



Taiwan Semiconductor Manufacturing Company, Ltd.



# ENVIRONMENTAL, SAFETY and HEALTH

## Annual Report

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*On the path to Sustainable Development*

2001



- 01 Letter from the President
- 02 Company Profile
- 04 ESH Policy
- 05 ESH Organization
- 07 ESH Milestones

### **Energy and Resources**

- 08 Water Resource Recycling
- 10 Energy Conservation

### **Pollution Prevention**

- 12 Wastewater Treatment
- 14 Air Pollution Control
- 15 Waste Management
- 17 Global Warming Gases Emission Reduction

### **Management of Safety and Health**

- 18 Occupational Injury & Illness Statistics
- 20 Contractors & Suppliers Management
- 21 Chemical Management
- 23 Ergonomic Engineering Improvement
- 25 Wellness-Employee Health Promotion
- 26 Equipment Risk Assessment
- 28 Emergency Response
- 30 AAA (Triple A) Property Loss Control Program
  
- 31 ESH Activities
- 32 Awards
- 33 Perspective

#### Steere's Babbler

The Steere's Babbler is a species unique to Taiwan. The plumage is olive-green and its song consists of bright, resonant notes. It inhabits mid- and high-elevation forests and appears in small flocks under shrubs. It is a common resident bird.



## LETTER FROM THE PRESIDENT



Being a world-class enterprise, TSMC always believe that employees is the valued company assets and nature conservation. We strive for work safety, employees's health and environmental protection and place these priorities as an important aspects of company operations.

We always follow environmental management system (ISO-14001) and occupational health and safety management system (OHSAS-18001) in meeting international standards. In accordance with the spirit of "pollution & accident prevention", "design for environment", "promote industrial safety & health" and "protect company assets", we pursue continuous improvement and creativity for sustainable development. There are four elements to achieve excellence in the fields of sustainable development:

### 1. Staff Training:

To provide comprehensive Environmental, Safety and Health (ESH) training courses to raise hazard awareness and improve emergency response competence for both TSMC employees and contractors and suppliers.

### 2. Equipment Safety:

To use production equipment that meets both national codes and international standards to lower equipment operational risk..

### 3. System Management:

To go through ISO-14001 & OHSAS-18001 management systems and follow the PDCA (Plan-Do-Check-Act) methodology to seek continuous improvement.

### 4. Compliance Audit:

To provide both internal & external audit programs to ascertain that all company operations and activities meet ESH requirements.

There is a proverb, "The stones of the mills may be used to polish gems." We aggressively participate in international ESH programs and benchmark best practice of other world-class companies. We anticipate not only being in the leadership of semiconductor manufacturing technology but also in the fields of ESH. For example, we join the Perfluorinated Compounds (PFCs) emission reduction, energy saving and chemical management programs of World Semiconductor Council (WSC) and International SEMATECH.

On the path to sustainable development, we will introduce relevant advanced ESH management tools and technologies to improve ESH performance and creat a healthy and sustainable living as well as working environment.

Rick Tsai,  
President and COO  
April 2002

## COMPANY PROFILE



*Corporate Headquarters,  
Fab 2*



*Fab 3*



*Fab 12*

Founded on February 21, 1987, Taiwan Semiconductor Manufacturing Company (TSMC) is the world's largest dedicated integrated circuit (IC) foundry. Based in the Hsin-Chu Science-Based Industrial Park, known as Taiwan's Silicon Valley, TSMC is listed on both the Taiwan Stock Exchange (TSE) and the New York Stock Exchange (NYSE) under the symbol TSM.

TSMC is the first dedicated IC foundry in the world, and remains the industry leader. The goal of the Company was straightforward from its very inception, namely, to provide advanced IC manufacturing services to its customers. TSMC's charter prevents it from designing, manufacturing or marketing IC products under its own brand name, making it a true partner with and not a competitor to its customers. TSMC's success in the foundry industry has served as an inspiration for many companies, enhancing significant acceleration in technological innovation in general. With TSMC as the driving force of change since 1987, the number of global fabless IC companies has grown substantially. What was once only a concept, a "pure play" of the foundry industry, has played a vital role in technology advancement and generated billions of dollars in revenues. As the semiconductor industry faces constant consolidation and ever rising costs of IC fab construction, dedicated foundry companies like TSMC are expected to become an important source of IC manufacturing worldwide.

As a leader in the foundry sector, TSMC has built its reputation by offering cutting-edge technologies, advanced wafer production processes, and unparalleled manufacturing efficiency. From the very beginning, TSMC has consistently produced the foundry industry's leading technologies, including 0.18um, 0.15um and 0.13um complementary metal oxide semiconductor (CMOS) logic processes. TSMC now offers the foundry industry's most comprehensive set of technology processes, including CMOS logic, mixed-signal/radio frequency, flash, high-density embedded memory, BiCMOS and silicon germanium (SiGe) BiCMOS.

To further enhance its organizational efficiency, TSMC Fab 3 and 4 were consolidated in the first quarter of 2002. Fab 1, which TSMC had previously leased from Taiwan's Ministry of Economic Affairs and Industrial Technology Research Institute since the inception of the Company will be decommissioned on March 31, 2002. However, most of the processes in Fab 1 had been moved to other TSMC facilities to ensure continuing high-quality





Swinhoe's Pheasant

## COMPANY PROFILE

The Swinhoe's Pheasant is a species unique to Taiwan, exhibiting brilliant colors and dazzling beauty. It sings its song with low, suppressed notes. This gorgeous bird lives in the undergrowth of mid- and low-elevation broadleaved natural forests and tends to be active at dawn as well as dusk when it hunts for food. It is a rare resident bird.



Fab 5



Fab 6



Fab 7



Fab 8

customer service. TSMC operates one 6-inch wafer fab (Fab 2), five 8-inch fabs (Fab 3, 5, 6, 7 and 8), and one 12-inch fab (Fab 12). The Company also has substantial capacity commitments to its subsidiary WaferTech in the United States; its affiliate Vanguard International Semiconductor Corporation (VIS) in Hsin-Chu; and its joint venture partner Philips Semiconductor, known as Systems on Silicon Manufacturing Company (SSMC) in Singapore. TSMC is currently constructing another 12-inch manufacturing facility, Fab 14, in Tainan, which is expected to begin production in 2003. Total installed annual capacity in 2002 is approximately 4 million 8-inch equivalent wafers.

Another one of TSMC's major objectives is to be its customers' "Virtual Fab". That is, to provide its customers with the benefits of an in-house fabrication plant without the associated expense or organizational complexity. Its intent is to make foundry services as transparent to customers as possible. To that end, TSMC launched the industry's first "e-foundry" service in 2000 that continued in 2001 to extend much of its structure of customer service onto the Internet to provide customers with a real-time and "personalized" view into our manufacturing operations.

As a responsible corporate citizen, TSMC takes both community service and employee relations seriously. For example, TSMC's award-winning Culture and Education Foundation supports activities in Taiwan that promote education programs, social services, art and cultural activities both in the Company's immediate communities and in the country. The Foundation also strives to upgrade quality of life for Taiwan's society through long-term community development efforts.

TSMC's operating committee is comprised of many outstanding individuals, all of whom are committed to the success of the foundry industry in general and TSMC in particular. TSMC's Chairman and CEO Dr. Morris Chang has been at the forefront to lead this unique task force and has received both national as well as international recognition for his achievements. In 2001, both Time Magazine and CNN named Dr. Chang one of the 25 most influential global executives. In addition, the Common Wealth Magazine also ranked Dr. Chang number one among "The Most Admired Entrepreneurs in Taiwan" for the fourth consecutive year. In 2000, Dr. Chang received the first-ever Robert N. Noyce Medal from the Institute of Electrical and Electronics Engineers (IEEE) for his vision and leadership in pioneering the silicon integrated circuit foundry industry.



### Collard Scops Owl

With big eyes and round head, Collard Scops Owls become actively searching food when the night falls. Between March and April, it is their mating season. You can easily hear them making boo-ing, boo-ing sound in the night.

Founded in 1987, TSMC provides state-of-the-art semiconductor manufacturing services. All materials and tools used in the manufacturing process, including silicon wafers, chemicals, gases, electricity, water, etc., should be well managed in daily operations. TSMC's activities should not only meet relevant environmental, safety and health (ESH) legal requirements, but should also be benchmarked against recognized international practices. TSMC's goals are to prevent incidents, improve employee safety and health, protect property, prevent pollution, and to efficiently use all resources. To achieve these goals, TSMC is committed to continually improving the following.

1. All managers should take responsibility to ensure a safe and healthy workplace and maintain the highest-level quality of the environment.
2. Comply with ESH legal requirements, and make continuous efforts to implement international state-of-the-art practices.
3. Promote ESH concepts and awareness company-wide by providing sufficient training and resources, and actively seek cooperation and communication with employees.
4. Introduce new international ESH concepts and technologies to enhance and support all levels of management.
5. Conduct ESH assessments for new tools and materials used in research and development to reduce ESH risks.
6. Communicate ESH issues with suppliers, and encourage them to improve their ESH performance.





