# UNDERWRITING MARKETING REPORT - EXAMPLE

**MEXICANA S.A. de C.V.**
Lerma, Mexico, Mexico
File No. EXA-100

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|---|---|
| Address: | Mexicana S.A de C.V.<br>Circuito de la Industria S/N<br>KM 22.5 Carretera<br>Lerma, Mexico CP 5200 |
| Survey Date: | November 18-20, 2010 |
| Consultant(s): | Mr. J. W. Wilson, Risk Engineer, PE, CSP, CPCU |
| Exit Conference with: | Mr. F. Fuentes, Plant Manager<br>Mr. E. Zarape, Engineering Supervisor |

*Scope of Report:* The report is for property insurance purposes only. It does not provide an analysis of all factors related to the safety of the Facility or of its operations, nor does it purport to identify all major factors relating to the safety of the Facility and its operations. Accordingly, any recommendations in this report are not meant to be taken as proof of all improvements that could be made to the facility or its operations. Furthermore, the absence of recommendations does not mean that no such improvements to the Facility are possible. Any risk assessment in this report relates only to damage to physical property and its direct ensuing financial consequences and is based purely upon the information supplied by the Client.

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# LOSS PREVENTION

## 1.1 SUMMARY

This is the second survey of this site by this office. The first survey was conducted in 1998.

Housekeeping throughout this facility was found to be quite good. Additional positive features at this location include the high level of staff experience and the thorough inspection of all plant equipment prior to the re-startup of this facility.

The recommendation regarding the Purification Area fire proofing has been moved to the Long Term Project List as the Site has agreed to the upgrade and will do it over a series of years.

## 1.2 LOSS PREVENTION INITIATIVES

The facility completed seven previously submitted Loss Prevention Recommendations as noted in the "Closed Recommendations" Section of this report. These improvements included the installation of separated and independent shutdown systems and a substantial upgrade in the capabilities of the site fire brigade that included both equipment and training.

## 1.3 LONG TERM PROJECTS

*Fire protection upgrade for Purification Area process structure*. A combination of automatic deluge waterspray protection and structural steel fire proofing is being provided for this structure over a 5 year period ending in 2005.

## 1.4 FIRE PROTECTION SYSTEM TEST RESULTS

Both fire pumps were flow tested during this survey. The diesel engine driven fire pump is rated as "Good". The electric motor driven pump tested "Excellent". See Appendix B for details.

The Fire Protection System Inspection and Testing Program was reviewed with no major deficiencies noted other than Recommendation 2002-4-FP, Fire Pump Maintenance.

| FIRE PUMPS | RATING | DRIVER | LOCATION | RESULTS |
|---|---|---|---|---|
| 1 | 2500 gpm@125 psi<br>1760 RPM | Diesel | 500,000 gallon tank | Good |
| 2 | 2000 gpm@100 psi<br>1785 RPM | Electric | 500,000 gallon tank | Excellent |

## 1.5 RECOMMENDATION RANKING TABLE

| Rec. | Description | Ranking | Status |
|---|---|---|---|
| 2000-1-FP | New Dowtherm Heater | B | Under review |
| 2000-2-FP | SCBAs | B | Under review |
| 2000-3-FP | Ortho-xylene Pumps | C | Under review |
| 2000-4- FP | Fire Pump Maintenance | D | Will do |
| 1998-1-MI | Mechanical Integrity Program | A | 2004 |
| 1998-5-PS | Control Room Pressurization | B | 2001 |
| 1998-2-PS | Emergency Shutdown Procedures | B | Completed |
| 1998-3-FP | Emergency Response Plan | B | Completed |
| 1998-4-FP | Truck Unloading Rack Deluge System | C | Alternate Completed |
| 1998-6-FP | Dowtherm Heating System | B | Alternate Completed |
| 1998-7-FP | Purification Area Fire Proofing | B | Long Term Project |
| 1998-8-PS | Emergency Shutdown Systems | C | Completed |
| 1998-9-MI | Install Salt Detection System on PA Reactor ... | C | Completed |
| 1998-10-MI | Install Vibration Monitoring on … PA Blower… | B | Completed |

Rankings:

| | | | |
|---|---|---|---|
| A | Loss Exposure > $50MM<br>Major Management System issue<br>Fire or Building Code Issue | B | Loss Exposure <$50MM<br>Moderate Management System issue |
| C | Loss Exposure < $10MM<br>Minor Management System issue | D | Loss Exposure <$1MM<br>Minor maintenance type issues |

Categories:

| | |
|---|---|
| FP | Fire Protection Recommendation (fire detection/suppression type issues) |
| PS | Process Safety Recommendation (Loss prevention type issues) |
| MI | Mechanical Integrity Recommendation (Equipment/system reliability and protection issues). |

## 1.6 OPEN RECOMMENDATIONS

### 2002-1-FP Dowtherm Heater Protection (B)

Provide the new gas fired dowtherm heater and pumps with the following loss control features.

A. Automatic deluge water spray protection over the dowtherm pumps (100 L/min per pump).

B. Automatic, fail close isolation valves on the dowtherm discharge and return lines out of the heater.

#### Assessment

The heater is in a remote, inaccessible location. The isolation valves are not separated from the heater or the pump by a brick wall like the primary heater does. A local, plug type valve manually actuates the water spray system.

#### Justification

A heater fire could damage the PA Flaking and bagging operation, shutting down the facility.

#### Alternatives

Use remote actuated control valves like the one used for the ortho-xylene pumps.

#### Action Plan

**Will review recommendation with corporate instrumentation & electrical engineering staff. A formal Action Plan will be developed this year.**

## 1.6 OPEN RECOMMENDATIONS - continued

**2000-2-FP SCBAs. (B)**

Provide a Self-Contained Breathing Apparatus (SCBA) for each fire brigade member with one spare bottle of air. Maximize the reliability of the fire pumps per the following suggestions.

### Assessment

The facility has purchased new fire fighting bunker gear for its brigade. Not all of is members have a SCBA with a spare air supply.

### Justification

It will probably take the Mutual Aid Society 20-30 minutes to arrive on site with additional SCBAs.

### Alternatives

Obtain a cascading type air refilling system for the air bottles.

### Action Plan

**Plan to do this year.**

## 1.6 OPEN RECOMMENDATIONS - continued

### 2002-3-FP Ortho-xylene Pumps (C)

Provide 100 mm curbs around the pumps.

