TECHNICAL NOTE

Hazardous Area Classification Source list

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ELIXIR ENGINEERS

1 Introduction

1.1 Project Introduction

t is planned to drill two deep wells in Delft. From the first drilled well (GTD-GT-01), geowater will be extracted from the depth of approximately 2,100 meters to derive geothermal heat.

There will be two circuits in the system. In the primary salty water circuit, the hot geowater flows from the production well to the separator and heat exchangers. The heat is then transferred via heat exchangers to the secondary sweet water circuit which is distributed among TUD buildings for heating.

Gas dissolved in the geo-water (mainly methane, CO2 and nitrogen) is separated in a gas-water separator. Then, the gas is treated and sent to grid. In case it is not possible to send the gas to grid, or in case of maintenance or emergencies, the gas can be burnt via a flare system.

The geowater pressure downstream of the separator is increased by booster pumps. Geowater then flows through production filters upstream of heat exchangers and injection filters downstream of heat exchangers. The cooled geo-water is brought back into the soil via injection pumps in the injection well-head. The second drilled well is (GTD- GT-02).

1.2 Objective of Document

Objective of this document is to define the hazardous source and to describe the basis of the hazardous area classification.

1.3 Codes and Standards

The hazardous area classification will be based on the worst-case situation of all operational modes according to the following codes and standards:

Code/standard	Description
NPR 7910-1:2010+C1:2012	Classification of hazardous areas with respect to explosion hazard
NEN-EN-IEC 60079-10-1:2009	Explosieve atmosferen - Deel 10-1: Classificatie van gebieden - Explosieve gasatmosferen

2 Characteristics and quantities of the flammable materials

The ventilation conditions for the hazardous areas are defined as outdoor or 'open' buildings. Flammable gases might collect in high points in piping or pumps in the hot water system within the building. The amount of gas in these high points are considered to be negligible. Therefore, no flammable materials identified within the building.

Identified flammable materials:
- Natural gas; more than 50kg (class 2, cat. 1 and 2)
- Natural gas condensate; less than 500kg (class 6, cat.2) and/or 50kg (class 2, cat. 1 and 2)

Nonflammable materials: CO2, nitrogen, cold/hot water (after V-120).

The hazardous area classification will only be based on Natural gas results in:

Temperature class T1
Gas group IIA

3 Grades of release

3.1 Wellheads

The NPR 7910-1 breaks the well systems in 3 categories, i.e. producing wells, protected wells and secured wells.

Generally, according to NPR 7910-1, the production well “TNT-GT-01” would fall under a category of “producing wells” and would require a zone 2 with a radius of 7 m. However, it is important to mention that guidelines laid out in NPR 7910-1 are written for production wells designed specifically for natural gas/oil extraction. If the well “x-mas tree” valves in these production wells are closed, the pressure can naturally build up to high pressure (e.g 250 barg), therefore requiring a large zone radius.

In Geothermal plants, on the other hand, the production well is designed for geowater production, with natural gas being a by-product dissolved in geowater. By design, the water is extracted from the well by an electric submersible pump (ESP). Therefore, if the well “x-mas tree” valves are closed, the maximum pressure in the well head is limited by the maximum pressure of the ESP pump, which is no greater than the maximum pressure in the production lines. Because of that, it makes no sense to make the hazardous zone radius of TNT-GT-01 larger than the hazardous area of the production lines, which is 1 m. This hazardous area is zone 2 since the flanges/valves near the tree are considered a secondary release source with the standard leak rates used for flanges of < 1g/s.

The production well is fully located in an underground well cellar. Since the whole well cellar is walled and only the cover is grated, the cellar is considered a closed building with a moderate ventilation (VV < 5). Therefore, the whole production well cellar is considered a hazardous zone 2.

The production well cellar has openings, which is classified as Type A according to NPR 7910-1. Therefore, the openings of the well cellar shall be treated as secondary hazard sources. As the leak rate stays the same (< 1g/s), the hazardous zone 2 extends up to 1 m radius around the grating of the well cellar.

The injection well is not considered a hazardous area since, the injection well is flushed with injection water that does not contain natural gas. Therefore, even when the plant is stopped, there will be no chance of gas coming up from the production well because it was all flushed away by the injection water.

3.2 Pumps and compressors

The ESP is a subsurface pump and therefore not part of this hazardous area classification
No other pumps are installed upstream the gas water separator.

3.3 Tanks/Gas treatment package/filters

Flammable gases can/will be collected in the separator V-120 and gas treatment package U-060.
Any release from the tank nozzle flanges and from the tank vents are considered hazardous.
Flanges/valves are considered a secondary release source using the standard leak rates used for flanges of <1g/s.

Filter F-140, F-141 contain hot water and flammable gasses might collect at the top. Because of nitrogen purging there is no hazardous area. Sufficient maintenance to the purging system is required to keep this a non-zoned area.
The separator V-120 is equipped with a PSV. As this PSV is only considered to be opened in case of a catastrophic failure (high pressure) this vent is not considered as normal operation.

3.4 Equipment drain and sample points

Because of absence of (natural gas) condensate, equipment drains and sampling points are not considered to be a hazard source.

3.5 3.6 Flare system

If flammable material is released from the flare, it will generally be immediately ignited
due to the presence of a continuous source of ignition (e.g. a flame) in the immediate vicinity. The hazard resulting from the operation of the hazard source cannot therefore be combated by establishing a hazard zone classification and taking measures regarding sources of ignition on that basis. The flare system is therefore defined as a "deviating area".

The "deviating area" is kept as small as possible and limited to a maximum of 1m around the potential source of ignition. At the flame a radius of 2 m is used.
by:
• limit the number of potential leak sources in the "deviating area" to the absolute minimum
• to take constructive measures to minimize the leakage rate of the potential leak source (s)
• to keep the ventilation conditions in the environment of the potential leak source optimal.
A "deviating area" may not border a hazardous area zone unless it is part of the "deviating area".