
PROTECTION SYSTEMS FROM
firefly
SAFE WOOD PELLET STORAGE
MARCH 12, 2026
SiloGuard - Concept
How to prevent fires and dust explosions
PREDICTION/PREVENTION /PROTECTION

Who am I?

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Division Manager – Senior Advisor

23 years with Firefly

Involved in fire incident investigations within various process industries, Wood pellets, Wood Panel, Biomass, etc.

Involved in the development of advanced fire protection solutions

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Firefly in brief

- Firefly AB – a Swedish corporate group, founded in 1973
- Focus on innovative solutions and development of high-tech fire protection systems
- A leading developer of Spark detection and Quick suppression systems
- Listed on the NASDAQ First North stock exchange in Stockholm
- Head office in Stockholm, subsidiaries in USA, Poland and Italy
- Agents and distributors worldwide
- Multiple service centers located in all continents of the world
- Customers in over 90 countries
- Over 22 000 protection systems worldwide

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Industrial fire protection

Woodworking

Wood panel

Hygiene

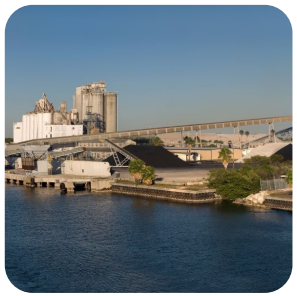
Power generation

Pulp and paper

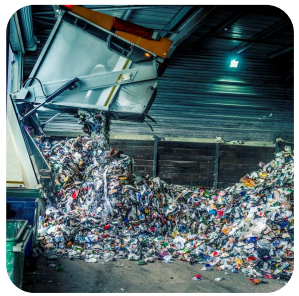
Tissue

Food

Bioenergy



Ports



Recycling

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Example of large enterprises protected by Firefly

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Predictive, Preventive and protective fire protection systems

Firefly offers complete solutions protecting everything from individual machines, filters and silos to complete processing lines.

Prediction

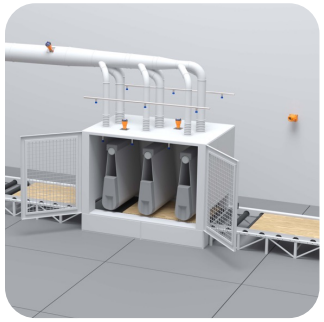
Identifying a problem, in a machine or a process part, even before ignition sources have been .

MGD – Electronic nose
GAS Monitoring
Temperature Monitoring
IR-Trend

Prevention

Detection and Extinguishing of ignition sources **before** a fire or Explosion has occurred.

Spark Detection Systems



Protection

Quick Detection and Suppression of Flames / Fires.

Quick Suppression Systems
Fast Water Mist Systems

Compliance with product performance- and application related safety standards

- Firefly solutions are designed to meet global safety Standards
- Management system frameworks (ISO 9001, IEC 80079-34)
- Recognized product performance standards (FM 3265, FM 3260, VdS 2518, IEC 61010-1, IEC 60079 series, EN 50130-4)
- Key application-specific standards (incl. **EN ISO 20024***, EN 14972, NFPA 750, NFPA 660)

* ***EN ISO 20024 Solid biofuels — Safe handling and storage of solid biofuel pellets in commercial and industrial applications***

