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Increase of safety-related requirements for biogas plants following the example of the chemical industry – development of model P&ID-flow charts with all safety-related circuits

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Background

The commission for process safety , an advisory committee of the German federal government for requests of safety of industrial installations, that was established in accordance with §51a of the German Federal Immission Control Act, worked out a technical rule for plant safety “Safety requirements of biogas plants” (TRAS 120).

Objective

To relieve the implementation of the TRAS 120, on behalf of the Federal Environment Agency of Germany, models of process flowsheets and P&ID-flow charts separated for agricultural biogas plants and waste fermentation plants should be prepare for general use. It should be assumed that both plants are subject of the German Major Accidents Ordinance (Störfall-Verordnung) the national equivalent of the EU Seveso-Directive. The elaboration should be done in coordination with all major stakeholders.

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Methods

As method a double-expertise with official certified consultants in combination with a multilevel consultation of an expert group was chosen. This method ensure that the required working depth is achieved. The work follows 3 tiers.

Realisation

Work has started, but the work is still in progress. Completion is expected in the late summer of 2019. Currently, the services are still based on block flow charts.

Results

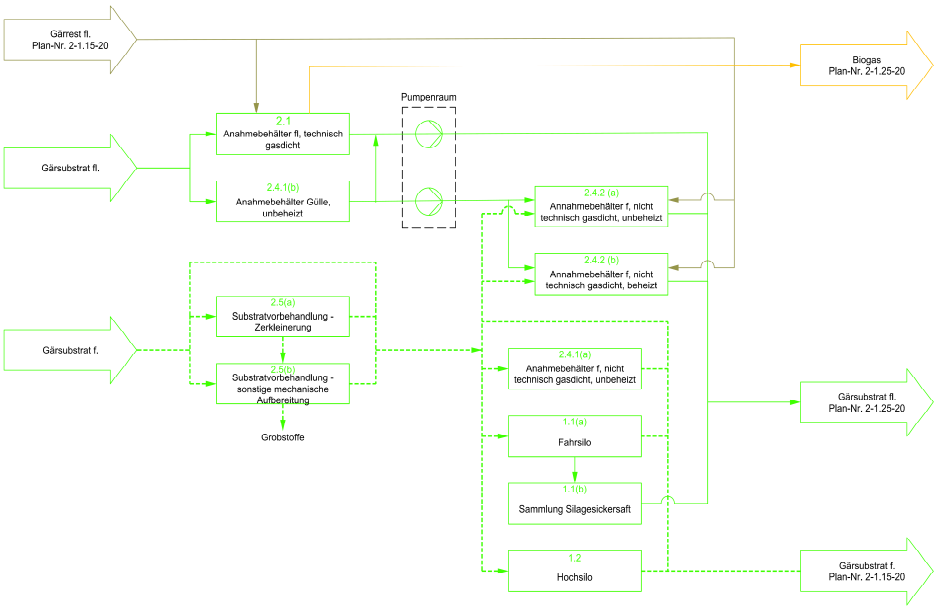
Exemplary, some results are constituted. As part of the completeness check, the following plant components were classified as relevant

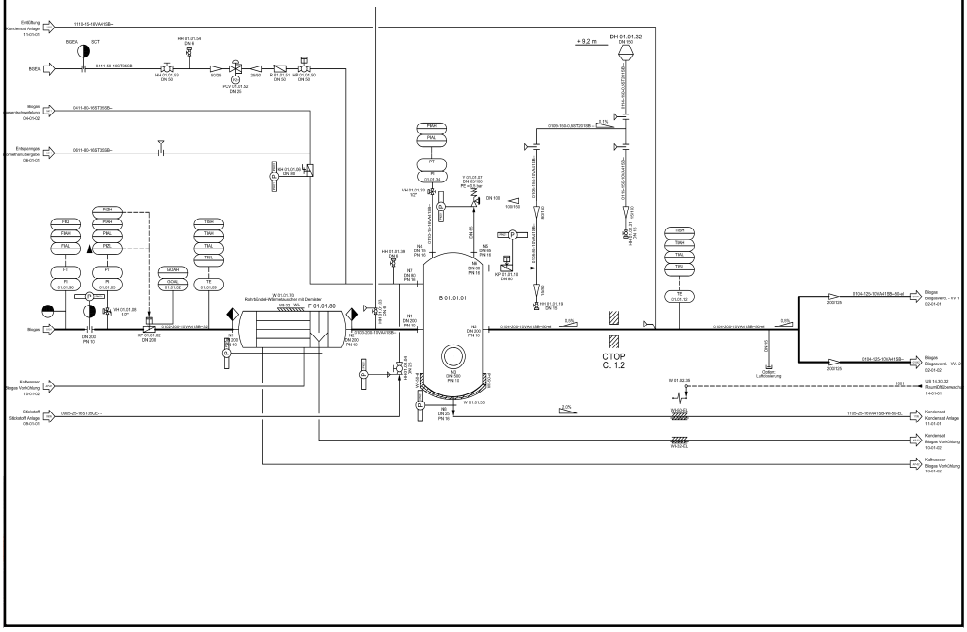
Prospects and summary

The example shows a gas drying plant with buffer (indications in German).It can be seen from the example, that very differentiated plant diagrams will result

