

Fusion Power in the Morrow Project

by **Steve Jackson**
td@sunSITE.utk.edu

Editors note: This document was found in the Project Archive "Answers to questions you would never ask Bruce" by Jamie Cardick. Jamie was listed as a member of the Morrow Project technical training unit before she was frozen with Recon team I-7 frozen at <<censored>> Iowa. Jamie's team has not been recovered as of the release of this data. In several places Jamie hints about social engineering, team dynamics, mission profiles, and other data files she has written. These files have all been recovered, and include "Economics of the Project", "How did we get all of the neat toys?", "Social Engineering and Sociogenesis, The Projects Real Goals", "Rank Structures in the Dynamic Project Work Group" and the whimsical "You and Your V". These files will be released if an when the project's security status further clarifies.

Susan Roy, Assistant Administrator, New Idaho Complex

So you have a new toy?

Fusion Power is one of the "hi-tech" advances that changed the Morrow Project from a effort at social engineering (injecting an organized group of highly educated people into the aftermath of world disaster in order to shorten the "turn around" time for recovery) into a functioning, continent spanning organization that will draw North and Central America out of the post disaster dark ages. Prior to the advent of fusion power, the Morrow Project planned to rely on high capacity battery cells (running bolt holes and fed from the United States power grid until the war), backed up by a set of hydroelectric, ocean barrage, and fission power plants hooked to a constellation of satellites for wireless power distribution. After Dr. Morrow returned with fusion power, the primary power services were still installed (except for the fission stations, which proved impossible to complete), but instead of feeding the project, they were designated to feed project sponsored communities.

Fusion power units are highly standardized. Project planners just barely know how they work, and certainly can't futz to much with Dr. Morrow's design. Four models of power plants are produced by Morrow Industries at various plants:

- PF-10 Small vehicular power plant.
- PF-17 Medium vehicle power plant
- PF-22 Large vehicle / small facility power plant
- PF-36 Large facility power plant

In cases where more power is needed, plants can be ganged. Vehicles carry these gangs of plants depending on needed power and weight restrictions.

1x PF-10 Dune Buggies (LAV)

2x PF-10 Commando Scout, XR311

1x PF-17 V-150, Ranger, SK-5, bolt holes

1x PF-22 Mars ONE, Science ONE

Design of the fusion plant-

Fusion plants were designed as "black box technology". Unlike vehicle drive trains, communications, and weapons systems, most personnel in the project could not be expected to have a basic understanding of fusion understanding. Fusion units were designed to be dropped into vehicles and building, turned on when needed, then removed for refurbishing and replacement when they ran dry.

Still, fusion plants have parts. Pull the plant from a handy V-150, set it on a "bomb tray" (a term that came into being because of a fusion plants passing resemblance to a silver bomb) and take a look at one. The unit you pulled from the V-150 is about 5' long, 3' wide, rounded with blunt ends. Three square "fins" keep it from looking like a nightmare cigar, one on each side, and one in the center. These heavy fins attach to the cradle mounts in the V-150 (where the main engine should be in a petrol powered V). Conceivably, these floating cradle mounts could get bent (say, by dropping your V-150 from twenty feet), or the bolts attaching the cradle mounts to the fusion units fins (called "bracket mounts" in the manual "You and Your Fusion Engine" TM-75-8) could shear, releasing the mount, and possibly damaging the E-Bats (Eternal Power Devices - batteries that don't go dry), or the electric motors of the drive train. Note that the bolts are not load bearing. Fusion power plants are designed to be easily changed with the help of a small crane or pulley cart (similar to the engine in an unmodified V). The fins are the load bearing element, fitting into guides in the engine compartment.

Notice anything else about the fusion plant? If you answered that it 's case is pierced at only four points, you win a cigar! That is because this is black box technology. Actually, the case is pierced in five places, but the fifth is not that easy to get to (but we will take you on a tour of it anyway, later).

On the rear of the unit is a single, round connector about three inches in diameter, with two big lugs on the outside and 16 large pin holes in the middle. This is the utility power connector, and in the PF-17, it is the similar to a 3 phase alternating current line found in many businesses. By connecting the various pins in different ways, you can get combinations of 110 volt and 220 volt AC power. On the V-150, it provides a pair of 20 Amp 110's to the power strips in the equipment racks and outside of the vehicle, and a 40 Amp 220 volt power source to the vehicles main power grid (powering all the fancy geegaws that the driver has, as well as the turret, winch, and even a (small) laser if one wants). The second connector is similar, with 16 connectors, but with a different pin pattern. It is the vehicle drive train power, and on a V-150 it provides 4x 220 Volt 40 Amp power services to the V-150's 4 electric motors. The next connector is an RS-422 data connector, a fairly standard centronics 50 pin cable. It attaches the plant to the vehicles integrated data system and allows diagnostics of the plant, power demand control, and other functions. The last connector is a DIN8 that feeds power into the plant for initial starts. It should connect to the power grid through the V-150's starter box.

