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The Ll. Torup Cavern Gas Storage Day Manned Operation Project

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Abstract

The Ll. Torup cavern gas storage was constructed and erected in four major stages in the period from 1985 to 1996. After the completion the storage included three compressor trains, three withdrawal trains, and seven caverns.

All units in the process plant were separate stand-alone units with their own supervisory control systems, control logic, alarm supervision, and electrical control panels, without interface to the other units in the process plant.

Main valves that were not an integrated part of a major process unit were also considered as a separate stand-alone unit.

All process units were manually operated at their own supervisory control systems, always in the right succession and at the right time:

- Station gas metering and measurements.
- Dehydration process plants.
- Flow- and pressure reduction valves.
- Pre-heater process plants.
- Gas compressors.
- Caverns, gas metering and glycol injection.
- Main valves.

On top of all the separate process units, there was a common SCMS (Station Control and Monitoring System) system. The main function of the SCMS system was alarm- and event handling and storing of some analog process data for only one month. The SCMS system was also equipped with "a theoretically constructed" automatic supervisory control system for the operation of the entire process plant. This system only worked in theory, not in practice; therefore it was not used in the daily operation of the process plant.

Because of the fact that the relevant authorities at the start-up of the Ll. Torup cavern gas storage in the spring of 1986 did not have the intention of approving unmanned automatic plant operation, a satisfactory correction or update of these "theoretically constructed" automatic supervisory control systems was never made, and the plant was manned 24 hours a day, seven days a week. The first year with two technicians/operators, later on only with one.

The Ll. Torup cavern gas storage plant was furthermore, as an ultimate safety, equipped with an independent relay-based "two out of three" SESD (Station Emergency Shut Down) system. The Cause/Effect diagram for the SESD system was very simple. The activation of only one of the essential input signals would result in an instant total shutdown and isolation of the process plant and the caverns.

Time changed in the following decade. Gas turbine driven heat- and power plants operated unmanned, and computer-based supervisory control systems had become much more reliable and accepted by the authorities.

In 1997 it was therefore decided to ask the relevant authorities for permission to establish "day manned automatic plant operation" of the Ll. Torup cavern gas storage plant. That meant that the process plant would be manned with minimum one technician/operator eight hours a day, seven days a week.

At the same time it was decided to initiate an engineering working group to identify all the necessary modifications and improvements at the process plant. The major issue was "nice to have" versus "need to have".

The paper describes the major issues that were identified, the discussion of them, and the reason for the decisions taken. It furthermore describes how the initiation of "day manned automatic plant operation" and the following replacement of the relay-based SESD system to a computer-based solution took place.

Keywords: Natural gas processing, Gas compression, Gas withdrawal, Caverns for natural gas storage, Cavern operation, Zechstein salt domes.