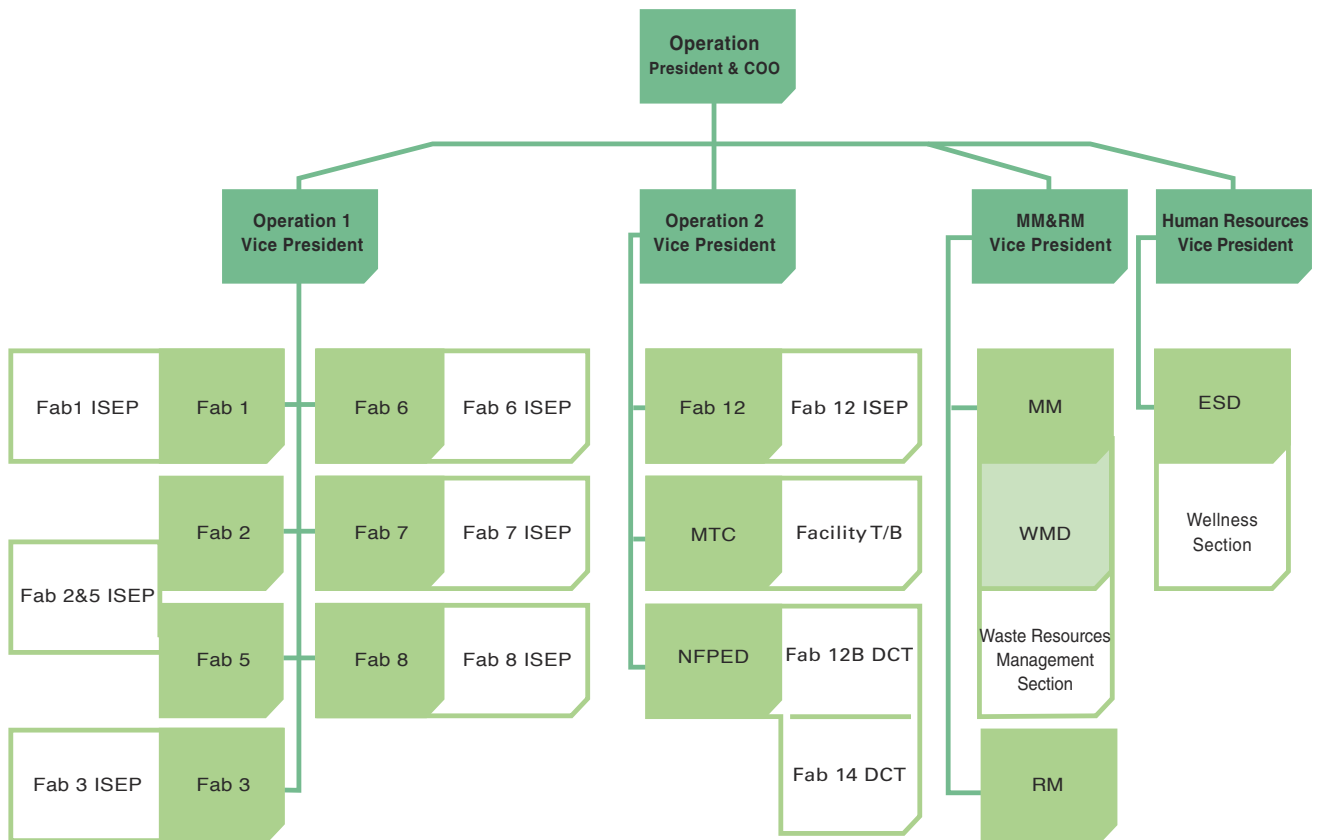
Northern Lapwing

# ESH ORGANIZATION

The Northern Lapwing, known in Chinese as the "Little Braid Bird," is named for the braid-like crest over its head. Its back is green while the belly and throat are white. Its song consists of a sound like cats and usually appears alone in open fields. It is an uncommon migratory bird.

Management plays an important part in the maintenance of ESH performance. Hence, TSMC re-organized its departments in 1995 by establishing a corporate ESH Risk Management Department (RM) and an on-site ESH Industrial Safety and Environmental Protection Department (ISEP). RM acts as a planning and auditing department, sets company policy and general ESH guidelines. RM looks for potential risks using system audit programs. RM introduces the best available technologies and practices to prevent or solve ESH problems. On-site ISEP not only stipulates ESH procedures and operational instructions but also performs daily inspections to assure that have been followed. As the company expanded in size, it was re-organized in 2001 to improve management efficiency. Originally under the operation organization, ISEP reported to the site vice president. In order to substantiate ESH management, ISEP reports to the fab director.

## Taiwan Semiconductor Manufacturing Company ESH Organization



- DCT: Design & Construction Team
- ESD: Employee Service Department
- ISEP: Industry Safety and Environmental Protection Department
- MM: Material Management Division
- MTC: Manufacturing Technology Center
- NFPED: New Fab Planning & Engineering Division

- RM: Risk Management Department
- T/B: Technical Board
- WMD: Warehouse Management Department



Northern Lapwing

## ESH ORGANIZATION

With regard to new fabs, the New Fab Planning & Engineering Division (NFPED) falls under the operation organization too. All the steps that include planning, construction and operation must follow the regulations and up-to-date international standards provided by RM. We commit to building not only technology-leading semiconductor fabs, but also fabs that meet world ESH standards.

In addition, TSMC established an Operation Technical Board in 1998 and re-named as Manufacturing Technology Center (MTC) in 2001. The MTC enhances the communications, information sharing and cooperation between fabs. The MTC also integrates limited resources in operation areas to generate Best Known Methods (BKMs) and implement standardization accordingly via cross-fab cooperation, furthermore, to achieve TSMC competitive advantages in the foundry business. The organization of MTC includes 10 technical boards. Regarding ESH subject, we generate BKMs and implement standardization to share our experience under the Facility Technical Board.







White-eared Sibia

The White-eared Sibia is a species unique to Taiwan so-named because of a conspicuous distinguishing white stripe over the eye. Its repeated note “de, de, de...,” which sounds like the rattle of a machine gun, is strong, clear, and pleasant to the ear. It can be found in mid-elevation broadleaved natural forests and is an uncommon resident bird.

**YEAR MILESTONES**

1987 TSMC founded.

1990 ISEP founded.

1995 Established corporate ESH Risk Management Department (RM) and on-site ESH Industrial Safety and Environmental Protection (ISEP).

1996 ISO-14001 Certification of Fab 2.

1997 ISO-14001 Certification of Fab 1, Fab 3 and Fab 4.

1998 TSMC established an Operational Technical Board. Regarding ESH subject, we generate BKM and implement standardization to share our experience under the Facility Technical Board.

1998 As a member company of International SEMATECH, we participate in ESH projects to get advanced ESH technology and make continuous improvement.

2000 ISO-14001 Certification of Fab 5.

2000 ISO-14001 Certification of Fab 7.

2000 OHSAS-18001 Certification of Fab 1, Fab 2, Fab 3, Fab 4 and Fab 5.

2001 Operation Technical Board re-named as Manufacturing Technology Center.

2001 ISO-14001 Certification of Fab 6 and Fab 8.

2001 OHSAS-18001 Certification of Fab 6, Fab 7 and Fab 8.



ISO – 14001 Certificate



OHSAS – 18001 Certificate



Yellow Tit

## WATER RESOURCE RECYCLING

The Yellow Tit, so-named because of the vivid yellow plumage over its face, throat, and belly, is a species unique to Taiwan. It usually appears alone or in pairs in mid-elevation broadleaved forests and is an uncommon resident bird.

According to the Ultra Pure Water (UPW) consumption rate and process water recovery ratio, the quantity of water which is conserved has increased every year. A standard swimming pool is an easy example to explain TSMC's water conservation efforts. The size of a standard swimming pool is 50 meter, 25 meter, 2 meter (length, width, depth), which contains up to 2,500 tons of water. TSMC saved 1,138 swimming pools of water in 1999 and 2,844 swimming pools of water in 2001. The quantity of water which is saved increased 2.5 times.

TSMC not only tries to improve the water recovery ratio, but also decreases the water usage by process tools. That reduces the demand of water resources. In order to reach the above objectives, TSMC invited the prestigious international semiconductor research organization, International SEMATECH, to measure the water usage quantity by process tools in early 2001. We try to reduce the water quantity used by process tools without affecting the production process.