#### Assessment

The pumps are located outside of the tank dike and are across the street from an electrical room. There is a remote actuated isolation valve and pump shutdown control inside the control room.

#### Justification

A small leak could easily be ignited and cause a bad fire at the motor control center.

#### Alternatives

Minimize probability of leaks by using only welded pipe and seal-less pumps. Or install a hydrocarbon detector over the pumps.

#### Action Plan

**Will do this year.**

## OPEN RECOMMENDATIONS – continued

**2002-4-FP Fire Pump Maintenance (D)**

Modify the fire pump maintenance program to include a 30 minute run time on the Cummins pump and weekly manual tests on both battery banks.

### Assessment

The maintenance program is good. It just needs to be expanded slightly.

### Justification

Compliance with NFPA 20, Fire Pumps. Maximize fire pump reliability.

### Alternatives

None.

### Action Plan

**Will do this year.**

## 1.6 OPEN RECOMMENDATIONS - continued

**1998-1 MI Improve the site mechanical integrity program. (A)**

This facility needs a written quality assurance program for the inspection, repair and alteration of pressure vessel, tanks and piping. As a minimum, a well developed quality assurance program for inspection should include sections on:

1. Program Management
2. Personnel
3. Inspection Procedures
4. Equipment Monitoring
5. Maintenance and Construction Inspections
6. Data Management
7. Audits
8. Corrective Action
9. Document Control
10. Incident Investigation

### Assessment

Although this facility has an experienced corrosion engineering group, the existing mechanical integrity program for pressure vessels, tanks and piping could be improved.

A rudimentary program is in place and vessels are routinely inspected. However, some improvements as described above would be beneficial. The Maintenance Supt. has received a copy of the Corporate Predictive and Preventive Maintenance Program. The PPM program contains all of the elements necessary for a good mechanical integrity program and should be utilized as a resource document for this facility.

#### Justification

Implementing a formal, organized mechanical integrity program will help insure that critical production equipment is suitable for continued service. Mechanical integrity of pressure vessels, tanks and piping systems helps prevent hazards presented by toxic, corrosive, and flammable materials.

#### Alternatives

There are no practical or viable alternatives to a formal mechanical integrity program.

#### Action Plan

**Site has begun updating their P&IDs and Equipment Files. Full completion of this recommendation is expected to occur by 2004.**

## 1.6 OPEN RECOMMENDATIONS - continued

**1998-5-S Control Room Pressurization. (B)**

Provide a clean external air source for the Control Room per NFPA guidelines for Class I Division 2 classified areas.

## Assessment

The control room (building) is set adjacent to the Purification Area, which handles large amounts of superheated dowtherm and boiling combustible liquids. The building has two stories and contains offices in addition to the process control operations.

### Justification

Protection of personnel and property in the event of vapor release from the Purification Area.

### Alternatives

Block up and seal all penetrations (including doors) in the wall facing the Purification Area and provide a standard HVAC system with air intakes on the opposite wall.

### Action Plan

**Plant will review during the next Process Safety Analysis of this unit as part of their Building Siting Assessment Survey. A formal Action Plan is expected this year.**

## 1.7 CLOSED RECOMMENDATIONS

### 1998-2-PS Emergency Shutdown Procedures. (B)

Provide explicit procedures and training for the operators on the timing and use of the “kill buttons” provided on the control panels and document this in the operations manual.

#### Assessment

The emergency “kill buttons” in the control room can shutdown the reactor feed, turns off power to the dowtherm heater, or turn off power to the Purification Area. The are no explicit documented conditions in the operating manuals that tell an operator when to push the buttons other than the very generic statement “in the event of an emergency push button”.

#### Justification

Clearly spelled out operator instructions are easier to review and train on and will dramatically increase the effectiveness of this critical process safety feature.

#### Alternatives

Hard wire these shutdowns such that they are automatically actuated.

#### Action Plan

**Completed. SOPs have been updated.**

## 1.7 CLOSED RECOMMENDATIONS - continued

### 1998-3-FP Emergency Response Plan (B)

Incorporate as much as possible realistic fire fighting strategies and tactics into the Facility Emergency Response Plan.

#### Assessment

The facility relies totally upon a volunteer fire brigade with limited assistance from an external volunteer fire brigade. Currently there are no detailed pre-plans for fire fighting or fire simulations being conducted on site by the plant or by the external fire fighting organization.

#### Justification

Pre-planning will allow the fire brigade to respond faster and more effectively in the event of significant fire or other incident.

#### Alternatives

Significantly increase the use of remote operated; fire resistant, process isolation valves and automatic sprinkler protection.

#### Action Plan

**Completed. Mutual aid society has begun having joint drills. Site emergency training and simulations have also begun.**

## 1.7 CLOSED RECOMMENDATIONS - continued

### 1998-4-FP Truck Unloading Rack Deluge System. (C)

Automate the manual deluge water spray system serving the truck rack using a pilot head heat detection system.

#### Assessment

A local valve can operate the existing deluge system only. The rack has an electrical grounding system and a spill containment system.

#### Justification

Increase the effectiveness of the deluge system by decreasing the system response time and the exposure to plant operators.

#### Alternatives

Provide control room actuation for the deluge system along with hydrocarbon detectors.

#### Action Plan

**Completed alternative. Installed quick acting ball valves on manual deluge system. Extra person stationed at rack during loading operations in case of emergency.**

## 1.7 CLOSED RECOMMENDATIONS - continued

### 1998-6-FP Dowtherm Heater Deluge System. (B)

Automate the manual deluge water spray system over the dowtherm pump and tank using a pilot head heat detection system.

#### Conditions

The deluge system over the pumps and storage tank is manually operated via a local valve. The valve and the heater are relatively isolated from normal working areas.

#### Benefits

Quicker response by the deluge system in the event of a fire and reduced exposure to operating personnel.

#### Alternatives

Provide control room actuation for the deluge system along with hydrocarbon detectors.

#### Action Plan

**Completed alternative. Installed quick acting ball valve on deluge system riser. Looking at installing organic vapor detectors as well.**

## 1.7 CLOSED RECOMMENDATIONS - continued

### 1998-7-FP Purification Area Fire Proofing. (B)

Extend fire proofing on the load bearing, vertical and horizontal structural steel supports (process structure, vessels and piping) to 10 meters above grade.

#### Assessment

The process structure and process vessels in this area are exposed to potential dowtherm pool fires. Some of the vertical structural steel is provided with fire proofing to 3 meters above grade

#### Justification

Protection of the Purification Area from spill fires and flange leaks. Reduction of the Normal Loss Expectancy estimate for this area by at least 50% and the other loss estimates by 10 - 20%.

