B. Advantages of Testing "at speed".

The obvious advantage to testing modules "at speed", rather than at micro speed, is the ability to find virtually all problems in Module Test. Speed related problems that would not be seen until in the machine can now be found in Module Test. Termination problems, such as resistors of improper value or placement that may not have been seen when testing at micro speeds, can now be flagged. Also, data patterns can be fed into the modules, to cause chips to toggle at their fastest rates. Specific data patterns have been chosen to work the chips as hard as possible.

Testing "at speed" also aids in the isolation of design problems in the early stages of module developement. Included in these are termination-reflection problems only seen at certain clock frequencies, and short or long path problems.

Slow input and output latches on modules can also create problems, particularly in a machine with a clock rate as fast as the Cray 2. Path lengths are so critical that any such slow latches could conceivably cause problems in the machine, and be very difficult to isolate. By testing the modules "at speed", and using tuned input and output wire lengths (personality harnesses), these slow latches can be flagged in module test.

II. Cray 2 Module Troubleshooting.

A. Full Power Testing.

Most of the final testing of Cray 2 modules is done under full power. To allow this, special tanks were designed to immerse the module in liquid coolant. The liquid coolant is continually cooled and pumped through the module under test.

The module, while powered up in the tank, is being tested under the same temperature and voltage conditions as in the mainframe. Tests are written to emulate the modules' function in the mainframe as closely as possible. All tests are performed on the module while voltage and clock speed margins are run. In addition, special hammers have been built in the tanks so that the modules can be shock tested while immersed. The module must pass all these tests as a final Module Test QA.