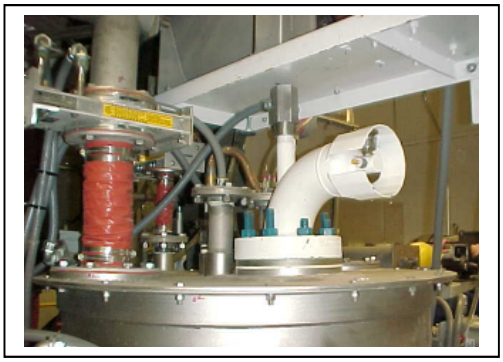
PLANT SYSTEMS ENGINEERING

Process Safety Project Case Studies



Project:	**Design of Explosion Protection Systems**
Client:	Earthshell (Sweetheart Cup)
Project Location:	Owings Mills, MD
Material:	Starch, Guar Gum, Mag Stearate
Services:	Engineering Design
Constructed Value:	$1M

Member of design team designing material handling, size reduction, mixing and dust collection equipment for brand new product for bio-degradable food containers. Provided complete process design engineering package of explosion protection systems per NFPA 61, 68, 69 and 654. Detail all connections and vessels to withstand reduced pressure. Utilized SBC chemical isolators on interconnecting chutes and ducts, SBC suppressants in mixing vessels and relief vents in dust collectors.

Conducted presentation of systems and approach to AHJ – Baltimore County Fire Marshal. Coordinated all designs with equipment vendor Fike.

Project:	**Study and Report / Explosion Protection Systems**
Client:	Confidential
Project Location:	York, PA
Hazard. Material:	Phenolic Resin Binder
Services:	Engineering Study and Report
Constructed Value:	Not constructed as of this date

Phenolic Resin is used in binders, inks and other materials and has a history of causing explosions and flash fires (See Chemical Safety Board Case Studies for US Ink/Sun Chemical Corporation and CTA Acoustics). Our scope on this project was to review all existing systems handling phenolic resin and recommend solutions satisfying NFPA 654. Our final solution was to isolate all storage and handling systems of phenolic resin in an isolated room, protect all equipment per NFPA 68 and 69 and mechanically convey the resign to the mixer in a separate pipe.

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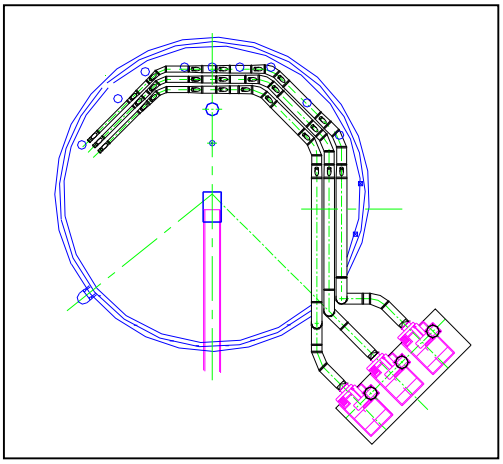
Project: **100 TPH Rail Load Out System**
Deflagration in Wood Pellet Silo

Client: Andritz Feed and Biofuel
Project Location: Georgia Biomass, Waycross, GA
Material: Wood Pellets
Services: Engineering Design-Build
Constructed Value: $3M

$3M design build project at the largest wood pellet facility constructed in North America. Our design-build scope included infrastructure, 300 tons of storage, weighing systems and equipment to load rail cars with wood pellets. For storage, PSE engineered (3) custom 100T storage bins arrays equipped with explosion panels and reinforced to withstand reduced pressure per NFPA 68. On June 20, 2011 a deflagration caused by burning embers transferred to the silos via drag conveyors (not in our scope) occurred in one of the silos. The explosion panels released the pressure, and there were zero injuries or structural deformation to the silos – as designed.

Project: **Clean Coal Silo Ventilation**

Client: U.S. Steel Mining
Project Location: Hueytown, AL
Material: Coal / Methane Vapor
Services: Engineering Design
Loss Value: $1M



When a 150' tall by 75' diameter silo was being filled with clean coal, attrition of the coal released methane vapors trapped in the coal, causing methane monitors to consistently trip and shut down the operations.

PSE was engaged to design a dilution ventilation system to ventilate the silo head space to reduce the methane levels to below Code LEL levels. A system of large diameter ductwork was designed for the calculated dilution volumes. Instead of using dry dust collectors and dealing with explosion and fire risk, three Roto-Clone wets scrubbers were used to separate out any captured coal dust.

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Project: **Explosion at Food Processing Plant**

Client: Proprietary
Project Location: Maryland
Material: Proprietary Food Additive
Services: Investigation
Loss Value: $5M

An explosion and baghouse fire occurred in a spray dryer dust collector at a food additive plant. Products of combustion propagated throughout the interconnected equipment.

PSE was called to conduct an investigation into the cause and origin as well as scope of damages and scope of repairs.

Project: **Explosion at West Pharmaceuticals**

Client: West Pharmaceuticals
Project Location: Kinston, NC
Material: Polyethylene (PE) Dust
Services: Investigation
Loss Value: $125M

A primary explosion occurred in the plants PE mixer. The resultant pressure wave dislodged the ceiling tiles in the entire facility, creating a series of secondary explosions that claimed six lives and caused $125M in damage, the largest non-wild fire loss of 2003 per NFPA.

PSE was part of the investigative team to document the scope of damages and scope of repairs to the facility, and review rebuild construction costs including new fire and explosion protection systems.

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Project: **Explosion at ADM Grain Elevator**

Client: ADM
Project Location: Destrehan, LA
Material: Grain
Services: Investigation
Constructed Value: $45M

Con October 30, 2008 an overheated bucket elevator bearing caused a propagating explosion throughout a 125' tall grain elevator, causing extensive structural, mechanical and electrical damage.

PSE was part of the investigative team to document the scope of damages and scope of repairs to the facility, and review rebuild construction costs including new fire and explosion protection systems. Our scope also included sworn depositions and testimony at arbitration hearings regarding the scope of repairs, Code (NFPA) requirements for the rebuild and duration of repairs.

Project: **Explosion at Tar Plant RTO**

Client: Koppers
Project Location: Cicero, IL
Material: Coal and Petro Tar
Services: Investigation
Constructed Value: $2.75M

An explosion occurred in a vapor duct in a thermal oxidizer system. PSE was called to perform a cause and origin investigation.

After review of operational and product data, it was determined the thermal oxidizer was loaded with combustible vapors beyond its design load. The design load was properly labeled on the thermal oxidizer per NFPA 86: Standard for Ovens and Furnaces.

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