#### Alternatives

Automatic deluge water spray protection over the area would also provide adequate protection for the equipment.

Discontinue the use of Dowtherm Liquid in the area.

#### Action Plan

**Moved to the Long Term Project List. This item will take several years to complete. The cost of water spray protection versus fire proofing is being evaluated.**

## 1.7 CLOSED RECOMMENDATIONS - continued

### 1998-8-FP Emergency Shutdown System (C)

Separate and independent emergency shutdown systems for the critical process safety interlocks on the Reactor and dowtherm heater should be provided.

**Assessment**

All automatic emergency shutdown functions are currently incorporated into the DCS process control system serving the facility.

**Justification**

A more reliable Emergency Shutdown System less prone to spurious and unsafe failures.

**Alternatives**

Hardwire all critical process shutdowns.

**Action Plan**

**Completed. Safe-guarded PLCs (per NFPA 85) installed for the PA reactor and the Dowtherm Heater.**

## 1.7 CLOSED RECOMMENDATIONS - continued

### 1998-9-MI Install a Salt Detection System on PA Reactor Shell.

The presence of salt on the process side would be a positive indicator of tube sheet or tube failure. Down stream process side detection of salt to indicate vessel failure is recommended.

#### Assessment

The PA Reactor is a shell and tube pressure vessel reactor. Cooling of the exothermic reaction is provided on the shell side by a circulating molten salt bath. The shell side pressure is higher than the tube side or process side pressure. Therefore a mechanical integrity failure of the tube sheets or tubes in the reactor should result in the presents of salt on the process side

#### Justification

Installing downstream salt detection should provide early warning of vessel failure, allowing for early action to reduce damage.

#### Alternatives

At this time, there appear to be no appropriate alternatives to this recommendation.

#### Action Plan

**Salt leaks to the process side of the PA Reactor will result in a sudden process side temperature increase. Therefore, two high temperature monitors set to alarm at 380°C have been installed downstream of the PA Reactor to detect salt leaks. Recommendation is completed.**

## 1.7 CLOSED RECOMMENDATIONS - continued

### 1998-10-MI Install Vibration Monitoring on the Primary PA blower. (B)

**Permanently installed vibration monitoring should be installed and connected to the control room process control system from the PA Blower.**

#### Assessment

The primary air blower is critical to the PA process. Currently this piece of rotating machinery is not equipped with installed vibration monitoring.

#### Justification

Installing vibration monitoring with appropriately set alarms and, perhaps automatic shutdowns, can provide early detection of excessive vibration levels and help reduce the consequences of high vibration.

Loss of this equipment will shutdown the process.

#### Alternatives

Currently there are no appropriate alternatives for early prompt detection of high vibration levels.

#### Action Plan

**An IRD vibration monitor has been acquired. Seven radial vibration sensors have been installed on this compressor. UCN wiring will be installed to connect the sensors to the operating room DCS.**

# UNDERWRITING

## 2.1 SUMMARY

The Lerma Facility is a small chemical plant that produces phthalic anhydride flake. The facility sells its bagged product both domestically and for internationally. The facility produces 12,000 tons per year of the finished product.

The buildings are of masonry and steel construction and are mostly one story high. The process structures are of steel construction and range up to four levels high. The tank farm is well detached from the closest building and is provided with diking. A 6" and 8" inch ( 150 & 200 cm) private fire water main supplied by two fire pumps supply manual deluge systems, hydrants, monitor nozzles and hose stations.

The principal hazards include the exothermic reaction of ortho-xylene in air, dowtherm heat transfer systems, combustible dusts, and the storage and handling of flammable liquids.

Critical services consist of steam, electrical systems, cooling water, and industrial gases. These services are considered reliable.

## 2.2 NEW CONSTRUCTION & PROCESS CHANGES

A small Plasticizer operation is being considered. It will use an unwanted by-product (maleic anhydride) of the PA process. The facility should produce about 9,000 tpy of PA in 2002.

The next catalyst changed for the PA Reactor is planned for the second quarter of 2001.

## 2.3 LAYOUT AND CONSTRUCTION

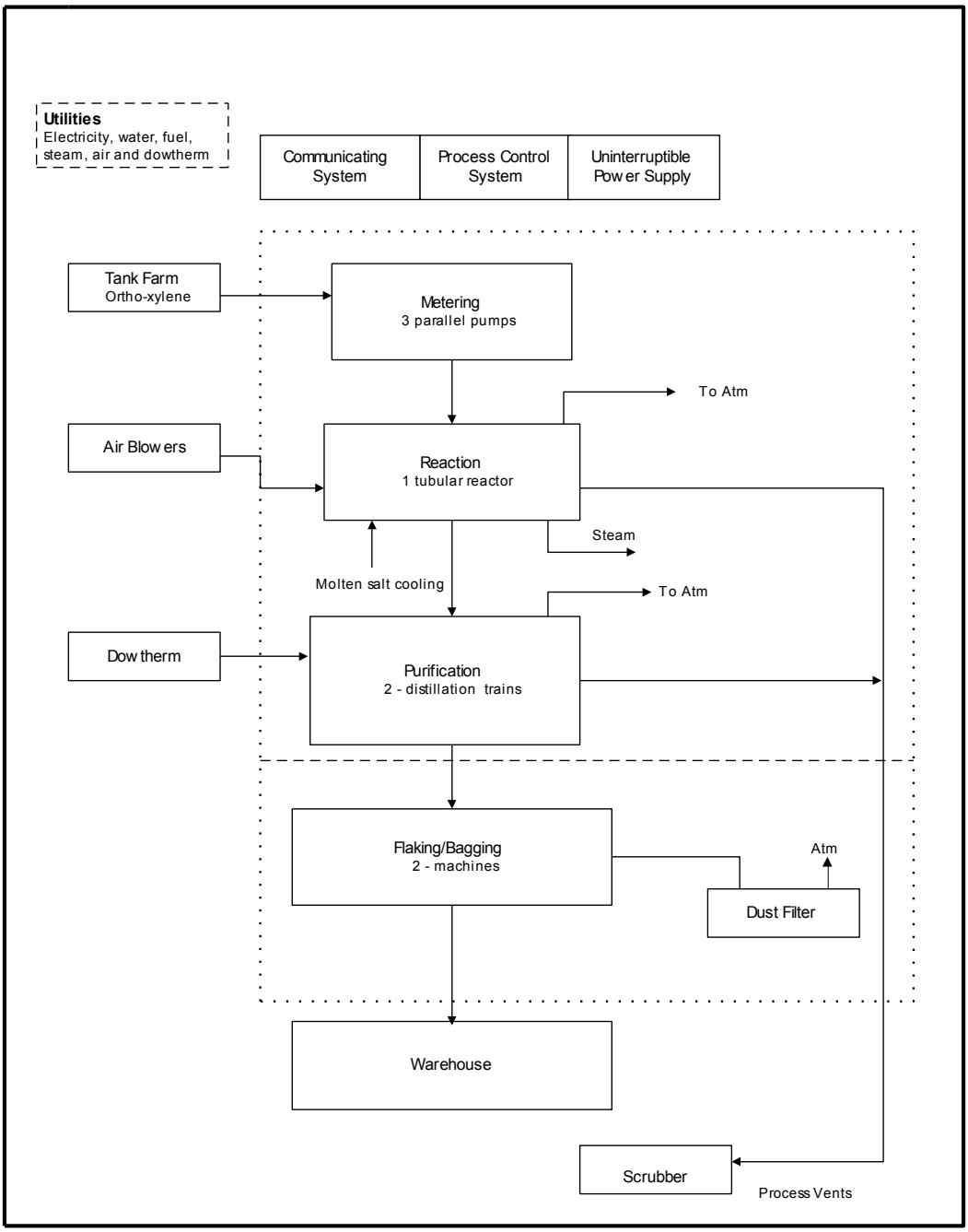
The site is 30 km outside of the Mexico City on the other side of the mountains that surround the city at an elevation of 2600 m. The soil base silt on bedrock. The facility was constructed approximately 20 years ago. The total site area is approximately 100 hectares. The site is has two processing areas separated by 20 meters. The tank farm and utility areas are well detached from one another. There are several small warehouse and office buildings