Fire risks
Biofuel Storage


Statistically **8 out of 10** large losses in
the industry are caused by fires
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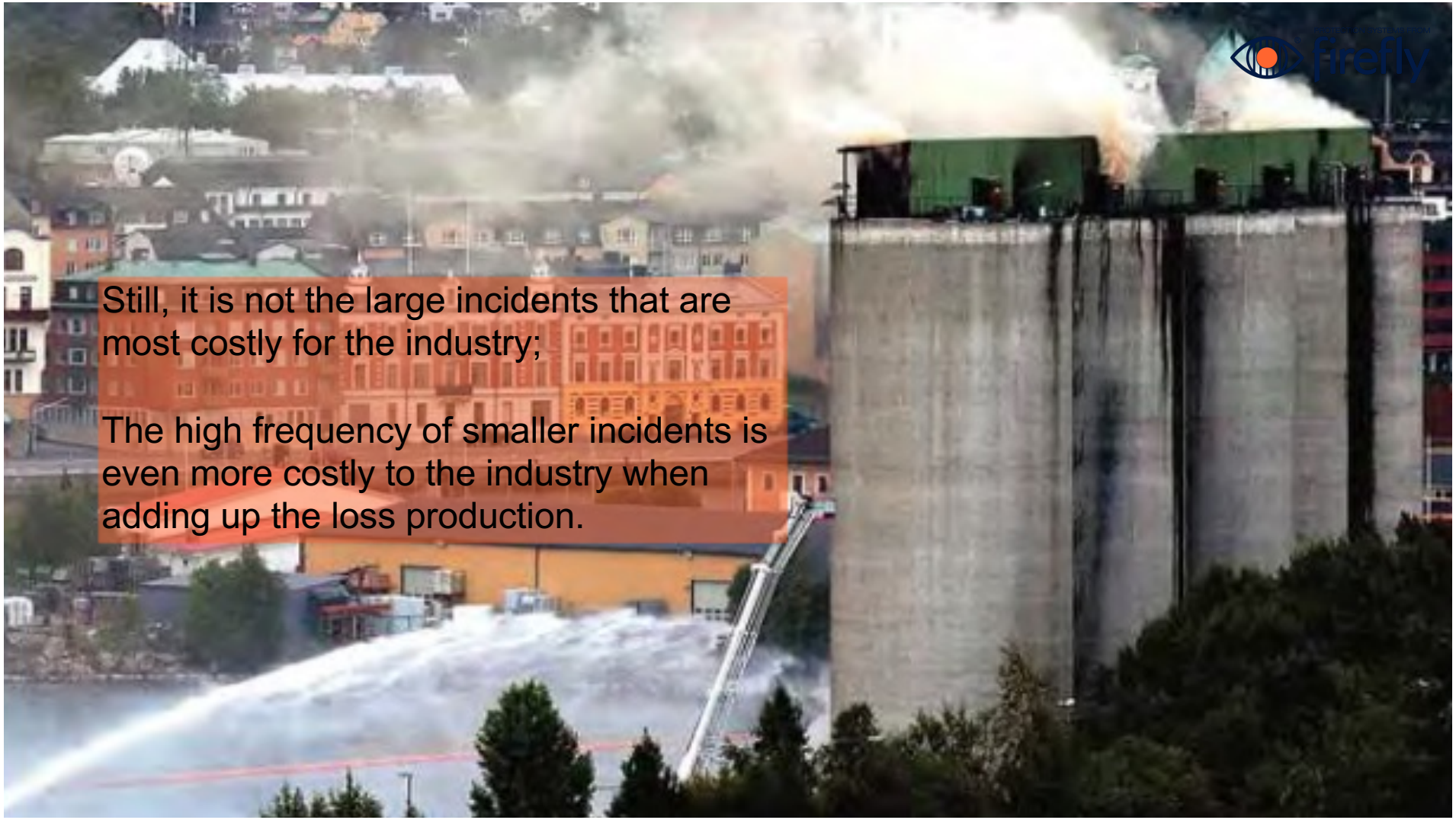
Still, it is not the large incidents that are most costly for the industry;
The high frequency of smaller incidents is even more costly to the industry when adding up the loss production.
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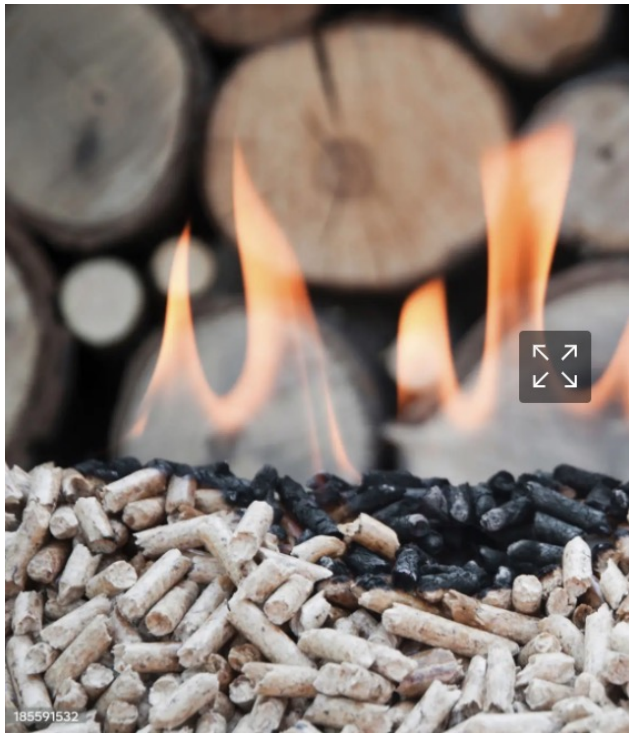
WHY?

