

Space factory contains own control software

Galen Gruman, Assistant Editor

McDonnell Douglas will place a fully automated space factory in a space shuttle cargo bay in summer 1986. The factory will contain its own control software, developed by Robert J. Wood, a lead software engineer and network architect for the production prototype.

The remote-processing factory will make purer pharmaceuticals than is possible on Earth through electrophoresis, a separation process that uses an electrical field to separate biological and chemical substances.

All such substances have inherent electrical charges and separate in relation to those respective charges when in an electrical field. The lack of gravity makes such separated substances about four times as pure as those separated in full Earth gravity.

The language used to develop the factory's software was a version of Forth, an interactive metalanguage "well-suited to process control and data acquisition issues," Wood said. "I can do a lot more with the payload because I can modify the program during flight."

The language's quick diagnostics translated into a 40 percent savings in the space factory's software development time, an important issue for

commercial space applications, Wood said. "It was significantly less expensive than comparable Ada or Pascal systems," he added.

Wood will be on board the 1986 shuttle mission as payload specialist to monitor and fine-tune the system, which has been designed for commercial-scale production. McDonnell Douglas expects to orbit the factory on three to six flights a year, Wood said.

Wood will also be an alternate, ground-based payload specialist for a space shuttle mission late this month that will orbit a smaller-scale (about four percent output of the commercial-scale factory) version of the factory that has been tested and been in limited production during six flights since 1982.

The automated factory's computer will evaluate new pictures of the electrophoresis process every few seconds. As each image is evaluated, the software locates newly produced material and controls the movable collection mechanism to pick up the material. Support modules control the filtering of buffer solutions, the material flow, and the cooling of the factory.

A shuttle would put the factory in low Earth orbit (roughly 300 miles

above the planet), and another would retrieve it and its refined contents a half a year later.

While data will be sent to ground stations from the unattended orbiting factory, McDonnell Douglas decided to have the factory monitor itself to avoid the problems caused by the split-second delay in ground-to-space communications and by the periods in which the satellite would be out of receiver range.

"The computer can easily recognize when the process is wrong," Wood said. However, "it's easier to tell if something is wrong than to make it right again," he added. Should a problem arise, commands from the ground would be sent to reconfigure and continue processing. Severe problems could require a space shuttle to pick up the orbiting factory earlier than planned so an on-board specialist could try to fix the problem.

Longer-range plans include a version of the factory for the US manned space station, construction of which is scheduled for the early 1990s. As the program develops, "we will consider inference machines to look at the recurring, more complex problems so we don't have to deal with them again and again," Wood said.