All project plants can operate in four modes. "Off" is the normal mode when you get the vehicle. Off means that the engine is generating no power, it is dead. The advantage to the off position is that the

engine could be buried in a land fill, retrieved a decade later, and it will still be ready to go. To start the power plant, some one needs to get a very high amperage, 1500 watt jolt into the case. This jolt usually comes from the vehicle's starter (a capacitor ballast similar to ones found on a fluorescent light). Engineering units carry "starter" carts with them that consist of a set of e-bats, a ballast, and a long din cable.

Once started, a plant can run in four modes. "Conserve" is the first setting, and it is rarely used in vehicles. Conserve only powers one of the legs of the secondary power out (in V-150's, it runs the secondary power system), and only powers that leg with around 5 watts of power. Inside the plant, the laser is powering once every hour or so, flashes a single tube of hydrogen, then allows the stripper to slowly generate power from the bottle. More power is used to sustain the reaction than is output, but in this mode a fusion plant could conceivably run for two centuries (of course, no one has ever tried one before for two centuries, have they? Bruce assure me that they will last that long, though). Note that a pair of PF-17s power each bolt hole. The main computer and data link needs two watts of power, while each freeze tube needs two watts of power once they are through the freeze cycle. E-Bats in each tube, plus a big e-bat to run the radio and the facility CRT allow the system to wake up without even kicking the PF-17s into action. The intention is that both PF-17s will act as spare power supplies, either in the group vehicle, or used in recovery projects. That's why engineering teams are trained to strip bolt holes for materials.

The second mode is "idle". In idle, the big power outs are not hot (can't move the V), but the secondary power out works. This mode allows the plant to operate for about five years. In the the third mode, called "active mode", the main power runs at less than half capacity (generating around 35,000 watts of power), more than enough power to drive the V-150. In addition, another 12,000 watts are generated for the secondary power system. This mode, when used in normal operation, limits the life span of a plant to around six months. If your going to drive you V about, this is the mode that you will usually operate in.

The last mode is called "over drive". No vehicle needs as much power as a fusion plant can generate, but just in case, the plant (in the case of the PF-17) can generate a grand total of around 90,000 watts of power for around three to four months. This feature is not expected to be needed by normal Recon teams, as the only thing they can do with 90 KW is light a football field, or maybe build electrified rodent fences for 20,000 gardeners, but is instead a feature that engineering teams can use to generate "lots" of power from a small unit. Units like the Air Scout, and various piston powered airframes used in the project need a lot of power to lift a fusion plant off the ground, so they do use this higher setting.

As for maintenance? If a cable fall off (a possibility if the vehicle is dropped from 20 feet in the air, as discussed earlier), reattach it. If the connector is screwed up, get a hammer and a wrench, and pound the thing into shape. If an APDS round penetrates the engine compartment and cores the engine, get a new engine, or a new V, depending on what you think is best.

But I really want to play with the insides of my power plant!

First, although project fusion plants are designed to be refueled and maintained, they were never designed to be maintained in the field. Instead, they are swapped by engineering and recovery teams for new plant, the older plants are collected at regional depots, and are refurbished.

One subject that we should get out of the way. YOUR FUSION PLANT CANNOT BE MADE INTO A

BOMB! This is not a design feature that can be worked around, it is the facts of life. A bomb creates a fusion event that is, for a short time, self sustaining, but to create that event requires a huge amount of energy. The only way the big domes in the US war machine could figure to trigger a fusion event was to first trigger a fission event, then use the energy from the fission event to create a condition with appropriate temperatures and pressure that fusion occurred. A really powerful laser, fired at a suitably constrained mass of material can also create a short fusion event, but with a net loss of power. No bang.

So, get over it. Anyone who thinks that they just have to have a weapon of mass destruction to save society with needs to find another continent spanning secret project to work for.

