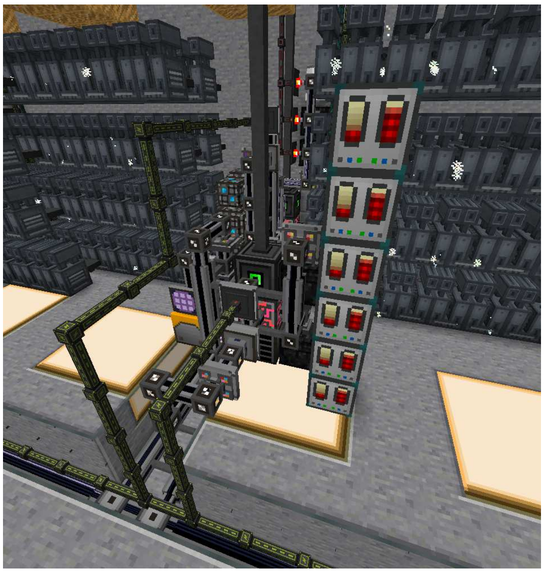


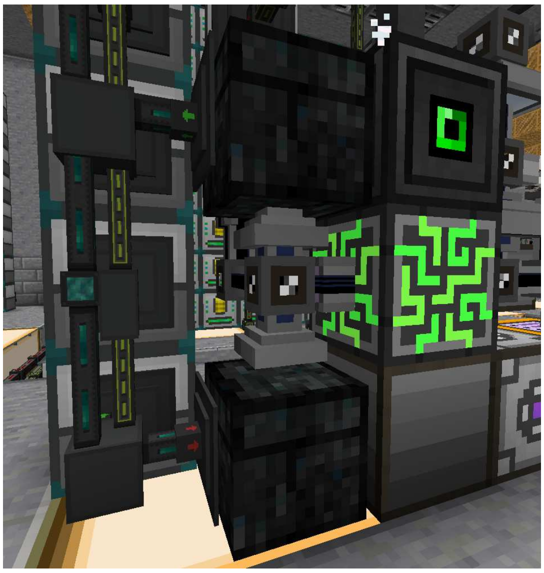
Figure 15-1. Fluxed Phyto-Gro Production Diagram

15.3. Setup Photos



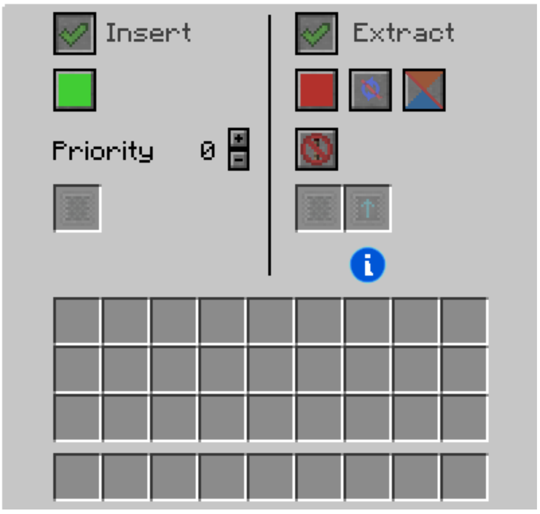
Photograph 15-1. Fluxed Phyto-Gro production systems

Photograph 15-2. Resource Provision Systems; P2P Tunnel (right) provides Rich Phyto-Gro.

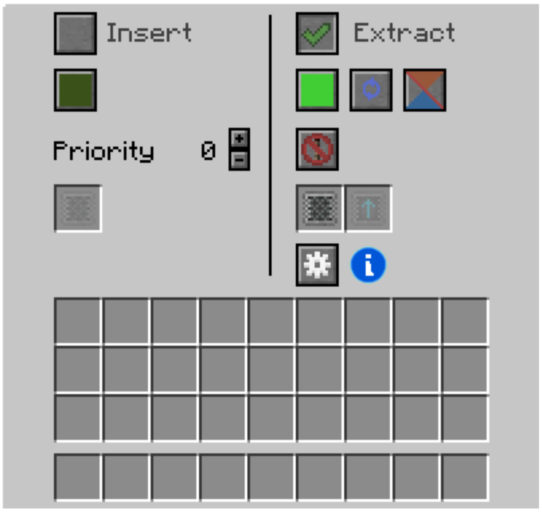


Photograph 15-3. Rich Phyto-Gro buffer chest (top), and Fluxed Phyto-Gro (bottom).

Configuration 15-1-1. Energetic Infusers augment configuration.

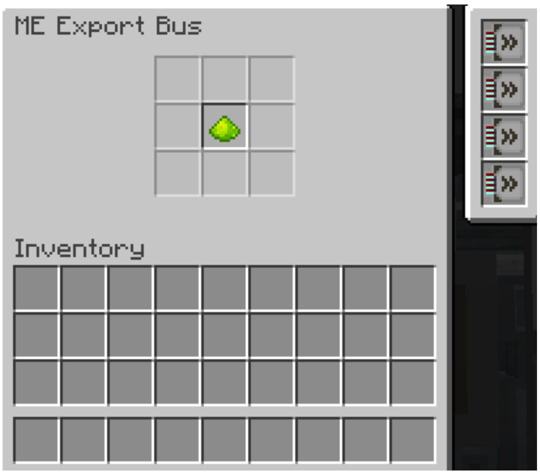


Configuration 15-1-2. Item Conduit configuration for Energetic Infusers.

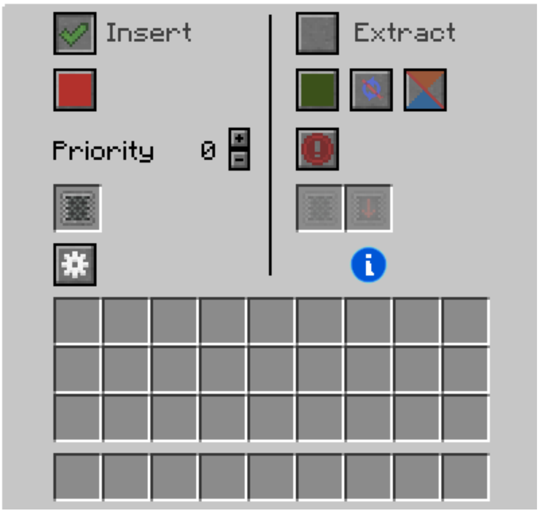


Configuration 15-2-1. Item Conduit configuration for Rich Phyto-Gro buffer chest.

Configuration 15-2-2. Item Conduit extract filter configuration for Rich Phyto-Gro buffer chest.

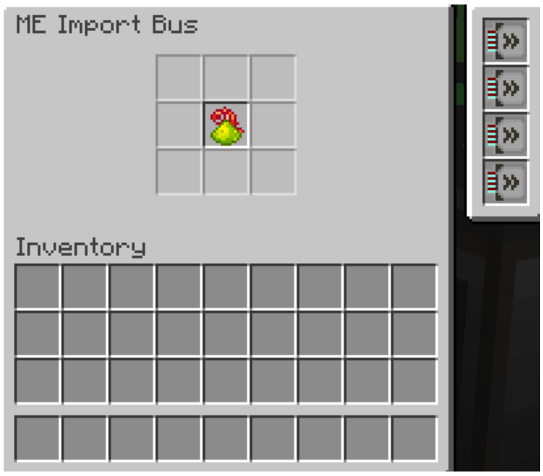


Configuration 15-2-3. ME configuration for Rich Phyto-Gro buffer chest.



Configuration 15-3-1. Item Conduit configuration for Fluxed Phyto-Gro buffer chest.

Configuration 15-3-2. Item Conduit insert filter configuration for Fluxed Phyto-Gro buffer chest.



Configuration 15-3-3. ME Import Bus configuration for Fluxed Phyto-Gro buffer chest.

Configuration 15-4-1. Product - Fluxed Phyto-Gro - ME Storage Bus

Configuration 15-4-2. Product - Fluxed Phyto-Gro - ME Interface

16. Redstone-Growing

The fourteenth stage of the production process involves producing Redstone. The following is an outline of the production process:

1 Fluxed Phyto-Gro and Water are inserted into Phytogenic Insolators. A single Red Orchid is present within each Phytogenic Insolator.

2 The above materials produce a single piece of Redstone.

3 Redstone is inserted into the Redstone buffer chest.

4 Redstone within the Redstone buffer chest is imported and stored in the AE production network.

5 If the quantity of Redstone within the production network falls below one-thousand twenty four (1024), emit a Redstone signal using a ME Level Emitter. A Redstone Conduit is attached to this ME Level Emitter which takes the redstone signal as input on the 'green' redstone channel.

Redstone is used in the following production stage(s):

- Rocket Fuel

The following machinery is used during this production stage:

- Phytogenic Insolator - Thermal Expansion

16.1. Description

During this stage of production, Redstone is grown inside of Phytogenic Insolators. The purpose of this stage is to mitigate the loss of Redstone due to the supply demand of the Rocket Fuel production stage. Each Phytogenic Insolator has the following augments installed: one (1) Monoculture Cycle, and three (3) Auxiliary Reception Coils.

If this stage cannot meet the supply demand of Redstone, then a Redstone signal will be emitted using a ME Level Emitter, as described in step 5 of the production process above.

16.2. Flow Charts

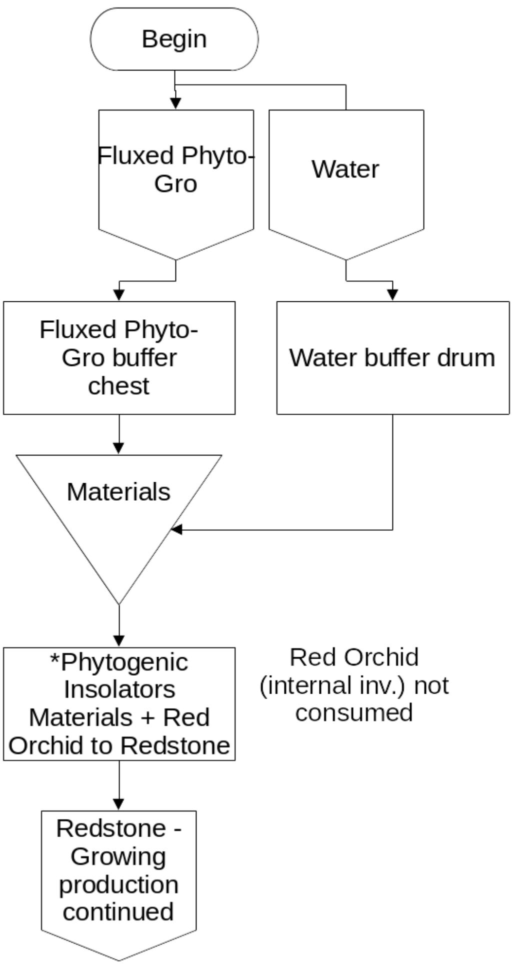


Figure 16-1. Redstone-Growing Production Diagram

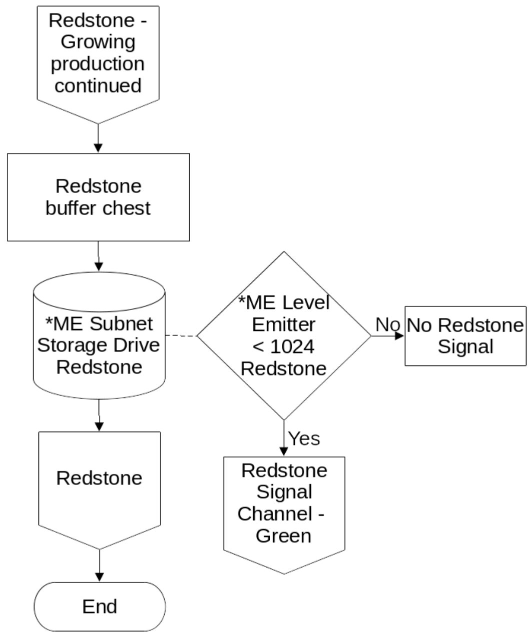
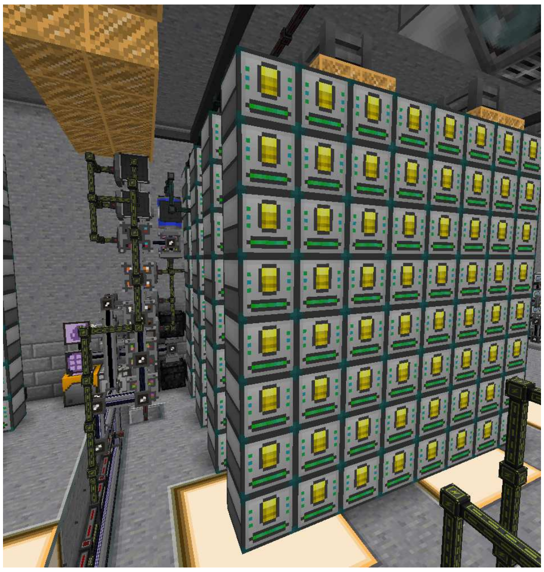


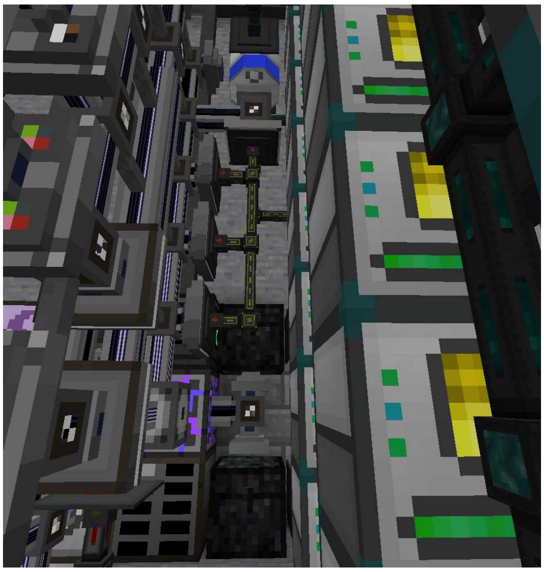
Figure 16-2. Redstone-Growing Production Diagram continued

16.3. Setup Photos

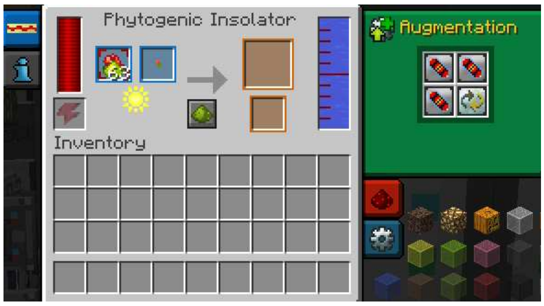


Photograph 16-1. Redstone-Growing production systems

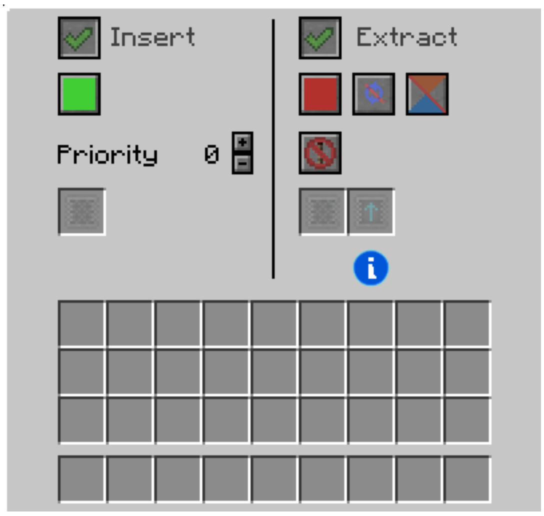
Photograph 16-2. Resource Provision Systems; Starting from top-to-bottom, three (3) P2P Tunnels provide Water, the last (bottom) P2P Tunnel provides Fluxed Phyto-Gro.



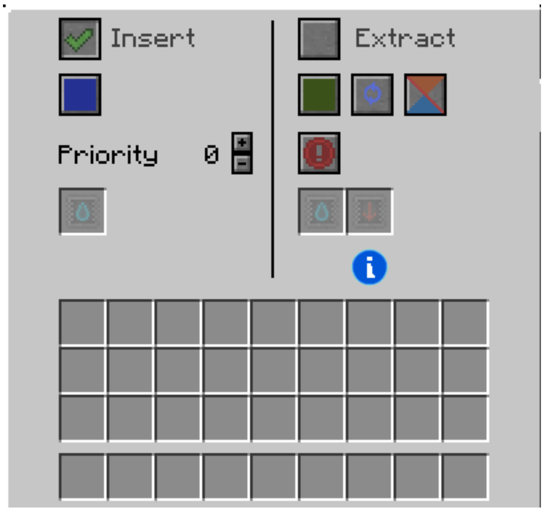
Photograph 16-3. Water buffer drum (top), Fluxed Phyto-Gro buffer chest (middle), and Redstone buffer chest (bottom).



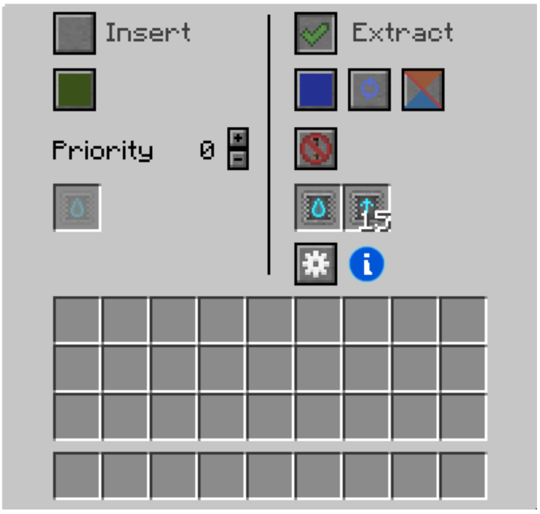
Configuration 16-1-1. Phytogenic Insolators augment configuration.



Configuration 16-1-2. Item Conduit configuration for Phytogenic Insolators.

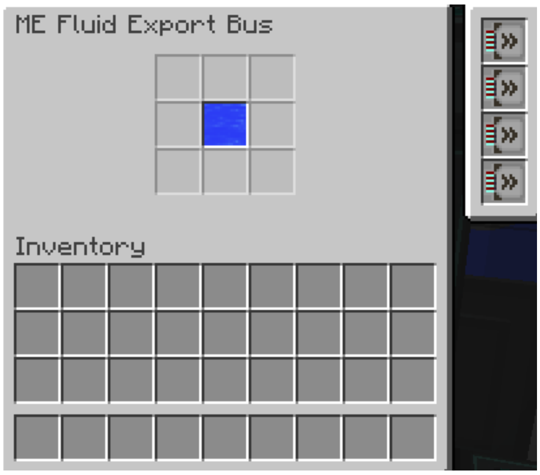


Configuration 16-1-3. Fluid Conduit configuration for Phytogenic Insolators.

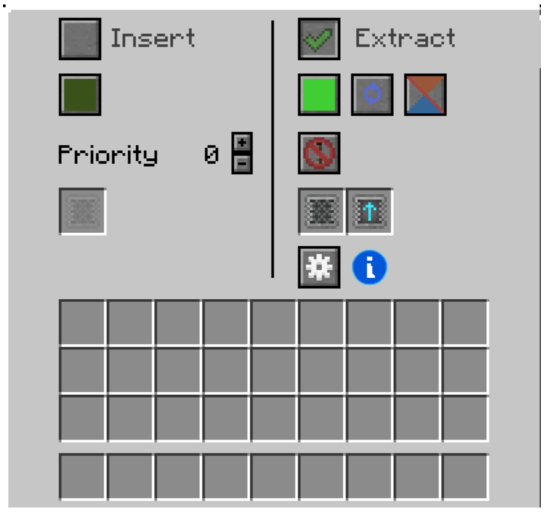


Configuration 16-2-1. Fluid Conduit configuration for Water buffer drum.

Configuration 16-2-2. Fluid Conduit extract filter configuration for Water buffer drum.

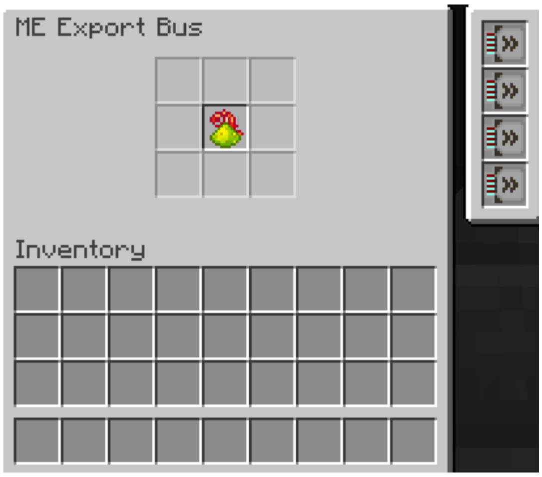


Configuration 16-2-3. ME Fluid Export Bus configuration for Water buffer drum.

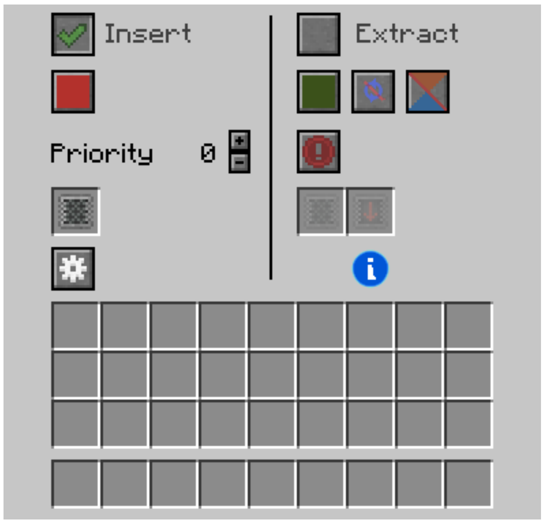


Configuration 16-3-1. Item Conduit configuration for Fluxed Phyto-Gro buffer chest.

Configuration 16-3-2. Item Conduit extract filter configuration for Fluxed Phyto-Gro buffer chest.

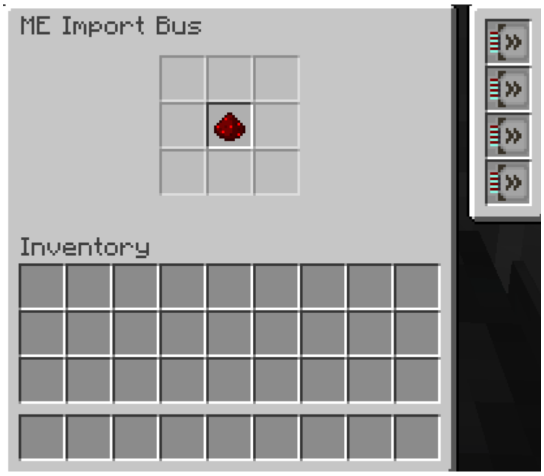


Configuration 16-3-3. ME Export Bus configuration for Fluxed Phyto-Gro buffer chest.

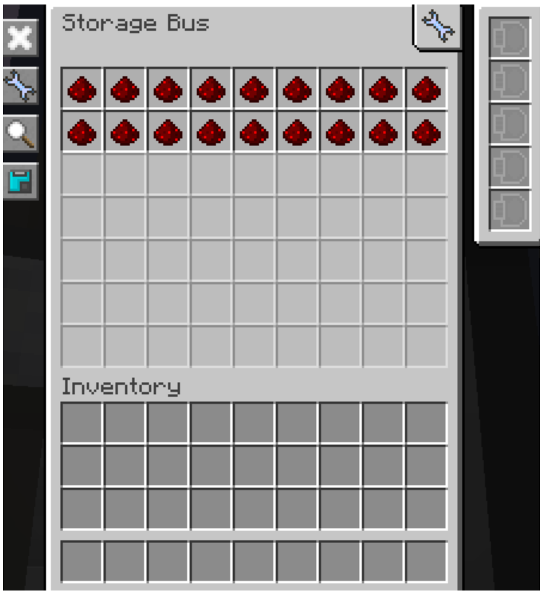


Configuration 16-4-1. Item Conduit configuration for Redstone buffer chest.