### TSMC Last 3 Years water conservation performance

Item	1999	2000	2001
Average process water recycle rate *	63.1%	66.2%	69.5%
Water quantity saved (million tons)	2.85	5.31	7.11
Water saved measured by swimming pools	1,138	2,124	2,844

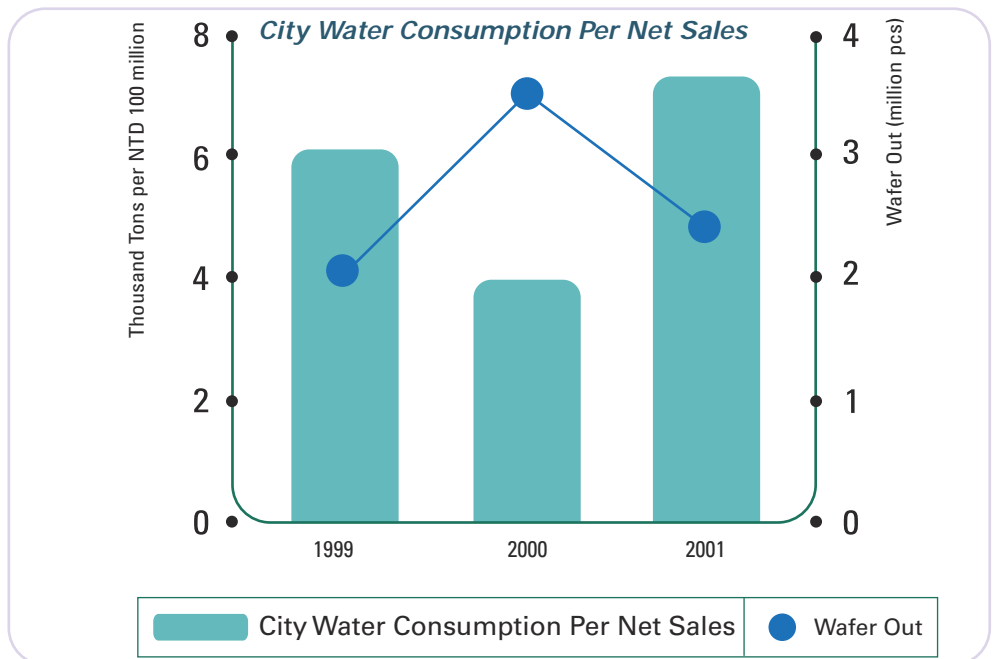
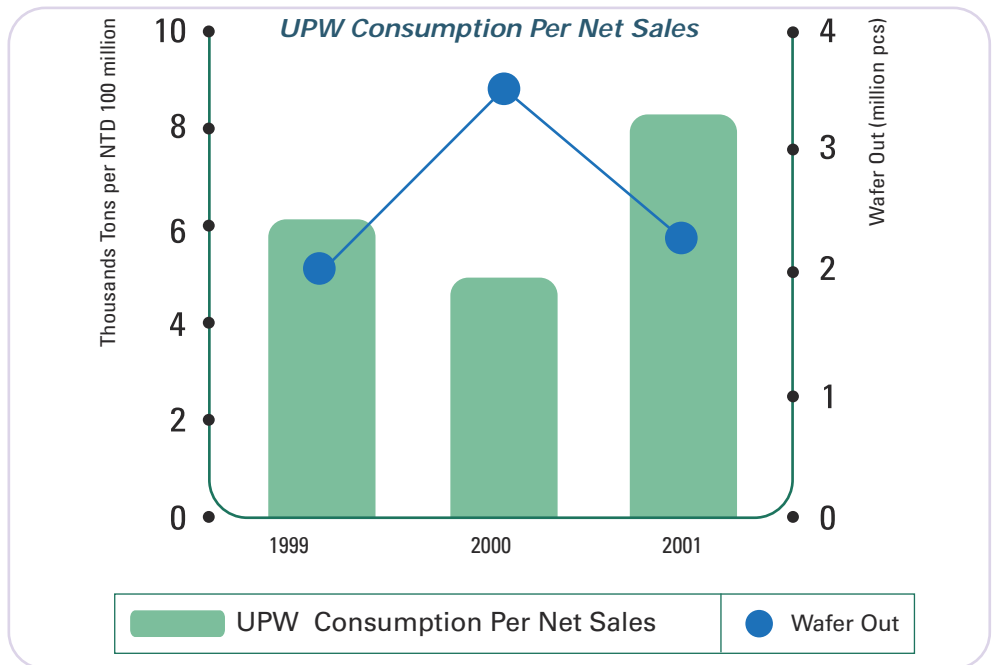
\* Average process water recycle rate is following the definition of Hsin-Chu Science-based Industrial Park Administration and Tainan Science-based Industrial Park Development Office.



Yellow Tit

# WATER RESOURCE RECYCLING

Since Fab 6 started operation in early 2000 and the addition of Fab 7 and Fab 8 to TSMC family in July 2000, the total production scale of TSMC has increased dramatically. However, the economy slowed down in 2001, and the wafer output decreased in 2001. As a result, the city water consumption per net sales and UPW consumption per net sales were both higher than before. The reasons include the world economy downturn and the decrease of wafer output. Furthermore, a basic amount of water usage is required to keep production tools and pollution prevention facilities working normally. Therefore, the city water & UPW consumption per net sales increased and our water conservation efforts were not effective.





Yellow Tit

# ENERGY CONSERVATION

TSMC practices energy conservation measures both during the stages of fab construction and operation with exceptional results. In 2001, Fab 6 was awarded the “Energy Conservation Award” by Minister of Economic Affairs (MOEA) and saved about USD\$574,000 per year (12,245 MWH per year).

## Energy conservation design (the examples of 8-inch fab)



### \* Mini-environment

Adopted mini-environment to provide partial class 1 environment, which complies with process specifications and reduces fab operation cost. Annual power saving is about 17,580 MWH.



### \* Chiller heat recovery system

Adopted chiller heat recovery system which reduces the energy consumption by the boiler. Annual power saving is about 29,940 MWH.



### \* Ice storage system

Ice storage system, which complies with national energy policy, shifts the peak power load and reduces contract capacity.



### \* 5°C & 9°C chilled water system

Most semiconductor manufacturing fabs only set up 5°C chilled water system. TSMC adopted 5°C & 9°C chilled water system which saves energy. Annual power saving is about 2,896 MWH.

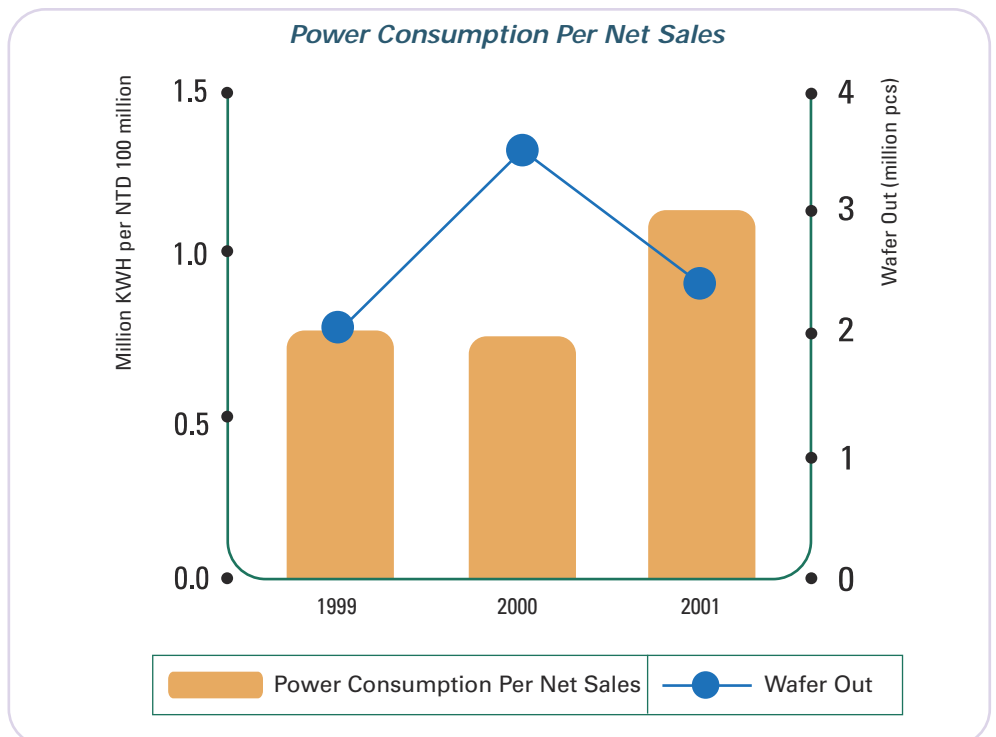


Yellow Tit

# ENERGY CONSERVATION

The global economic recession in 2001 caused a substantial decline in wafer output. Since a minimum amount of power is required to maintain the cleanliness, temperature and humidity as well as equipment parameters in a clean room, the power consumption per net sales was higher than that in 2000. Under such adverse economic conditions, TSMC kept pushing forward the following energy saving measures and attained distinguished accomplishments( the examples of 8-inch fab):

- \* Optimized process cooling water to avoid excess usage, which saves about 327 MWH annually.
- \* Reduced positive pressure and air velocity in fab clean rooms without interfering with the process, which saves about 7,435 MWH annually.
- \* Reduced process tools exhaust, which reduces power consumption of fans and saves about 2,463 MWH annually.
- \* Recycled cooled water to cooling tower from air-conditioning units, which reduces fan load and saves about 680 MWH annually.
- \* Reduced lighting of mechanical areas, offices, power stations and restrooms, which saves about 1,340 MWH annually.
- \* Temporarily shutdown some of the process tools to save power consumption according to the fab utilization rate, which saved about 7,140 MWH in 2001.







