

here comes an opportunity to get hundreds of spindles in a relatively small area with automatic correction in the controller. It's scheduled for completion at the end of this year so it will be ready with the first CRAY-3's. I don't know what it's called yet. Tom Hoddle is doing that under Steve Johnson's area in Chippewa Falls.

Q: What is the total bandwidth on disk drives?

A: My impression is that it's twice the DD-40, but I'm not very confident of what that number is. The real effort there was small disk drive units, redundancy in the spindles, and getting more parallelism--18 mechanisms instead of 4 per cabinet. I think that's what we have in the DD-40, but you can find that number. Ask Dave Judd--he's supposed to know.

Q: What about chip erosion with the high velocity of fluorocarbon fluid over the unprotected die?

A: It's an interesting area and one that we're studying as much as we can. The die are put on the boards face against the board. The ball bonds are about  $2\frac{1}{2}$  mils when they're pressed into the board so we have a gap of about  $2\frac{1}{2}$  mils with a lot of posts around it in the fluid flow. What we have for protection on the die is about a micron of glass so the question is: Will there be enough fluid flow over the face of the die? Most of the fluid will flow around the die, but some will flow over the face of the die. Will it have a high enough velocity to erode the die before the warranty runs out? I think that's about 10 years. We'll study machines as we assemble more, get good statistics, and if indeed we see any erosion, let alone failure, we'll put a mylar pad on the face of the die to block that fluid flow. It could be a loose one. If you can imagine a square die, 150 mils square, 52 pads uniformly around the edge, there's a fine spot to drop in a little mylar die at assembly time. We haven't done it because we don't know that there's a need yet, but it's an easy solution to that problem to fill the gap, and stop the fluid flow.

Q: Question unclear, but pertaining to the automation of system checkout in Chippewa Falls.

A: We've got to write a lot of programs. That's automation in a sense. We have to check out computers farther away by 2 systems than we have in the past. Using an oscilloscope gets to be very hard because it's in a tank with high velocity fluid flowing by. What you have to do is work through the