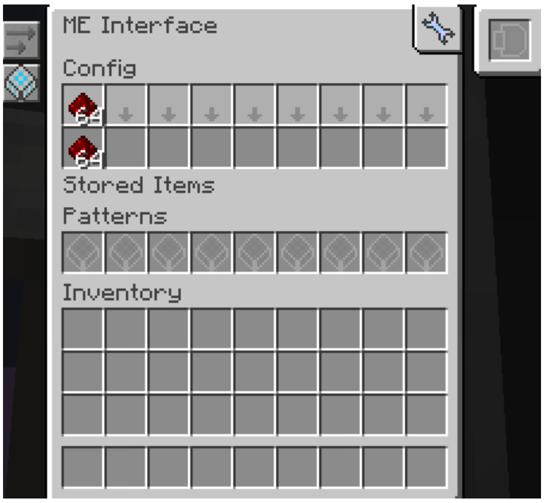
Configuration 16-4-2. Item Conduit insert filter configuration for Redstone buffer chest.



Configuration 16-4-3. ME Import Bus configuration for Redstone buffer chest.



Configuration 16-5-1. Product - Redstone - ME Storage Bus



Configuration 16-5-2. Product - Redstone - ME Interface

17. Mob Farm and Logic Systems

This section describes the systems used in the mob-spawning process. Such systems: route and nullify appropriate mob drops, control the on/off state of the mob spawners and accompanying sub-systems, and emit redstone signals based on the quantity of Redstone and Gunpowder within the mob farm production system. Without these systems there would be nothing to control the spawning of mobs, and the routing logic of their drops. As such, the following systems are essential to the production process.

This section will deviate from the format described in section 1.2.

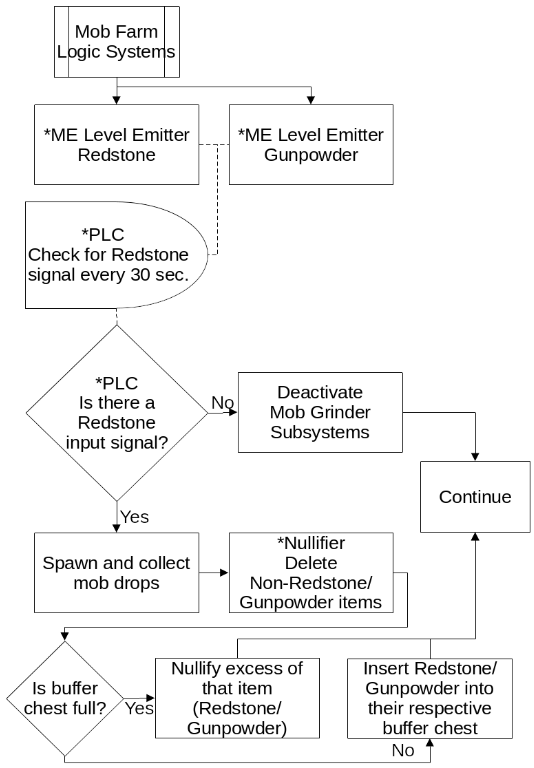


Figure 17-1. Mob Farm Subsystem Control and Mob Drop Routing Logic.

17.1. Mob Farm Logic Controller

The mob farm logic controller is comprised of four components: a Processor from the RFTools Control mod, two (2) ME Level Emitters, a breaker switch to toggle the mob farm on/off, and redstone conduits to use as the control signal transport medium (see section 17.1.1.). The Processor uses the following components: CPU Core S1000 (x1), and RAM Chip 8E (x1). Variable 0 is allocated to the primary program card (the program card which enables/disables the mob farm subsystems).

The mob farm logic controller has two (2) purposes which are as follows:

- Ensure the mob farm does not rapidly toggle itself on and off when the quantity of Redstone and Gunpowder in the AE production network reach maximum capacity.
- Provide a way to toggle on/off the mob farm using a separate redstone signal than the one provided by the ME Level Emitters.

The mob farm logic controller has two (2) Program Cards installed on it. The first (and primary) program operates in the following way:

1 An event ('Event: repeat' opcode) repeats every 600 ticks (30 seconds).

2 The program will then run the 'Eval: test lock' opcode to see if the lock of NAME is set (where NAME is a string) which returns true if the lock is set, or false if not set.

3 Using the 'Test: is value set/true' opcode, test to see if 'Eval: test lock' returned true or false.

4 If the 'Test: is value set/true' opcode returns true, then the redstone signal which controls the mob farm subsystems is disabled using the 'Operation: set redstone' opcode, the program will execute this opcode every time the program repeats execution, the program will not move past this point until the test above ('Test: is value set/true') returns false.

5 If 'Test: is value set/true' returns false, then the 'Eval: number' opcode evaluates and returns an integer of 15 (I). Where (I) specifies an integer.

6 This integer (15 (I)) is set as the value of the first variable (V:0), this variable is used as a parameter for a later opcode.

7 The redstone signal from the ME Level Emitters on SIDE (where SIDE is one of the six (6) sides (i.e. North, South, East, West, Top (up), Bottom (down))) is evaluated using the 'Eval: redstone' opcode, the value returned (an integer) is used in the next opcode ('Test: equality').

8 The 'Test: equality' opcode evaluates the last returned integer (the value of the redstone signal from the ME Level Emitters) and the value of the first variable (V:0), which when written as code looks like this: x == 15 (I). Where 15 (I) is the value of V:0. Where X is the value of the last returned integer, which is the value returned by the previous opcode, 'Eval: redstone'.

9 If the redstone signal from the ME Level Emitters equals 15 (I), then enable the mob farm subsystems.

10 If the redstone signal from the ME Level Emitters does not equal 15 (I),

then disable the mob farm subsystems. When this occurs the mob farm is put into the STANDBY Operating State (see section 17.2).

The second program card operates in the following way:

1 A redstone event ('Event: redstone on') is triggered if a redstone signal becomes a non-zero value on SIDE.

2 After triggering the 'Event: redstone on' event, the mob farm subsystems are disabled using the 'Operation: set redstone' opcode.

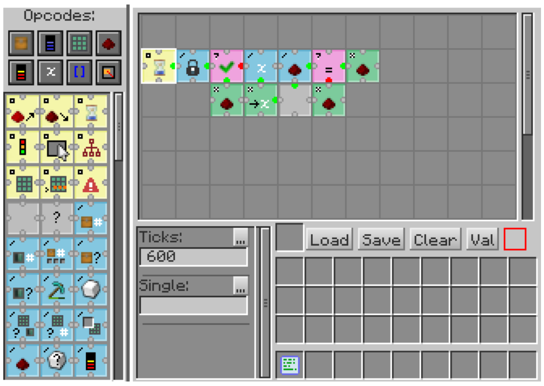
3 After disabling the mob farm subsystems, a lock with a name of NAME is set using the 'Operation: test and lock' opcode.

4 A redstone event ('Event: redstone off') is triggered if a redstone signal becomes a zero value on SIDE.

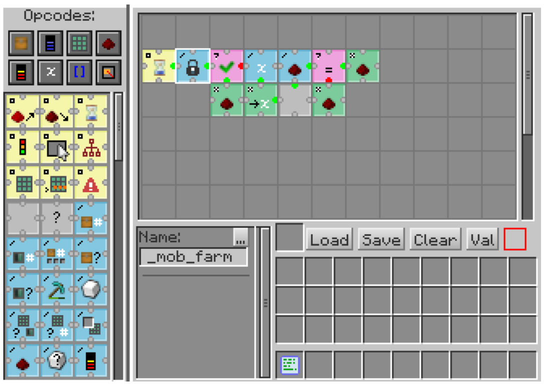
5 After triggering the 'Event: redstone off' event, the lock with the name of NAME is released using the 'Operation: release lock' opcode.

Photograph 17-1. The RFTools Control Processor, a Redstone Conduit (top) provides a signal to the Processor from the ME Level Emitters. A Redstone Conduit and Ender Energy Conduit provide a control signal to the mob farm subsystems, and energy for the Processor respectively.

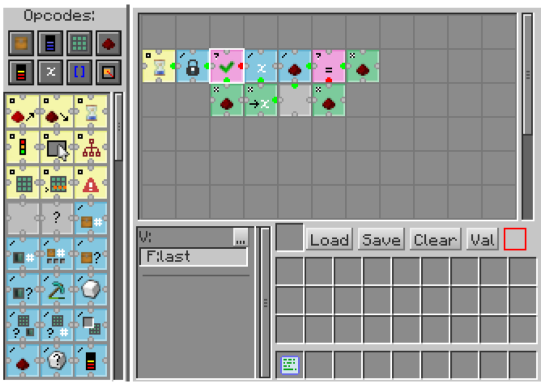
The first (and primary) program card used in the mob farm logic controller has the following configuration:



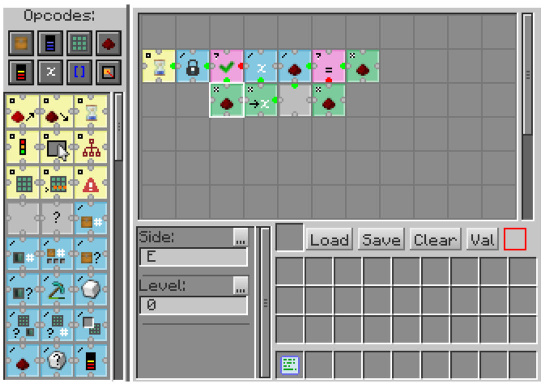
Configuration 17-1-1. Primary routine - Event: repeat.



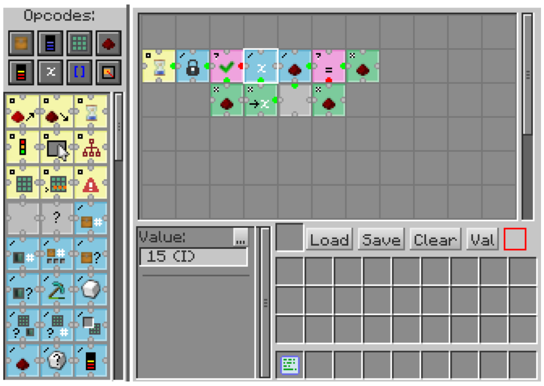
Configuration 17-1-2. Primary routine - Eval: test lock.



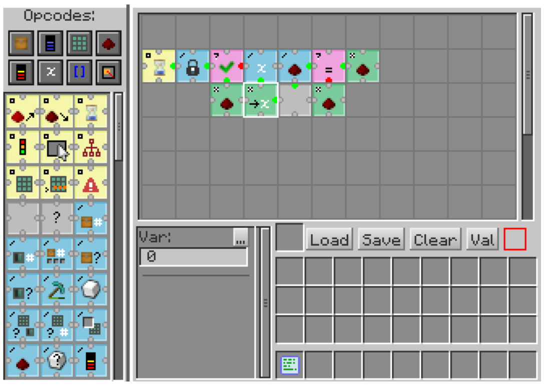
Configuration 17-1-3. Primary routine - Test: is value set/true.



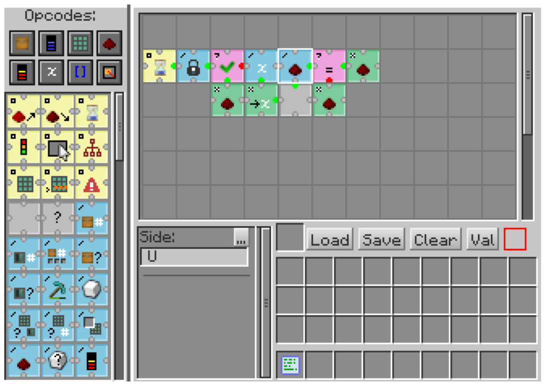
Configuration 17-1-4. Primary routine - If Test: is value set/true is true - Operation: set redstone.



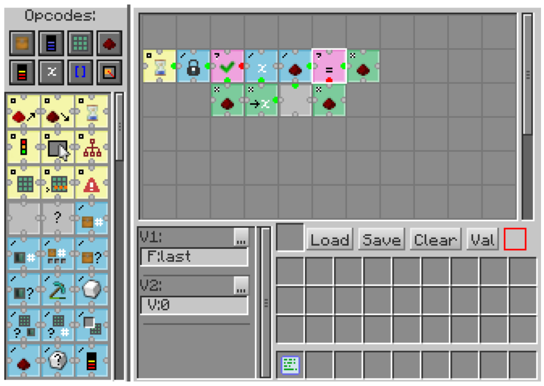
Configuration 17-1-5. Primary routine - If Test: is value set/true is false - Eval: number.



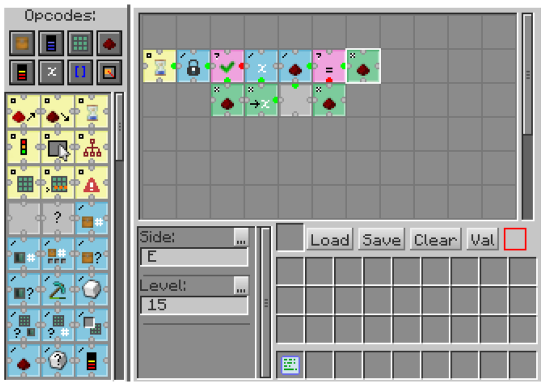
Configuration 17-1-6. Primary routine - Operation: set variable.



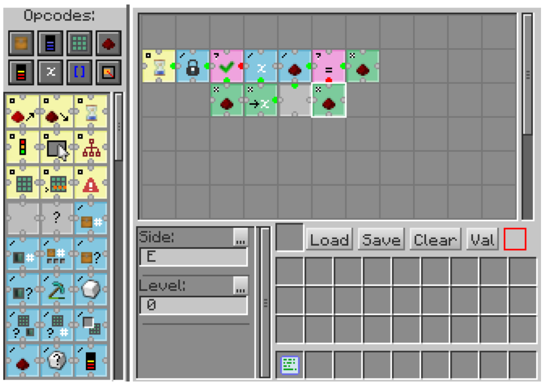
Configuration 17-1-7. Primary routine - Eval: read redstone.



Configuration 17-1-8. Primary routine - Test: equality.

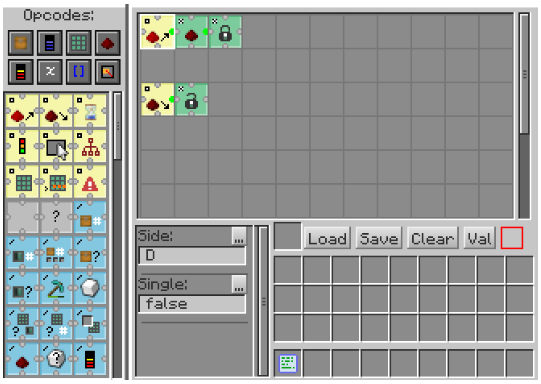


Configuration 17-1-9. Primary routine - If Test: equality is true - Operation: set redstone.

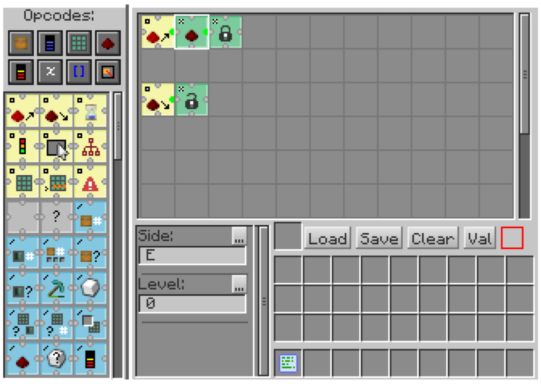


Configuration 17-1-10. Primary routine - If Test: equality is false - Operation: set redstone.

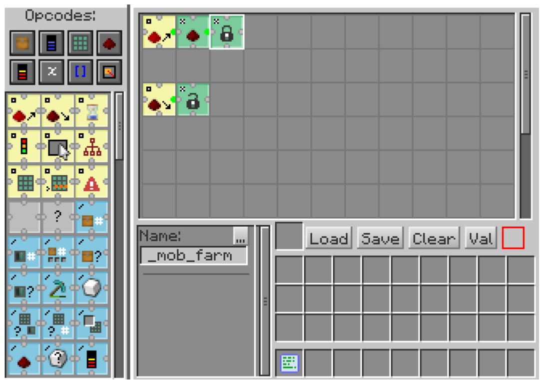
The second program card used in the mob farm logic controller has the following configuration:



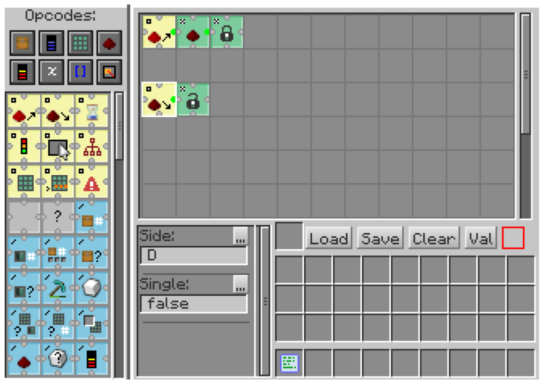
Configuration 17-2-1. Subroutine - Event: redstone on.



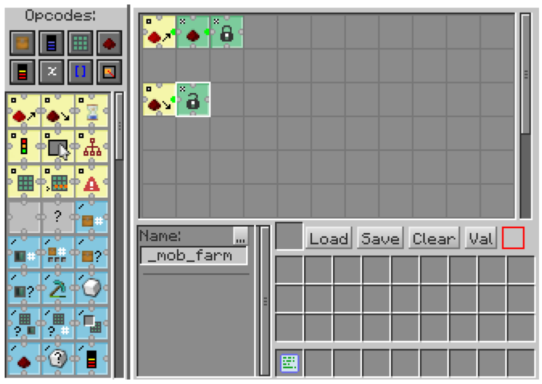
Configuration 17-2-2. Subroutine - Operation: set redstone.



Configuration 17-2-3. Subroutine - Operation: test and lock.



Configuration 17-2-4. Subroutine - Event: redstone off.



Configuration 17-2-5. Subroutine - Operation: release lock.

17.1.1. Control Signal and Transport Medium for the Mob Farm Logic Controller

Two (2) ME Level Emitters are used in this setup. The first will be configured to emit a redstone signal when below maximum capacity of Redstone (less than 520,192), the second will be configured to emit a redstone signal when below maximum capacity of Gunpowder (less than 520,192). A

Redstone Conduit will connect to these ME Level Emitters, as shown in Photograph 17-2-1 which will take an input signal on the 'purple' channel. This Redstone Conduit will then connect on the top side of the mob farm logic controller, as shown in Photograph 17-2-2.

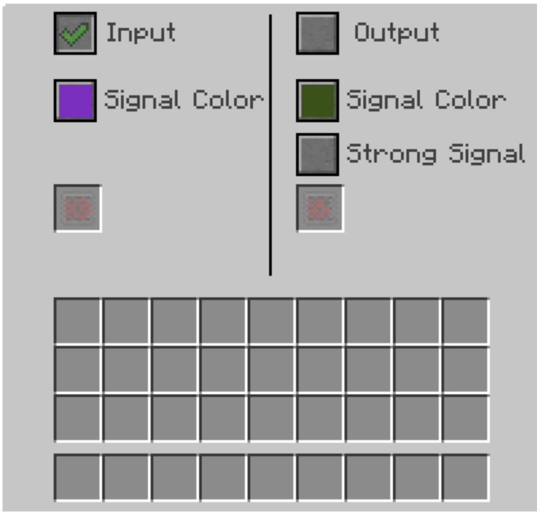
The mob farm logic controller will output a redstone signal on its left side. This signal will be inputted into a Redstone Conduit which will transfer that redstone signal over the 'red' redstone channel.

Photograph 17-2-1. Redstone Conduits connecting to the ME Level Emitters.

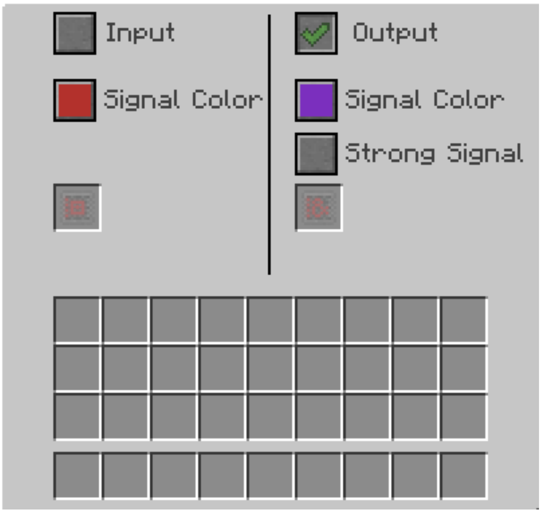
Photograph 17-2-2. Redstone Conduit connecting to the top of the mob farm logic controller.

Configuration 17-3-1. Level Emitter configuration for Redstone.

Configuration 17-3-2. Level Emitter configuration for Gunpowder.

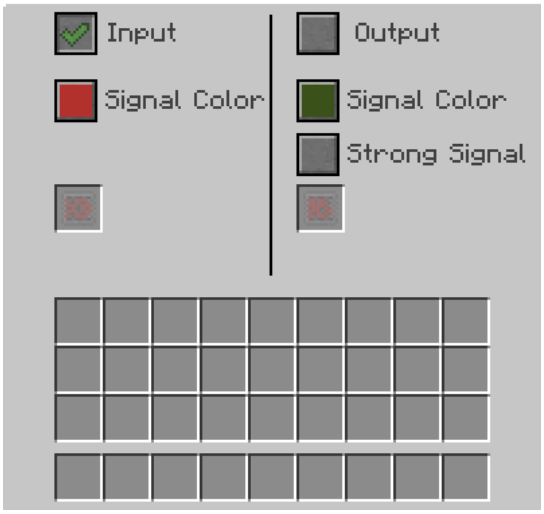


Configuration 17-3-3. Redstone Conduit configuration for connections to the ME Level Emitters.



Configuration 17-3-4. Redstone Conduit configuration for connection to top of the mob farm logic controller.

Photograph 17-2-3. Redstone Conduit on left side of the mob farm logic controller which provides the control signal to the mob farm's various subsystems.



Configuration 17-3-5. Redstone Conduit configuration for connection on the mob farm logic controller left side.

17.2. Operating State Advisory

What follows is a list of one or more Operation States that modify this production system's physical/logical behavior, along with the specific systems modified:

- STANDBY - When this production system is put into this state: the Nullifier is deactivated, the Powered Spawners are deactivated, and the Mob Mashers are deactivated. Additionally, mob drops which are not Redstone or Gunpowder will not be removed from the Absorption Hoppers. XP collected by the Absorption Hoppers and XP Vacuums will not be pumped out.

17.3. Mob Drop Routing

The routing system will prioritize the insertion of Redstone/Gunpowder into their respective buffer chest over inserting them into the Nullifier. However, Redstone/Gunpower MUST NOT be blacklisted from inserting into the Nullifier. As an example, if the Gunpowder buffer chest is full, any extra Gunpowder will be inserted into the Nullifier, as that is the next available route.

