

## **Lockheed Martin Case Study**

**\*Lockheed Martin Corporation\***

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### **Company Description**

Lockheed Martin Corporation is a diverse, high-technology company involved in aerospace, information technology, energy research and production and environmental technology and defense programs. The corporation has 160,000 employees and annual sales of \$30 billion.

Lockheed Martin Utility Services, Inc., operates the Paducah Gaseous Diffusion Plant for the United States Enrichment Corporation. The plant produces enriched uranium that fuels nuclear reactors in the United States, Japan, Korea and Europe. The plant has 4,300,000 square feet under roof. Four large process buildings constitute about 75 percent of the plant's total floor space. There are also cooling towers, electrical switchyards and several support operations structures, including sewage and liquid effluent treatment plants, decontamination and recovery operations, water treatment, a coal-fired steam plant, maintenance operations, laboratories, fluorine facilities and air plants.

Revenues from 1996 sales were \$1.6 billion for the Paducah Plant and her sister facility in Portsmouth, Ohio. Together, the plants use more than 3,000 megawatts of electricity, equivalent to about one percent of the total electricity generated in the United States. At the same time, the amount of enriched uranium both plants produce in one year is sufficient to meet the electricity needs of California and New York.

The Paducah Plant has 1950 employees working in four shifts, seven days a week. The hourly labor force is represented by two collective bargaining agents, Oil, Chemical and Atomic Workers Union, Local 3-550 (OCAW) and the United Plant Guard Workers of America, Local 111 (UPGWA). The two unions represent over 900 employees, 876 in OCAW and 35 in UPGWA. Each bargaining unit has elected officials which serve on a number of improvement teams throughout the year. Their knowledge and experience of plant operations plays a vital role in the success of the safety and health programs.

### **Safety & Health Program**

#### **A. Overview**

The Paducah Plant's strategic plan is based on a "Survive and Thrive" strategy that focuses on:

- Accident- and -Error Free Performance
- 100% Availability of Production Equipment
- Reducing Costs

The Paducah Plant views accident- and error-free performance, employee safety and health and productivity as part of a closely linked process. When the plant operates without errors, accidents are avoided and equipment is maintained in a fully operational condition. The plant has adopted a home-grown version of a Japanese Five S program (based on the work of Takashi Osada) called Conduct of Operations. This program focuses on accurate procedures, extensive training and qualification of employees, work control and pre-job briefings as the basis of maintenance work and an extensive program of internal surveillances, audits and self-assessments. Paducah employees place emphasis on planning, good housekeeping, standardization of work practices, communication and discipline. All plant personnel are expected to report any problems (and recommend solutions) through a structured problem reporting system, which identifies about 8,000 issues a year. The problem reports are reviewed daily by Industrial Safety to identify safety issues. Safety evaluations are conducted and immediate compensatory actions are implemented. After the safety evaluation is conducted the problem reports are classified as safety suggestions if warranted and assigned to the responsible organization for correction. Additional focus on safety is provided through safety meetings, a rigorous lockout and tagout program, a joint union and management safety committee, a staff of health and safety experts and the use of empowered union/management teams to improve safety and work processes. The OCAW union has an appointed safety and health representative who identifies safety and health issues and provides input for making improvements to the plant's safety and health program. He works as a craftsman half a day and as a safety professional the remainder. This arrangement has enabled him to contribute to the successes in resolving safety issues.

Each month, union representatives from OCAW and UPGWA and management meet to identify safety-related issues in the plant and discuss concerns raised at off-site union meetings. As a result of the monthly meetings, actions are assigned to the managers and progress on corrective actions is tracked through the minutes of the meeting until resolved. Electrical issues are referred to the Plant Electrical Safety Committee for resolution. Plant personnel also conduct extensive root cause analysis of any major Safety or operational problem and examine the root causes of minor repetitive problems.

The plant's senior management takes a very active role in the safety program. Senior management regularly spend time walking spaces throughout the plant evaluating health, safety and operational conditions. Facility evaluations are conducted based on their personal observations and reports are issued quarterly. First line managers are also vital leaders for safety and productivity. These managers conduct the crew briefings, hold safety meetings, verify compliance with procedures and assure that their employees meet documented qualification standards. First line managers and maintenance work planners review all aspects of jobs prior to the initiation of job activities. Planners ensure adequate parts and procedures are available. First line managers go to the work area and review Lockout/tagout (LO/TO) permits and boundary controls parameters. First

line managers are the first people to receive and act on any type of safety or operational issue.

