Protecting Emergency Power Fuel Storage Systems from Storms & Flood Damage
Vulnerability Assessments of Fuel Storage Tanks for Critical Facilities’ Backup Power Systems
Critical Facilities

**use generators fueled by diesel contained in storage tanks for back-up power**

- Hospitals, Emergency Treatment Facilities, Pharmaceutical Distributors
- Police, Fire, Ambulance, Emergency Response, and Rescue Buildings
- Water Facilities Required for Fire Suppression
- Public Power Generating Stations and Utilities
- Aviation Control Towers
- Facilities Critical to National Defense
- Data Centers
- Facilities with Toxic or Hazardous Substances
Generator types vary from facility to facility. Locations vary from facility to facility.

- **Generator Types**
  - Compression Ignition
  - Spark Ignition

- **Building Code Requirements**
  - Emergency Systems
  - Legally Required Standby Systems
  - Optional Standby Systems

- **Locations**
  - Roof
  - Basements
  - Ground Floor
  - Adjacent Generator Rooms
There are various types of tanks used and their locations vary from facility to facility.

- Tanks
  - Aboveground Storage Tank
  - Day Tanks
  - Concrete Vaulted
  - Underground Storage Tanks

- Exposure Issues
  - Weather
  - Temperature changes
  - Fuel degradation/contamination
  - Pitting and corrosion
  - Operational issues (i.e. filters plugging)
ABOVEGROUND STORAGE TANKS
CONCRETE VAULTED TANK
UNDERGROUND STORAGE TANK
Fuel Storage and Systems are vulnerable to natural disasters

Examples of Natural Disasters affecting Fuel Storage Systems

- Flooding - Floods are caused by many different phenomenon; heavy rains, snow melt, earthquakes, tsunamis, hurricanes, and inadequate drainage in urban areas.

- Hydrostatic - Hydrostatic pressure can easily drive groundwater into the basement through gaps and cracks in the masonry. High water pressure can also cause seepage through solid concrete.

- Tornadoes
- Hurricanes
- Earthquakes
- Extreme Temperatures
What can go wrong.....

• Japan – Fukishima
• Arkema – Houston
• Hospitals – NY, NJ post Sandy
Fukushima Daiichi Nuclear Disaster - Tōhoku earthquake and tsunami

• In this case, backup generators to keep cooling the plant in the event of main power loss — was built in harm’s way. At the four damaged nuclear power plants (Onagawa, Fukushima Daiichi, Fukushima Daini and Toka Daini), 22 of the 33 total backup diesel generators were washed away, including 12 of 13 at Fukushima Daiichi. Of the 33 total backup power lines to off-site generators, all but two were obliterated by the tsunami. Unable to cool itself, Fukushima Daiichi’s reactors melted down one by one.

• “What doomed Fukushima Daiichi was the elevation of the EDGs (emergency diesel generators),” the authors wrote. One set was located in a basement, and the others at 10 and 13 meters above sea level — inexplicably and fatally low.
Arkema Plant Disaster, Houston – Hurricane Harvey

- During Hurricane Harvey, the facility was flooded during the historic rainfall causing widespread flooding. This led to the plant losing its main power and backup power, causing the failure of the facility’s refrigeration system. The loss of the refrigeration system caused the organic peroxides to decompose, sparking multiple fires and explosions at the facility. Approximately 200 people were evacuated and 21 people, including rescue personnel, were treated for chemical exposure. Over the course of the storm, Hurricane Harvey killed 68 people and flooded over 300,000 structures. Over 40,000 people were forced to evacuate.
Manhattan VA Hospital after Hurricane Sandy 2014

- Manhattan VA Hospital after Hurricane Sandy 2014
  Superstorm Sandy flooded much of Manhattan’s East Side, crippling hospitals in Bedpan Alley. But it was the VA Medical Center on East 23rd Street that fared the worst, closing for six months.

- At the same time, the hospital, which sits just across the Franklin D. Roosevelt Drive from the East River, has received a $207 million appropriation from Congress to make improvements that will help it withstand future flooding.

- Among other things, that funding would pay to relocate most of the utility systems from the basement to various spaces above ground and build a two-block-long sea wall slated to be around 12 feet tall.
Why do systems keep failing.....