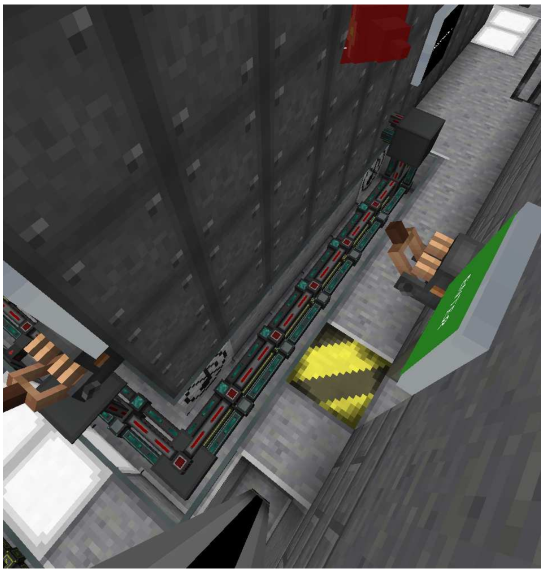
17.4. Mob Farm Containment Structure and Accompanying Subsystems

Mobs are spawned in a containment structure, who's external dimensions measure 20 meters x 11 meters x 7 meters (Length X Width X Height). Because Creepers will be spawned within this containment structure, the material(s) used to construct it MUST have a blast resistance value of 11.2 or higher (Explosion, 2021)[6].

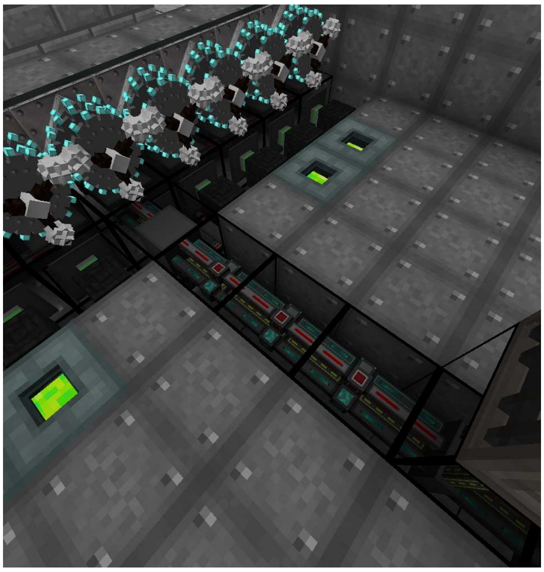
17.4.1. Containment Structure Wiring

The containment structure uses Item Conduits, Ender Fluid Conduits, Ender Energy Conduits, and Redstone Conduits to provide the subsystems material routing, energy, and control. These conduits are wrapped within a conduit bundle that runs throughout the containment structure, hidden by Hardened Conduit Facades which are painted as the same material as the containment structure.

Each Redstone Conduit is configured to output a redstone signal from the 'red' redstone channel. This is the redstone channel that is controlled by the mob farm logic controller.



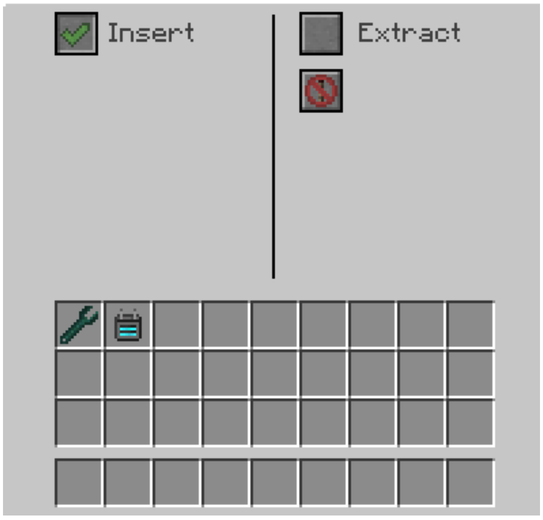
Photograph 17-3. The main conduit bundle coming from the buffer chests, mob farm logic controller, Nullifier, and eight (8) FE-configured P2P Tunnels (left). And going into the containment structure (right).



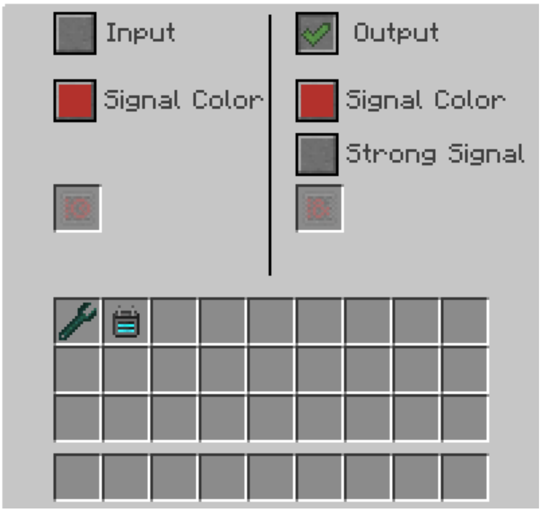
Photograph 17-4. The main conduit bundle hidden under the floor of the containment structure.

17.4.1.1. Wiring for Powered Spawners

Powered Spawners use Ender Energy Conduits and Redstone Conduits to provide energy and control. In the bottom row of Powered Spawners, those conduits connect to them on the bottom side. On the top row of Powered Spawners, those conduits connect to them on the top side, as shown in Photograph 17-9.



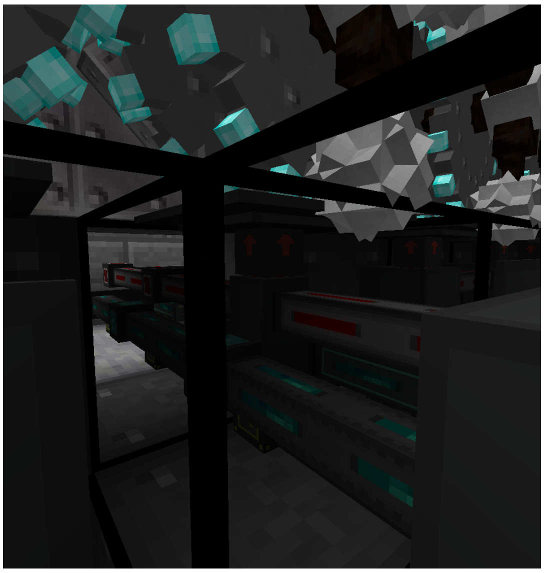
Configuration 17-4-1. Powered Spawners Energy Conduit configuration.



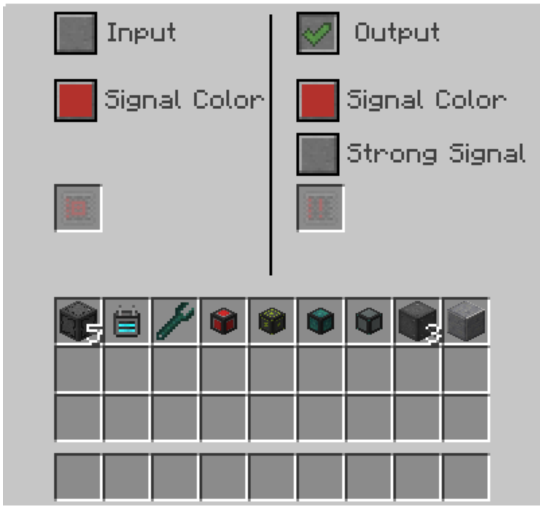
Configuration 17-4-2. Powered Spawners Redstone Conduit configuration.

17.4.1.2. Wiring for Mob Mashers

Mob Mashers use Redstone Conduits to toggle them on/off. Redstone Conduits connect to the Mob Mashers on the bottom side.



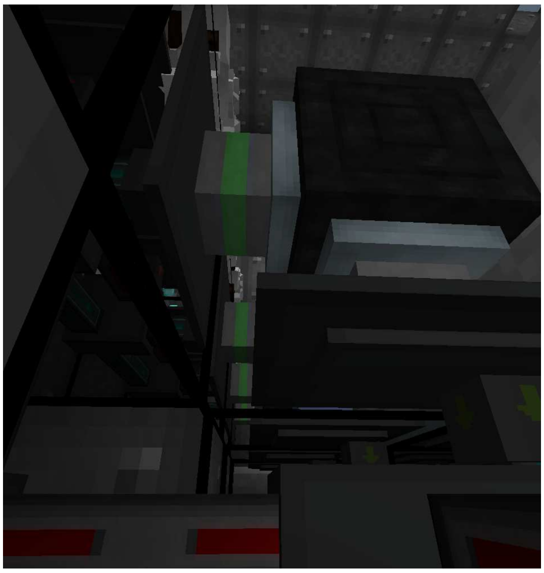
Photograph 17-5. Redstone Conduit placement for the Mob Mashers.



Configuration 17-5. Mob Mashers Redstone Conduit configuration.

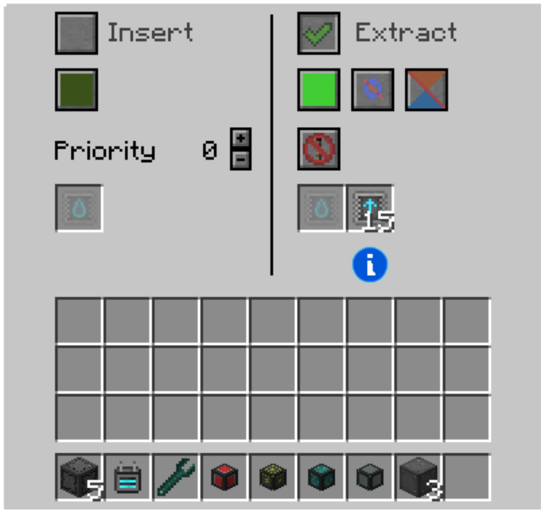
17.4.1.3. Wiring for Absorption Hoppers

Absorption Hoppers use Item Conduits and Ender Fluid Conduits to extract items and fluid from them. The Item Conduits connect on the bottom side of the Absorption Hoppers, while Ender Fluid Conduits connect on the side that faces toward the front of the containment structure (the front is the way mobs are being pushed).



Photograph 17-6. Item Conduit and Ender Fluid Conduit placement for the Absorption Hoppers.

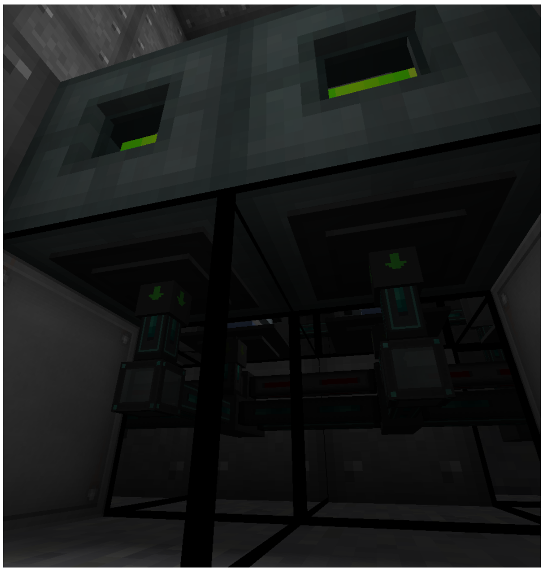
Configuration 17-6-1. Absorption Hoppers Item Conduit configuration.



Configuration 17-6-2. Absorption Hoppers Ender Fluid Conduit configuration.

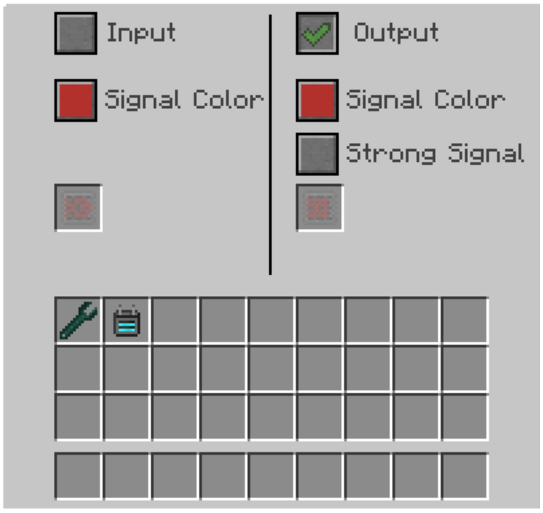
17.4.1.4. Wiring for XP Vacuums

XP Vacuums use Ender Fluid Conduits to extract fluid from them. The Ender Fluid Conduits are placed on the bottom side of the XP Vacuums.



Photograph 17-7. Ender Fluid Conduit placement for the XP Vacuums.

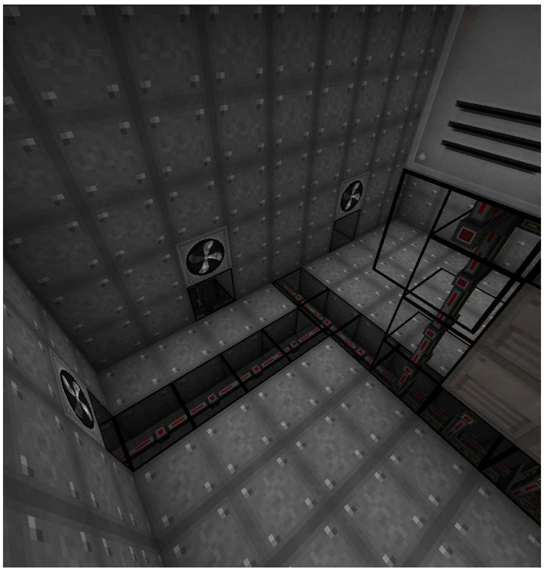
Configuration 17-7. XP Vacuums Ender Fluid Conduit configuration.



Configuration 17-8. Mob Fans Redstone Conduit configuration.

17.4.1.5. Wiring for Mob Fans

Mob Fans use Redstone Conduits to toggle them on/off. Redstone Conduits connect to the Mob Fans on the bottom side.

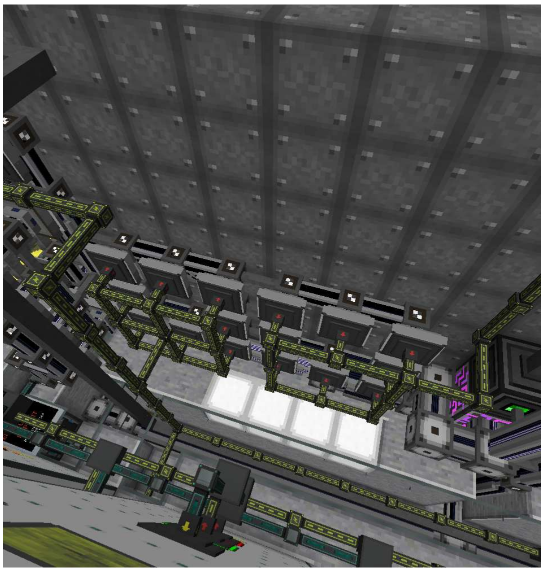


Photograph 17-8. Redstone Conduit placement for the Mob Fans.

17.4.1.6. Power Delivery System

The Powered Spawners are the most power-intensive machines used in the Rocket Fuel production process. As such, the power delivery system MUST be capable of supplying sufficient power to the Powered Spawners, and the other mob farm subsystems.

To ensure sufficient power delivery, eight (8) Ender Energy Conduits supply power to the mob farm, for a maximum power throughput of 163,840 (FE/t).



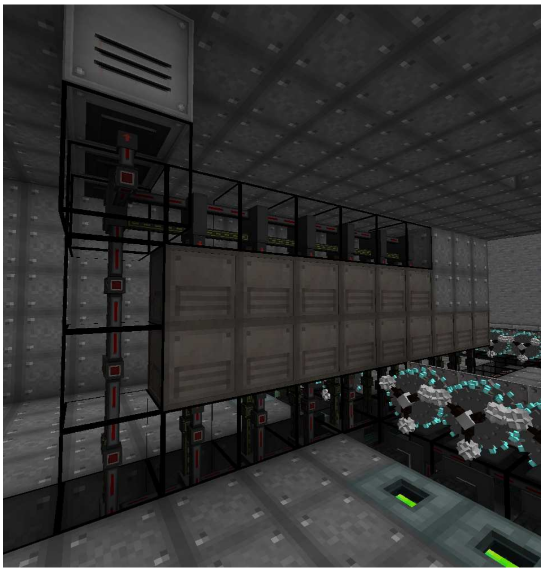
Photograph 17-9. Power Delivery System. Eight (8) P2P Tunnels take power from the main power line (left), the accompanying eight (8) P2P Tunnels output that power into the mob farm (right).

17.4.2. Mob Spawning Systems

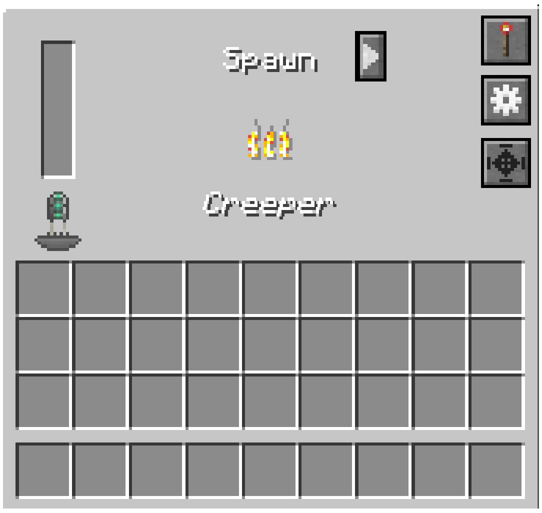
Within the containment structure there can be a total of eighteen (18) Powered Spawners which are broken up into two (2) rows consisting of nine (9) Powered Spawners per-row. The first row of Powered Spawners are to be placed one (1) meter above the floor of the containment structure (that is to say there is a one (1) meter gap between the first row of Powered Spawners and the containment structure floor). The second row of Powered Spawners are placed on top of the first row of Powered Spawners, making them two (2) meters above the containment structure floor.

All Powered Spawners MUST use Octadic Capacitors to ensure sufficient spawning speed. Using an Octadic Capacitor will allow a Powered Spawner to spawn mobs in a 9 meter x 9 meter x 4 meter area (Length X Width X Height). As such, a radius of four (4) meters MUST be kept between the Powered Spawners and the outside of the containment structure. The walls, floor, and ceiling count towards this four (4) meter radius, as Powered Spawners do not consider spawning mobs within solid material.

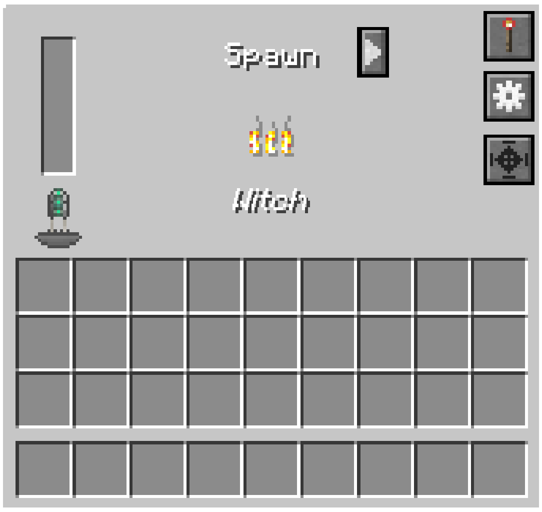
The Powered Spawners are toggled on/off using a redstone signal provided by Redstone Conduits, as such all Powered Spawners MUST have their Redstone Mode setting set to 'Active with signal'.



Photograph 17-10. The physical placement of the Powered Spawners, with conduit facades hidden.



Configuration 17-9-1. Configuration of Creeper Powered Spawners.



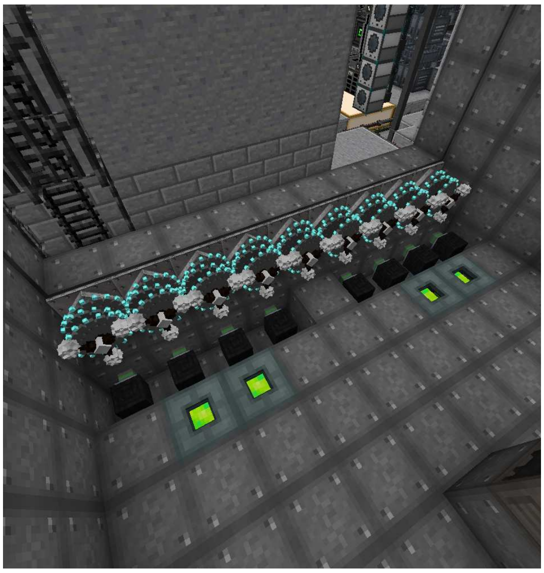
Configuration 17-9-2. Configuration of Witch Powered Spawners.

17.4.3. Mob Drop Collection

Mob drops and XP orbs are collected using Absorption Hoppers, XP Vacuums assist in collecting XP orbs. In total there are: sixteen (16) Absorption Hoppers, and eight (8) XP Vacuums. This is to ensure there are enough collection points to handle the large volume of material the mob farm produces.

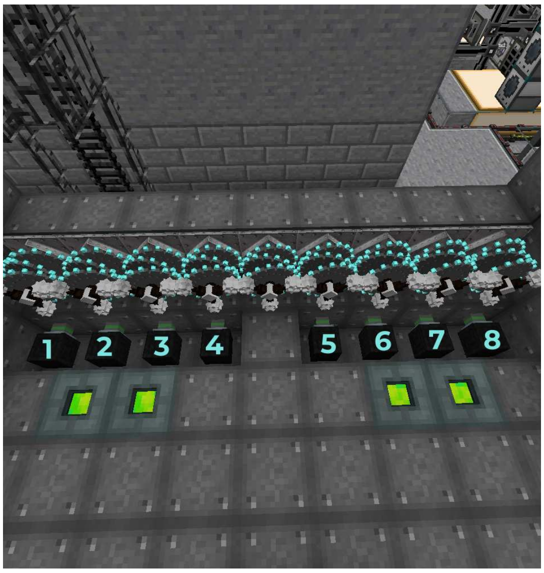
17.4.3.1. Absorption Hoppers

With the exception of vertical space, the Absorption Hoppers are configured to cover the internal area of the containment structure only. To do this each Absorption Hopper needs to be configured based on its placement within the containment structure.

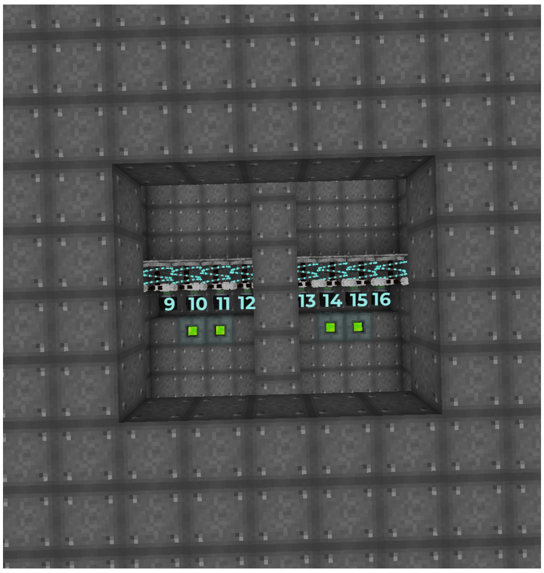


Photograph 17-11. Absorption Hoppers and XP Vacuums.

What follows are two photographs depicting Absorption Hoppers numbered in incrementing order from left-to-right. These photographs will be used to reference the specific Absorption Hopper being configured in section 17.4.3.1.1.