Formosan Blue Magpie

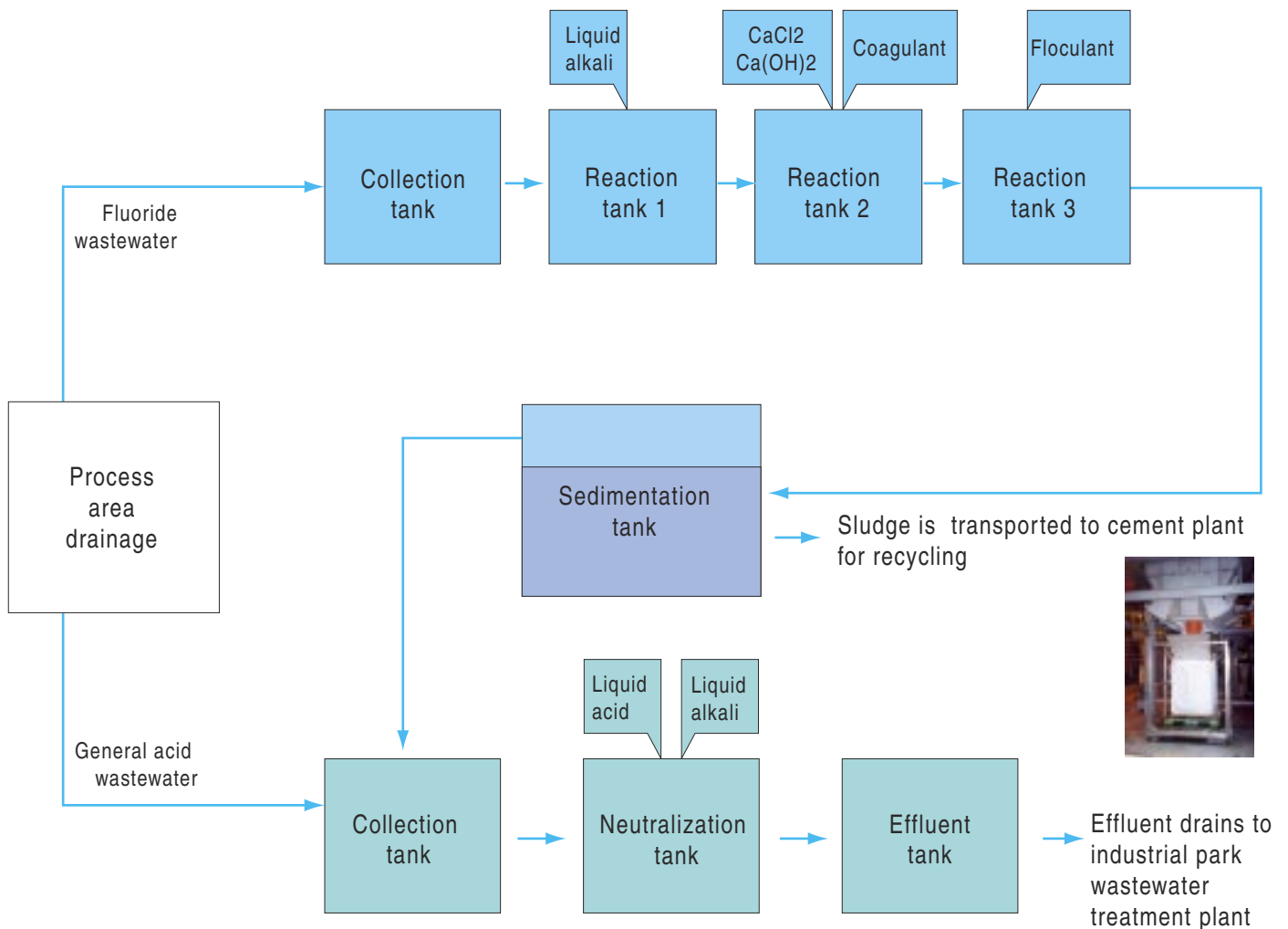
# WASTEWATER CONTROL

The Formosan Blue Magpie is a species unique to Taiwan. The plumage is generally bright blue except on the head, which is black; the long tail is of a beautiful shape. This fierce bird appears in mid- and low-elevation broadleaved forests and is an uncommon resident bird.

Wastewater drained by TSMC can be divided into two major categories: process wastewater and sewage. Process wastewater is the greater of the two in quantity.

Process wastewater includes general acid wastewater and fluoride wastewater. This wastewater is collected separately by pipes from the process area and then sent to TSMC's wastewater treatment plant. The treated wastewater, which meets the Science-based Industrial Park wastewater standard, drains into the science park sewer system. The industrial park wastewater treatment plant collects and again treats all process wastewater and sewage.

*Process Wastewater Treatment flow chart*





Formosan Blue Magpie

# WASTEWATER CONTROL

All TSMC fabs not only monitor the real time wastewater quality, but also perform wastewater analysis at least three times a year. The analysis results meet the wastewater standards of Science-based Industrial Park. The following table is a sample of Fab 2 wastewater quality analysis report from 1999 to 2001.

*Example: Fab 2 Last 3 Years Wastewater Quality Analysis Report*

Date / Items	1999			2000			2001			SIPA
	18 Jan	11 Jun	28 Oct	22 Feb	13 Jun	2 Nov	26 Apr	8 Aug	10 Dec	Standard
pH	7.0	6.2	6.4	6.8	6.8	7.0	7.3	7.1	6.8	5-10
Temperature (°C)	23.0	25.6	26.4	23.1	26.4	21.0	26.4	28.0	24.0	35
Suspended Solid (mg/L)	23.0	100.0	35.0	10.8	146.0	6.5	165.0	13.2	20.2	300
Chemical Oxygen Demand (mg/L)	145.0	62.0	46.5	43.9	68.7	53.7	108.0	9.7	16.4	500
Biochemical Oxygen Demand (mg/L)	89.0	30.0	19.0	29.6	42.7	22.7	52.2	2.2	7.8	300
Fluoride (mg/L)	8.8	6.8	3.2	3.4	3.3	5.3	2.6	5.3	9.1	15





Formosan Blue Magpie

# AIR POLLUTION CONTROL

With regard to air pollution prevention, TSMC has not only installed new air pollution prevention facilities to meet new environmental standards, but also expanded backup pollution prevention facilities and backup fuel supply systems to reduce the risk of facility breakdown since 2001.

All TSMC fabs monitor the real time concentration of Non-Methane Hydrocarbon (NMHC) and conduct an annual emission measurement as required by environmental laws. TSMC's emissions are far below the legal standard every year. The following table is a sample of TSMC's Fab 5 measurements in 2001.



*Acid & Alkali gases pollution control facility - Wet Scrubber*

*Volatile Organic Compounds (VOC) pollution control facility - zeolite concentration rotor*



**Example: Fab 5 Exhaust Analysis Result**

**Date: Nov. 20-23, 2001**

Item	Unit	Stack1	Stack2	Stack3	Stack4	Stack5	Stack6	Standard
H <sub>2</sub> SO <sub>4</sub>	kg/hr	0.0601	0.0703	0.0010	x	x	x	0.1
HF	kg/hr	ND	ND	ND	x	x	x	0.6
HCl	kg/hr	ND	ND	ND	x	x	x	0.6
Cl <sub>2</sub>	ppm	0.20	0.17	ND	x	x	x	30
NH <sub>3</sub>	g/sec	x	x	x	0.0085	x	x	13
HNO <sub>3</sub>	kg/hr	ND	ND	ND	x	x	x	0.6
H <sub>3</sub> PO <sub>4</sub>	kg/hr	ND	ND	ND	x	x	x	0.6
NMHC cut down rate	%	x	x	x	x	95	100	90
Exhaust	Nm <sup>3</sup> /min	2,003	1,674	1,688	224	886	763	---

