To The Point
Biogas Energy Production

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In a world of fluctuating fuel costs and a push for climate decarbonization, the demand for alternative energy sources is at an all-time high. While hydro, solar, and wind are well established, the United States is experiencing rapid growth in biogas production, driven primarily by state-level food waste regulations.

As a world leader in organic waste production (70 million tons annually), the United States continues to search for solutions to reduce the environmental and public health impact.[1] To help reduce carbon emissions, minimize waste, and improve overall public health, biogas plants can create a simple and cost-effective solution. By turning waste organics, manure, and other feedstock into renewable natural gas or power, biogas plants can help address our energy demand while offering added benefits, such as the production of an agricultural byproduct that can be used for compost or fertilizer.

While there are numerous environmental and financial benefits to the production of biogas, these operations come with unique risks. Common hazards include fire, explosion, asphyxiation, odors, and poisonous gas (H^2S). However, the most frequent causes of loss include tank implosions, membrane failure, loss of bacteria, and hot work ignitions.

Protecting Property

Biogas plants present an inherent risk of fire and explosion as they generate or process methane-rich gas. The following controls are recommended:

- Install methane gas detectors, commonly set to alarm at 10% of the Lower Explosive Limit (LEL), and auto shutdown and flare the gas at 25% of the LEL.
- Ensure electric systems and equipment are properly rated per NFPA 70: National Electric Code (e.g., Class I Division 1 or Class I Division 2).
- Install flame arrestors on any process piping that could backflash into the digestor or other process vessels containing methane, such as tank vents, flares, blow-off pipes, or power generation equipment.

Risk Engineering Services

Install signage prohibiting smoking or open flame in areas potentially subject to methane gas accumulation.

Other significant failure modes, such as tank implosions, can lead to process upsets and property damage. The following best practices are recommended to prevent these types of events:

- Install dual (2) high/low (over/under) pressure relief devices. Relief devices are inherently subject to clogging, which can lead to an explosion (overpressure) or implosion (under pressure). Having redundancy helps prevent either situation from occurring.
- In cold-weather environments, wrap relief devices in insulated jackets or place them in an insulated enclosure with ventilation and accessibility for service.
- Install a selector mechanism before dual relief devices to allow one relief device to remain open while performing maintenance on the other.
- If isolation valve(s) exist between the biodigester and the pressure relief device(s), secure them in the OPEN position and inspect and maintain them, per ASME Section 8 Appendix M.
- Monitor key performance indicators (KPI) of the bacteria in biodigesters to avoid business interruptions associated with the loss of the bacteria. Use third-party software to monitor KPIs such as the overall health of bacteria, process temperatures, pressures, feedstock quality, and liquid levels.
- Select a high-quality membrane and fastening system to help protect against membrane damage. Inspect membranes periodically for physical damage and proper securement.
- Properly ground and maintain all process equipment, per NFPA 70.
- Install and maintain lightning protection in areas more prone to lightning strikes, per NFPA 780/IEEE 3001.9.
- Install signage prohibiting smoking or open flame in areas potentially subject to methane gas accumulation.
- Implement a robust and documented hot work permitting program—Reference Chubb's "Hot Work" To The Point document for more information.

Liability Considerations

Operations within densely populated areas can have an increased risk of trespassing, odor complaints, and contracted trucking operations. Maintaining public image and protecting third parties from on-premises injury should be considered when designing and constructing biogas facilities. Consider the following best practices:

- Odor control and pest management are key elements in maintaining a public image. Install and implement a robust odor control system and pest management program by qualified animal control specialists, especially near a densely populated area.
- Implement a formal contractor management and risk transfer program for third-party contractors. For more information, reference Chubb's "Contractor Management" and "Managing Contractual Liability" To The Point documents.
- If a Power Purchase Agreement (PPA) exists, legal counsel should review it to ensure there are no unfavorable terms and potentially significant financial penalties that would result in the inability to meet the power production requirements.
- Alert and train third parties on potential hazards at the facility.
- Depending on the facility's location, security measures (e.g., fencing, signage, lighting, cameras) may be necessary.
- Install signage warning of potential hazards, such as electrocution, confined space, H^2S, fall from heights, methane gas, or no smoking.

Machinery Maintenance

Every biogas plant is unique, but process upsets related to equipment failure can wreak havoc, even at the smallest facility. Strong preventative maintenance and inventory of critical spares can help reduce the overall impacts of these events. When developing your equipment resiliency programs, consider the following:

- Perform a thorough assessment to inventory all critical production equipment.
- Manufacturers recommended maintenance needs to be followed on each identified piece of equipment. Inspection intervals may vary in frequency based on equipment environment, location, etc.
- All internal combustion engine (e.g., generator) maintenance must be logged, tracked, trended, and completed on time as a minimum requirement.
- Document daily rounds of physical inspections for all production areas and retain findings. These daily inspection opportunities can identify potential issues that the SCADA system would not pick up.

Importance of Biogas

Biogas production has numerous benefits, from boosting the economy to addressing food waste. Biogas presents a simple and cost-effective solution to tackling current socioeconomic issues. However, these facilities come with inherent and operational hazards, which can be mitigated through proper facility design, construction, operations, maintenance, and ongoing monitoring.

References

1. **Environmental and Energy Study Institute,** https://www.eesi.org/papers/view/fact-sheet-biogasconverting-waste-to-energy

Resources

1. **ANSI B149.6 Code for Digester Gas, Landfill Gas, and Biogas Generation and Utilization**
2. **NFPA 70 National Electric Code**
3. **NFPA 780 Standard for Installation of Lightning Protection**
4. **IEEE 3001.9 Recommended Practice for the Lighting of Industrial and Commercial Facilities**
5. **AgStar Project Development Handbook,** https://www.epa.gov/agstar/agstar-project-development-handbook
6. **Hot Work To The Point** (located on the Chubb Risk Engineering Services Resource Library)
7. **Contractor Management To The Point** (located on the Chubb Risk Engineering Services Resource Library)
8. **Managing Contractual Liability To The Point** (located on the Chubb Risk Engineering Services Resource Library)

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For more information about protecting your biogas plant, contact your local Chubb Risk Engineer, email RiskEngineeringServices@chubb.com, or visit www.chubb.com/engineering.

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