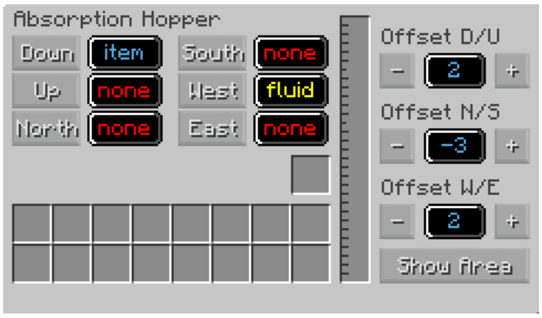
Photograph 17-12-1. Numbered Absorption Hoppers 1 through 8.



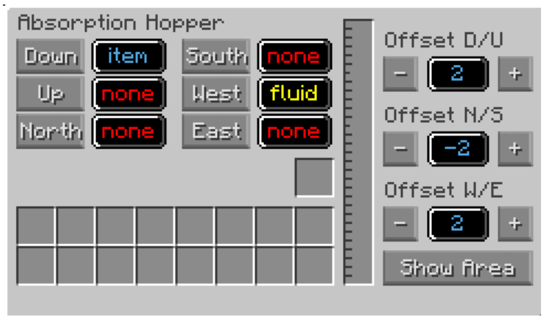
Photograph 17-12-2. Numbered Absorption Hoppers 9 through 16.

17.4.3.1.1. Absorption Hopper Configurations

This section provides configuration screenshots for Absorption Hoppers 1-16, each screenshot will have the accompanying text: 'Configuration for Absorption Hopper N' where N is a number corresponding to the number-labels over each Absorption Hopper, as shown in Photograph 17-12-1 and Photograph 17-12-2.

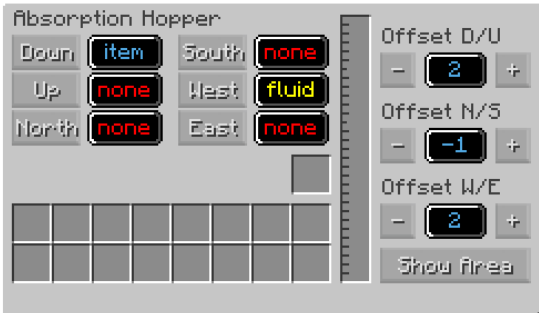


Configuration 17-10-1. Configuration for Absorption Hopper 1.

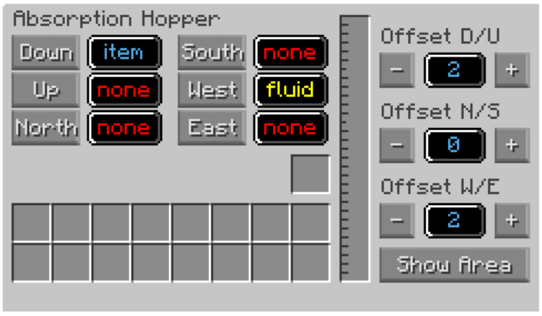


Configuration 17-10-2. Configuration for

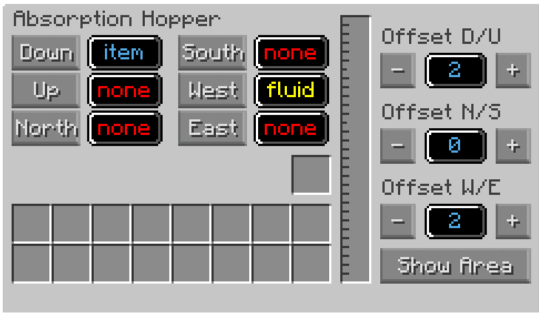
Absorption Hopper 2.



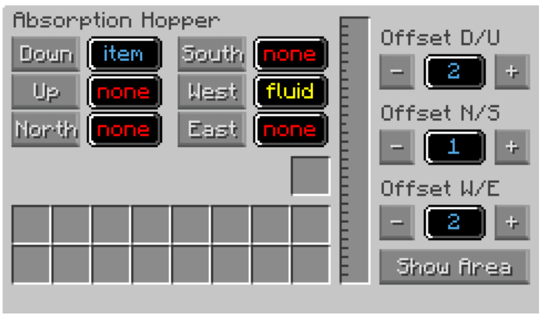
Configuration 17-10-3. Configuration for Absorption Hopper 3.



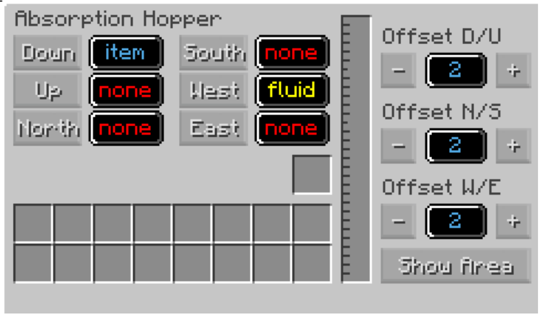
Configuration 17-10-4. Configuration for Absorption Hopper 4.



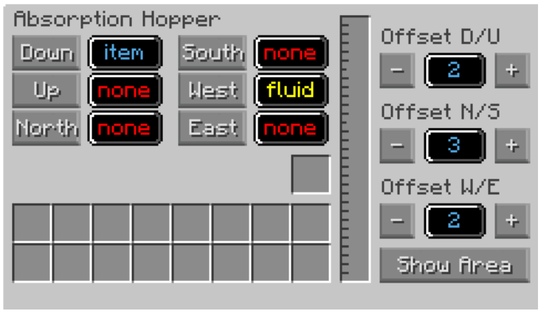
Configuration 17-10-5. Configuration for Absorption Hopper 5.



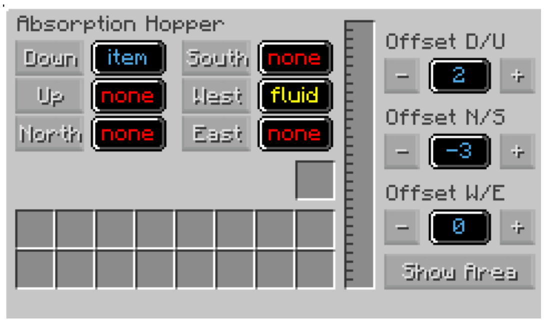
Configuration 17-10-6. Configuration for Absorption Hopper 6.



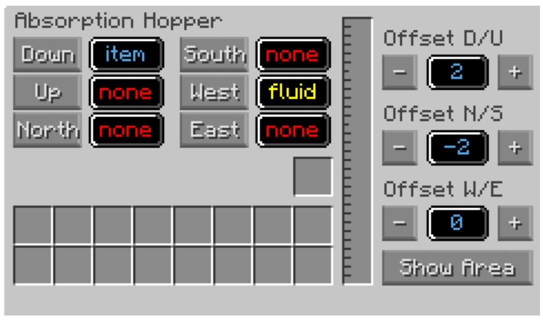
Configuration 17-10-7. Configuration for Absorption Hopper 7.



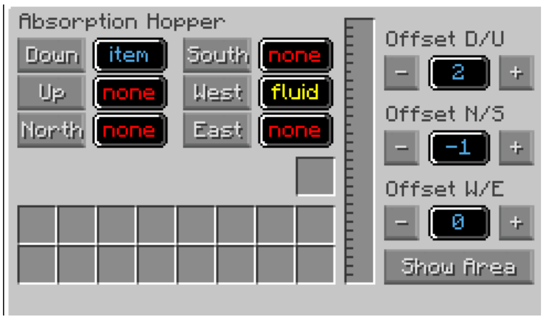
Configuration 17-10-8. Configuration for Absorption Hopper 8.



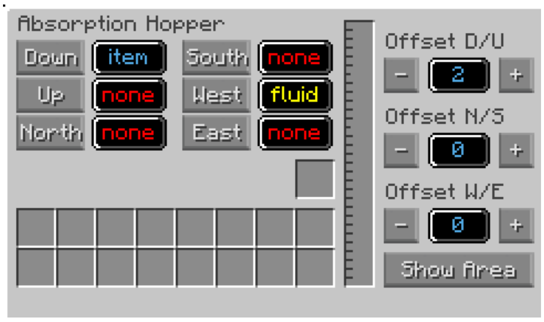
Configuration 17-10-9. Configuration for Absorption Hopper 9.



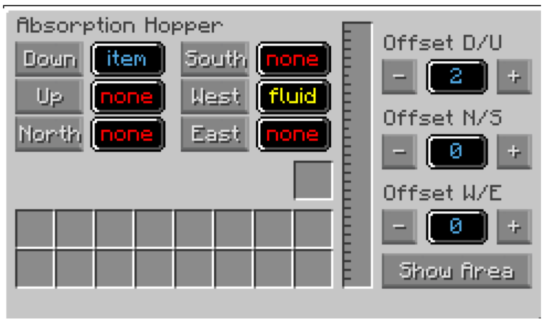
Configuration 17-10-10. Configuration for Absorption Hopper 10.



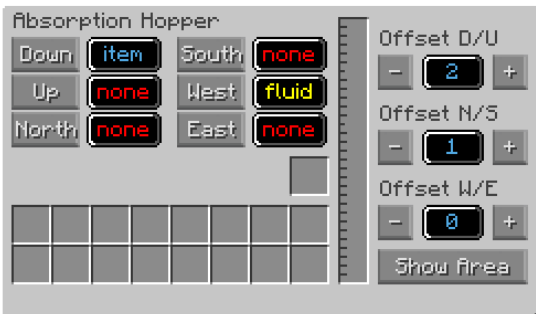
Configuration 17-10-11. Configuration for Absorption Hopper 11.



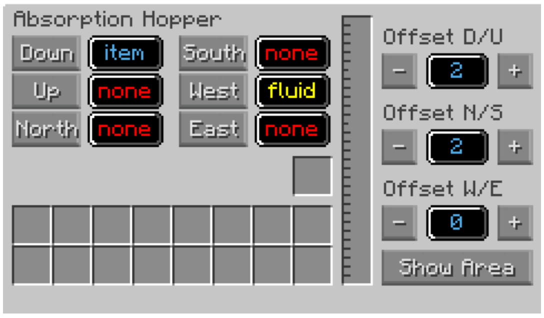
Configuration 17-10-12. Configuration for Absorption Hopper 12.



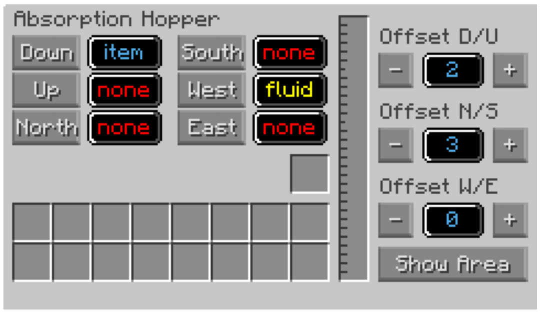
Configuration 17-10-13. Configuration for Absorption Hopper 13.



Configuration 17-10-14. Configuration for Absorption Hopper 14.



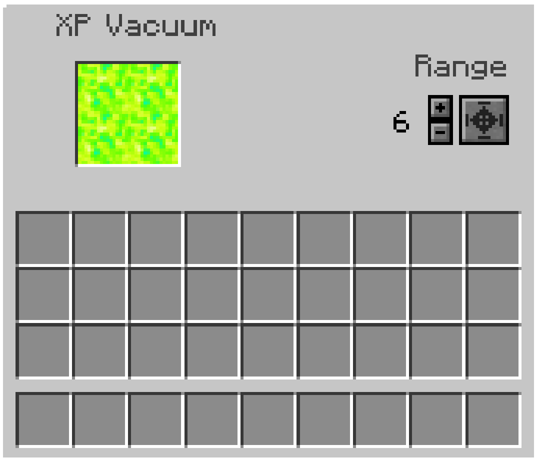
Configuration 17-10-15. Configuration for Absorption Hopper 15.



Configuration 17-10-16. Configuration for Absorption Hopper 16.

17.4.3.2. XP Vacuums

XP Vacuums are placed in-front of the Absorption Hoppers, as shown in Photograph 17-11. They are configured for maximum range, which is a radius of six (6) meters.



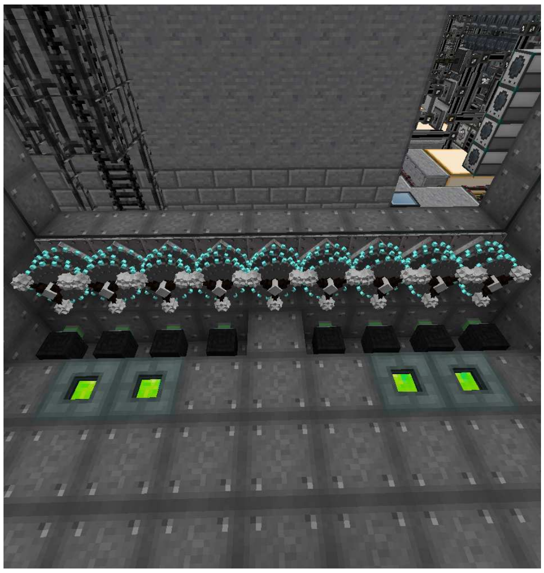
Configuration 17-11. Configuration of the XP Vacuums.

17.4.4. Mob Termination

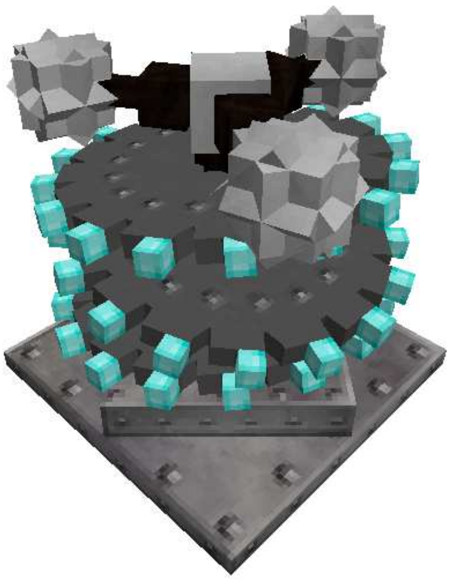
The mob farm terminates the spawned mobs using Mob Mashers. In total there are seventeen (17) Mob Mashers broken up into three (3) sets.

The first set consists of nine (9) Mob Mashers, which are located at the front of the containment structure. The second and third sets consist of four (4) Mob Mashers each, which are separated by eight (8) meters from the first Mob Masher set, as shown in Photograph 17-13-4. The second and third Mob Masher sets are positioned further into the containment structure to increase the mob termination rate. This is important as the Powered Spawners will scan the nearby area for mobs, if there are more than six (6) mobs around the Powered Spawner (by default configuration) then they will not spawn more mobs. So ideally, mobs should be terminated as fast as possible.

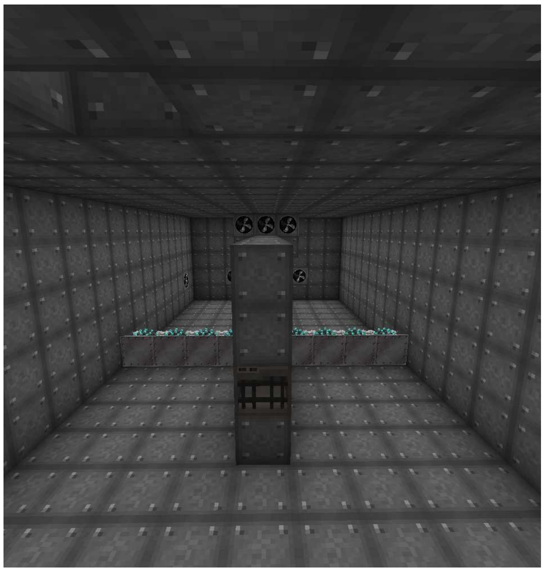
Each Mob Masher is given ten (10) Sharpness upgrades and ten (10) Looting upgrades to increase time-to-kill, and mob drops respectively. Each Mob Masher is controlled using a redstone signal provided by a Redstone Conduit.



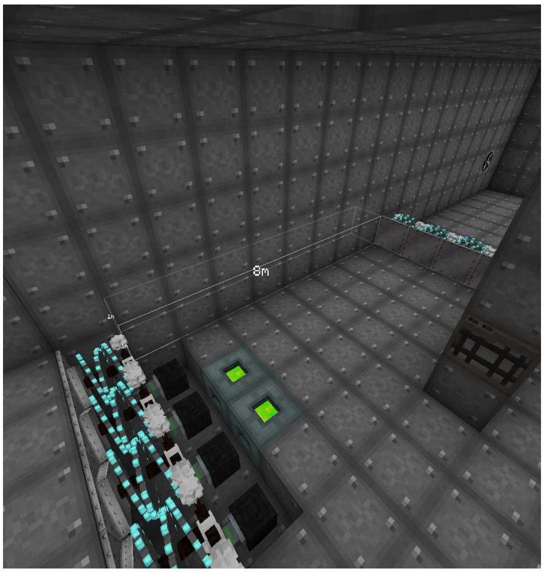
Photograph 17-13-2. The first set of Mob Mashers.



Photograph 17-13-1. In-game model of the Mob Masher.



Photograph 17-13-3. The second and third Mob Masher sets.



Photograph 17-13-4. Distance between first Mob Masher set and the second and third Mob Masher set.

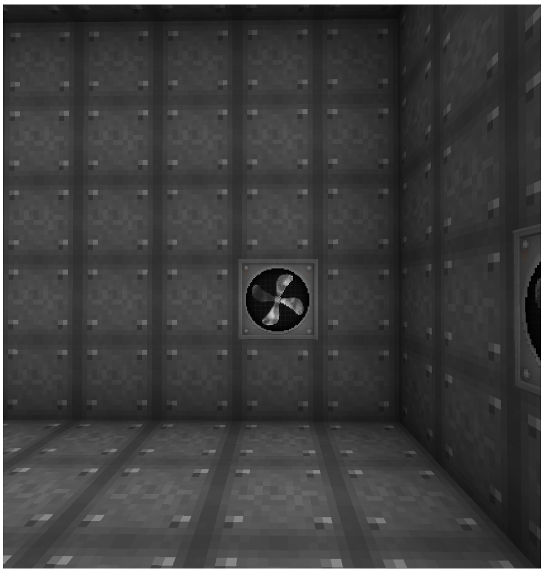
Configuration 17-12. Mob Masher upgrades. Ten (10) Sharpness upgrades (left), and ten (10) Looting upgrades (right).

17.4.5. Mob Routing

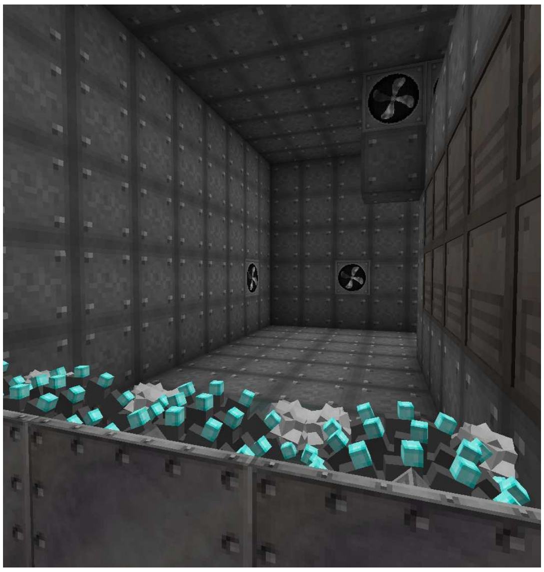
Mob Fans push the spawned mobs into the Mob Mashers. These Mob Fans are strategically placed within the containment structure to ensure the mobs do not get stuck, and that mobs are routed into the Mob Mashers efficiently. Within the containment structure there are six (6) Mob Fans with three (3) different configurations.

17.4.5.1. Mob Fan Left Wall

On the left-side of the containment structure there is a Mob Fan which makes sure mobs do not get pushed into the back of the Powered Spawners. This Mob Fan uses: two (2) Width Modifiers, one (1) Height Modifier, and one (1) Distance Modifier.



Photograph 17-14-1. Mob Fan on the left-side of the containment structure, the Mob Fan is located one (1) meter right of the back wall, and one (1) meter above the floor.

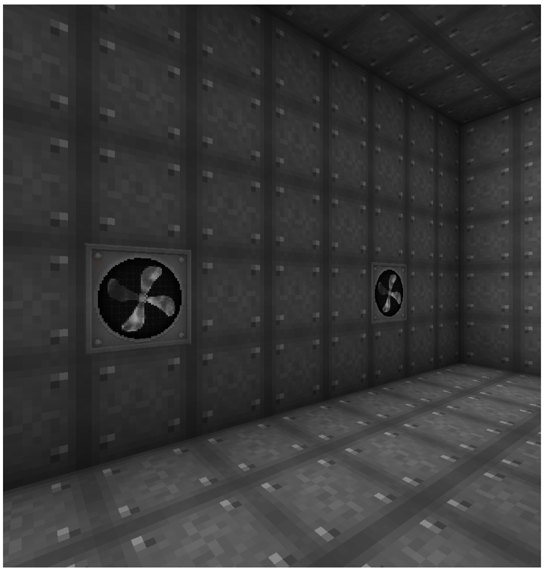


Photograph 17-14-2. Left Mob Fan from another point-of-view.

Configuration 17-13. Left Mob Fan upgrades.

17.4.5.2. Mob Fans Back Wall

There are two (2) Mob Fans on the back wall that overlap coverage areas with each other, nearly encompassing the entire interior space of the containment structure. Both Mob Fans use three (3) Width Modifiers, three (3) Height Modifiers, and ten (10) Distance Modifiers.

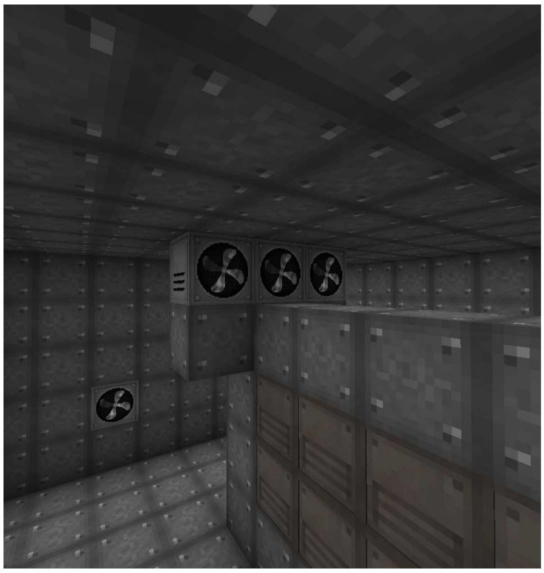


Photograph 17-15. Mob Fans on the back wall of the containment structure.

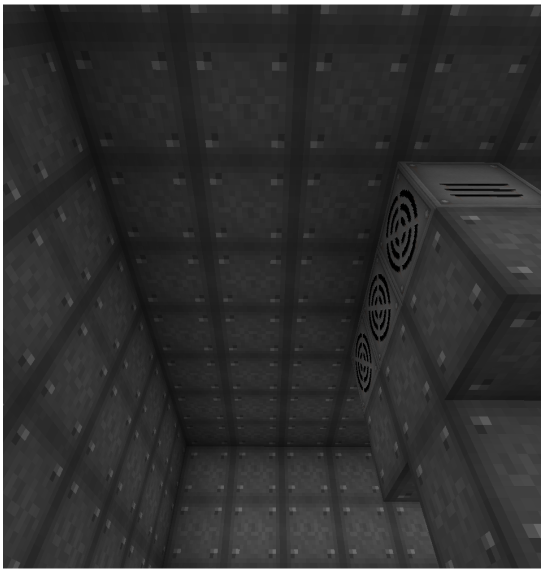
Configuration 17-14. Back wall Mob Fan upgrades.