Note: X : analysis not required

ND: Analyte Not Detected at or above the detection limit

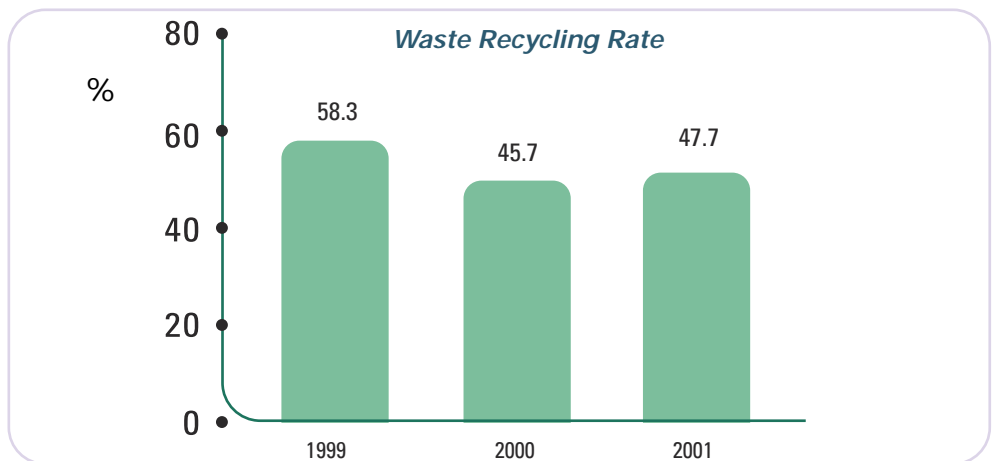


Formosan Blue Magpie

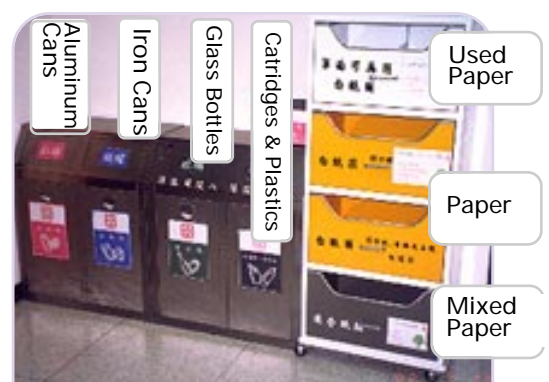
## WASTE MANAGEMENT

Most of the waste solvents generated by TSMC in 2001 complied with “The principle of cement rotary kiln complementary fuel”. Except for waste Isopropyl Alcohol (IPA) which is sent for recycling, other waste solvents have been sent to cement plants for complementary fuel since February 2001. This not only solves the problems of waste treatment, but also meets our policy of waste recycling. Meanwhile, TSMC understands that the disposal of calcium fluoride (CaF<sub>2</sub>) sludge is made difficult by the limited landfill space available in Taiwan. Hence, we cooperated with cement plants to apply for permission to recycle the sludge as the raw material for cement manufacturing. Environmental Protection Administration (EPA) approved our application and we shipped CaF<sub>2</sub> sludge to a cement plant on 28th June 2001, becoming the first semiconductor manufacturer to recycle CaF<sub>2</sub> sludge through a cement plant. Consequently, our waste recycling rate rose to 47.7% in 2001 from 45.7% in 2000.

Waste reduction and recycling are our waste management policy. TSMC plans to apply for the recycling of waste Hydrogen Fluoride (HF) in the near future. Besides, we conduct annual audit plans to ensure that the waste is disposed of legally by our contractors. In 2001, we spent 76 man-day to execute auditing of that year.



Resource recycling box in cafeteria



Waste paper recycling box in office



Formosan Blue Magpie

## WASTE MANAGEMENT

16

TSMC continues to promote waste reduction and recycling with the following approaches:

### Waste recycling

- \*  $\text{CaF}_2$  sludge recycled as cement raw material.
- \* Waste solvent recycled as cement kiln complementary fuel.
- \* Chemical suppliers recycle empty drums and bottles.
- \* Recycling of waste  $\text{H}_2\text{SO}_4$ ,  $\text{H}_3\text{PO}_4$ , HF.
- \* Recycling of copper sludge.
- \* Recycling of laser printer carbon cartridges.
- \* Recycling of scrap wafers.
- \* Waste recycling in office (including paper, plastics, iron/aluminum cans, glass bottles and batteries).
- \* Recycling of waste fluorescent lamps.

### Waste reduction

- \* Separation of waste solvent collection pipes to avoid wastewater draining to waste solvent tank and reduce waste quantity.
- \* Separate and recycle high concentration waste HF to reduce the quantity of  $\text{CaF}_2$  sludge.
- \* Set up sludge dryer to reduce water content in sludge and lower the cost of disposal.
- \* Promote office OA system to reduce the usage of paper and transparencies.
- \* Washable dishes, bowls, chopsticks and spoons are used to reduce waste quantity.



*$\text{CaF}_2$  sludge is shipped to cement plant for recycling*



*Recycling of waste fluorescent lamps*





Formosan Blue Magpie

## GLOBAL WARMING GASES EMISSION REDUCTION

Perfluorinated Compounds (PFCs) such as  $\text{CHF}_3$ ,  $\text{C}_2\text{F}_6$ ,  $\text{SF}_6$ ,  $\text{CF}_4$ ,  $\text{C}_3\text{F}_8$ ,  $\text{C}_4\text{F}_8$  and  $\text{NF}_3$  are widely used in the etching and Chemical Vapor Deposition (CVD) chamber cleaning process of semiconductor manufacturing processes. According to the calculation method of World Semiconductor Council (WSC), Taiwan Semiconductor Industrial Association (TSIA) promised to reduce PFCs emission to 10% below the average emission value of 1997 and 1999 by 2010. In the mean time, a "Memorandum of Understanding on Perfluorinated Compound Emissions Reduction of TSIA" has been signed between member companies in 2001. TSMC has also created a "TSMC PFCs emission reduction procedure" to serve as the guide for PFCs emission reduction activities.

Besides, TSMC has achieved the following results after implementing PFCs emission reduction activities:

1. Accomplished the research on using  $\text{C}_3\text{F}_8$  to substitute for  $\text{C}_2\text{F}_6$  in CVD process.  $\text{C}_3\text{F}_8$  is widely used in the process now.
2. Completed the process parameter optimization study of AMAT HDP tools to reduce the usage of  $\text{NF}_3$ .
3. Finished the process parameter optimization study of etching tools to reduce the usage of  $\text{NF}_3$ ,  $\text{CF}_4$  and  $\text{SF}_6$ .

The above second and third accomplishments have been published in the eighth International Semiconductor Environmental, Safety and Health (ISESH) conference so as to share our experiences with the other companies. In order to promote the study of technologies related to PFCs emission reduction, TSMC participates actively in the TSIA PFCs emission reduction working group to share its PFCs emission reduction experiences and technologies.



# OCCUPATIONAL INJURY & ILLNESS STATISTICS

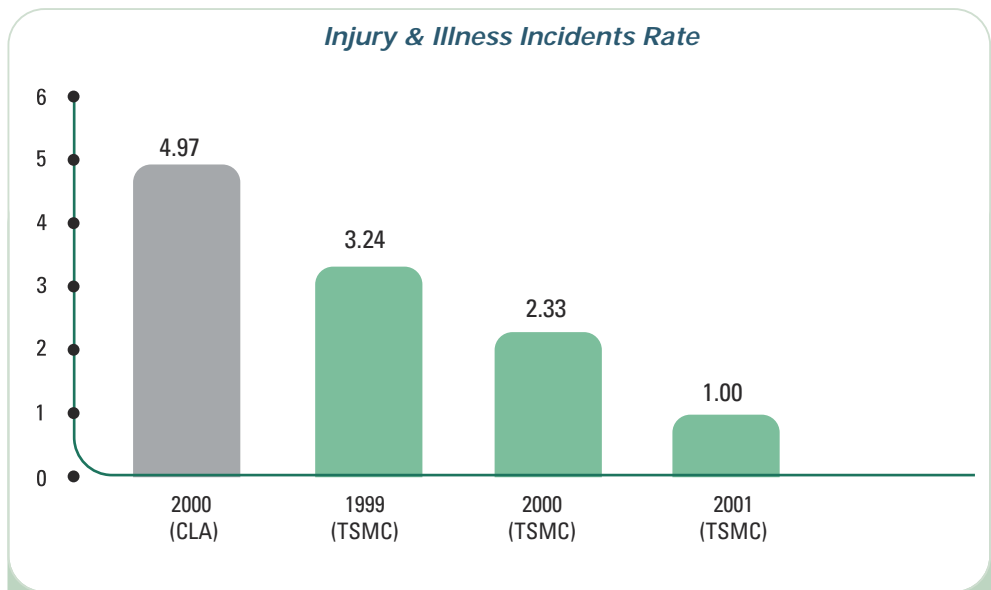


The Gray-throated Minivet gets its name from its gray-white throat. The male has an orange-red breast, belly and tail and the female is yellow. It can frequently be spotted in flocks in mid- and low-elevation broadleaved forests and is a common resident bird.

According to the definition of occupational injury & illness indices by the Council of Labor Affairs (CLA), TSMC has applied the three following indices as the performance evaluation:

- Injury & Illness Incidents Rate (The number of loss-day injury & illness cases per 1000 workers)
- Frequency Rate (FR, the number of disabling injury & illness cases per million man-hours)
- Severity Rate (SR, the number of loss days due to disabling injury & illness per million man-hours)

For the third straight year, the rate of occupational injury & illness of TSMC was substantially reduced, which indicated the concept of work safety was being incorporated into TSMC's daily work.