The Safety and Health Work Permit (S&HWP) and the LO/TO programs are two fundamental elements of the overall safety and health program at the Paducah plant. The S&HWP is a tool used to evaluate planned work to identify potential job hazards. The S&HWP consists of two major sections. The first section lists a broad description of the entire project and is titled, "ENTIRE WORK SCOPE." This section applies to all work groups that will perform work under this permit. Space is provided in this section for support groups such as Nuclear Safety, Fire Services, Industrial Safety, as well as other needed groups to provide further recommendations for the control or elimination of safety hazards. Appropriate safety guidance such as system preparations, nuclear criticality requirements, LO/TO permits, etc., are listed in this section as it applies to the entire work scope. The next section is job specific and is titled "PERMIT BLOCK" Permit blocks are subdivisions of the operations required to complete the broad objective stated in the entire work scope section. Each craft will receive their own permit block that encompasses the tasks they are to perform. Space is provided in these blocks for Health Physics and Industrial Hygiene groups to perform specific health hazard evaluations, as needed. Pertinent requirements such as required personal protective equipment heat stress work/rest regimens, sampling requirements, additional special equipment, etc., are listed in this section. In 1992, the LO/TO program was enhanced to meet new standards which include the use of personal locks, lock boxes and lockable valve covers.

All employees are expected to work in accordance with the plant's procedures. Employees are expected to report any and all problems with equipment or procedures and any form of safety and health concern through the problem reporting system. Employees who report problems always receive a reply to let them know what corrective action is being taken.

A general plant policy to empower all plant employees with Stop Work Authority is an example of the management's team concept in operating the plant. All employees have the authority to stop work if they notice a change in their job scope which presents a hazard. Any procedure error detected is adequate reason for stopping work. Work cannot continue until errors are corrected and all job hazards are eliminated.

## **B. Capital Improvements**

Since 1990, various internal and external safety and health audits performed at PGDP have resulted in the identification of more than 14,600 unsafe conditions. The audits compared the company workplace conditions with the United States Department of Labor, Occupational Safety and Health Administration (OSHA) General Industry Standards. The majority of the unsafe conditions identified during that time period were related to working platforms, machine guarding,

electrical equipment and fire protection upgrades. Through April 1998, all but 30 of the 14,600 unsafe conditions have been repaired or replaced to meet OSHA standards and improve employee workplace conditions. As stated before problem reports can be written by any employee who discovers an unsafe act or condition. All problem reports written related to employee safety are evaluated by a dedicated group of industrial hygiene and safety specialists.

Since 1993, management has spent approximately \$12million dollars on OSHA compliance upgrade projects.

Major projects include:

#### \* [Guardrail Installation](#)

Over 7 miles of guardrail have been installed on work platforms at elevated heights to protect employees from fall hazards.

Approximately 125 ladders, platforms and stairways have been repaired or replaced to meet OSHA standards.

#### \* [Machine Guarding](#)

Currently, 1500 pieces of process and auxiliary equipment have had machine guards installed or modified to meet OSHA machine guarding standards.

#### \* [Electrical Safety](#)

Over 600 circuit breaker panel directories were retraced and labeled to ensure overcurrent protection of equipment.

#### \* [Fire Protection](#)

Significant improvements to sprinkler systems have been made to various buildings throughout the plant to protect employees and process equipment.

#### \* [Health Hazard Upgrades](#)

Comprehensive studies to identify health hazards including respiratory protection, heat stress and hearing protection were conducted, evaluated and applicable recommendations implemented.

### **C. Union/Management Safety and Health Teams**

The plant makes frequent use of Total Quality Management (TQM) teams to improve work processes and employee safety. These teams are composed of union employees and members of management. The combined knowledge of these groups have enhanced facility operations. Some of the team.s recent accomplishments include:

-Improving hot work (welding and burning) by revising procedures, modifying

training and enhancing the overall welding program with these quality improvements.

-Reducing the amount of paperwork and preparation time required by the permit system by combining various work permits into one permit while still addressing all safety and health issues and ensuring employee protection.

- Researching new ways to protect workers in the plant's high temperature environments through the use of cool vests and portable air cooling equipment. The process floors can have temperatures reaching 140 degrees.

- Developing a safe new method for cleaning air cooled power transformers in production buildings and capturing the dust particles in a HEPA vacuum system. The new method meets OSHA requirements, prevents damage to equipment from build-up of dust and improves operating efficiency.

#### **D. Injury/Illness Performance**

Recent data on the plant's injuries and illnesses shows that in the past six years, recordable injuries and illnesses (RII) have declined from 8.31 in 1991 to the 1997 rate of 3.07. (See Fig. 1) Total lost workday cases (LWC) have also declined. In 1991, the LWC rate was 4.1 and in 1997 had declined to 1.13. (See Fig.2) In comparison with the Bureau of Labor Statistics injury/illness data for 1996, the plant was below the industry average for our industry code. This improvement can be attributed to management's commitment, personal accountability, an effective safety program and teamwork, which has continually improved since 1990. Safety professionals work with employees during job planning. Conducting evaluations and question/answer sessions have also been beneficial for the employees. Utilizing a strong work planning philosophy has also been a key to reducing injuries and increasing production.