The Oxidation process structure is of open steel, two level construction with fire proofing provided for the legs of the reactors. The Purification process structure is also of open steel construction four levels high with fire proofing provided for the distillation column skirts. The Control Building (70 sq.m.) is set adjacent to the Purification Area and is a two level masonry building. The tank farms and utility areas are well detached. The Flaker Building (65 sq. m) is a separate noncombustible structure connected to the warehouses by a conveyor. The Office and warehouse buildings (1400 sq.m) are of masonry and light weight metal construction one story high. The tank farm is diked and very well detached from processing areas.

## PROCESS UNIT SUMMARY TABLE

| Process Unit | Nameplate Capacity | Production Rate | Internal Consumption |
|---|---|---|---|
| PA Plant | 12,000 tpy | 75% | None |

## GENERAL FLOW DIAGRAM



## 2.6 PROCESS DESCRIPTIONS

Liquid ortho-xylene is pumped from a storage tank, heated with steam, sprayed into hot air and injected into a packed tube reactor. This is a low pressure reaction that operates below the LEL. Molten salt cools the reactor. The reaction gases are cooled and then condensed in switch condensers. The crude phthalic anhydride is purified in two distillation lines consisting of batch distillation and vacuum distillation. The purified ortho-xylene is flake and bagged and stored three meters high in the warehouse for shipment to customers. A common scrubber is used for all vapors coming off of process vents. Distillation is achieved by heating with superheated dowtherm liquid. The reactor is rated for 40 tpd and is running at 32 tpd. All processes are run out of a single, constantly manned control room located adjacent to the Purification Building.

## 2.7 SPECIAL FEATURES

**Tank Farm:** Ortho-xylene is stored in a 200,000 gallon tank with a concrete dike with a manual deluge water spray system, as well as a remote actuated isolation valve on its product discharge line. The ortho-xylene transfer pumps are interlocked with the automatic and manual emergency shutdown systems.

**Truck Rack**: The tank is filled by tanker trucks via a dual bay, bottom unloading system. Plant personnel do unloading. Electrical grounding, manual deluge water spray protection and bunding is provided. A manual deluge water spray system is provided over the rack.

**PA Flaker:** Phthalic anhydride is flaked and bagged in a dedicated room. The dust collector has explosion venting through an external wall.

## 2.8 SERVICES

**Electricity:** Electricity is purchased from the local public utility. The incoming voltage of 23KV is distributed through three, three phased oil filled transformers that step down the incoming voltage to 480 volts or 600 volts. Transformers range in size from 1500 kVa to 2000 kVa. There is one spare 1000 kVa transformer on site. Rental transformers are of these sizes and voltage ranges are readily available in the area. Plant demand is normally about 4,400 kW. There is no standby generator.

**Industrial Gases:** Natural gas is provided by the local utility and enters the plant property via one underground supply main. Natural gas is used primarily for fuel. Standard manual shutdown procedures are utilized.

There are a variety of typical industrial bottled gases stored at the site in designated areas. Bottled gases are adequately secured during storage.

**Steam:** Steam is produced during normal plant operations by Dowtherm heaters and the PA process mixing reactors. The plant can also purchase steam at 450 psi from an adjacent plant for cold start up. Rental boilers are readily available in the area. This facility has no fired steam boilers.

**Dowtherm Heaters:** There are three Dowtherm heating systems at this location. System 1 is a natural gas fired 5 million BTU/hr watertube type heaters that serve the PA process. System 2 is a natural gas fired 7 million BTU/hr watertube heaters that serve the PA and the shutdown DOP processes. System 3 uses waste heat from the PA process to generate 300 psi steam. Full combustion controls are provided.

## 2.8 SERVICES - continued

**Water**: Service water is supplied by one on site deep well which was refurbished prior to the start up of the facility. Additional water supply is available from adjacent facilities. Process water is used for various process cooling systems.

**Cooling water/ towers:** There are three interconnected, one-cell cooling towers supply all of the cooling water needs. The towers are of counter flow design. There is no excess capacity within the cooling water system.

**Refrigeration:** All process cooling is done with water. There are no refrigeration systems at this facility.

**Compressed Air:** There are two small reciprocating air compressors at this facility. Compressed air is required for maintenance and instrumentation. Rental compressors are readily available in the area.