17.4.5.3. Mob Fans Ceiling

The last set of Mob Fans are located on the ceiling of the containment structure three (3) meters from the back wall, there are three (3) Mob Fans in this set. The purpose of these three Mob Fans is to push mobs the last couple of meters that the Mob Fans on the back wall do not reach. These Mob Fans use: three (3) Width Modifiers, three (3) Height Modifiers, and nine (9) Distance Modifiers.



Photograph 17-16-1. Mob Fans on the ceiling of the containment structure.



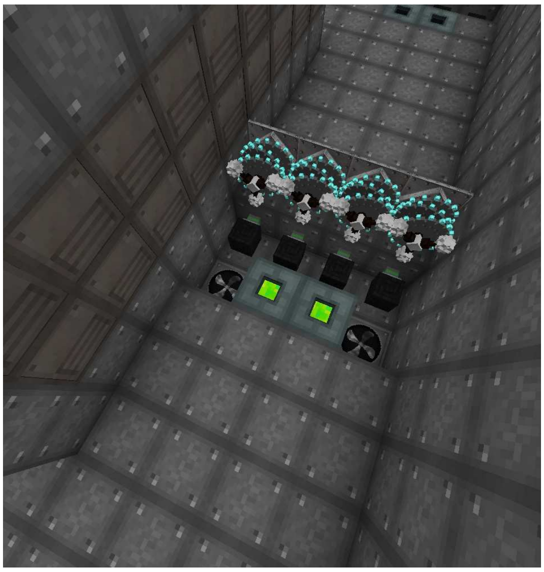
Photograph 17-16-2. Alternate view of the ceiling Mob Fans showing the distance between them and the back wall.

Configuration 17-15. Ceiling Mob Fan upgrades.

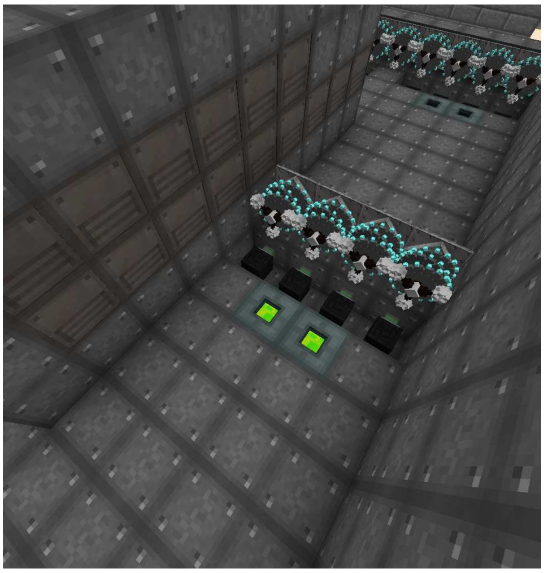
17.4.6. Mitigating Mobs from becoming Stuck within Containment Structure

When using Conduit Facades, mobs (including the player) have a tendency to phase through them. Since the containment structure uses Hardened Conduit Facades on its floor, mobs tend to become stuck. To mitigate this, Mob Fans are placed one (1) meter under the floor, which are located to either side of the XP Vacuums. These push mobs up from the Hardened Conduit Facade they have phased through. Because a block is placed directly over the Mob Fans, their range is significantly reduced, which is a 3 meter x 3 meter x 1 meter (Length X Width X Height) area. These Mob Fans use: one (1) Width Modifier, and one (1) Height Modifier.

These Mob Fans are toggled on/off by Redstone Conduits, which attach on the bottom side of the block.

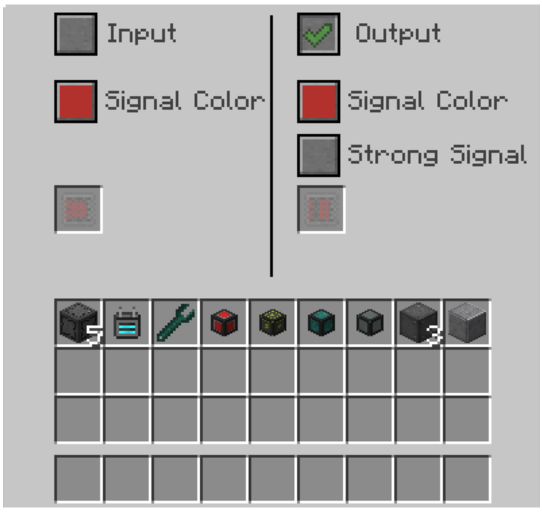


Photograph 17-17-1. Exposed view of the Mob Fans.



Photograph 17-17-2. Hidden view of the Mob Fans.

Configuration 17-16. Mob stuck mitigating Mob Fans upgrades.



Configuration 17-17. Mob stuck mitigating Mob Fans Redstone Conduit configuration.

17.4.7. Mob Death Sound Muffling

To lessen the noise created by the constant death of mobs, place a Sound Muffler (from Extra Utilities 2) underneath each of the four corners of the containment structure. This is optional.

Photograph 17-18. Sound Muffler underneath a corner of the containment structure.

17.4.8. Comment by Author

In Photograph 17-10, the physical Powered Spawners are depicted. As shown in said Photograph, only fifteen (15) Powered Spawners are present: eleven (11) Witch Powered Spawners, and four (4) Creeper Powered Spawners. While adding more than eleven (11) Witch Powered Spawners is certainly feasible, it is NOT RECOMMENDED. This is because the increased witch spawn rate will cause the Powered Spawners to idle more frequently, due to the maximum number of mobs in the area being reached.

17.5. Machinery Used

- Absorption Hopper - mob_grinding_utils
- Mob Fan - mob_grinding_utils
- Mob Masher - mob_grinding_utils
- Nullifier - Thermal Expansion
- Powered Spawner - Ender IO
- Processor - RFTools Control
- XP Vacuum - Ender IO

18. Redstone and Gunpowder

The fifteenth stage of the production process involves producing Redstone and Gunpowder. The following is an outline of the production process:

1 Mobs are spawned and terminated within the mod farm containment structure.

2. Mob drops are collected by the mob farm subsystems, unwanted material is inserted into a Nullifier or if the buffer chest designated for a specific wanted material is full, that material will too be inserted into the Nullifier.
3. Wanted material, Redstone/Gunpowder is inserted into their appropriate buffer chests.
4. Redstone/Gunpowder within their respective buffer chests are imported and stored within the AE production network.
5. If Redstone within the production network falls below one-thousand twenty four (1024), then emit a Redstone signal using a ME Level Emitter. A Redstone Conduit is attached to this ME Level Emitter which takes the redstone signal as input on the 'red' redstone channel.

Redstone/Gunpowder is used in the following production stage(s):

- Rocket Fuel

The following machinery is used during this production stage:

- Refer to Section 17.5.

18.1. Description

During this stage of production, Redstone/Gunpowder is collected from a mob farm. This is the main supplier of Redstone/Gunpowder for the Rocket Fuel production stage. It is capable of meeting the Rocket Fuel production stage's supply demand of Gunpowder with four (4) Creeper Powered Spawners. Together with the Redstone-Growing production stage and this stage's eleven (11) Witch Powered Spawners, the production capacity of Redstone is sufficient to reach the supply demand of Redstone for the Rocket Fuel production stage.

If this stage cannot meet the supply demand of Redstone, then a Redstone signal will be emitted using a ME Level Emitter, as described in step 5 of the production process above.

18.2. Flow Charts

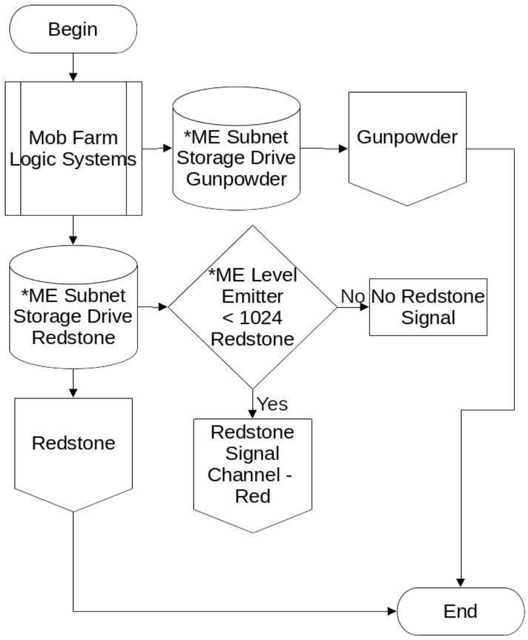
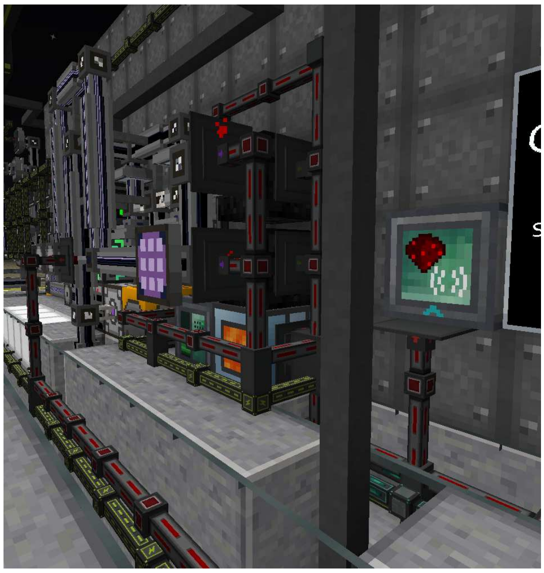
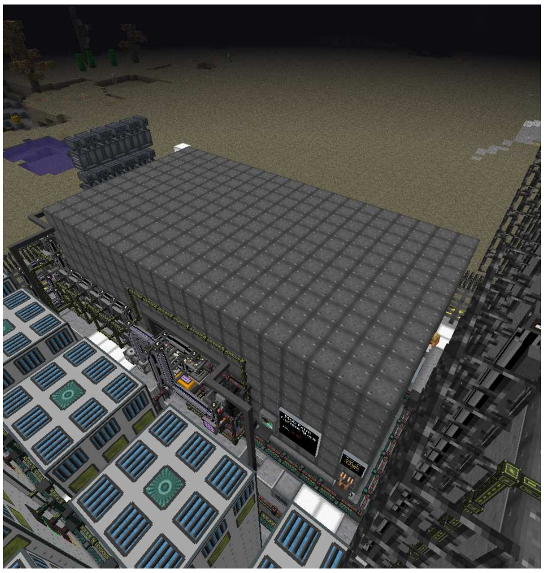


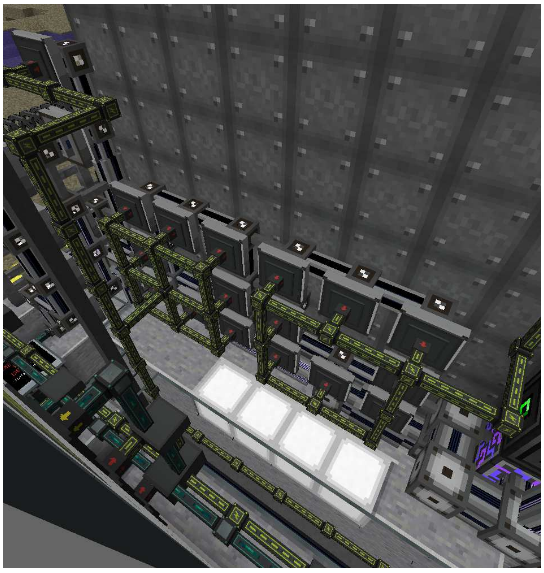
Figure 18-1. Redstone and Gunpowder Production Diagram.

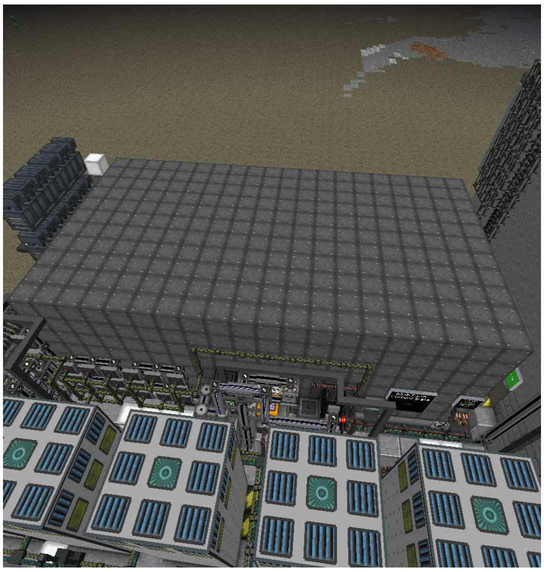
18.3. Setup Photos



Photograph 18-1-1. Redstone and Gunpowder production systems, ground view.


Photograph 18-1-2. Redstone and Gunpowder production systems, aerial view.


Photograph 18-1-4. Power Input/Output buses; FE-configured P2P Tunnels.

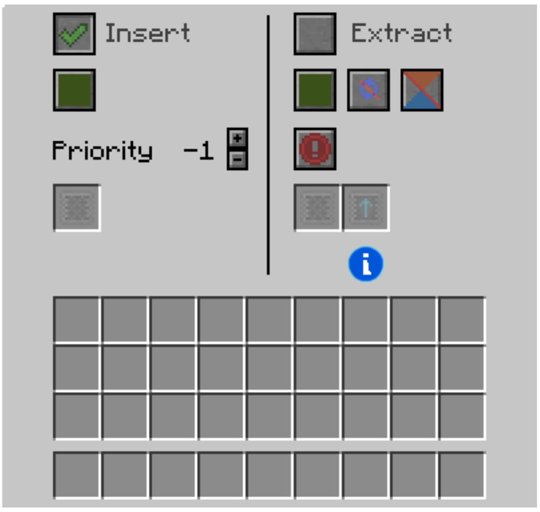

Photograph 18-1-3. Redstone and Gunpowder production systems, alternate aerial view.

Photograph 18-2. Redstone buffer chest (top), and Gunpowder buffer chest (bottom).

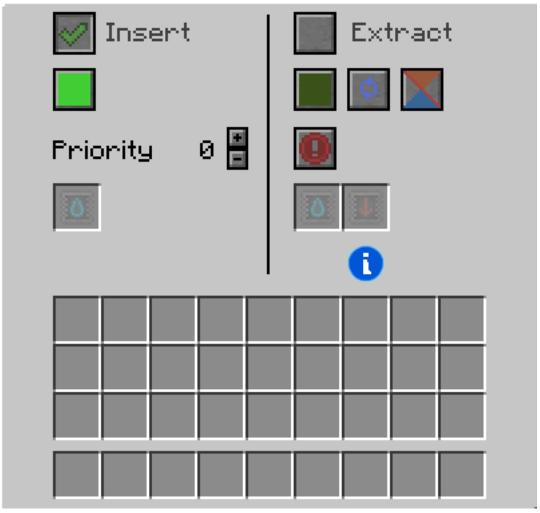
Photograph 18-3. Redstone product export systems (left), and Gunpowder product export systems (right).

Configuration 18-1-1. Nullifier Redstone Control configuration.

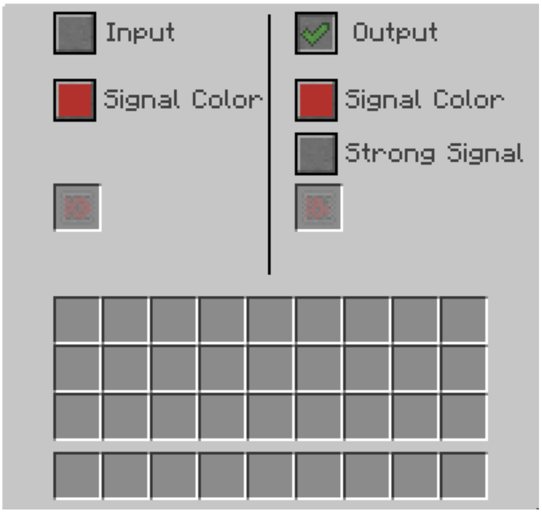
Configuration 18-1-2. Nullifier Input/Output side configuration.



Configuration 18-1-3. Item Conduit configuration for Nullifier.

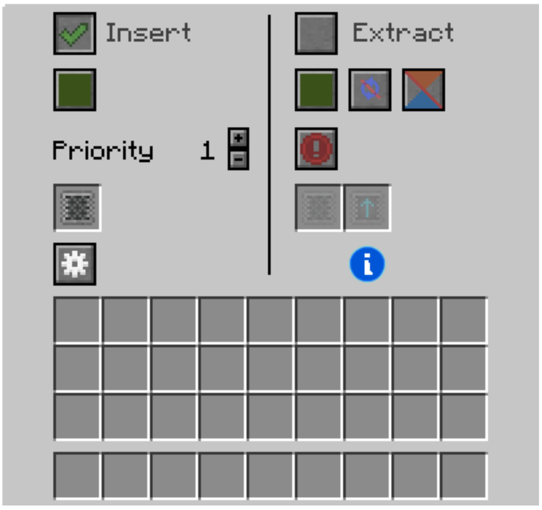


Configuration 18-1-4. Fluid Conduit configuration for Nullifier.

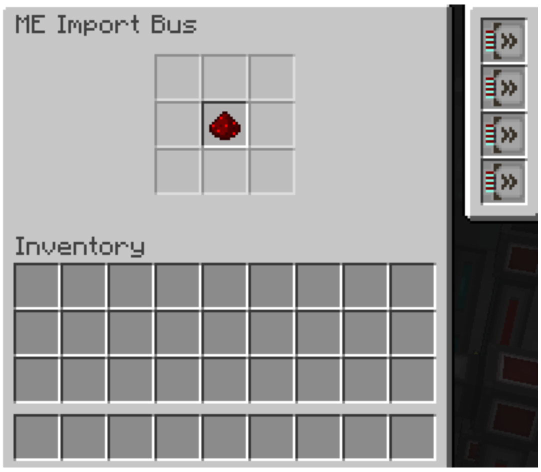


Configuration 18-1-5. Redstone Conduit configuration for Nullifier.

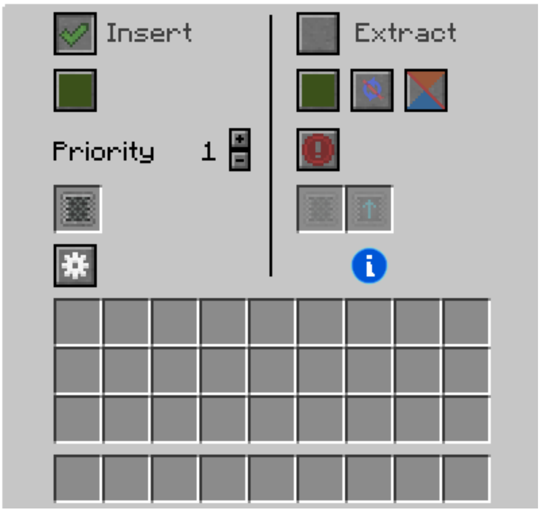
Configuration 18-2-2. Item Conduit insert filter configuration for Redstone buffer chest.



Configuration 18-2-1. Item Conduit configuration for Redstone buffer chest.

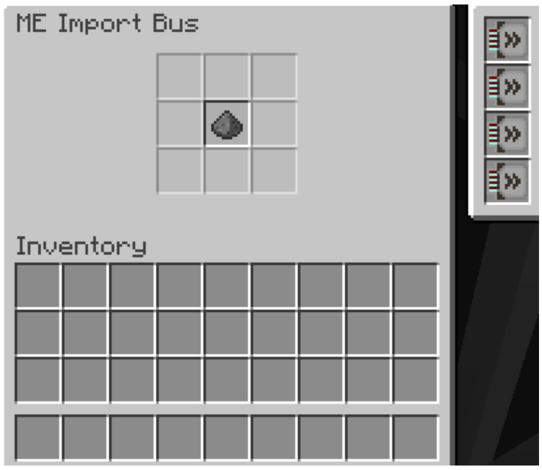


Configuration 18-2-3. ME Import Bus configuration for Redstone buffer chest.

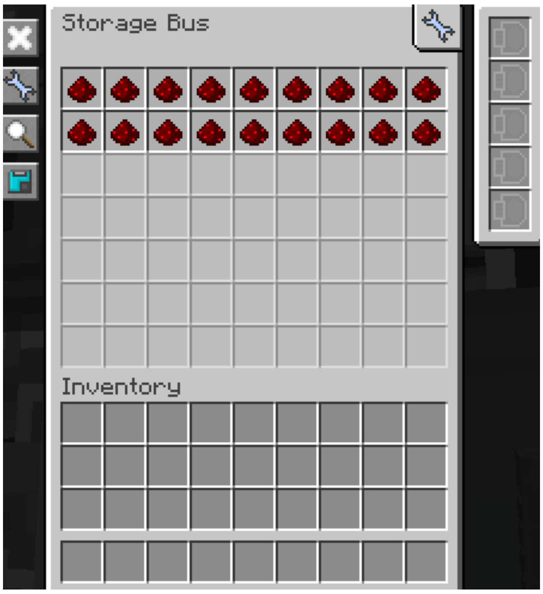


Configuration 18-3-1. Item Conduit configuration for Gunpowder buffer chest.

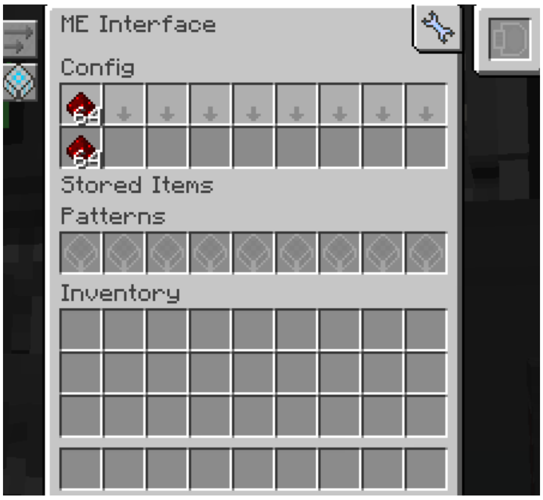
Configuration 18-3-2. Item Conduit insert filter configuration for Gunpowder buffer chest.



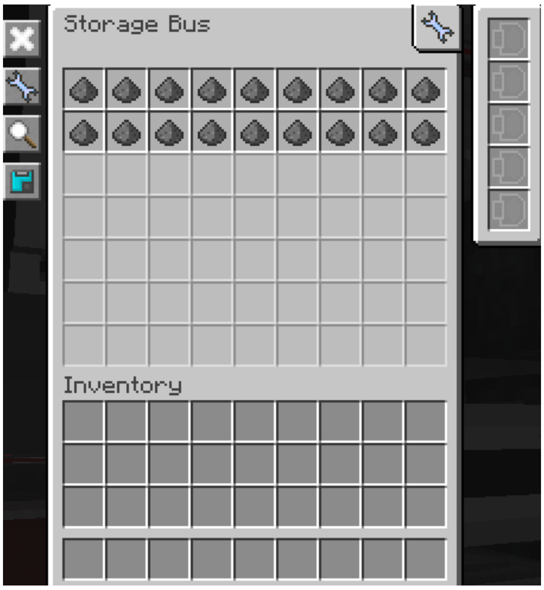
Configuration 18-3-3. ME Import Bus configuration for Gunpowder buffer chest.