Total Recordable Injuries/Illnesses Rate (figure1)

1991	1992	1993	1994	1995	1996	1997
8.31	5.29	5.57	4.67	4.5	3.19	3.07

Total Lost Work Day Rate (figure2)

1991	1992	1993	1994	1995	1996	1997
4.1	1.96	0.84	0.98	1.1	1.27	1.13

Increasing safety awareness among employees has been a continuous goal for the plant. The more safety information an employee receives, the more likely he/she will think about how to complete a job in a safe manner. The plant has embraced the STAR concept - Stop, Think, Act and Review. This concept serves as a mental signal for employees to stay focused on being safe.

Many factors contribute to the plant's success in reducing injuries. For example:

- Crew briefings.
- Job evaluations.
- Discussions on potential hazards.
- Reviewing near-misses.
- Accident investigations (injuries and vehicles).
- Identifying hazards and immediately reporting.
- Communicating trending information.
- Displaying safety information/charts/graphs throughout the plant for employees to view (see following example).
- Motivating employees to be actively involved in their safety.
- Continuous training.
- Prompt reporting of minor injuries.

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Making Safety Visible

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	<b>Goals</b>	<b>Actual</b>
LWC-A	<=8/year	_____
LWC-A RATE	0.42	_____
RII	<4/month	_____
RII RATE	2.83	_____

PREVIOUS DAY INJURIES: \_\_\_\_\_

Accident- and error-free performance is not limited to on-the-job performance. It includes off-the-job performance as well. Off-the-job injuries can affect production by forcing a reassignment of employees, overtime work and job rescheduling. Safety meeting topics are selected to remind employees to be safety-minded away from work. Examples include vehicle/transportation safety, recreational safety and home safety (which includes fire, electrical, lawn equipment, etc.). Emphasis on off-the-job safety has been instrumental in the decline of off-the-job accidents, resulting in increased productivity.

Off-The-Job Injury Rate (figure3)

1991	1992	1993	1994	1995	1996	1997
9.24	5.67	4.85	4.29	2.48	3.81	2.45

Setting target goals for injury/illness performance is an integral part of the safety program to reduce injuries/illnesses and is used in conjunction with a safety award and recognition program. Employees are recognized for their safety performance. Demonstrations, safety fairs, seatbelt day, tool safety and electrical safety are some examples of campaigns utilized with specific safety awards distributed.

### Effect On Productivity

The Paducah Plant uses the separative work unit (SWU) to measure productivity based on total production output. Productivity is measured based on the unit cost of a SWU and based on the number of SWUs produced divided by the number of employees. Other measures that are important to the plant are on-time delivery and compliance with production schedules.

The Paducah Plant's safety based culture has enabled it to operate efficiently and reach all-time production records. The plant has maintained 100 percent delivery of its product on schedule and has constantly met quality standards. Factory costs have been reduced by 20 percent over the last 5 years and a 24 percent improvement in employee productivity has been achieved based on the unit output per employee. (See figure4)

<<figure4 : Omitted>>

One significant contributing factor to the 20 percent reduction in factory cost was the elimination of costly process incidents. Historically, these incidents have been caused by personnel error, inadequate preventive maintenance, or inadequate procedural controls. Several of these incidents have cost in excess of \$12million in equipment and production losses. (See figures 5 & 6)

<<figure5 : Omitted>>

Production Cells On-Stream (figure6)

1993	1994	1995
57.8%	72.0%	96.9%

The efforts to instill a safety culture at the facility involved the revision and generation of numerous procedures, improvements in training, significantly increasing the focus on procedural adherence, increased employee sensitivity to

conditions which could lead to equipment malfunction and improvement to the preventive maintenance program. These actions helped identify unsafe conditions and practices, thereby improving industrial safety performance. As a result of these actions, plant operations and maintenance has improved. The improvements have been demonstrated by reductions in equipment failure, the near total elimination of equipment downtime resulting from personnel error and increased production.

In addition to the positive trends in industrial safety and production, the increased rigor and attention to detail is in keeping with the expectations of the facility regulator, the Nuclear Regulatory Commission. Increased focus on improving industrial safety is clearly conducive to improving productivity of plant operations.

### **Comments and Coclusions**

High productivity rates in manufacturing can only be achieved by focusing on accident- and error-free performance. Safety and productivity are two sides of the same coin and are gained or lost through the rigorous daily focus on details through procedures, work control and effective communication.

The plant has been the recipient of several awards which demonstrate our ability to integrate safety, quality and productivity. In 1995, the plant received the Kentucky Governor's Safety and Health Award for working over man-hours without a lost workday requiring days away from work. In 1997, two awards were received; one national award and one state award. The plant was selected as one of the ten best plants in America by Industry Week magazine. In December, PGDP received a 1997 Commonwealth of Kentucky Quality Achievement Award. This award is presented annually to Kentucky companies that set and maintain a high standard for quality in daily operations.

It is evident that the safety and health of plant employees is of the utmost importance to senior management. Management's willingness to spend millions of dollars to identify and alleviate unsafe acts and conditions is evidence of their support. PGDP continues to evaluate workplace hazards and work on upgrade projects to improve workplace conditions and enhance employee safety. These changes have come during a time where emphasis was also being placed on production issues and improvements. The declining accident rates continue to show the compatibility of safety and production.