## 2.9 OTHER PERILS

**Exposures:** The site is located in an industrial/commercial park. Exposures to the site are rated as severe and include:

North: Vacant lot and car assembly plant - 50 meters from site.
South: Ethylene glycol plant - severe exposure 75 meters from site.
East: Pigment - detached 10 meters
West: Wax plant - detached 50 meters

Earthquake: The site is located outside of the Mexico City basin in Cresta Zone 25. This peril is considered severe.

There are no unusual features associated with the perils of collapse, vandalism and malicious mischief; windstorms, flooding or collapse was identified.

## 2.10 LOSS PREVENTION SYSTEMS

**Fire Protection Water:** There are two centrifugal fire pumps on site. There is a 2500 gpm at 125 psi diesel engine driven pump and a 2000 gpm at 120 psi electric motor pump. They both take suction from a 250,000 gallon vertical steel tank. There is also a normally closed 8 inch cross connection with the fire water supply of an adjacent plant.

**Fire Hydrants and Water Mains**: The facility has a gridded system of 8 and 6 inch fire water mains that supply hose stations, manual deluge systems and a few monitor nozzles.

**Fire Alarm System**: The fire pump running and trouble alarms annunciate in the Control Room. There is an audible site wire siren as well.

**Sprinkler/Water Spray Systems**: Manual deluge water spray systems on an extra-hazards schedule are installed over the truck rack, the main dowtherm tank and its pumps, the new dowtherm pumps, the Plasticizer columns and the Ortho-xylene storage tanks.

**Fixed Foam Systems.** Small foam hose stations are provided in the tank farm areas.

**Gas Detection:** None.

## 2.10 LOSS PREVENTION SYSTEMS - continued

**Process Control/Emergency Shutdown Systems:** The plant is on a DCS process control system with dedicated, safe guarded PLCs Reactors provided for the PA reactor and Dowtherm Heater. There are also hardwired master trips provided for the PA reactor and Dowtherm heater. The reaction can be killed by stopping reactant feed to the reactor. The reactant feed isolation valves fail close. The Flaker dust collector has been provided with explosion relief venting directly to the atmosphere.

**Drainage:** The process units are individually curbed. Storage tanks are diked. The truck rack can store up to 40 cubic meters of material.

**Gaseous Extinguishing Systems:** There are no fixed gaseous extinguishing systems.

**Fire Detection Systems.** None.

**Security**: The entire facility is fenced in with a constantly manned gate provided for access.

## 2.11 MANAGEMENT SYSTEMS

**Mechanical Integrity.**

Annual switchgear inspections as well as annual chemical and physical analyses of transformer oils and dissolved gas in oil analyses are performed. Prior to the restart of the plant, the transformers received the benefit of power factor testing as well excitation current testing. Infrared thermographic surveys are performed on a six-month frequency.

A small onsite maintenance staff performs all routine maintenance. Specialty maintenance is typically sub-contracted. Predictive and preventative maintenance programs are in place. Some efforts at pressure vessel tank and piping mechanical inspection programs are underway.

Maintenance, inspection and testing are manually scheduled on annual calendars. Documentation of maintenance practices; repairs and inspection are kept in individual equipment history files.

Internal inspections of the various process pressure vessels are coordinated with unit shutdowns. Ultrasonic thickness testing and corrosion coupon analysis are conducted to monitor corrosion and deterioration. Minimum thickness calculations are maintained in equipment history files to evaluate life expectancy and replacement criteria for all pressure vessels. Welded repairs are contracted to companies with certified welders (not usually ASME stamp holders) using Corporate welding procedures.

**Process Hazards Analysis:** The site has done Process Hazards Analysis on all operations. They comply with the new Celanese Mexicana process safety guidelines. There are no outstanding HazOp type recommendations. The MOC program is controlled out of Corporate in Mexico City.

**Safe Work Permits:** A new safe work permit system is in effect. Permits are required for all types of maintenance work. Specific permits are required Hot Work and Confined Space Entry. A fire watch is maintained during hot work. All energized equipment is physically locked out.

## 2.11 MANAGEMENT SYSTEMS - continued

**Training:** The training program for process and utility operators is fairly simple due to the small size of the operations involved. Experienced operators were hired when the plant restarted in 1998. Operators are certified by position.

**Emergency Response:** The Site Fire Brigade has 13 members on the daylight shift and 7 on the second shift. All are volunteers who receive bi-weekly training on site and annual training at a fire fighting school in Mexico. The Local Mutual Aid Society is "GIREL" which can respond with fire fighting equipment but not fire pumper trucks. The response time is 20 to 30 minutes.

## 2.12 BUSINESS INTERRUPTION FEATURES

Production Bottlenecks:

| Process Area & Equipment | Bottleneck<br>- product line<br>- product | B.I. loss to product line | Replacement Time in Months |
|---|---|---|---|
| Reaction | PA Reactor<br>PA Production | 100% of production | 6 months including commissioning |
| Flaking | 2 Flakers<br>PA Production | 50% of production apiece. | 2 months including commissioning |
| Purification | 2 distillation lines each having a pair of columns. | 50% of production apiece | 4 months including commissioning |

Additional plant items at this location include the primary and standby air blowers, rated at 1320kw and 750kw respectively, a mixer vessel, a reactor vessel, a gas cooler followed by various filters, two distilling vessels (one required), two distillation columns (one required), flaking and bagging equipment.

There is a spare Hastelloy heat exchanger tube bundle on site. A spare 8,000 scfm primary blower on site would require several weeks of refurbishment to be used. The old dowtherm boiler has been restarted.

The PA Reactor is a 1968 Deggendorfer unit.

Interdependencies:

There are no interdependencies with other Corporate facilities. They receive all of their ortho-xylene from a single supplier; however, other suppliers have been identified.

# FINANCIAL

## 3.1 SUMMARY

The Lerma Site has a Total Insurable Value estimated at $24.3 MM USD which $22.0 MM USD consists of physical assets.

There are five types of Loss Estimates are included in this report. Three are in regards to Fire and Associated Perils; two are in regards to Boiler and Machinery Perils.