Finding the risk factors in Biomass Storage Fires

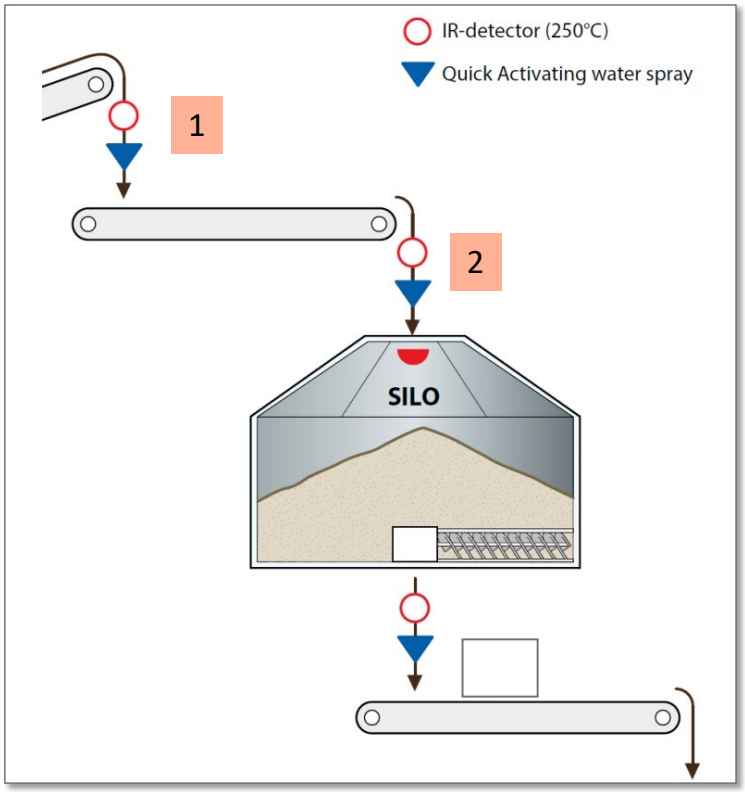
- Ignition Sources arriving with the Feed Stock
- Mechanical failure in the feed mechanism, Conveyors, Screws, etc.
- Spontaneous combustion / Self-Ignition
- Mechanical failure in the storage out feed mechanism



Ignition Sources arriving with the Feed Stock or failure in the feeding mechanism

- The LIT (Layer Ignition Temperature) for most Biofuel is around 260-270°C, Wood Pellets, Wood Flakes, etc.
- Ensure the Detection System can detect below the LIT
- Avoid the suppression water to enter the Silo
  - Location 1 is preferable, worse case location 2

NOTE: Location 1, after system is active the down stream conveyor will be reversed to dump the wet material, adding water into a storage silo will increase the risk of Self combustion.



Self-Ignition / Spontaneous Combustion

- Self-ignition is complex, difficult to detect while developing and extremely challenging to extinguish
- Silo fires require specialized expertise often beyond standard fire brigade training
- Proven knowledge and technology are available to detect self-ignition early and suppress it safely

Parameters that will influence Self-ignition

- Moister Content
  - Higher moister content, higher microbial activity and oxidation, both generate heat.
- Biomass type and composition
  - Vergin wood have a higher degree of oxidation, build up heat faster
  - Dust content, more dust greater risk of a dust explosion.
- Air flow and Oxygen availability
  - Microbial oxidation and chemical oxidation in biomass can start from low level of oxygen, it can start with O_2 levels >5%