- Backup systems are a costly distraction from daily business, until needed
- Major hospitals still have critical systems in basements prone to flooding
- Newly constructed hospitals are required to place systems above flood level but, this does not apply to already built hospitals
Applicable Regulations

• Tank Regulations National Fire Protection Association (NFPA)
  • “Emergency power systems should consider the 100-year storm flooding level” meaning locate the generator in an area above the flood plain
• National Electric Code (NEC)
  • Critical Operations Power Systems (section 708) must be located above the 100-year flood plain

• Environmental
  • Air permits
  • Tank registration
  • Release detection systems
Applicable Regulations

- Underground and Aboveground Storage Tanks
  - Regulated by Fed, State and local
  - Regulations determined by capacity and content
  - Regulations cover integrity and release, not system functionality
Storage Tank Systems – Vulnerable Components
Failed Systems and Fuel Release

Besides the system failing and the tank being damaged, extended contact with floodwaters may cause damage to electrical equipment associated with UST systems.

- Tank gauging
- Panel boxes
- Emergency shutoff switches
- Pumps
- Dispensers
- Motors
- Cathodic protection
TTI Case Study - Atlantic City Utilities Authority
UST Removal/Replacement Hurricane Sandy Relief Project
Upgrading from UST to AST
The state’s Community Development Block Grant disaster recovery (CDBG-DR) action plan was approved by the United States Department of Housing and Urban Development on April 29, 2013.

This plan and its amendments detail how the state is spending the $3.17 billion in federal CDBG-DR funds it received for eligible superstorm Sandy disaster recovery and rebuilding activities.

Requires strict superstorm Sandy performance reports to document scope of work and work proceedings.
Best Practices

- Assessing the vulnerability of your system
- Having an action plan when an event is imminent
Vulnerability Assessment

- Are generators above floodplain?
- Are fuel tanks and pumps above floodplain?
- If tanks are IN floodplain are they encapsulated?
- Do electrical panels or quick connects allow for rapid connection to emergency generator?
- Do you have a location for temporary portable generator?
- Do you a stock of expendable parts?
- What percentage of your load can be supplied by emergency power?
- Is the system remotely monitored?
- Does the facility have uninterruptable power supply (UPS) units?
Mitigation Strategies

Before disaster strikes:
• Verify location on updated floodplain maps
• Elevate emergency power
• Anchor/strap fuel tanks
• Dry floodproof
• Install redundant systems
• Maintain secondary containment
• Perform mechanical integrity inspections
  • Repair systems identified

When disaster is imminent:
• Check fuel levels
• Verify sump and fuel pumps are operational
SERVICES

**UST & AST Storage Tank Services**
- Removals, Installations
- Systems Upgrades
- Demolitions
- O&M Programs
- Complete Fuel Dispensing Systems Installations
- Leak Detection/Monitoring Systems
- Tank & Line Integrity Testing
- Federal & SPCC Tank Inspections
- On-line Inspection Tracking
- Cathodic Protection Systems
- Federal & State Compliance Audits
- Annual Inspection & Maintenance Contracts
- Oil/Water Separator
- Tank Cleaning Services
- Water/Sediment Removal of In-Service Tanks
- Compliance & O&M Training
- Secondary Containment Construction

**Environmental Construction & Contracting**
- Remediation
- Demolition/Decontamination
- Plant/Facility/Decommissioning
- Hazardous Waste Handling/Disposal
- Remedial System Construction
- Secondary Containment Construction/Storage Tanks
- Complete Fuel Systems Construction

**Tank, Piping & Pressure Vessel Integrity Inspection**
- Ultrasonic Thickness
- Magnetic Particle
- Liquid Penetrant
- Visual Weld Inspection
- Remote Video Inspection
- Vacuum Box Testing
- Acoustic Emissions
- IR Thermography
- Tank Floor Scanning
- Pre-Installation/Pre-Operation Vendor Surveillance
- New Fabrication Inspection/Expediting
- AWS-CWI Welding Inspections, Fabrication Shop Audits and Training
CERTIFICATIONS / STANDARDS / PRACTICES

Inspection Standards and Certifications
- American Petroleum Institute 653 (Tank Inspection, Repair, Alteration, and Reconstruction)
- American Petroleum Institute 510 (Pressure Vessel Inspection Code: In-Service Inspection, Rating, Repair and Alteration)
- American Petroleum Institute 570 (Inspection, Repair, Alteration, and Rerating of In-service Piping Systems)
- Steel Tank Institute SP001 (Standard for the Inspection of Aboveground Storage Tanks)
- CWI Certified Welding Inspector
- American Society of Non-Destructive Testing

Recommended Practices
- American Petroleum Institute RP 575 (Inspection of Atmospheric and Low Pressure Storage Tanks)
- American Petroleum Institute RP 572 (Inspection of Pressure Vessels)
- American Petroleum Institute RP 574 (Inspection Practices for Piping System Components)

Various State CERTIFIED Inspectors / Installers / Removers
- AST - IAF, IAM, AMMX, AMNX, AMR, AMEX, ACVL
- UST - IUM, UMX UMR
QUESTIONS?

FOR MORE INFORMATION VISIT
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