NLE = Normal Loss Expectancy
EML = Engineered Maximum Loss
MFL = Maximum Foreseeable Loss

The Largest Maximum Foreseeable Loss estimate is based upon a physical explosion and ensuing fire at the PA reactor.

| Loss Estimates | P.D. ($MM) | B.I. ($MM) | I.B.I./E.E. ($MM) | TOTAL ($MM) |
|---|---|---|---|---|
| NLE - Fire | 2.2 | 0.6 | -0- | 2.8 |
| EML -Fire | 6.6 | 0.8 | -0- | 7.4 |
| **MFL- Fire** | **22.0** | **2.7** | **-0-** | **24.7** |
| EML - BM | 0.2 | 0.1 | -0- | 0.3 |
| MFL - BM | 3.0 | 1.1 | -0- | 4.1 |

## 3.2 INSURABLE VALUES (As of January 2010 - $USD)

Property Damage: $22.0 MM

Business Interruption: $2.3 MM

Total: $24.3 MM

**Estimated P.D. breakdown by type.**

| Operation | Building ($MM) | Machinery & Equipment ($MM) | Stock ($MM) | Total ($MM ) |
|---|---|---|---|---|
| **Lerma Site** | **1.8** | **20.2** | **N/A** | **$22.0** |

NOTES: Stock not covered in policy.

## 3.3 LOSS ESTIMATES

Fire and Associated Perils - Normal Loss Expectancy

*Definition:*

The expected economic loss resulting from a significant release of flammable materials and ensuing fire or deflagration. All fixed loss prevention systems and emergency response organizations are expected to respond normally. The amount of direct damage is assumed to be proportional to the characteristics of the process unit and its loss prevention systems. Typical initiating events: catastrophic pump seal failure, site glass failure or spill fire in tank farm dike.

*Scenario:*

A dowtherm fire in the Purification area would cause significant local damage before the fire brigade could extinguish it. An azeo pump could burn for at least an hour and cause significant damage before the fire. The damage to instrumentation and piping could take up to three months to repair and to restore production.

*Physical Damage:*

| Unit | PD Value | Damage | Loss |
|---|---|---|---|
| Plant | $22.0 MM | 10% | $2.2 MM |

*Business Interruption*

| Line | BI /month | Interruption | Loss |
|---|---|---|---|
| Plant | $0.19 MM | 3 months @ 100% | $0.6 MM |

*IBI/Extra Expenses*

| Product | Excess Product | Lost Value | Loss |
|---|---|---|---|
| N/A | N/A | ----- | -0- |

| | |
|---|---|
| **GRAND TOTAL** | **$2.8 MM** |

## 3.3 LOSS ESTIMATES – continued

Fire and Associated Perils - Engineered Maximum Loss

*Definition:*

The expected economic loss resulting from a large release of flammable materials and ensuing fire or low order explosion. Partial failure of the fixed loss prevention systems is assumed. Normal performance from the emergency response organizations is expected. The amount of direct damage is assumed to be proportional to the characteristics of the process unit and the loss prevention systems remaining in service. Typical initiating events: catastrophic compressor failure, opening in piping of 1 inch or large in diameter, etc..

*Scenario:*

A large release of dowtherm in the Purification Area would cause heavy localized damage as well as damage to the control room before the fire brigade could extinguish the fire. It would take up to four months to restore production.

*Physical Damage:*

| Unit | PD Value | Damage | Loss |
|---|---|---|---|
| Plant | 22.0 $ MM | 30% | $6.6 MM |

*Business Interruption*

| Line | BI/month | Interruption | Loss |
|---|---|---|---|
| Plant | $0.19 MM | 4 months@ 100% | $0.8 MM |

*IBI/Extra Expenses*

| Product | Excess Product | Lost Value | Loss |
|---|---|---|---|
| N/A | N/A | ----- | -0- |

**GRAND TOTAL** **$7.4 MM**

## 3.3 LOSS ESTIMATES – continued

Fire and Associated Perils - Maximum Foreseeable Loss

*Definition:*

The worst case loss resulting from a catastrophic incident such as a vapor cloud explosion with and ensuing fire, or some other type of explosion and ensuing fire. A total failure of loss prevention systems is generally assumed along with a lack of effective response from emergency response organizations. The extent of fire damage will depend upon the nature of the process affected by the incident and the passive loss prevention features associated with the facility. Examples: total release of the contents of a process circuit or short duration releases from pipelines and storage tanks.

Vapor clouds can be drifted up to 350 ft. to maximize the loss estimate *provided* that the new assumed center of the explosion can provide the confinement and obstacle density needed for a VCE event. All material in a cloud is assumed to be in the flammable range. The amount of material in a cloud is calculated using the super heated flashing liquid formula. An adjustment is made for the expected aerosol effect. A maximum cloud size of 60 tons is assumed. The TNT equivalency method is used to approximate the damage caused by a vapor cloud explosion. Different explosion efficiencies are used for different materials with ethylene oxide and propylene oxide using the highest efficiency of 12%.

*Scenario:*

An explosion and ensuing fire at the PA reactor spreading to the Oxidation and Purification areas. Damage is not expected to occur at the tank farm. The control building would have some damage as well. The Plant would have to be totally rebuilt. This could take up to 14 months.

**Physical Damage Loss Estimate Table**

| Area/Unit/Category | P.D. Value ($MM) | Damage | P.D. Loss ($MM) |
|---|---|---|---|
| **Plant** | **22.0** | **80%** | **17.6** |
| **T.A.F.* (25% of Subtotal)** | | | **$4.4** |
| **Grand Total** | | | **$22.0 MM** |

* The TAF or Technical Adjustment Factor, includes the following surcharges .

| | | | |
|---|---|---|---|
| Debris Removal/Decontamination: | 5% | Inflation (3% over 3 year adjustment period) | 10% |
| Modernization Fees | 5% | Engineering and Permitting Fees | 5% |

**Direct Business Interruption:** **$2.7 MM**

| Product Line | B.I. ($MM) | Loss % | Months | Loss ($MM) |
|---|---|---|---|---|
| Plant | **2.3** | **100** | **14** | **2.7** |

**Extra Expenses.** **-0-**

**GRAND TOTAL = $22.0 MM P.D. + $2.7 MM B.I. = $24.7 MM**

## 3.3 LOSS ESTIMATES - continued

Boiler & Machinery Perils - Engineered Maximum Loss

*Definition:*

The maximum probable sudden and accidental loss that can occur to an object, with credit given to spare equipment or expediting efforts which may reduce the loss.

*Scenario:*

The event chosen is a mechanical failure of the 1750 H.P. primary PA air blower. Damage would include the blower, gearbox and motor drive. A smaller (550 H.P.) standby blower is maintained (a remnant of the original PA process line). The standby blower can run the PA process line at about half of the design capacity (40 TPD). Repairs would require a significant amount of time. Replacement could be achieved in about one month. . As a result of this type of occurrence, PA production would be reduced by about 50%.