Self-ignition – From microbial activity to Fire

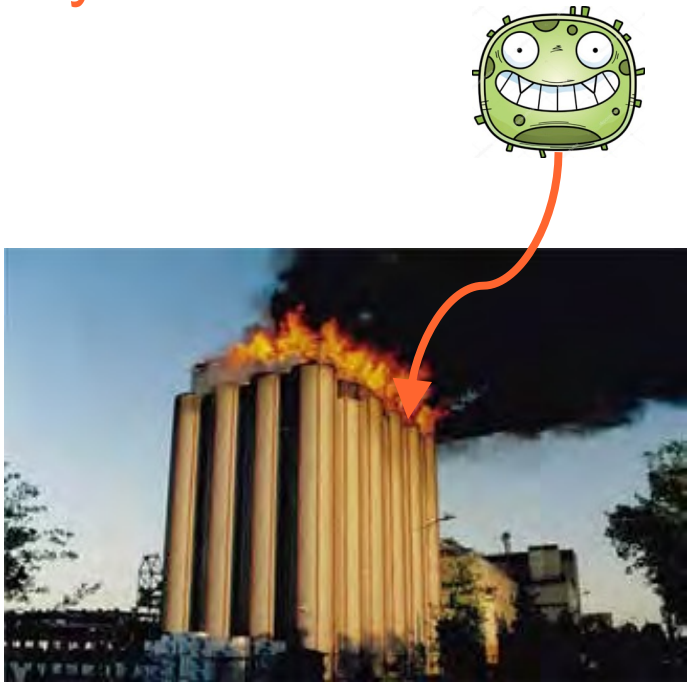
1. Microbial Activity (Initial Heating Stage),
   - ✓ Heat, CO2 and Water vapor is generated
   - ✓ Temperature rise from ~30-70°C
   - ✓ Time: days or probably much longer if poorly ventilated volumes

2. Chemical Oxidation (Self-Heating Stage)
   - ✓ As temperature rises past 70–80°C, microbial life dies off.
   - ✓ Heat generation accelerates if heat can't dissipate which will happened in large biomass storage.
   - ✓ Temperature will rise to ~150-200°C
   - ✓ Gases released CO, CO_2, H_20, CH4, VOCs

Self-ignition – From microbial activity to Fire

3. Pyrolysis (Thermal Decomposition)
   - ✓ Around 200-300°C biomass begins to thermally degrade without a flame.
   - ✓ Produces:
     - ✓ Combustible gases (CO, CH4, VOCs)
     - ✓ Char
     - ✓ Tar

4. Ignition / Fire
   - ✓ If the local temperature reach ~270-280°C and oxygen is available a self-ignition can occur
   - ✓ The smouldering fire can start deep inside the biomass
   - ✓ First progress is slow
   - ✓ If the smouldering part reach the outfeed of the Silo it will ignite into a fire immediately due to the Oxegyn level (21%), if dust is present there is a high risk of a dust explosion.



VOCs stands for Volatile Organic Compounds. VOCs are organic chemicals that have a high vapor pressure at room temperature, which means they easily evaporate into gases. In the context of biomass and combustion, VOCs are released during: Microbial activity, Chemical oxidation, Pyrolysis.
During the pyrolysis and self-heating phases in biomass (e.g., wood chips or pellets), VOCs are released such as: Formaldehyde, Acetic acid, Methanol, Terpenes, Toluene, Benzene. Many VOCs are highly flammable and can form explosive mixtures with air. Can be really dangerous when discharging a Silo.

Self-ignition – From microbial activity to Fire

Example Timeline

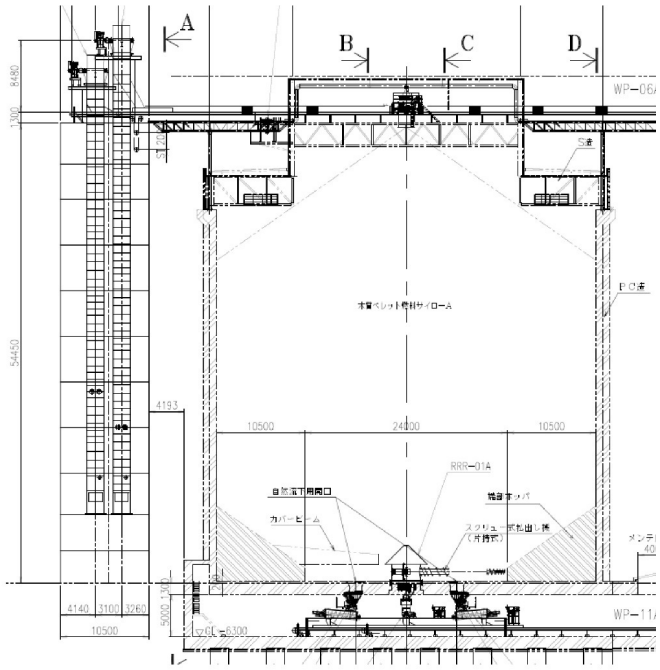
(Under Poor Storage Conditions)

- Day 1–3: Microbial heating starts
- Day 4–10: Temperature rises to 80–100°C
- Day 10–20+: Chemical oxidation raises core temperature >150°C
- Beyond ~20 days: Pyrolysis gases form, risk of ignition becomes high.

