# Power and Drive Systems

- Primary power comes from two fusion reactors, powered by a reaction mass of heavy water (H22O).
- The reaction mass is ionised by sheer heat in a pre-reaction ionisation chamber. Deuterium and oxygen ions are magnetically divided (like a mass spectrometer), and electrons are inducted directly to the power system.
- The temperature of the ionisation chamber is maintained by the nearby fusion reaction and, where necessary, electrical power.
- Frequently, the temperature in the ionisation chamber will exceed safe limits. Heat, and sometimes plasma, are vented directly to space. Even running at minium power, it’s difficult go without venting for more than a few hours.
- If the ionisation chamber is cooled, it takes quite some time to reheat it to operating temperature. In this case (a cold start) the reaction mass must be ionised and the chamber heated using battery power. It’s normal practice to start one reactor this way and cross-vent the ionisation chambers to start the other. This increases the time to start the reactors by about 50 per cent, but halves the battery power required.
- normal cold-start takes eight hours for the first reactor (giving half power) and another four for the second. At normal output, the batteries will take about a week to recharge from a normal cold start.
- Starting both reactors at once, and really rushing it (which can damage the reactors) will take four to six hours, and the batteries will take two weeks to rechrage.
- The ionised oxygen is stored for later use (see below)
- The deuterium ions move on to the reaction chamber, where they undergo a fusion reaction, forming helium. The reaction chamber must also be maintained at a high temperature, but once it is heated, it is self-sustaining so long as the deuterium keeps coming.
- The ionised helium is stored with the oxygen.
- The oxygen/helium mix can be de-ionised and hydrated and used for life-support in emergencies, but it’s not recommended. There is a chance of it being radioactive.
- The oxygen/helium mix can also be re-introduced into the reaction chamber for further fusion. This requires greater temperatures (only just within the design tolerances, so it’s not possible to conduct secondary fusion without continuous venting) but also produces far more energy. This method of extracting extra energy from the system is not recommended for prolonged use, as the resulting heavy elements, some of them radioactive, result in either erosion or clagging of the exhaust vents. On the Lady Jane, for some reason the port vent always clags, and the starboard is always eroded. Even swapping the reactors didn’t change this. Engineers have suggested it’s due to a slight imbalance in the gravity fields, but since clagging and erosion both result in similar costs and repair times, nobody’s got too carried away with fixing it.
- Normally, though, the oxygen/helium mix is used as reaction mass for the ion drives. Not only is the mix pre-ionised (so long as you don’t leave it sit for too long—if you do it de-ionises, draining battery power and causing ship-wide corrosion) it also provides far more thrust than the ionised hydrogen used in traditional ion drives.
- If there is insufficient oxygen/helium mix to run the drives (because of continued high thrust or heavy power demands), heavy water can be used as ion drive reaction mass instead. Because the heavy water must be ionised separately, this adds extra power demands, but not usually anything critical.
- The mass of the heavy water is actually slightly higher than the mass of the oxygen/helium mix, so it produces about the same thrust for the same power consumption. But it does increase heavy water consumption considerably.

- The practical upshot of this is that increased power or thrust both increase the consumption of reaction mass.
- With a nominal load of reaction mass, the Lady Jane has a range of 3 months at normal power output.
- Battery power is recharged gradually by the fusion reactors.
- At minimum life support (and no artificial gravity) batteries will last for about a week. This includes the power needed for the emergency beacon.

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Back to Lady Jane

The Lady Jane