*Physical Damage:*

| Equipment | Repair/Replacement | Other Fees | Total |
|---|---|---|---|
| PA Blower | $0.2 MM N/A | | $0.2 MM |

*Business Interruption*

| Line | BI/Month | Interruption | Total |
|---|---|---|---|
| PA | $0.19MM | 1 month @ 50% | $0.1 MM |

*IBI/Extra Expenses*

| Product | Product Loss | Extra Cost | Total |
|---|---|---|---|
| NA | | | |

| **GRAND TOTAL** | **$0.3 MM** |
|---|---|

## 3.3 LOSS ESTIMATES - continued

Boiler & Machinery Perils - Maximum Foreseeable Loss

*Definition:*

The maximum amount of sudden and accidental loss that can occur to an object, without any credit to spare equipment or expediting efforts which may reduce the loss.

*Scenario:*

The event chosen is overheating or major mechanical failure of the larger PA Reactor. Repair or replacement of this large shell and tube reactor could take up to six months (This reactor contains 8,927 one inch diameter tubes). Discounting the presence of the adjacent smaller reactor (a remnant of the original PA process line), loss of the larger reactor would cause a 100% business interruption.

*Physical Damage:*

| Equipment | Repair/Replacement | Other Fees | Total |
|---|---|---|---|
| PA Reactor | $3.0 MM | N/A | $3.0 MM |

*Business Interruption*

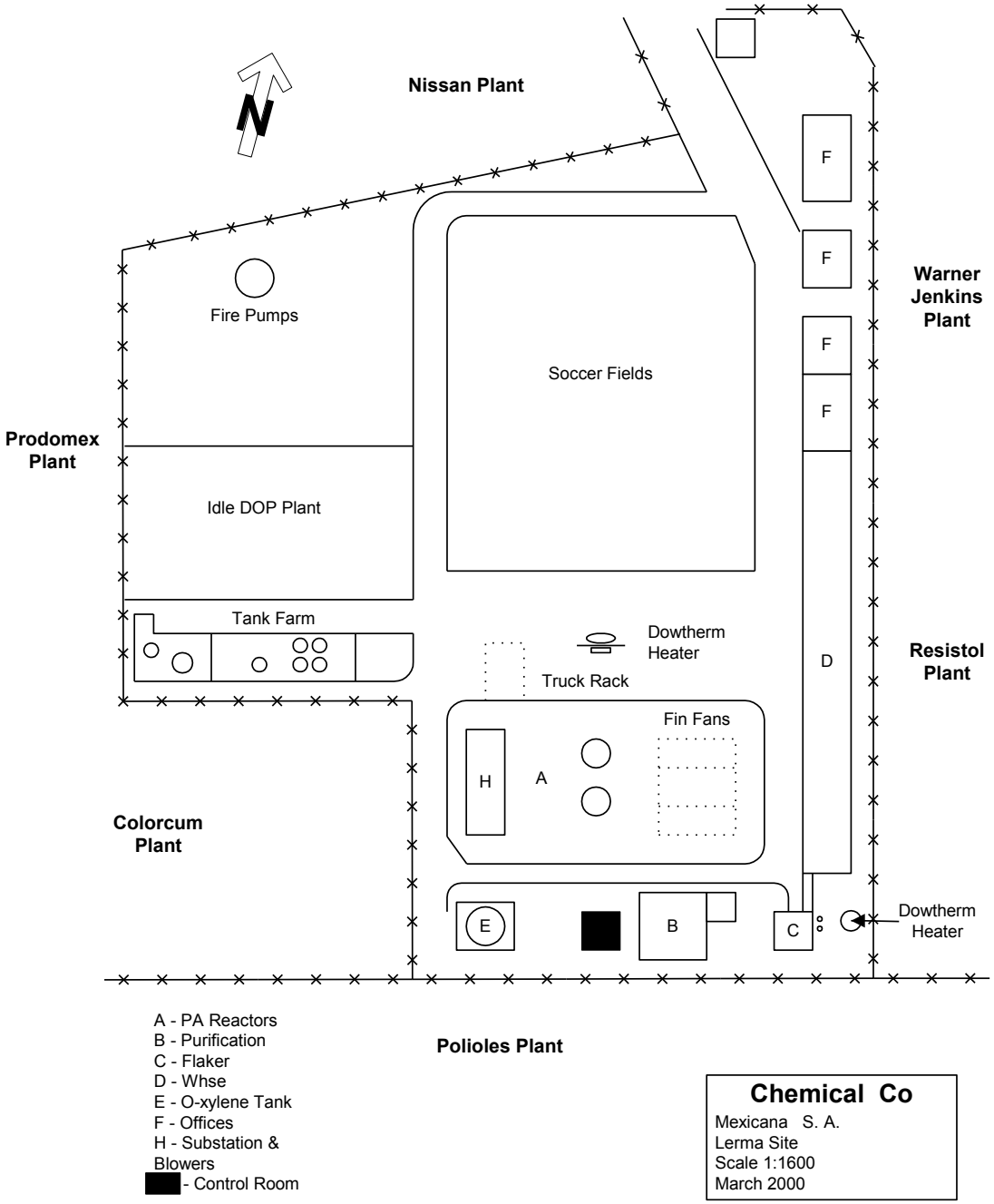
| Line | BI/Month | Interruption | Total |
|---|---|---|---|
| PA | $0.19 MM | 6 months @ 100% | $1.1 MM |

*IBI/Extra Expenses*

| Product | Product Loss | Extra Cost | Total |
|---|---|---|---|
| NA | | | |

| | |
|---|---|
| **GRAND TOTAL** | **$4.1 MM** |

## APPENDIX A – SITE DIAGRAM



## APPENDIX B – FIRE PUMP CURVES

**Location:** Lerma
**File No.:** EXA-100
**Pump No.:** No. 1
**Driver:** Diesel
**Driver Rating:** Satisfactory
**Pump Rating:** Good

| Pump Data (horizontal centrifugal) | | | Rated Flow (US gpm) | Shop Head (psi) | Head x 95% (psi) |
|---|---|---|---|---|---|
| Rated Flow (US gpm) | | **2500** | 0 | 150.0 | 143 |
| Rated Pressure (psi) | | **125** | 2500 | 125.0 | 119 |
| Rated Speed (RPM) | | **1760** | 3750 | 110.0 | 105 |