Configuration 18-4-1. Product - Redstone - ME Storage Bus



Configuration 18-4-2. Product - Redstone - ME Interface



Configuration 18-5-1. Product - Gunpowder - ME Storage Bus

Configuration 18-5-2. Product - Gunpowder - ME Interface

19. Hootch

The sixteenth stage of the production process involves producing Hootch (alcohol). The following is an outline of the production process:

1 Enhanced Vats take Sugar, Potatoes, and Water to produce Hootch.

2 Hootch is then inserted into the Hootch buffer chest.

3 Hootch within the Hootch buffer chest is imported and stored in the AE production network.

Hootch is used in the following production stage(s):

- Rocket Fuel

The following machinery is used during this production process:

- The Enhanced Vat - Ender IO

19.1. Description

This production stage creates one of three primary components for the production of Rocket Fuel. The amount of Hootch-producing Enhanced Vats MUST be greater-than or equal to the amount of Rocket Fuel-producing Enhanced Vats. As the rate of production for both are the same. Additionally, Hootch-producing Enhanced Vats SHOULD use Octadic Capacitors when possible. The same type of capacitors MUST be used in the Rocket Fuel-producing Enhanced Vats.

19.2. Flow Charts

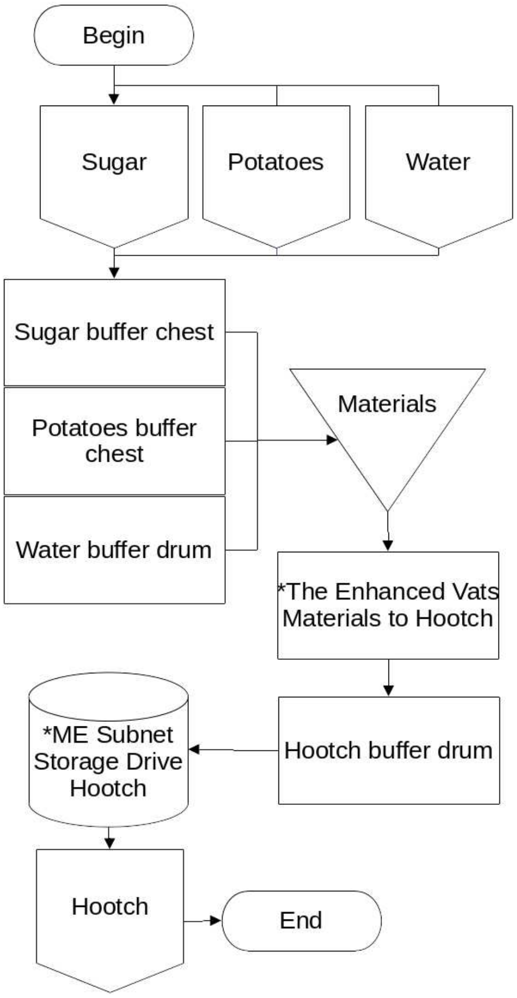
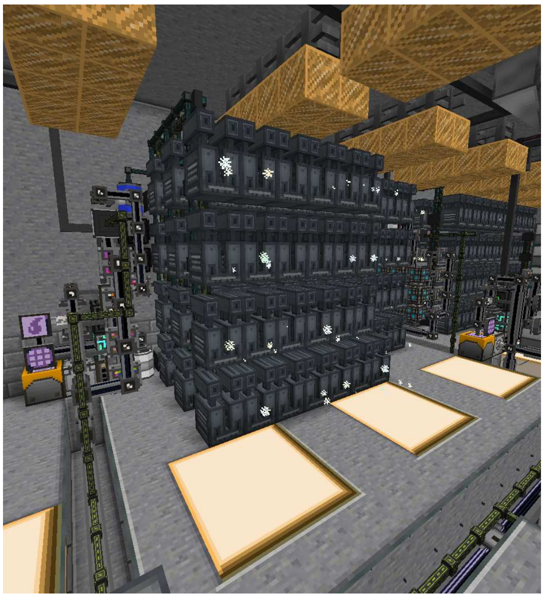
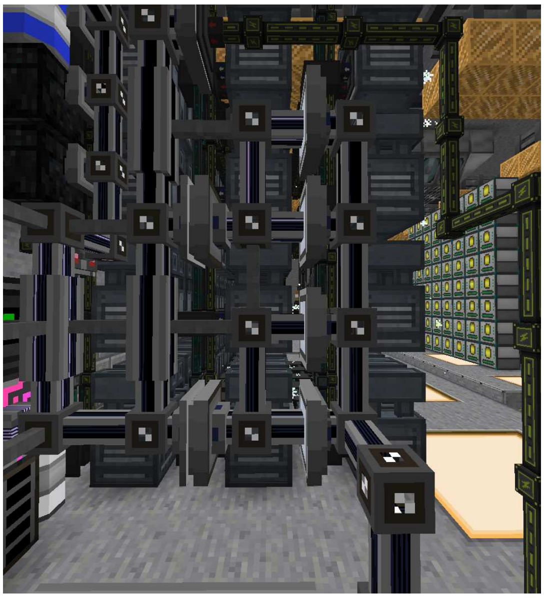


Figure 19-1. Hootch Production Diagram.

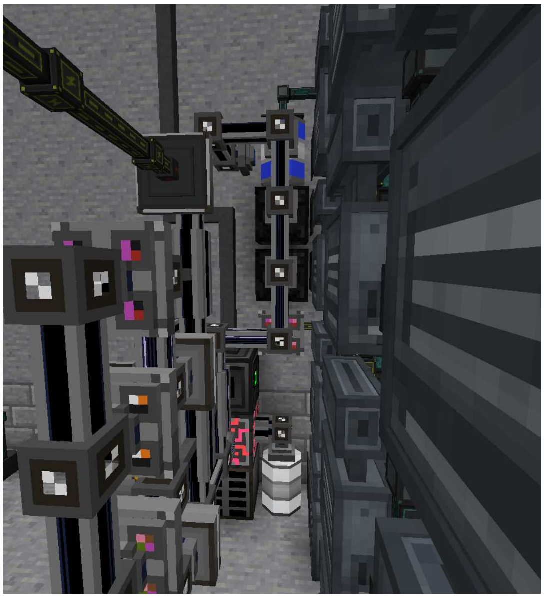
19.3. Setup Photos



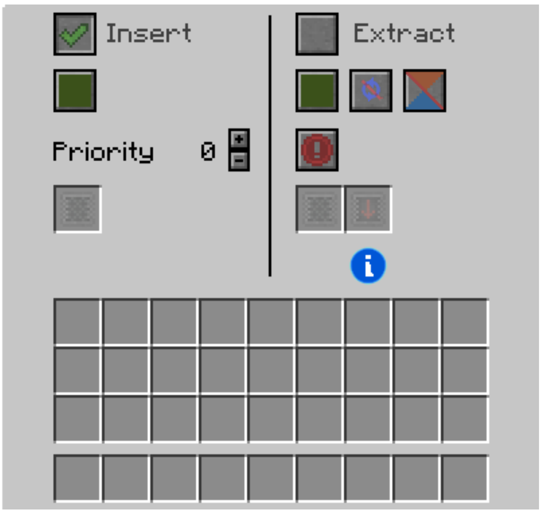
Photograph 19-1. Hootch production systems



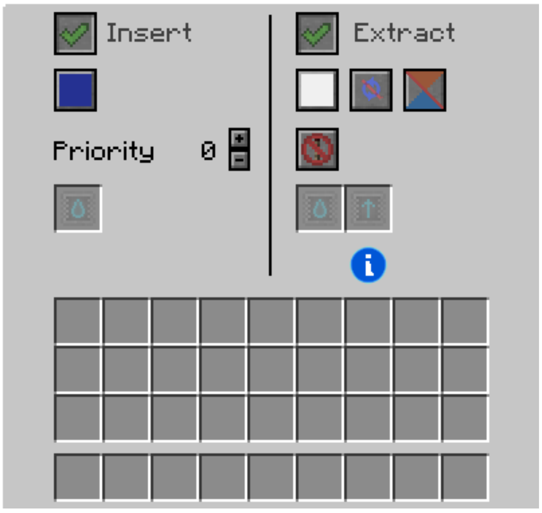
Photograph 19-2. Resource Provision Systems; The first two P2P Tunnels starting from the top provide Water, the third P2P Tunnel from the top provides Potatoes, the fourth P2P Tunnel from the top provides Sugar.



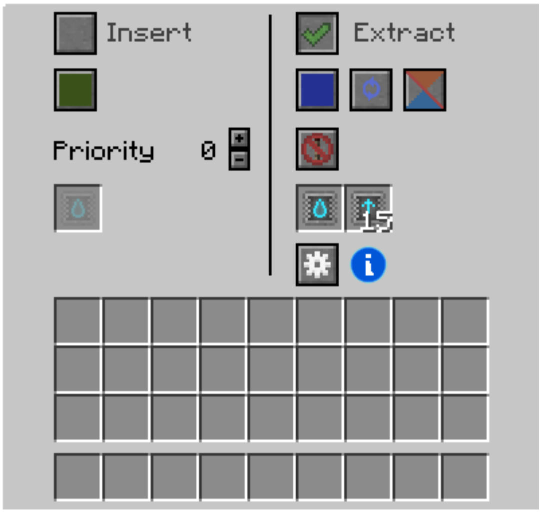
Photograph 19-3. Water buffer drum (top), Potatoes buffer chest (second from top), Sugar (third from top), Hootch buffer drum (fourth from top).



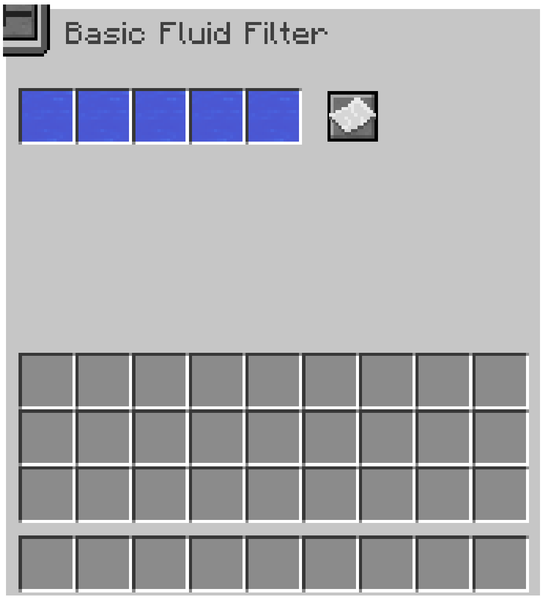
Configuration 19-1-1. Item Conduit configuration for The Enhanced Vats.



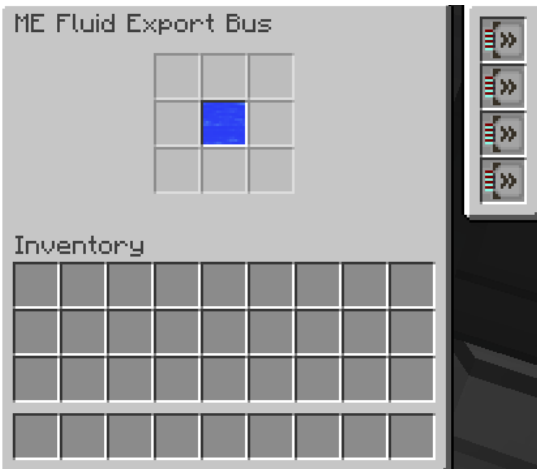
Configuration 19-1-2. Fluid Conduit configuration for The Enhanced Vats.



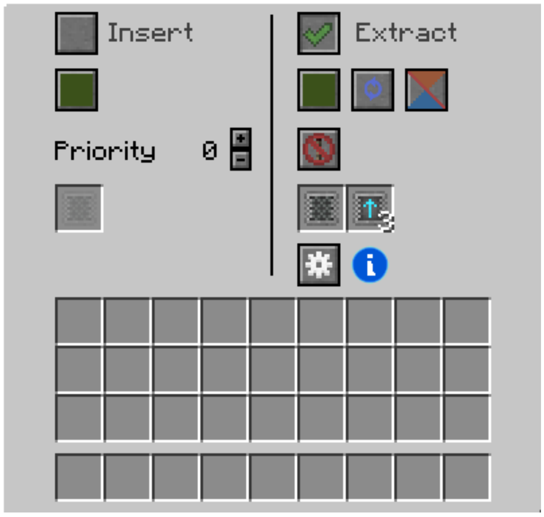
Configuration 19-2-1. Fluid Conduit configuration for Water buffer drum.



Configuration 19-2-2. Fluid Conduit extract filter configuration for Water buffer drum.



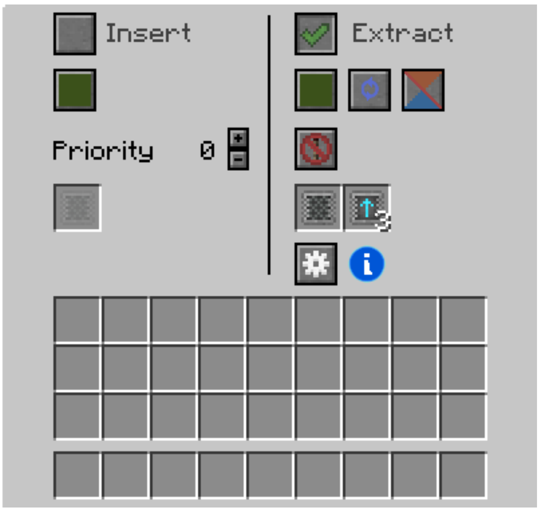
Configuration 19-2-3. ME Fluid Export Bus configuration for Water buffer drum.



Configuration 19-3-1. Item Conduit configuration for Potatoes buffer chest.

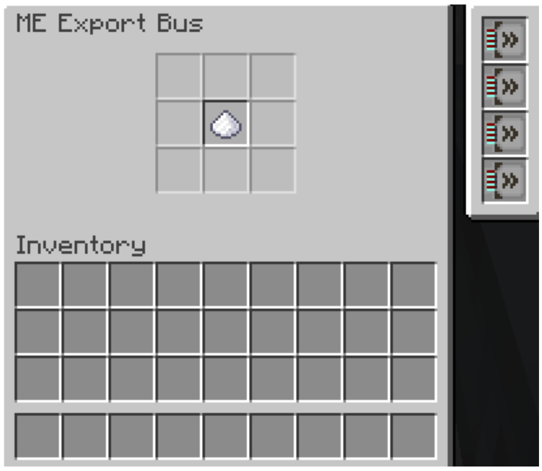
Configuration 19-3-2. Item Conduit extract filter configuration for Potatoes buffer chest.

Configuration 19-3-3. ME Export Bus configuration for Potatoes buffer chest.

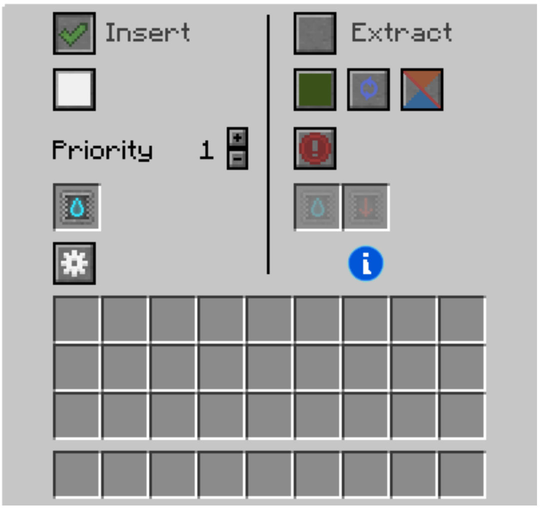


Configuration 19-4-1. Item Conduit configuration for Sugar buffer chest.

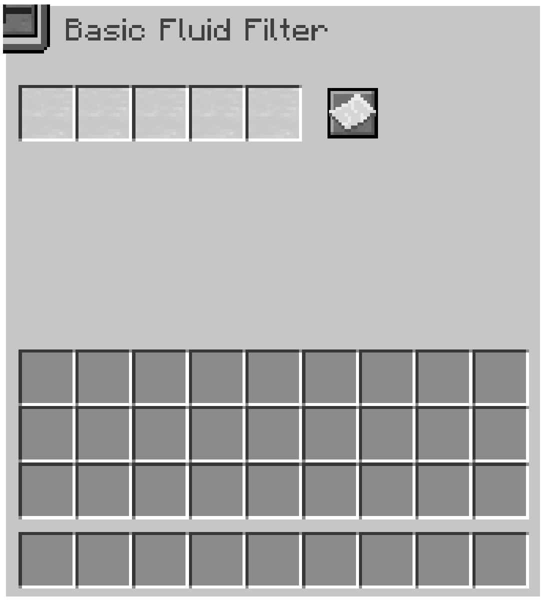
Configuration 19-4-2. Item Conduit extract filter configuration for Sugar buffer chest.



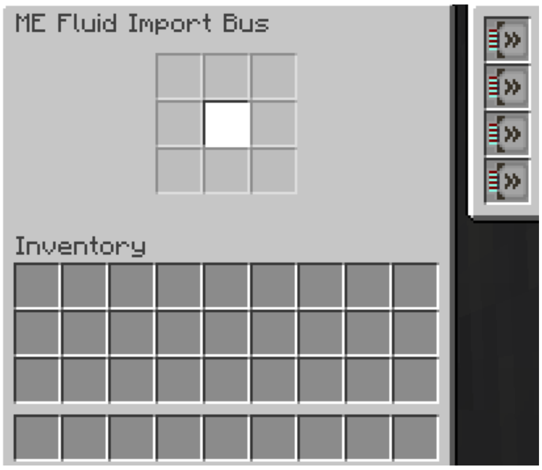
Configuration 19-4-3. ME Export Bus configuration for Sugar buffer chest.



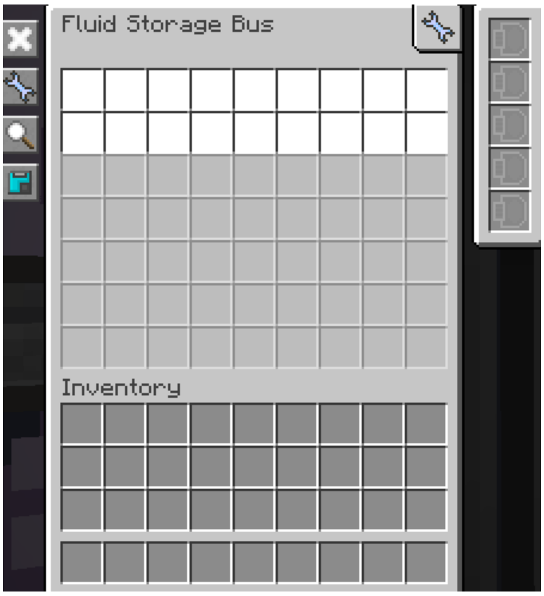
Configuration 19-5-1. Fluid Conduit configuration for Hootch buffer drum.



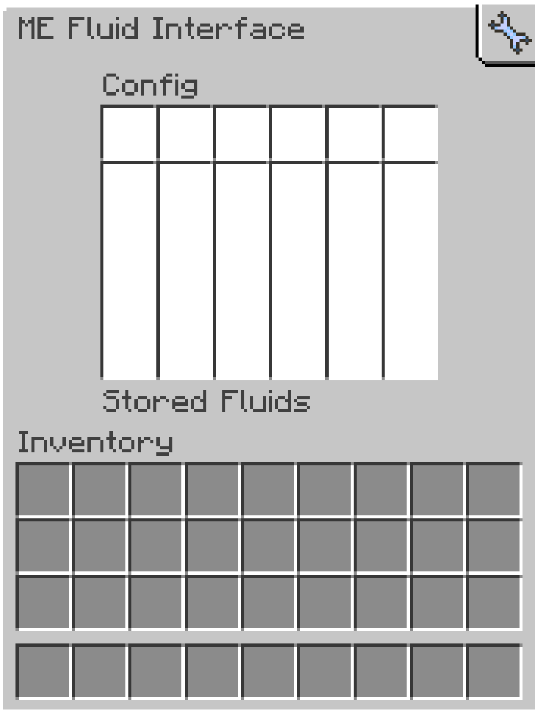
Configuration 19-5-2. Fluid Conduit insert filter configuration for Hootch buffer drum.



Configuration 19-5-3. ME Fluid Import Bus configuration for Hootch buffer drum.



Configuration 19-6-1. Product - Hootch - ME Fluid Storage Bus



Configuration 19-6-2. Product - Hootch - ME Fluid Interface

20. Rocket Fuel

The seventeenth (and last) stage of the production process involves producing Rocket Fuel. The following is an outline of the production process:

1 Enhanced Vats take Redstone, Gunpowder, and Hootch to produce Rocket Fuel.

2 Rocket Fuel is then inserted into the Rocket Fuel buffer drum.

3 Rocket Fuel within the Rocket Fuel buffer drum is imported and stored within the AE production network.

4 During operation, the Rocket Fuel Production Vats PLC can disable half of the Rocket Fuel production vats if the amount of Redstone in the: Redstone and Gunpowder, and Redstone-Growing production stages both fall below one-thousand twenty four (1024).

Rocket Fuel is used in the following production stage(s):

- None, end of production process.

The following machinery is used during this production stage:

- Processor - RFTools Control
- The Enhanced Vat - Ender IO

20.1. Description

This production stage takes Redstone, Gunpowder, and Hootch to produce Rocket Fuel. The Enhanced Vats in this stage MUST use the same capacitors used in the Hootch Enhanced Vats from the previous stage. Unlike previous stages, this stage uses a Quantum Network Bridge (QNB) to share Rocket Fuel with an off-site location, see Section 21.

20.1.1. Rocket Fuel Production Vats PLC

The Rocket Fuel production stage uses a Processor to toggle on/off half of the Rocket Fuel production vats using a redstone signal provided on the white redstone channel. This redstone signal is transferred using Redstone Conduits, as shown in Photograph 20-6-2. The processor takes redstone signals from the: Redstone and Gunpowder (Red redstone channel), and Redstone-Growing (Green redstone channel) production stages, as shown in Photograph 20-5-1 and Photograph 20-5-2 respectively. A Redstone Conduit, equipped with a Redstone AND Filter connects to the processor, and will output a redstone signal on the white redstone channel, as shown in Photograph 20-6-1. Because of the Redstone AND Filter, both the Red and Green redstone channels are required to be active for a redstone signal to be outputted to the Processor. Since a Redstone AND Filter is used, the redstone signal to the Processor will stop being emitted when one of the previously mentioned production stages stops supplying their respective redstone signal. When this occurs the Processor will wait 1200 ticks (1 minute) before re-enabling half of the Rocket Fuel production vats. The Processor uses the following components: CPU Core B500 (x1).

This system is used because it is possible that at some point during operation the: Redstone and Gunpowder, and Redstone-Growing production stages will not have enough Redstone to continue production, which would put them into the STALL Operation State. To prevent this, half of the Rocket Fuel production vats are disabled so both the aforementioned production stages have a chance to produce Redstone without a net-loss. While half of the Rocket Fuel production vats are disabled, the Rocket Fuel production stage is put into the REDUCED Operation State.

20.2. Operating State Advisory

What follows is a list of one or more Operation States that modify this production system's physical/logical behavior, along with the specific systems modified:

- REDUCED - When this production system is put into this state: half of the Rocket Fuel production vats are disabled via a redstone signal.