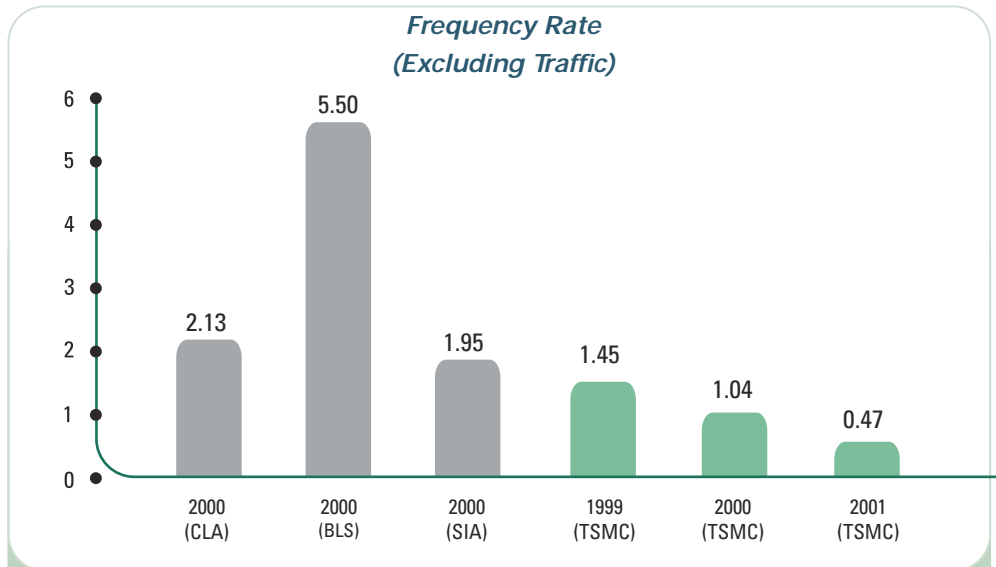


### (1) Injury & Illness Incidents Rate

The number of injury & illness cases per thousand workers of TSMC reduced to 1.00 in 2001 from 3.24 and 2.33 in 1999 and 2000 respectively. It is also lower than the rate of CLA (4.97) in 2000.



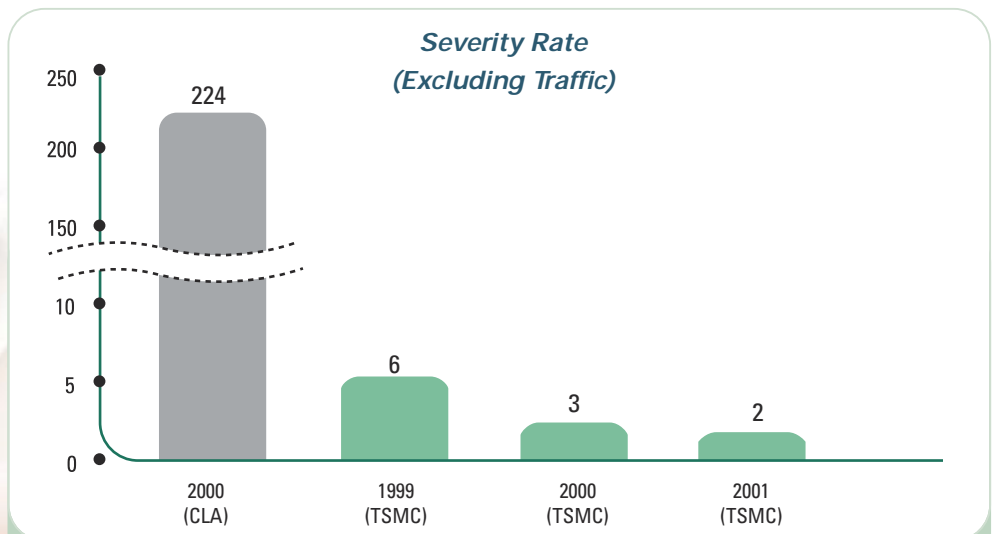
# OCCUPATIONAL INJURY & ILLNESS STATISTICS



### (2) Frequency Rate

The frequency rate of TSMC reduced to 0.47 in 2001 from 1.45 and 1.04 in 1999 and 2000 respectively. It is also lower than the rate of CLA (2.13) in 2000. The frequency rate of the Semiconductor Industry Association of USA (SIA) and that reported by the Bureau of Labor Statistics (BLS) in 2000 were 1.95 and 5.50 respectively.

*Note : The frequency rates of SIA and BLS have been normalized to fit CLA's indices.*



### (3) Severity Rate

The severity rate of TSMC reduced to 2 in 2001 from 6 and 3 in 1999 and 2000 respectively. It is also lower than the rate of CLA (224) in 2000.



## CONTRACTORS & SUPPLIERS MANAGEMENT

To increase understanding between TSMC and contractors & suppliers, TSMC holds an annual contractors & suppliers communication meeting. At the meeting, TSMC announces ESH notifications to representatives and receives their suggestions.

According to the number of visitations recorded in the TSMC security system, TSMC invited the top 120 contractors & suppliers to attend 2001 annual communication meeting. The participating companies represent 85% of all TSMC's contractors & suppliers.

In spite of industry downturn in 2001, TSMC still recorded 570,000 contractors & suppliers workdays (1,560 workers per day on average). The huge number of contractors & suppliers workdays has allowed TSMC to complete most of its projects smoothly, especially Fab 12 project, which has established a new milestone in Taiwan. In another perspective, such a huge number of contractors & suppliers bring high risks. According to the accident records in 2001, TSMC still need to do efforts on improvements. TSMC hopes that contractors & suppliers can achieve zero-accident record while achieving business success.

TSMC established an ESH Performance Evaluation System and linked it to the procurement system in 2001. It helps us to establish a procurement policy that balances between quality, price and ESH.



*Award to ESH excellent performance contractors*



*A glance of the contractors & suppliers communication meeting*



## CHEMICAL MANAGEMENT

Before using new process chemicals, Risk Management department reviews ESH related information including flammability, potential health effects and the ability of safety control and handling based on the "Safety Management Of Change" procedure. A total of 17 new chemicals were evaluated in 2001, most of which were for R&D.

TSMC requests suppliers to provide "Material Safety Data Sheet" (MSDS) during the procurement stage and label the containers for hazardous material. MSDS is available in the operation area. For those departments using specific chemicals and organic solvents, their managers must have safety training and obtain licenses to take responsibilities for ESH in working areas.

Chemical operators must take safety and health training courses and follow operational instructions for handling chemicals. They also hold emergency response drills routinely to lower damage if accidents occur. Meanwhile, personnel is assigned to receive first-aid training for providing first aid in emergency response. Due to the possibility of HF injury in semiconductor industry, we prepare not only calcium glucose but also hexafluorine to treat the injured more effectively.



*Hexafluorine for HF injury first aid*



*First aid training- chemical injury*







## ERGONOMIC ENGINEERING IMPROVEMENT

TSMC has always been proactive in preventing ergonomic risk and solving potential problems. We established an "Ergo team" in early 2001, whose members include RM, ISEP and ESD at each fab. After one year's effort, we have achieved the following:

1. Established TSMC's first ergonomic management procedure and four operational instructions to prevent TA's muscular skeletal injury and provide workload, posture, hand-tool selection and human machine interface standard.
2. Cooperated with National Tsing Hua University to complete the evaluation of eye fatigue improvement for After Developing Inspection (ADI)/ After Etching Inspection (AEI) microscope inspection workers and the evaluation of TE's lower extremity aching caused by daily operations.



*Current work type*



*Recommended work type*

3. To reduce the strength applied by the waist and back of Chemical Mechanical Polishing (CMP) periodic maintenance workers, the engineering department developed an automatic Pad-removal tool by themselves. Temporarily, this year, we will add Teflon coating on CMP platen surface to reduce friction loss as permanent solution.
4. Stipulated the ergonomic injury determination procedure, including a committee hosted to form consensus. The procedure helps department managers to identify incidents incurred by ergonomic causes.

## ERGONOMIC ENGINEERING IMPROVEMENT

To promote ergonomic awareness, TSMC provides three ergonomic-related e-learning training courses. In January 2002, the symposium entitled "TSMC Ergonomic Engineering Achievements" was held at TSMC. National Tsing Hua University summarized the ergonomic programs that had been conducted in TSMC for the past few years. Based on TSMC's ergonomic belief "Fit for Work, not Work for Fit", TSMC's employees are working in a more human oriented environment.



# WELLNESS-EMPLOYEE HEALTH PROMOTION

We provide wellness programs to pursue the physical, mental, social and spiritual well-being of all employees. The goal of wellness services is to promote employees' health, ensure the quality of work life and prevent work-related injuries and diseases. Services include clinical consultation, fitness center & gym services, psychological counseling and nutritional & fitness consultation. The comprehensive wellness programs offered by TSMC are among the best in the industry.