NOTE: This is just an example, normally it takes longer time

The Solution

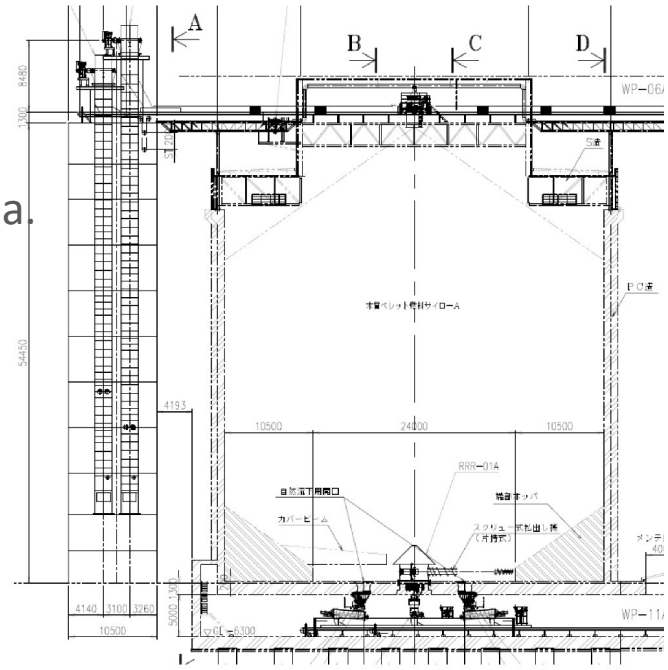
- Reliable Gas Detection System
- Redundance
- N_2 injection system in bottom of the Silo
- Inline 3D scanner



The Solution

N_2 injection system in bottom of the Silo

- Based on research, experience and full scale test N_2 is the most sufficient suppression media.
- Can also be use to “push” the released combustion gases in the silo to the top of the Silo where the measuring equipment is installed. (earlier detection of an on-going smoldering fire)
- Never use water suppression in a wood pellet silo the consequences can be catastrophic.

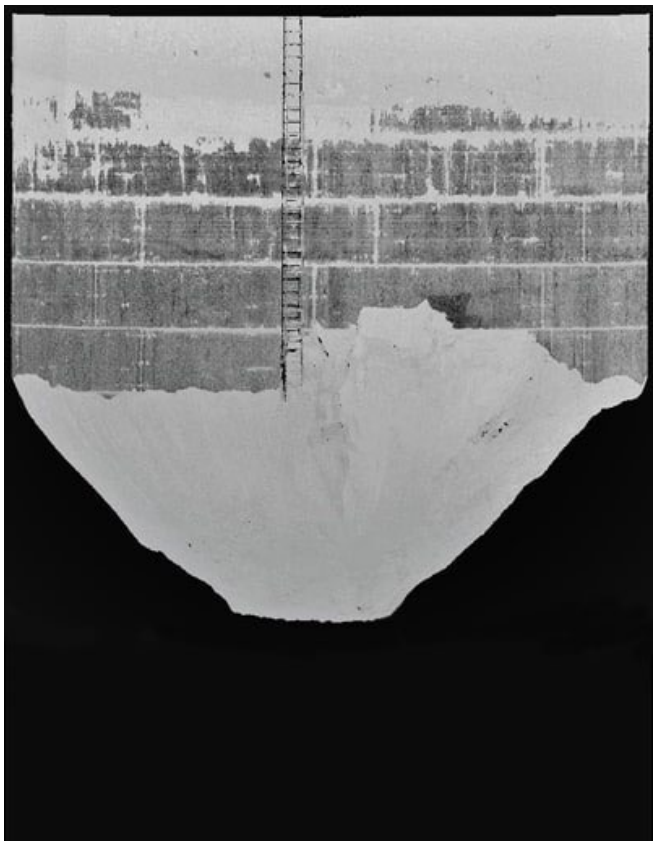


The Solution

Inline 3D Scanner

- Install a 3D Scanner in top of the silo to ensure the Silo is emptied evenly.
- Prevent “bridging”, know your Silo inside.
- A smoldering fire will force the pellets/flakes to release moister which can create bridging
- Bridging can generate a “block” of dissolve wood pellet with a weight of several 100 tons, if this drops down at some point, it can create a catastrophic event.