20.3. Flow Charts

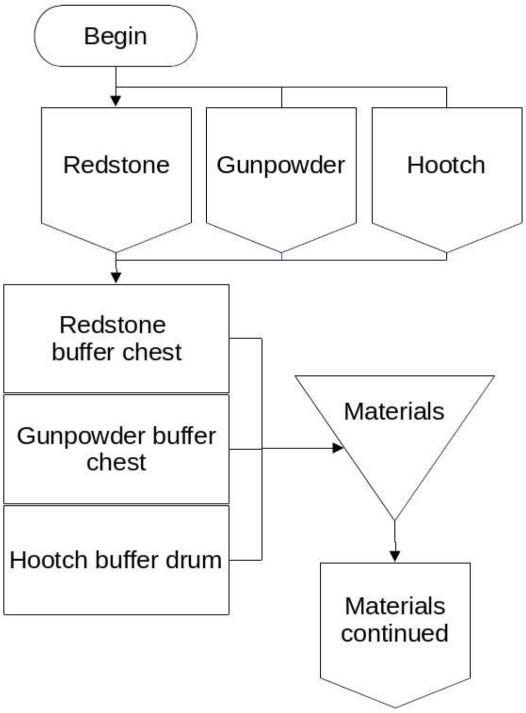


Figure 20-1-1. Rocket Fuel Production Diagram

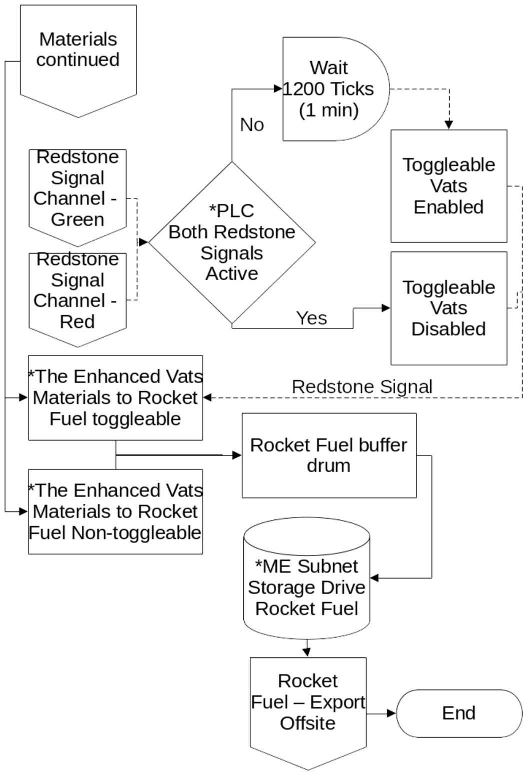


Figure 20-1-2. Rocket Fuel Production Diagram continued

20.4. Setup Photos

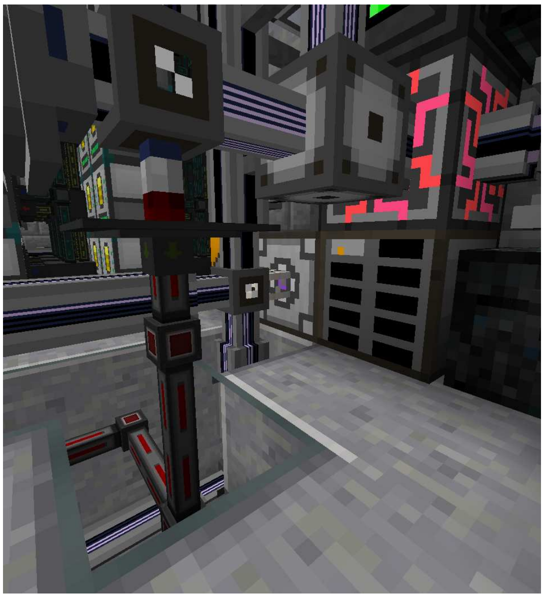
Photograph 20-1. Rocket Fuel production systems

Photograph 20-2. Resource Provision Systems; P2P Tunnel (top) provides Hootch, P2P Tunnel (second from top) provides Gunpowder, the last two P2P Tunnels provide Redstone.

Photograph 20-3. Hootch buffer drum (top), Redstone buffer chest (second from top), Gunpowder buffer chest (third from top), Rocket Fuel buffer drum (fourth from top).

Photograph 20-4. The Processor (bottom) and Dimensional Transceiver (top).

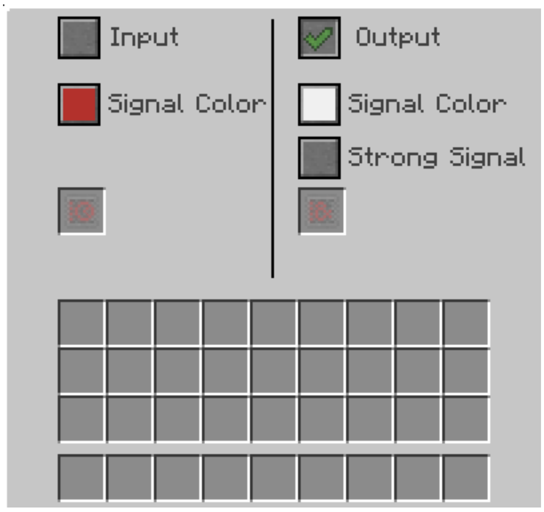
Photograph 20-5-1. Red redstone channel and ME Level Emitter on the Redstone and Gunpowder production stage.



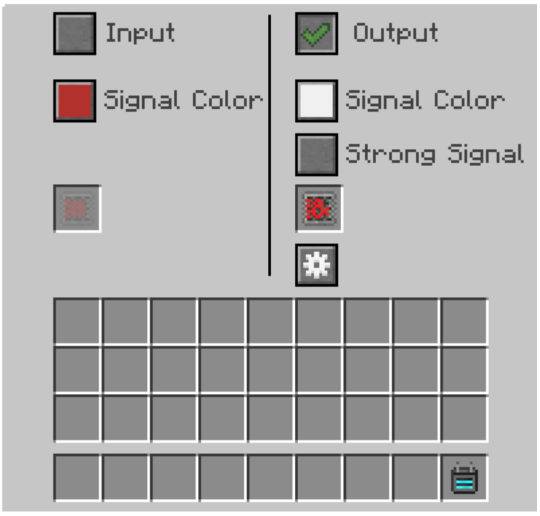
Photograph 20-5-2. Green redstone channel and ME Level Emitter on the Redstone-Growing production stage.

Photograph 20-6-1. A Redstone Conduit using a Redstone AND Filter, is configured to output a redstone signal on the white redstone channel to the Processor if both the Red and Green redstone channels are active.

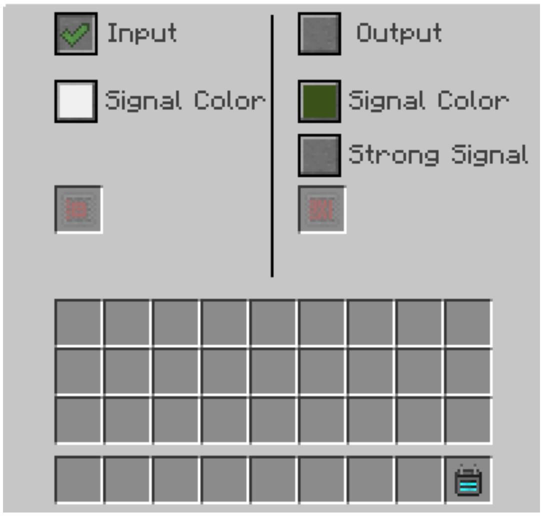
Photograph 20-6-2. A Redstone Conduit coming from the Processor transports a redstone signal on the white redstone channel to half of the Rocket Fuel production vats.



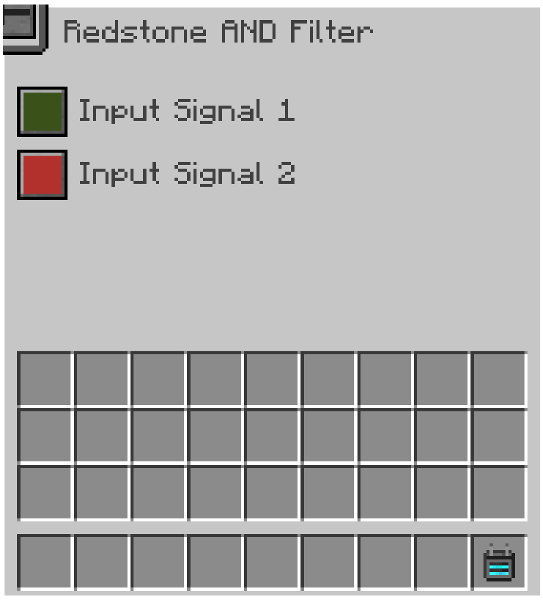
Configuration 20-1-1. Redstone Conduit configuration for The Enhanced Vats.



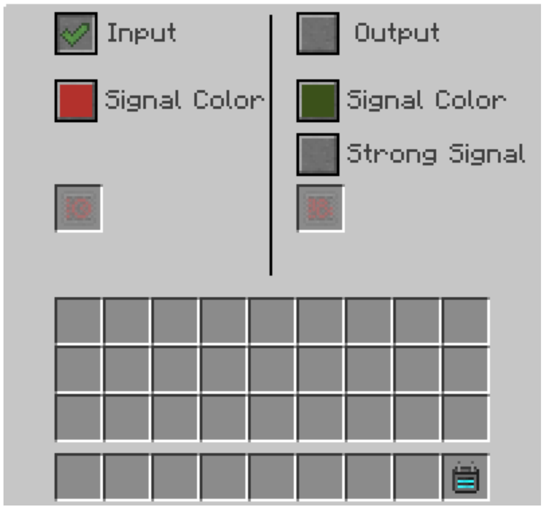
Configuration 20-1-2. Redstone Conduit output configuration for the Processor.



Configuration 20-1-3. Redstone Conduit input configuration for the Processor.

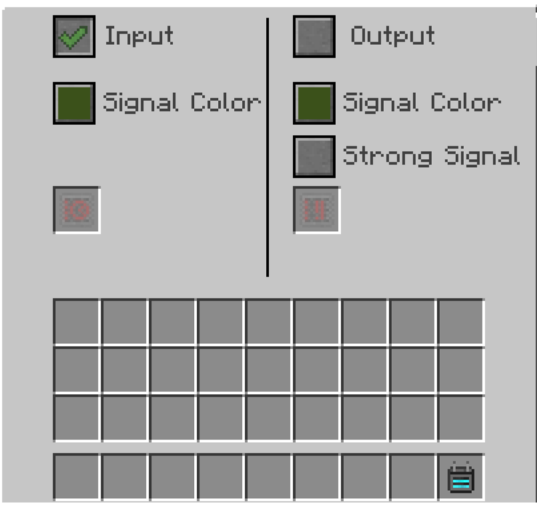


Configuration 20-1-4. Redstone Conduit Redstone AND Filter configuration for the Processor.



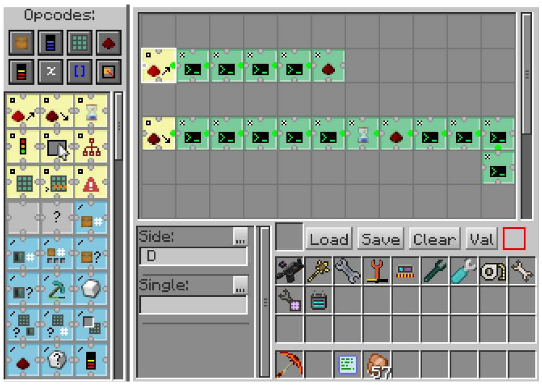
Configuration 20-1-5. Red redstone channel - Redstone Conduit configuration.

Configuration 20-1-6. Red redstone channel - ME Level Emitter configuration.

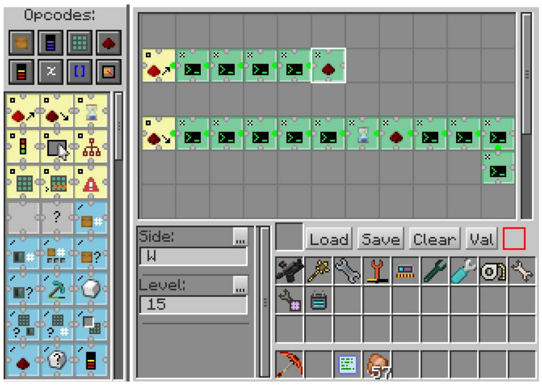


Configuration 20-1-7. Green redstone channel - Redstone Conduit configuration.

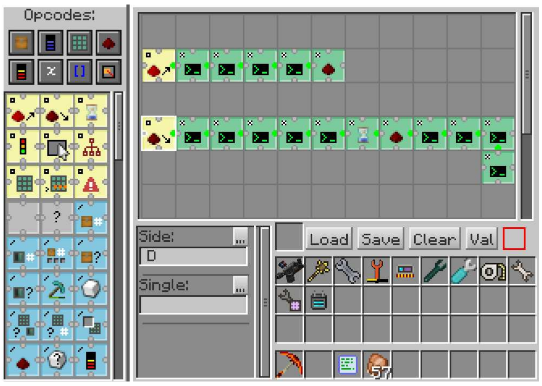
Configuration 20-1-8. Green redstone channel - ME Level Emitter configuration.



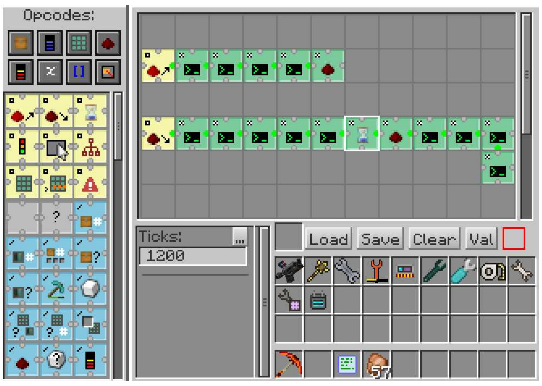
Configuration 20-2-1. Event: redstone on, trigger event when a redstone signal is applied to the bottom of the Processor.



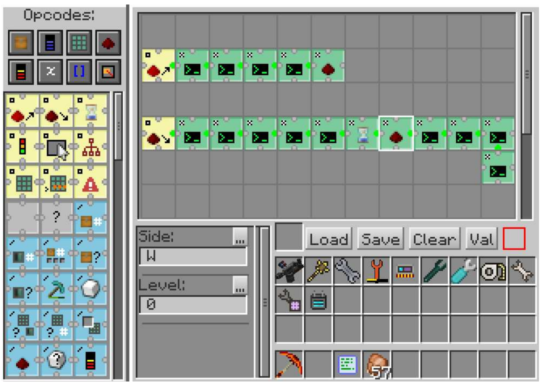
Configuration 20-2-2. Operation: set redstone, redstone signal output to ’15’ on West side.



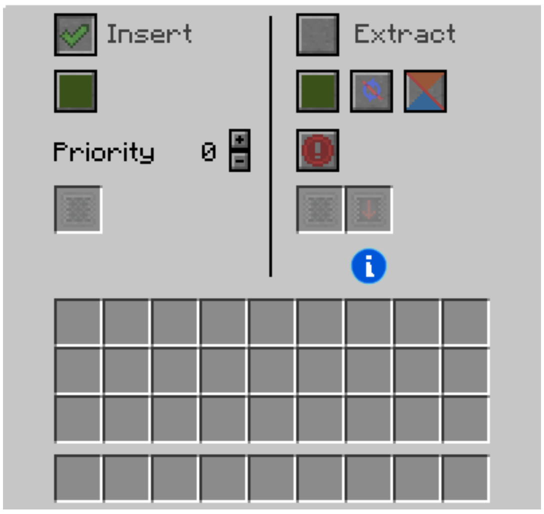
Configuration 20-2-3. Event: redstone off, trigger event when a redstone signal is unapplied to the bottom of the Processor.



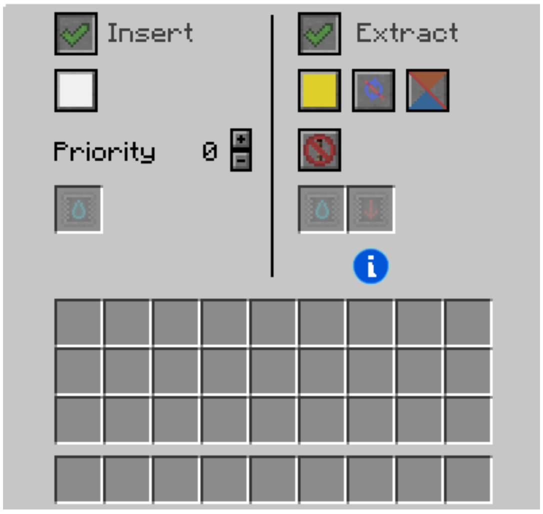
Configuration 20-2-4. Operation: wait, configured for 1200 ticks (1 minute).



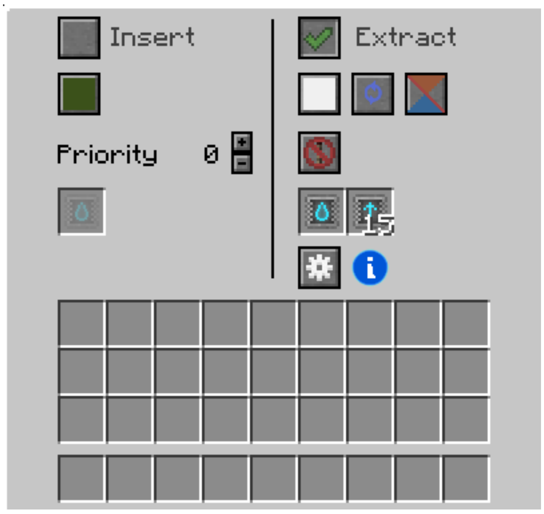
Configuration 20-2-5. Operation: set redstone, redstone signal output to ’0’ on West side.



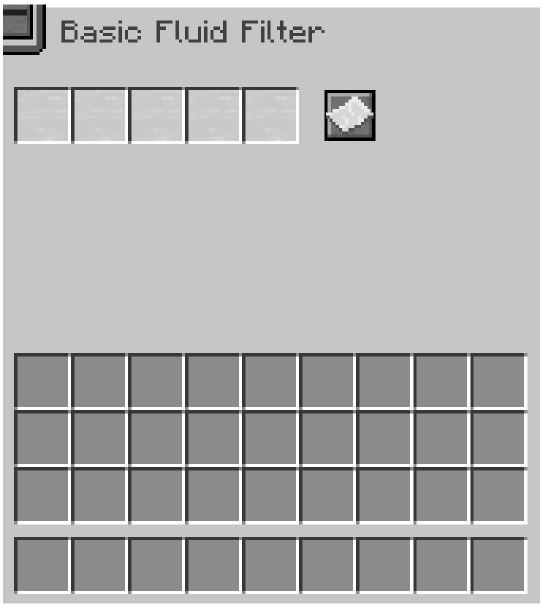
Configuration 20-3-1. Item Conduit configuration for The Enhanced Vats.



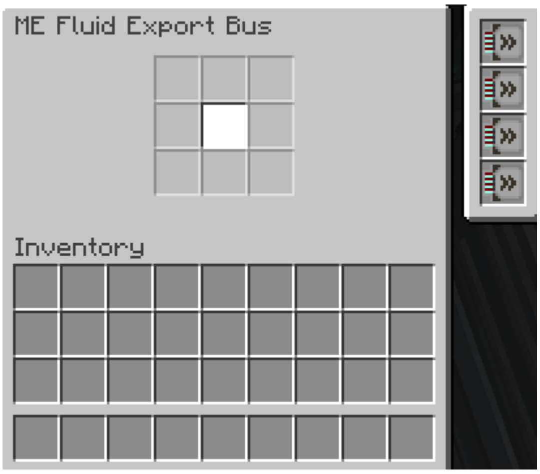
Configuration 20-3-2. Fluid Conduit configuration for The Enhanced Vats.



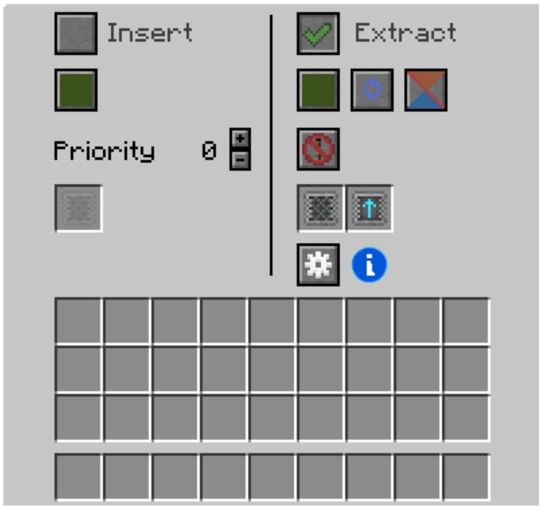
Configuration 20-4-1. Fluid Conduit configuration for Hootch buffer drum.



Configuration 20-4-2. Fluid Conduit extract filter configuration for Hootch buffer drum.

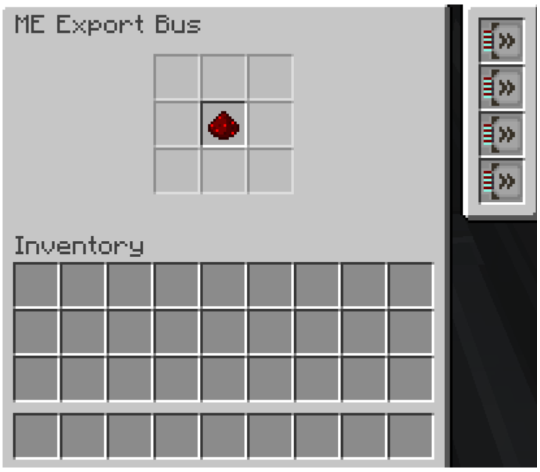


Configuration 20-4-3. ME Fluid Export Bus configuration for Hootch buffer drum.

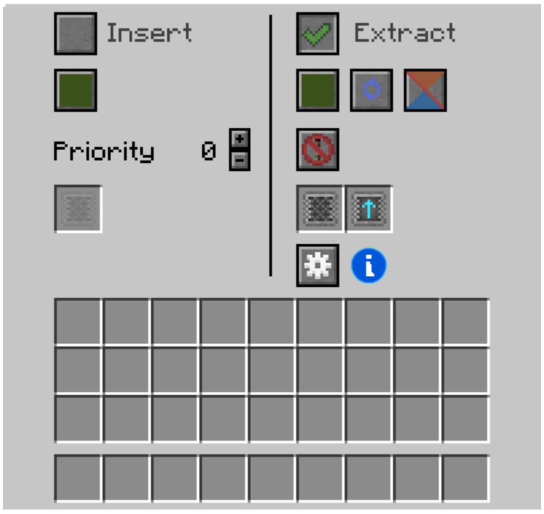


Configuration 20-5-1. Item Conduit configuration for Redstone buffer chest.

Configuration 20-5-2. Item Conduit extract filter configuration for Redstone buffer chest.

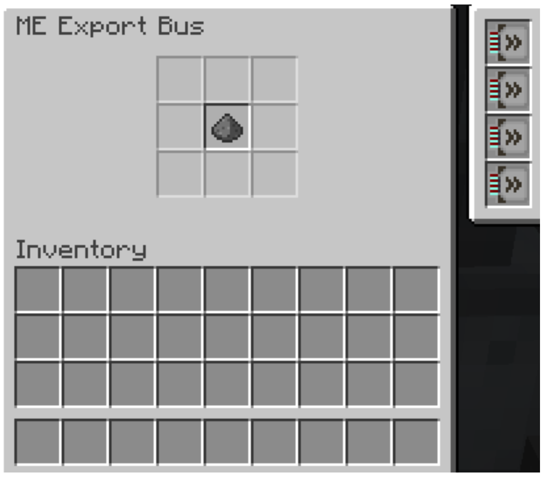


Configuration 20-5-3. ME Export Bus configuration for Redstone buffer chest.