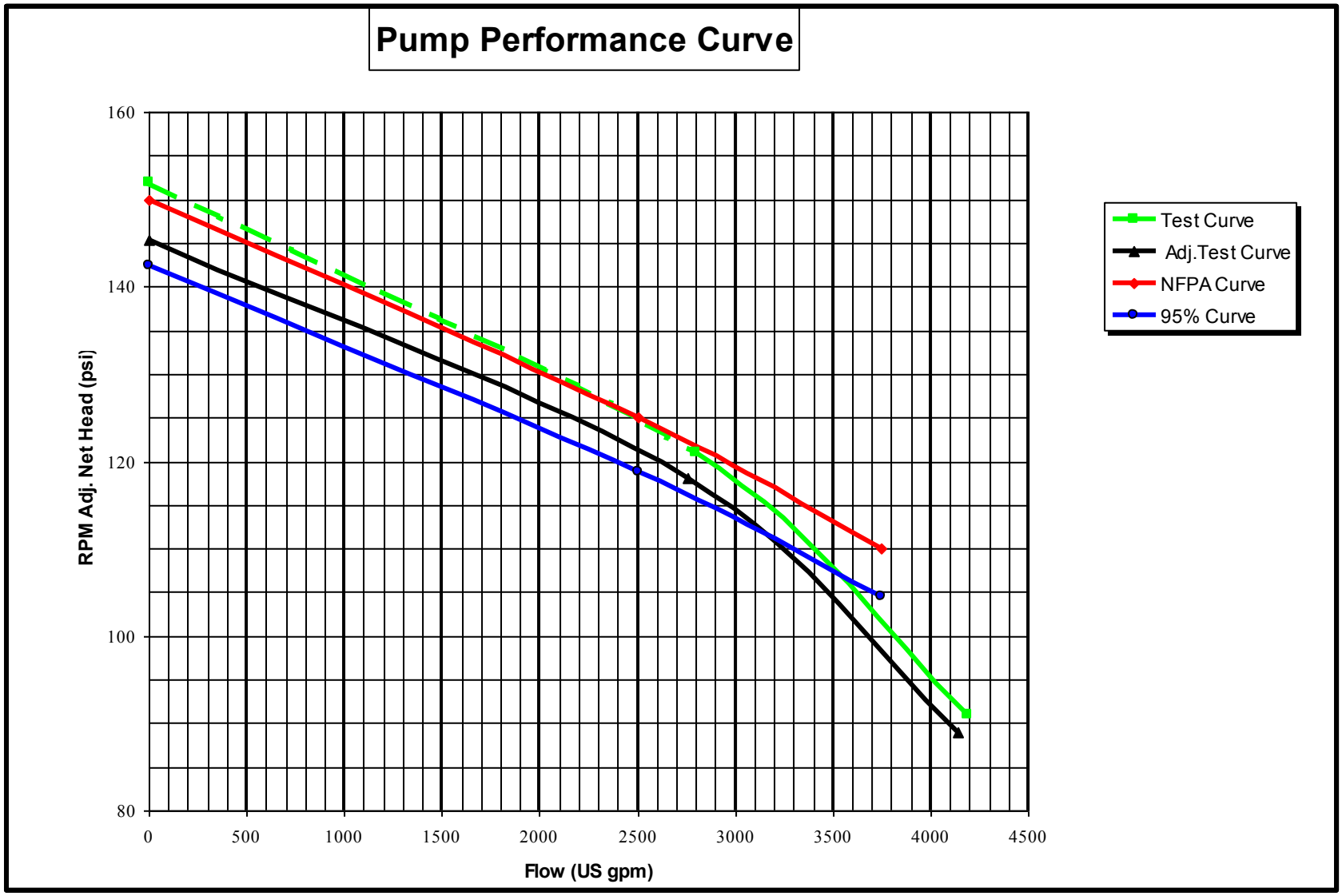
**Field Test Results:** **Test Curve** **Adjusted for speed**

| RPM | Disch. P (psi) | Suct. P (psi) | Net Head (psi) | Flow (US gpm) | RPM Adj. Net Head (psi) | RPM Adj. Flow (US gpm) | Rated Pressure (%) | Rated Flow (%) |
|---|---|---|---|---|---|---|---|---|
| **1800** | **162** | **10** | 152 | 0 | 145 | 0 | 116% | 0% |
| **1782** | **130** | **9** | 121 | 2796 | 118 | 2761 | 94% | 110% |
| **1780** | **100** | **9** | 91 | 4188 | 89 | 4141 | 71% | 166% |

**Pump Rating Guideline**
1) Excellent - within 95% of shop curve or above the NFPA curve
2) Good - within 95% of NFPA curve
3) Fair - within 90% of NFPA curve
4) Poor - anything less than that.

**Driver Rating Guideline**
Satisfactory if RPM drop less than 10%

## APPENDIX B – FIRE PUMP CURVES - continued



## APPENDIX B – FIRE PUMP CURVES - continued

**Location:** Lerma
**File No.:** EXA-100
**Pump No.:** No. 2
**Driver:** Electric
**Driver Rating:** Satisfactory
**Pump Rating:** Excellent

| Pump Data (horizontal centrifugal) | | | Rated Flow (US gpm) | NFPA Head (psi) | Head x 95% (psi) |
|---|---|---|---|---|---|
| Rated Flow (US gpm) | | **2000** | 0 | 120.0 | 114 |
| Rated Pressure (psi) | | **100** | 2000 | 100.0 | 95 |
| Rated Speed (RPM) | | **1785** | 3000 | 65.0 | 62 |

**Field Test Results:** **Test Curve** **Adjusted for speed**

| RPM | Disch. P (psi) | Suct. P (psi) | Net Head (psi) | Flow (US gpm) | RPM Adj. Net Head (psi) | RPM Adj. Flow (US gpm) | Rated Pressure (%) | Rated Flow (%) |
|---|---|---|---|---|---|---|---|---|
| **1787** | **130** | **10** | 120 | 0 | 120 | 0 | 120% | 0% |
| **1785** | **109** | **9** | 100 | 2045 | 100 | 2045 | 100% | 102% |
| **1780** | **80** | **8** | 72 | 2932 | 72 | 2941 | 72% | 147% |

**Pump Rating Guideline**
1) Excellent - within 95% of shop curve or above the NFPA curve
2) Good - within 95% of NFPA curve
3) Fair - within 90% of NFPA curve
4) Poor - anything less than that.

**Driver Rating Guideline**
Satisfactory if RPM drop less than 10%

## APPENDIX B – FIRE PUMP CURVES - continued