NOTE: A small volume can cause self-ignition, 1-2m^3 can be enough



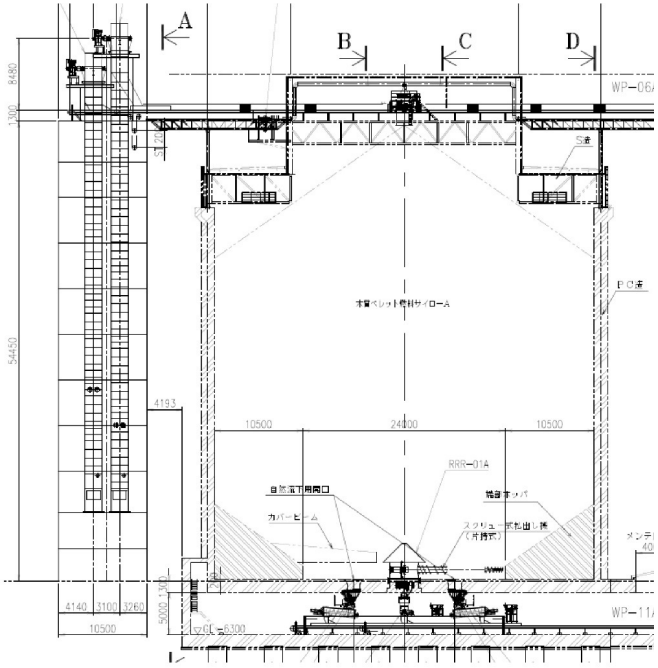
The Solution

Reliable Gas Detection System

- Recommended to install a redundant system, i.e. two pcs of every sensor this to ensure that the value is correct.

- MGD is the fastest detector to detect combustion gases
  - The MGD does not detect a specific level of each gas, the MGD searching for specific pattern between different combustion gases.
  - The MGD require 5-10 less volume of each gas to be able to confirm if there is n on-going smoldering fire

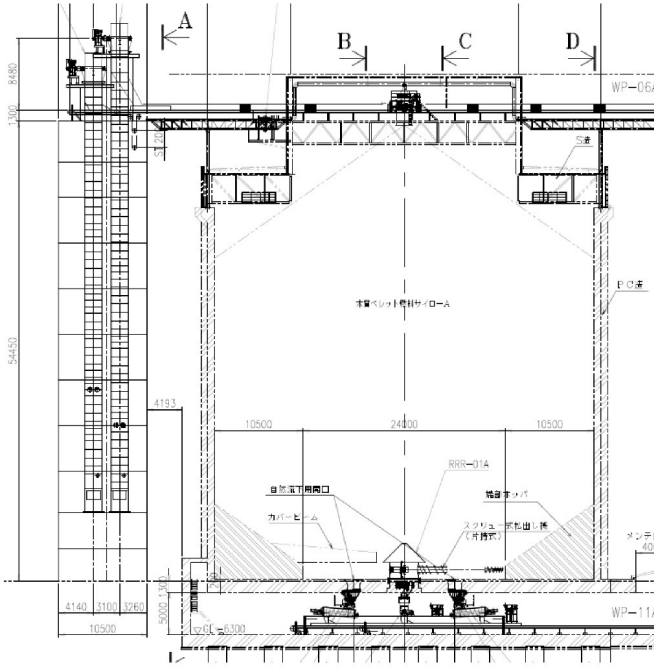
- Installed the correct sensors with the correct range.
  - Especially the CO sensor, it is common that the range is 0-3000ppm. 3000pm can appear in a silo if the silo is filled with virgin wood and the surrounding condition is optimal.



The Solution

Recommended Sensors

- O2 - Oxygen, O-25%
- CO - Carbon monoxide, 0-100 000ppm
- CO2 - Carbon dioxide, 0-5%
- CH4 – Methane, 0-100% LEL
- H2 – Hydrogen, 0-100% LEL
- RH – Moister level, 0-100%
- Temperature



Summary

- Make sure you install correct Spark Detection Sensors that can detect below LIT
- Never suppress a Wood Pellet Silo Fire with Water
- Always install Nitrogen injection system in the bottom of the Silo
- Redundance of Gas Sensors
- Choose the correct Gas Sensors
- Know your Silo, Inline 3D Scanner

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Q & A

THANK YOU!


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