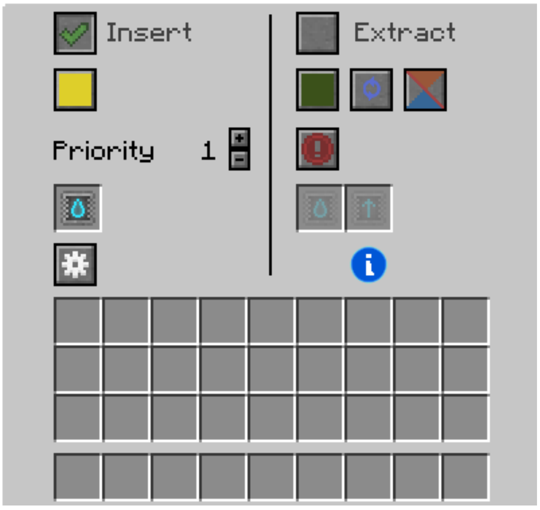


Configuration 20-6-1. Item Conduit configuration for Gunpowder buffer chest.

Configuration 20-6-2. Item Conduit extract filter configuration for Gunpowder buffer chest.

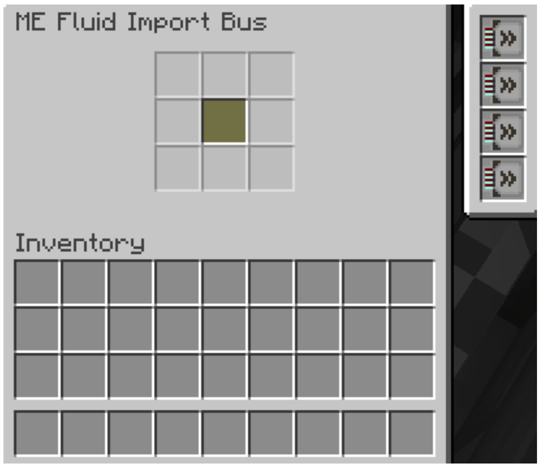


Configuration 20-6-3. ME Export Bus configuration for Gunpowder buffer chest.



Configuration 20-7-1. Fluid Conduit configuration for Rocket Fuel buffer drum.

Configuration 20-7-2. Fluid Conduit insert filter configuration for Rocket Fuel buffer drum.



Configuration 20-7-3. ME Fluid Import Bus configuration for Rocket Fuel buffer drum.

21. Exporting Rocket Fuel Off-Site

To export Rocket Fuel off-site, a dedicated Applied Energistics network is used (hereafter referred to as the ’export network’). The export network is divided into two (2) parts, an on-site portion and an off-site portion. The on-site portion is a subnetwork of the Rocket Fuel production network. The off-site portion is then connected to the on-site portion using a Quantum Network Bridge (QNB).

21.1. On-Site Export Network Setup Requirements

The on-site export network MUST have functionally the same logical configuration as shown in Figure 21-1. The on-site export network SHOULD have the identical physical configuration as shown in Photograph 21-1-1 and Photograph 21-1-2, deviation from the physical configuration is acceptable as long as the logical configuration remains consistent with what is shown in Figure 21-1. Additionally, the Rocket Fuel production network and export network MUST be separated from each other using Cable Anchors. Cable Anchors MUST be present at any and every point where the two aforementioned networks can connect to one another, see Photograph 21-1-1 and Photograph 21-1-2.

In order to isolate the on-site export network from the Rocket Fuel production network: the Rocket Fuel production network provides an ME Fluid Interface, then the export network attaches its ME Fluid Storage Bus to the Rocket Fuel production network’s ME Fluid Interface. In this configuration, both networks are now isolated from one another, the export network will only have access to Rocket Fuel and nothing else, additionally the export network will not know the actual amount of Rocket Fuel stored in the Rocket Fuel production network, the export network will display however much Rocket Fuel is currently stored within the ME Fluid Interface's internal buffers (when idle this is twenty four (24) buckets). To see this setup logically, refer to Figure 21-1.

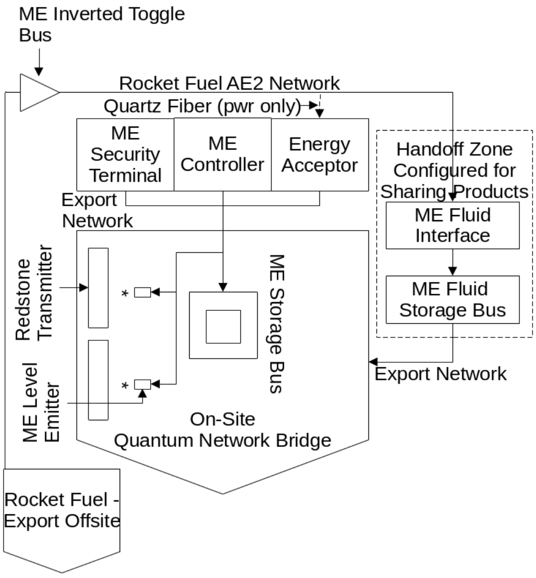
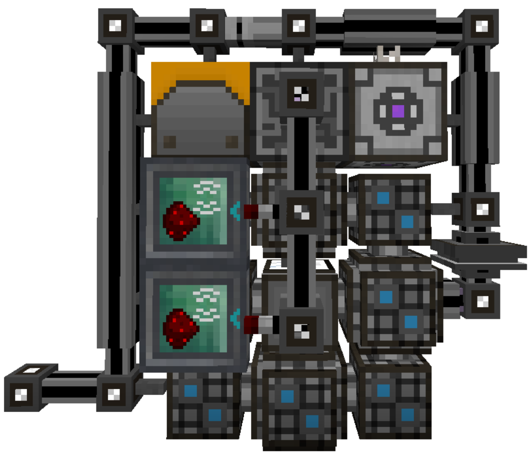
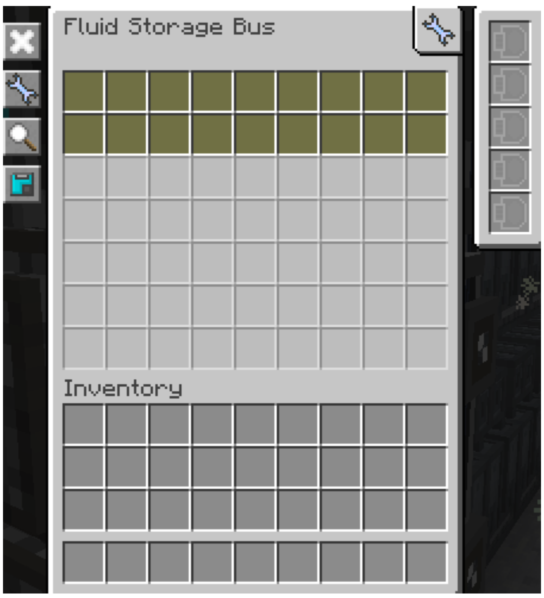


Figure 21-1. Logical network configuration of the on-site export network.

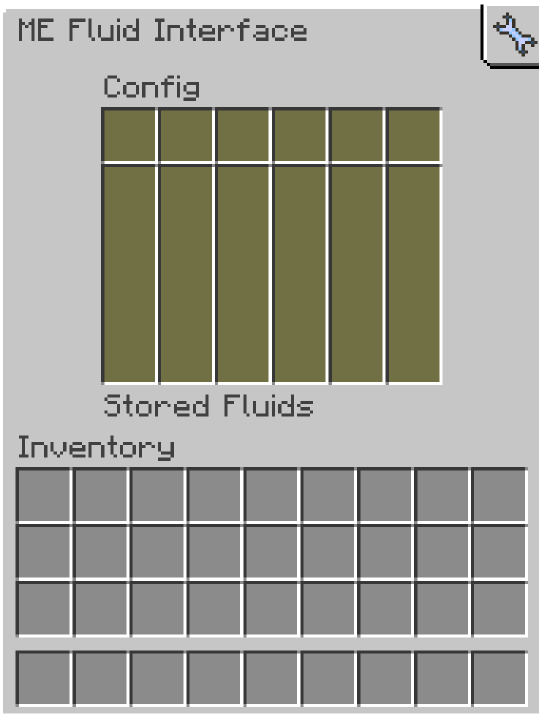


Photograph 21-1-1. Physical configuration of the on-site export network.

Photograph 21-1-2. Side view of the on-site export network.



Configuration 21-1-1. Product - Rocket Fuel - ME Fluid Storage Bus



Configuration 21-1-2. Product - Rocket Fuel - ME Fluid Interface

The on-site export network consists of the following components:

- Energy Acceptor - Applied Energistics 2
- ME Controller - Applied Energistics 2
- ME Fluid Interface - Applied Energistics 2
- ME Fluid Storage Bus - Applied Energistics 2
- ME Inverted Toggle Bus - Applied Energistics 2
- ME Level Emitter (x2) - Applied Energistics 2
- ME Security Terminal - Applied Energistics 2
- ME Storage Bus - Applied Energistics 2
- Quantum Entangled Singularity - Applied Energistics 2
- Quantum Network Bridge - Applied Energistics 2
- Redstone Transmitter (x2) - RFTools

The Energy Acceptor receives energy from the Rocket Fuel production network.

The ME Controller provides the path finding logic and channels for the export network. It allows for the operation of Applied Energistics network devices used on both sides of the bridge.

The ME Fluid Interface allows the Rocket Fuel production network to share Rocket Fuel with the export network. The ME Fluid Interface is on the Rocket Fuel production network.

The ME Fluid Storage Bus connects to the ME Fluid Interface to receive Rocket Fuel. The ME Fluid Storage Bus is on the export network.

The ME Inverted Toggle Bus is used to prevent power and data from flowing between the export network and Rocket Fuel production network, isolating them. When a redstone signal is applied to the ME Inverted Toggle Bus, the toggle bus is disabled. When a redstone signal is not applied to the ME Inverted Toggle Bus, the toggle bus is enabled.

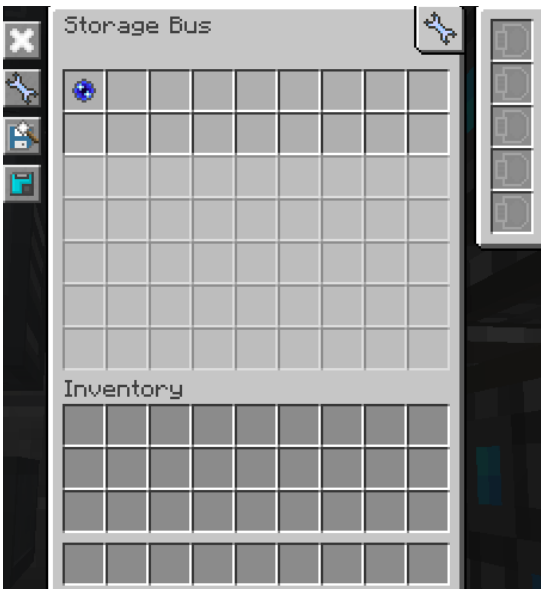
The ME Level Emitters provide information on the operating state of the on-site export network and the link status of the network bridge. To accomplish this, we use two (2) ME Level Emitters. One ME Level Emitter will provide information on the state of the on-site export network, meaning whether or not the network is currently powered (see Configuration 21-2-1). The second ME Level Emitter will provide information on the link status of the network bridge, meaning whether or not the on-site and off-site portions of the export network are connected to each other (see Configuration 21-2-2).

Configuration 21-2-1. ME Level Emitter configured to output a redstone signal based on the energy level of the on-site export network.

Configuration 21-2-2. ME Level Emitter configured to output a redstone signal if both Quantum Entangled Singularities are present on the network.

The ME Security Terminal provides security capabilities to both sides of the export network. This is especially important because the off-site export network is still our property, therefore we get to configure who has access to that network.

The ME Storage Bus is attached to the Quantum Link Chamber, the center block of the Quantum Network Bridge containing the Quantum Entangled Singularity. By doing this, the presence of the Quantum Entangled Singularity is exposed on the network as an item. Having both Quantum Entangled Singularities present on the network indicates that both sides of the export network are connected to each other (see Configuration 21-3).



Configuration 21-3. Configuration of the on-site ME Storage Bus.

The Redstone Transmitters are able to transmit the redstone signals (or in context to RFTools, channels) emitted by the ME Level Emitters wirelessly. To receive the output, pair either a Redstone Receiver or a Redstone Screen Module to the Redstone Transmitters. A Redstone Receiver and Redstone Screen Module can only be assigned one (1) redstone channel at a time, so you MUST use a minimum of two (2) Redstone Receivers and/or Redstone Screen Modules to capture both redstone channels.

21.2. Off-Site Export Network Setup Requirements

The off-site export network MUST have functionally the same logical configuration as shown in Figure 21-2. The off-site export network SHOULD have the identical physical configuration as shown in Photograph 21-2, deviation from the physical configuration is acceptable as long as the logical configuration remains consistent with what is shown in Figure 21-2.

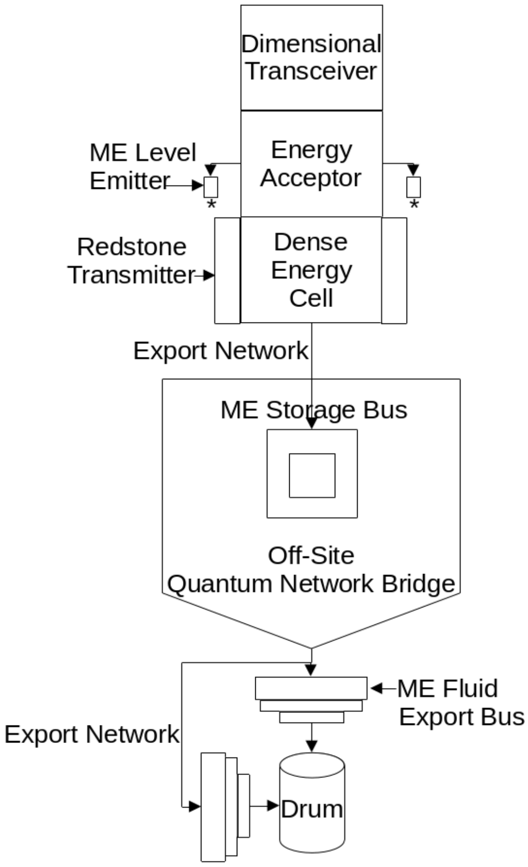
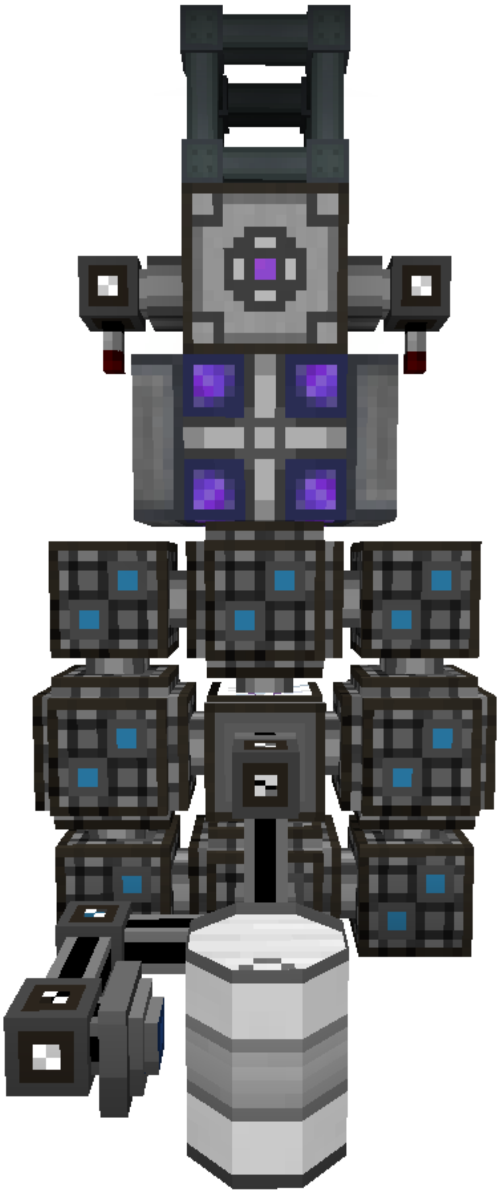


Figure 21-2. Logical network configuration of the off-site export network.



Photograph 21-2. Physical configuration of the off-site export network.

The off-site export network consists of the following components:

- Dense Energy Cell - Applied Energistics 2
- Dimensional Transceiver - Ender IO
- Drum (any variant) - Extra Utilities 2
- Energy Acceptor - Applied Energistics 2
- ME Fluid Export Bus (x2) - Applied Energistics 2
- ME Level Emitter (x2) - Applied Energistics 2
- ME Storage Bus - Applied Energistics 2
- Quantum Entangled Singularity - Applied Energistics 2
- Quantum Network Bridge - Applied Energistics 2
- Redstone Transmitter (x2) - RFTools

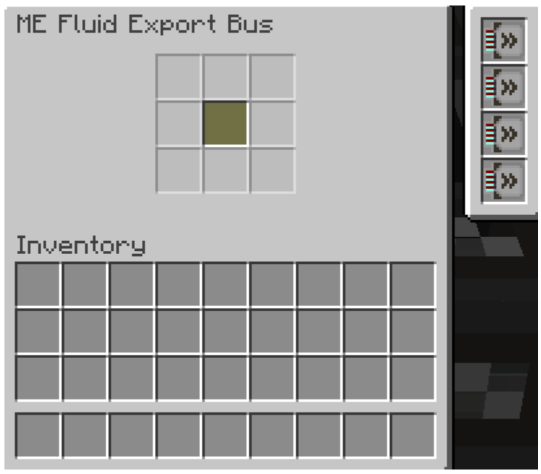
The Dense Energy Cell provides an additional energy reservoir to the export network, without it the export network will not be able to sustain rocket fuel transfer at full speed, which is twenty four (24) buckets per tick. Additionally, it prevents the Minecraft client from crashing when establishing a link to the on-site portion of the export network (see Section 21.5).

The off-site export network will need to receive energy from the on-site energy grid, we add a Dimensional Transceiver to facilitate this.

A drum from Extra Utilities 2 provides a fluid-storage medium. The export network will export rocket fuel into this drum, where another (independent) system can extract from it. It is intended to be a point of isolation between the export network and off-site networks (e.g. someone's personal AE network - which is not within our control).

The Energy Acceptor ensures proper conversion of FE into AE energy units.

Both ME Fluid Export Buses export fuel out of the export network and into the drum (see Configuration 21-4).



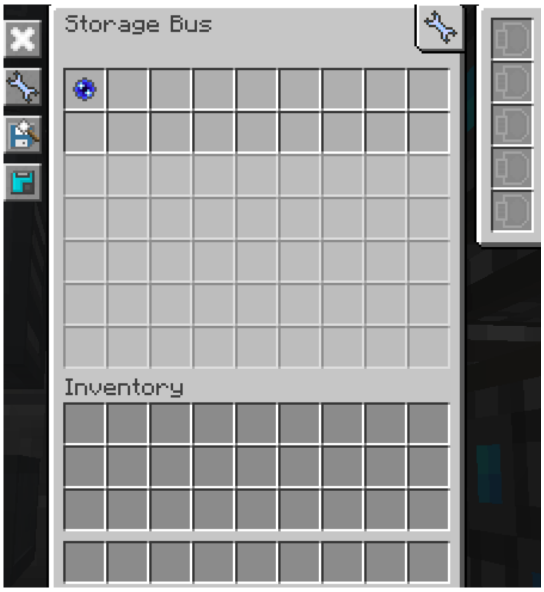
Configuration 21-4. ME Fluid Export Bus configuration.

The ME Level Emitters provide information on the operating state of the off-site export network and the link status of the network bridge. To accomplish this, we use two (2) ME Level Emitters. One ME Level Emitter will provide information on the state of the off-site export network, meaning whether or not the network is currently powered (see Configuration 21-5-1). The second ME Level Emitter will provide information on the link status of the network bridge, meaning whether or not the on-site and off-site portions of the export network are connected to each other (see Configuration 21-5-2).

Configuration 21-5-1. ME Level Emitter configured to output a redstone signal based on the energy level of the off-site export network.

Configuration 21-5-2. ME Level Emitter configured to output a redstone signal if both Quantum Entangled Singularities are present on the network.

The ME Storage Bus is attached to the Quantum Link Chamber, the center block of the Quantum Network Bridge containing the Quantum Entangled Singularity. By doing this, the presence of the Quantum Entangled Singularity is exposed on the network as an item. Having both Quantum Entangled Singularities present on the network indicates that both sides of the export network are connected to each other (see Configuration 21-6).



Configuration 21-6. Configuration of the off-site ME Storage Bus.

The Redstone Transmitters are used for the same purpose as with the on-site export network. With the understanding that the same redstone channels used for the on-site export network MUST NOT be used for Redstone Transmitters on the off-site export network, since we wish to monitor both networks separately.

21.3. Requirements for Power Delivery to Export Networks

When both sides of the export network are bridged to each other, there will be an idle power draw of approximately 815.24 FE/t (or 407.62 AE/t). At a minimum, the on-site energy grid MUST be able to provide said amount of energy.

The off-site export network MUST NOT be connected to any off-site energy grid. In order to power the off-site export network, use a pair of Dimensional Transceivers. Photograph 21-3 shows the on-site Dimensional Transceiver receiving energy from the Rocket Fuel production system, the second Dimensional Transceiver is supplying energy to the off-site export network, which can be seen at the top of Photograph 21-2.

Photograph 21-3. On-site Dimensional Transceiver sending energy from the Rocket Fuel production system to the off-site Dimensional Transceiver.

21.3.1. Avoiding an Energy Loop

The reason not to use an off-site energy grid is because energy transfer between all Applied Energistics 2 devices, including Quantum Network Bridges, is bi-directional. The result is the off-site energy grid supplying energy to all production systems. This happens because the on-site export network is connected to the Rocket Fuel production network (via a Quartz Fiber Cable), facilitating energy transfer between the two networks, and the Rocket Fuel production network is connected to the transport network (via a Quartz Fiber Cable), which again allows energy to transfer between themselves, resulting in all production systems being powered by the off-site energy grid.

Even in the required setup above (i.e. using only energy generated on-site), an energy 'loop' still occurs because of the configuration of both export networks, and the nature of Applied Energistics 2 devices. This energy loop will prevent the immediate loss of power in all production systems, as energy will be drawn from the Dimensional Transceivers' internal energy buffers. This introduces unexpected behavior into the entire process (across all production systems), and so it must be addressed.

To avoid an energy loop, an ME Inverted Toggle Bus is installed on the Rocket Fuel production network as shown in Photograph 21-1-1. Then to isolate the on-site export network from the Rocket Fuel production network, supply a redstone signal to the ME Inverted Toggle Bus. We use an ME Inverted Toggle Bus because in Direwolf20 1.12 v2.8.0. the ME Toggle Bus is bugged and does not operate correctly, in that AE2 devices on the same network as an ME Toggle Bus will go offline when a redstone signal is applied to it.

21.4. Chunkloading Requirements

Both the on-site and off-site export networks need to be chunkloaded. This includes all systems involved with the rocket fuel production process, and all systems involved off-site with exporting rocket fuel (i.e. what is shown in Photograph 21-2). Both sides of the export network MUST be chunkloaded at all times using whatever methods available. In the singleplayer environment it is RECOMMENDED that you use the Chunk Loader from ChickenChunks. In the multiplayer environment it is RECOMMENDED that you use the chunkloading methods provided to you by the server. When operating in the multiplayer environment it is NOT RECOMMENDED that you use alternative chunkloading methods other than those that are intended.

22. Glossary

Handoff-Zone A network between the production network and the transport network where the P2P Tunnels are located. This network is filtered, meaning only certain materials are visible to it. The purpose of this network is to isolate production networks from each other when sharing/receiving materials.

Product Items/Fluid produced by a production network that is provided to one or more production networks.

Production Network An Applied Energistics 2 network which is used in each stage of production.

Resource Items/Fluid provided by a production network to be used by the current stage of production.

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2. yueh, *P2P Tunnel* (2015-July-19). https://appliedenergistics.github.io/ae2-site-archive/P2P-Tunnel/.
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