These services include not only health promotion programs, but also general health care and occupational health services so as to meet employees' need in every aspect. For example, we provide "heart care" program to employees with cardiovascular risk factors, "liver care" program for employees with abnormal liver functions. Carotid duplex sonography examination and abdominal sonography examination are also among these programs provided by TSMC. Besides, another service available is cancer screening program for women, weight control & loss program, massage services to relax and relieve stress, office stretching exercise promotion, influenza vaccinations for employees and their dependents. Throughout the years, a number of seminars and speeches of different health-related topics have been held at the headquarters and individual departments.

There is a wellness web-site on the intranet called eWellness Center. It provides lots of health-related information and interactive services for all TSMC employees. Every employee is entitled to a comprehensive annual health check up free of charge and the result is kept in the intranet database. There are more than 40,000 visits to the eWellness Center each year. You can log on to search for individual health check up report, register for clinic service appointment or search for a variety of health information including first aid, exercise & fitness, health promotion activities, self care, nutrition, beauty care, counseling and mental health or health risk assessment.

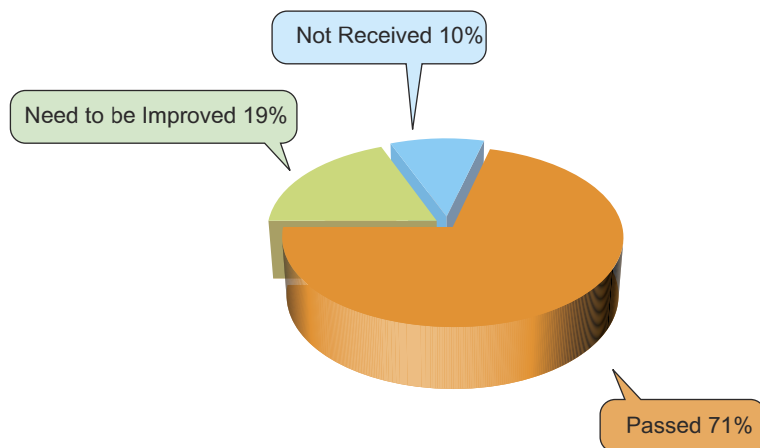


## EQUIPMENT RISK ASSESSMENT

In order to ensure the safety of personnel and property as well as the continuation of business operation, the process from the design, operation to decommission of the equipment used for semiconductor manufacturing should take into consideration of ESH. The new tools must be certified by SEMI S2-93A/0200 ESH Guideline (SEMI, Semiconductor Equipment and Material International) before they can be installed in TSMC's fabs. The SEMI S2-93A/0200 reports that suppliers provide to users should include:

- \* The Specifications of The Tools
- \* Seismic Protection
- \* Safety Interlock System
- \* Hazard Analysis
- \* Ergonomic & Human Analysis
- \* The List of Key Parts and Documents of Certification
- \* Fire Risk Evaluation
- \* The Certification of Fire-fighting Equipment and Equipment Category Required for Setup
- \* The Information of Industry Hygiene
- \* The Information of Environmental Protection

*12 inch equipment meet SEMI S2-93A/0200 statistic data  
(December 2001)*







## EQUIPMENT RISK ASSESSMENT

The installation period of semiconductor tools is one of the events with the highest risks. In order to ensure that each function and safety measure comply with design requirements during tool installation, TSMC has set up a "Tools Installation Sign-Off Procedure". The related personnel conduct the performance and operation safety inspections, which include three steps:



*New equipment installation check list*

### SL1 (Safety Level 1)

The safety inspection for turning on non-HPM (non-Hazardous Process Material) utility.

### SL2 (Safety Level 2)

The safety inspection for turning on HPM utility.

### SL3 (Safety Level 3)

The safety inspection to ensure that the technical personnel and maintenance workers work in a safe environment.



## EMERGENCY RESPONSE

The emergency response requires comprehensive considerations, continuous retrofit and practice. TSMC's emergency response procedures include the first time response (or emergency response period), crisis management step and disaster recovery plan.

About emergency response, each site facility has an Emergency Response Center(ERC). ERC workers are on duty 24 hours a day responsible for alerting the Emergency Response Team(ERT) and broadcasting the personnel evacuation announcement.



*Facility of ERC*

TSMC's emergency response training includes basic and advanced courses. Each ERT member must complete these two kinds of training courses. Only those who pass the test then become the ERT members. The accomplished rate of ERT training was over 95% at each fab in 2001. Being ERT members, they are required to receive the two days fire fighting training program in King-Shan. There were over 800 ERT members completed the training in 2001. Emergency response drills are held quarterly by each manufacturing department and annually by each fab.



*Emergency response drill - gas leakage*



*Emergency response drill - fire fighting*



# EMERGENCY RESPONSE

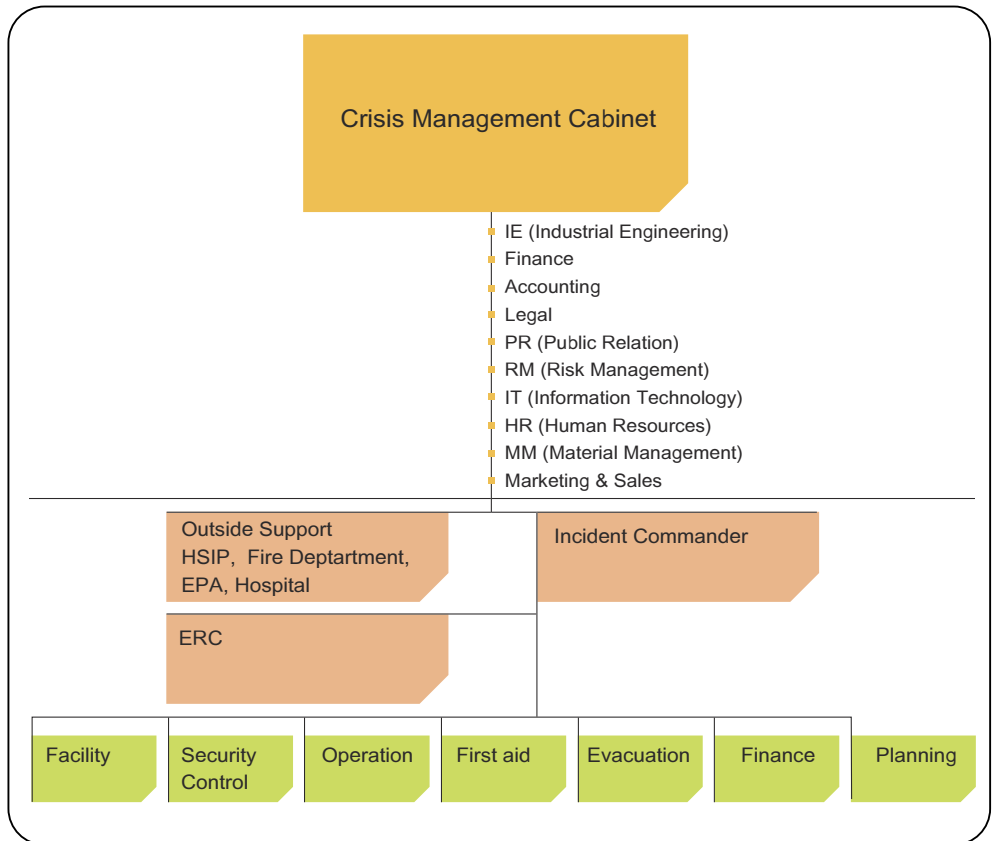
TSMC has a disaster response organization at the headquarters, which stipulates disaster recovery guidelines for each fab and supporting department to follow. Each fab also stipulates its own disaster recovery plan that specifies relevant response procedures for possible disasters.

With regard to the crisis management, TSMC Crisis Management Cabinet consists of senior executives. This cabinet conducts annual reviews of possible disaster scenarios and formulates relevant emergency response guidelines. For example, the "TSMC Natural Disaster Emergency Notification Procedure" announced in 2001 was established in accordance with the cabinet review and instruction.

## Disaster Response Organization



Crisis Management training



About the disaster recovery plan, TSMC holds a disaster recovery drill for new risks every two years. By this drill we review the feasibility of this plan and retrain the responsible personnel to improve their response abilities. The clients of TSMC are also very concerned with the disaster recovery plan. A total of seven clients requested to learn about TSMC emergency response and plan for disaster recovery in 2001.