Now, for the geek heads who really want to open up a power plant and fiddle around, you need a tool kit. The main tool kit for working inside a fusion plant is a TK-9 Fusion Tools Kit. It consists of a set of ablative gloves, polarized eye goggles, a full "bunny suit" similar to those used by chip designers, a hand held diagnostic (based on an Apple Newton 2100), a 25 mm spanner and a 25 mm lug wrench adaptor, a set of calipers, and the contents of a micro electric kit. Move the fusion unit into a clean room. Lacking a clean room, you can take it apart, but it probably won't go back together and work. Use the spanner to crack the lugs on the middle fin at each point that it attaches to the main unit. Drop the bottom part of the fin down and out of its key groove, then use a hoist, and a couple of Mars types in Bunny suits to lift the top part of the fin off and back. Save your lugs and the fins. Having parts left over at the end is not a good thing.

Revealed is a pair of big hex lugs recessed in the case. Get a big hex wrench (the one marked 16 in a vehicle tool kit - it's the one people use to pry open steamer trunks and the like) and crack all four hex lugs, two on each side. Slip something like the biggest caliper into the crack that appears, and "break" the case. Both sides will slide a little bit, hit a guide that pops them up and then can be lifted off.

Now, get a light and hang it over the 2' long and 2' wide access hole you have now made. The 6' circular tube running around the outside on both sides is the toko-ring. The big red geegaw hanging off of it is the injector, with the round bulb that connects between the injector and the toko called the regulator. In the middle of the space is a large oblong torus with a funny set of finials poking off of it. This is the power take off. Attached to it is and to the toko is a device called the electron stripper, it looks like a bent broom handle. Next to the power take off is a longish thick pipe, this is the laser assembly. The big round hub cap looking thing is the magnetic containment generator. All powered units are attached to the spine of the unit, which is actually the power feed. Looking forward and back (a little out of reach) is the hydrogen containment system and the e-bat capacitor system, as well as the power conditioner, and the logic module.

The fusion sequence is initiated from the outside by a high amperage sequence. This sequence charges the main capacitors, and powers the containment field. Once the containment field is powered, two bursts of hydrogen are injected into the toko ring moving in opposite directions. The amount of hydrogen determines the amount of power generated. This hydrogen flashed around the toko, until just before it reaches the power take off and stripper. Here a short pulse of phased laser light creates fusion. Unlike earlier attempts at fusion, where the laser had to be very high energy, the laser in the project fusion system is modulated to exactly three times the frequency of the hydrogen atoms' electron. This allows fusion at a fraction of the power cost. Once fusion occurs energy is stripped from the fusing hydrogen atoms in a manner similar to a MHD power converter. The stripper then pulls the fused helium and second stage fusion lithium atoms out of the containment track.

Note that this unit has no moving parts. Every three to twenty cycles the laser fires on a dry tube, allowing self calibration and targeting.

To refuel this puppy, you pull out the stripper, laser, the injector, and several other parts. They must be refurbished in a clean room. In particular, the laser will need new lense units. If spares are available, they can be returned after fueling. Next, the fuel cells are cranked into the opening one at a time, removed, and sent to the shop for fueling. They are hermetically sealed, except for a small magnetic feed gate. Once they have been filled, reverse the process.

What can I do with a dead plant?

First, the plants are not radioactive. The secondary fusion lithium can be a pain to handle, but the unit itself is environmentally safe. The unit is a hot fusion plant, no matter what some know-it-alls say about fusion. The proper term for it is low-temperature fusion gun assembly. All of the talk about cold fusion is hog wash. When Bruce read about the yo-yo's at University of Utah, he laughed, but was not willing to expend resources on cold fusion. He claimed that Utah probably got their beakers dirty, and someday it will be regarded as another Piltdown Man scam. (Yeah, and I asked him if it was like that idea some wacko had of freezing his head after he died, and he replied, "No, that makes sense". He never would explain.) The heat from the fusion reaction is about that of a ten of fluorescent lamps (just concentrated into a very small space).

Trainees ask me about the laser assembly. It is a cool little package. It is a laser cluster targeted at about 8 mm, and its phase generator is computer controlled. Lab geeks here turned one into a glass etcher, and another into a highly controlled tattoo gun. Its offensive power makes it perfect for killing flies, if you can get them to sit right on the lase element. Its really sensitive to dust though. The other identified use for a laser plant is as a barbecue. Rip all of the high tech garbage out, lase a couple of holes in it, and fill it with wood. Weld some trays in it for food, and get out the freeze dried bbq sauce to kept in your personals box. Have a blast!

Jamie Cardick

(formerly Project Training Cadre)

by Steve Jackson

td@sunSITE.utk.edu