Pai, Deputy Manager; and Simon Chen, Engineer—worked with system integrators Taiwan Fuhbic Corporation to develop a control system that could be used both for controlling all support facilities for the fab lines and for safety monitoring of production operations. After researching available systems, they chose integrated modules from the FactorySuite™ automation software made by Wonderware® Corporation of Irvine, Calif. These included InTouch® human-machine interface software, which was used to handle monitoring and control of supply systems, and IndustrialSQL Server™ real-time relational database, which serves as a data historian as well as a reporting, analysis and optimization tool.

Located in the advanced Science-based Industrial Park here in Hsinchu, south of Taipei, ProMOS began building its fabrication lines near the end of 1995, with a target date of early 1997 for installation in the fab area. Systems were installed to deploy deep UV (ultraviolet) stepper machines and associated processing equipment capable of handling 200mm silicon wafers and circuit geometries as small as .25µm. The fab lines included systems utilizing CMP planarization, deep trench capacitor, STI-shallow trench isolation and tungsten dual damascene.

In parallel with fab line construction, the ProMOS Facilities Department staff—which includes Cesar Juang, Section Manager; Josh
The support services system was designed to meet certain objectives:

- to provide continuous, high quality electrical power to all fab equipment
- to provide a constant supply of process gases and chemicals
- to provide pure water for processing and control treatment of wastewater
- to optimize HVAC systems to provide proper Class 1 and Class 100 clean room environments
- to monitor gas and chemical consumption for inventory management
- to provide alarm-specific messages for operators throughout the plant
- to monitor hazardous gas and chemical transport systems to prevent toxic leakages
- and to monitor all systems for fire prevention and personnel safety

“T hese management systems monitor the daily operation of all the facilities, including power, pure water, wastewater treatment, gases, chemicals and clean room air conditioning,” explained Simon Chen. “Important events and alarms are logged and handled by our operators in real-time. Operators also use the Wonderware applications to control the temperature and humidity of the air conditioning systems as well as to track and log chemical consumption for inventory control.

“M ost of the processing steps for integrated circuit manufacturing must be carried out under steady conditions in a clean room environment,” Chen added. “The reliability of the entire manufacturing facility plays an important role in increasing production yields. For example, constant supply of consumable supplies is critical to IC fabrication. In addition, a fire accident could destroy the processing lines or toxic gas leaks could endanger our personnel. Our supervisory facility management system is required to respond immediately under critical conditions and to provide continuous data access.”

Powerful, Flexible System

The FactorySuite application is implemented using 32 nodes of InTouch to monitor more than 25,000 tags. A variety of Siemens, Modicon, GE and Mitsubishi programmable logic controllers (PLCs) was implemented throughout the plant using the Siemens H1 interface and an Omron host link. One SCADA PC is dedicated to data acquisition, feeding the IndustrialSQL Server that is the central collection point for all data. About 4,000 of the tags are specified for reporting purposes.

“The network communication performance was considered to be critical to meeting the responsive I/O connection requirement,” said Cesar Juang. “Wonderware’s FastDDE protocol provides both the speed and performance we needed. The distributed alarm system provides plantwide access and visibility for any important alarm messages. We use LED display panels throughout the fab lines to provide real-time alarm displays, which are fed automatically from the IndustrialSQL Server. The database allows us to perform real-time trending to monitor any changes in our process. It also gives us the historical trending capabilities to trace any abnormalities in the process. Our operators can even generate duty reports right in the office without having to go out onto the shop floor.”

“Our engineers used Wonderware’s I/O Server Toolkit to develop many drivers to communicate with proprietary devices,” explained Tony Hung, manager from Taiwan Fuhbic. “We developed nine different third-party drivers for devices such as gas, moisture
and particulate analyzers. The whole facility management system cannot operate smoothly and effectively without these connections. We even created a special printer driver so we could print out alarm messages and production reports in color, using Chinese characters output.”

The combination of the process visualization and SQL database functionalities has paid off for ProMOS in allowing management to optimize fab lines to be the most advanced in Taiwan. “The tight control we have over our environmental systems has allowed us to become the first company in Taiwan to use .25µm geometries, PC100 specification compliant for 64 M b SD RAM production,” Chen said. “We have made significant improvements in the business of supplying fab lines with gases and chemicals while maintaining closer watch on safety systems. The same high level of capabilities that we use in our toxic gas management systems have now been applied to our chemicals, pure water, wastewater and gas supply systems.

“We are able to use historical data from IndustrialSQL Server to calculate gas and chemical consumption, for example, which allows us to maintain our inventory levels better,” Chen added. “In the same way, we are able to better monitor the quality of the air and track the negative pressure of our laminar air flow in our Class 1 clean rooms – with some facilities now rating as high as Class 1000. We can also make sure we don’t lose electrical power to any of the lines – even though we have a lot of thunderstorms in this area – because we can instantly bring on-line any of 12 sets of generators for emergency power. The power system itself accounts for 5,000 of the tags in our system.”

All of these systems are managed using just one operator in the master control room and four technicians in the fab area. The LED displays throughout the fab are triggered by any alarm events that are monitored within InTouch, and appropriate messages to the technicians are generated within IndustrialSQL Server based on the alarm condition. Each technician also has a cellular telephone for staying in touch with the control room operator while responding to an alarm event.

**Bottom Line Is Productivity**

The sophistication of the monitoring and control systems has meant that ProMOS has been able to meet or exceed all its production targets. In most cases, successive production phases have been achieved as much as six months ahead of schedule. The production volume goal in 1998 was 19,000 wafers per month with a minimum of 400 chips per 200 mm wafer. That goal was achieved ahead of schedule and the next target level is to achieve fab output of 26,000 wafers per month, with 0.20µm critical dimension for 64 M b SD RAM’s. Based on initial success with this effort, ProMOS is considering to launch fab lines in the future for adding 256 M b DRAM product as well.

“The bottom line is that our engineering and support systems for the fab lines are so good that they give us the security of knowing we can expand our fab capabilities to meet next generation production requirements well into the future,” Juang noted. “Given the technological capabilities of this joint venture between Mosel-Viteic and Siemens we feel we can lead the way in future deep submicron DRAM technologies and help make Taiwan one of the most advanced DRAM producers in the world.”