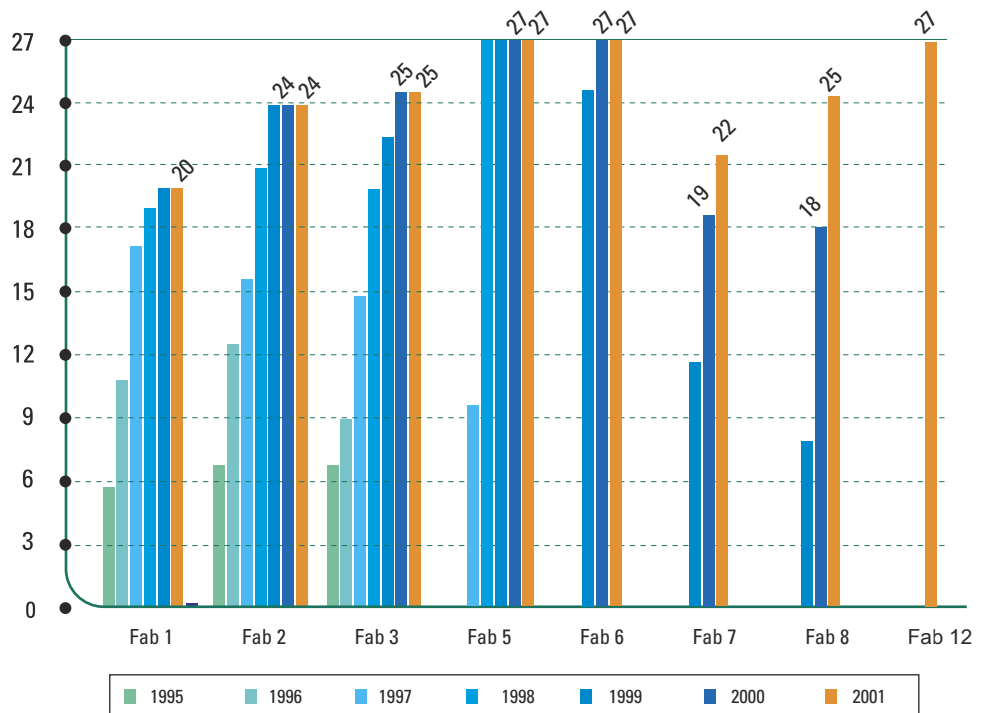
## AAA (TRIPLE A) PROPERTY LOSS CONTROL PROGRAM

The AAA program is a property loss control program that is comprised of 27 categories, including fire safety management systems, fire protection equipment, and semiconductor material distribution systems.

The function of this program is to help employees establish fire protection knowledge through a simple easy-to-understand program. This program enables the difficult-to-understand loss prevention concept to be applied throughout all fabs. The rating system is standardized, allowing top management to understand improvement performance as compared with all of the others fabs of TSMC. It also allows top management to set priorities for facility improvement recommendations and to enhance safety protection for each fab to reach world-class standards. In turn, the integration of loss prevention concepts within TSMC’s corporate culture helps to reach our goal of continuous growth.

Since we implemented the AAA program in 1995, risk reduction plans and continuous improvement projects have been continuously introduced to TSMC. Fab 5 achieved the highest AAA honors for the last four consecutive years. Fab 6 also achieved the highest AAA honors for the last two consecutive years. And Fab 12 achieved the highest AAA honors in 2001. These honors proved TSMC’s efforts on loss prevention again. Each fab continues to make improvements in lowering their risk.

*27 categories are the highest honors of AAA program*





Formosan Yuhina

# ESH ACTIVITIES

The Formosan Yuhina, so-named because of its distinct crest, is a species unique to Taiwan. It can be easily recognized by its pleasant "tu-mi-jiu" note. It often appears in flocks in mid- and low-elevation broadleaved forests and is a common resident bird.

Starting in 1994, TSMC has promoted environmental protection activities during the 3<sup>rd</sup> week of April as part of TSMC's Earth Week. This coincides with the worldwide Earth Day activities held annually on April 22<sup>nd</sup>. During the Earth Week, TSMC promotes the activities of environmental protection which include waste minimization, resources recovery, energy conservation, ecological conservation and ESH policy recognition.

To infuse environmental protection and work safety concepts into all employees, TSMC not only promotes a variety of ESH activities, also actively participates in related ESH activities of the government. The activities TSMC took part in 2001 are as follow:

- \* Participated in Tainan Science-base Industrial Park (TSIP) ESH promotion activities.
- \* Assisted the promotion of motorcycle exhaust examination held by Hsin-Chu County Environmental Protection Bureau (EPB).
- \* Joined "Run for blue sky" activity held by Hsin-Chu County EPB.
- \* Participated in "Environmental Protection Month" activities by Hsin-Chu Science-based Industrial Park (HSIP).
- \* Participated in "Safety & Hygiene Month" activities by HSIP.
- \* Participated in the activities of sustainable development of Hsin-Chu City.



*Participated in "Environmental Protection Month" activities by HSIP*



*Assisted in the promotion of motorcycle exhaust examination held by Hsin-Chu County EPB*



*Participated in "Safety & Hygiene Month" activities by HSIP*



*Participated in TSIP ESH promotion activities*





Black-faced Spoonbill

The Black-faced Spoonbill is a worldwide-known endangered species named because of its flat spoon-like bill and black face. The Tseng-Wen river estuary is its most important winter shelter in the world. It is a nocturnal bird, spending the daytime resting gregariously in the sandbar. It is a rare migratory bird.



***Pollution Control Equipment Maintenance Outstanding Performance Plant (2001)***



***Energy Conservation Award (2001)***

## AWARDS

Year	
2001	Pollution Control Equipment Maintenance Outstanding Performance Plant
2001	Energy Conservation Award
2001	HSIP Safety & Hygiene Excellent Unit Award
2001	CLA VPP 3 Years Honor
2000	1st Industrial Excellence Award
2000	Pollution Control Equipment Maintenance Outstanding Performance Plant
2000	National Safety & Hygiene Excellent Unit Award
2000	SIPA Safety & Hygiene Excellent Unit 5 Star Award
1999	8th Outstanding Environmental Protection Company
1999	National Industrial Waste Minimization Outstanding Performance Plant
1999	Energy Conservation Award
1999	Special Award for Outstanding EP Performance
1999	National Safety & Hygiene Excellent Unit Award
1999	HSIP Safety & Hygiene Excellent Unit Award
1999	CLA VPP 3 Years Honor
1998	HSIP Safety & Hygiene Excellent Unit Award
1998	WSO(World Safety Organization) Specific Award
1997	6th Outstanding Environmental Protection Company
1997	National Outstanding ESH Performance Company
1997	National Industrial Waste Minimization Outstanding Performance Plant
1997	National Safety & Hygiene Excellent Unit Award
1997	CLA VPP 2 Years Honor
1996	Energy Conservation Award
1996	5th Outstanding Environmental Protection Company
1995	Outstanding Environmental Protection Performance Company in Hsin-Chu County
1995	Pollution Control Equipment Maintenance outstanding Performance Plant
1995	4th Outstanding Environmental Protection Company
1995	National Pollution Control Outstanding Performance Company
1995	National Industrial Waste Minimization Outstanding Performance Plant



Brown Wood Owl

The Brown Wood Owl-its breast, belly, legs and eyelids yellowish and the rest black-appears in mid- and high-elevation open areas. It is a rare resident bird with low and gloomy note.

## PERSPECTIVE

Looking back at the economic downturn during 2001, both in the economy as a whole and within the semiconductor industry, we did not allow this economic downturn to affect our commitment to ESH improvements. Actually, we always contributed significant resources into ESH improvement programs and these efforts have not only led to recognition from government but also earned TSMC four national awards in 2001. They are the "Energy Conservation Award" from Ministry of Economic Affairs, "Pollution Control Equipment Maintenance Outstanding Performance Plant" from Industrial Development Bureau, "Voluntary Protection Program Three Years Honor" from Council of Labor Affairs and "Safety & Hygiene excellent unit award" from Hsin-Chu Science-based Industrial Park Administration.

Now, we have already accumulated much experience and knowledge of ESH. By introducing knowledge management tools, we deliver these experience and knowledge in all operation management and fab design. We look forward to these efforts can achieve the goals of preventing incidents, improving employee safety and health, protecting property, preventing pollution, and using efficiently all resources which disclose in TSMC ESH Policy.

Looking ahead, we will continue our existing activities to lower environment impact which include energy conservation, resource recycling, pollution prevention efforts, waste reduce, PFCs emission reduction and chemical management. In addition, we will introduce "Life Cycle Assessment" program, "Environmental Cost Accounting" system, and "Green Procurement" policy in 2002. In safety and health aspect, we will continue to promote occupational injury prevention programs and establish international audit system.

As a corporate citizen, we will spend more efforts in communicating with interested parties and legislative authorities on ESH development. We expect them to listen and understand our situation. This dual communication will build a healthy and sustainable living as well as working environment.



Brown Wood Owl

## ABOUT THIS REPORT

- \* ESH performance indicators of our 2001 report were collected from Feb 1, Feb 2, Feb 3, Feb 5, Feb 6, Feb 7, Feb 8 and Feb 12.
- \* ESH performance indicators of our 2001 report are not appropriate for making comparisons with other industries.
- \* If any question please

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