1.1(a) bunker silo
1.1(b) Collection of silage leachate
1.2 tower silo
1.3(a) flat waste bunker
1.3(b) underground waste bunker
1.4.1 storage for fuel
1.4.2 storage for other hazardous substances
2.1 tank liquid/pumpable, technical leakproof
2.2(a) container paste-like, not technical leakproof (in acceptance hall)
2.2(b) collection container paste-like, not technical leakproof (in acceptance hall)
2.3 acceptance hall
2.4.1(a) acceptance container solid, not technical leakproof, unheated
2.4.1(b) acceptance container liquid manure, unheated
2.4.2 (a) acceptance container solid, not technically leakproof, unheated
2.4.2 (b) acceptance container solid, not technically leakproof, heated
2.5(a) substrate pre-treatment - crushing
2.5(b) substrate pre-treatment - other mechanical processing
2.6 extraneous material deposition
3.0.1(a) solid disperser
3.0.1(b) push floor system
3.0.1(c) automatic crane system
3.0.1(d) stuffing screw
3.0.2 stirrer
3.0.3.1 gasholder as air inflated roof (double membrane system)
3.0.4 active addition of air into the fermenter for desulphurisation
3.0.5 inspection glass
3.0.6 wall or membrane bushing into headspace of the fermenter
3.0.7 wall or membrane bushing into substrate space of the fermenter
3.0.8 (a) bushing into fermenter for measuring point
3.0.8 (b) bushing into fermenter for sampling device
3.0.9 bushing into fermenter for withdrawal of gas and over-/negative pressure protection
3.0.10 supporting air supply for air inflated roof
3.0.11 clamp hose system (incl. air supply)
3.1 hydrolysis
3.2 disinfection before fermentation
3.3 fermenter
3.4 secondary fermenter
3.5 fermentation residue storage with contact to the gas system
3.6.1 spillway support by screws
3.6.2 spillway support by hydraulic shock
4.1 over-/negative pressure protection
5.1 gas storage, separate as gas bag in rooms
5.2 gas storage, separate with air inflated roof
5.3 gas storage, separate with solid roof
6 separate desulphurisation with activated carbon
7 separate desulfurization with fixed bed (grow up or iron mass)
8.1 gas blower in front of combined heat and power station (CHP
8.2 installation room for CHP (with other plant components)
9.1 connectors to gas pipes for sampling and / or inerting before maintenance
9.2 gas analyser
10.1 rooms for electricity distribution and switch
10.2 transformer station
10.3 emergency generation / emergency power
10.4 other rooms for electrical equipment
11.1 blower before gas flare
11.2 gas flare
12 condensate separator including gas drying / cooling
13 room for pumping systems for distribution and / or return of fermentation substrate and products
14.1 uncovered fermentation product storage
14.2 covered fermentation product storage without gas storage with natural aeration
14.3 covered fermentation product storage without gas storage with technical aeration
15.1 discharge and filling units for liquid fermentation residues, e.g. extraction gallows
15.2 discharge unit for sediments
16.1 pipes for liquids (substrates, fermentation residues) (incl. fittings)
16.2 pipes for raw biogas (incl. fittings)
16.3 pipes for treated biogas (incl. fittings)
17.1 mechanical fermentation residue follow-up treatment e.g. by solid/liquid separation
17.2 biological fermentation residue follow-up treatment, e.g. by composting of the solid fermentation residues
17.3 disinfection of fermentation residues (liquid/pumpable)
17.4 drying of fermentation residues
18.1 storage of aired and not-dried solid fermentation residue
18.2 storage for dried fermentation residue
19 surrounding wall / retention reservoir of the biogas plant
20.1(a) sulfuric acid tank
20.1(b) exhaust air scrubber
20.2 biofilter
20.5 other ancillary plants outside (e.g. scale)

Following, the block flow chart for the acceptance of fermentation substrate for agricultural plant is exemplarily constituted





Thank you for your attention

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