1. Introduction

The basic idea of CAES (Compressed Air Energy Storage) is to transfer off-peak energy produced by base nuclear or coal fired units to the high demand periods, using only a fraction of the gas or oil that would be used by standard peaking machine, such as a conventional gas turbine.

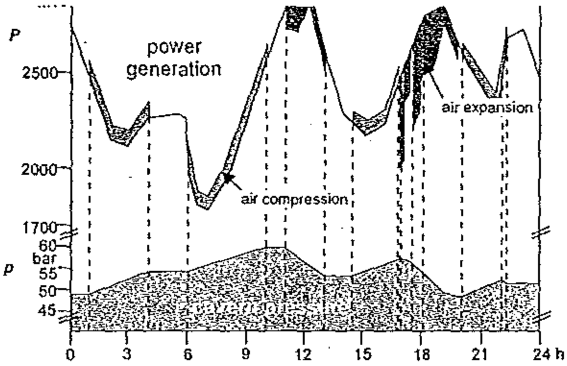

Fig. 1: Example of power production during a single day

So far, there are only 2 CAES plants in the world: the 290 MW plant belonging to E.ON Kraftwerke, Huntorf, Germany, built in 1978, and the 110 MW plant of AEC (Alabama Electric Corporation) in McIntosh, Alabama, USA, commissioned in 1991.

Because of the intended shut down of large power generating capacities in Germany, the importance of the "minute reserve" is expected to grow in the near future (the minute reserve refers to power station output that can be made available within a few minutes). Another argument in favour of CAES is found in the steadily rising capacity of wind power, which creates less precise short term predictability of necessary power production.

The aim of this article is to briefly describe the CAES plant in Huntorf (concentrating on the subsurface facilities) which has been successfully operated for over 20 years, and to report on the practical operating experience gained over this period. This looks in particular at the critical components of compressed air storage caverns:

- Production casing (risk of corrosion due to wet compressed air)
- Thermodynamics (heat exchange between the air and the surrounding salt)
- Long-term stability of the underground storage

2. Principles behind a CAES plant

A CAES plant mainly consists of (1) compressor train, (2) motor-generator unit, (3) gas turbine and (4) underground compressed air storage; see fig. 2.

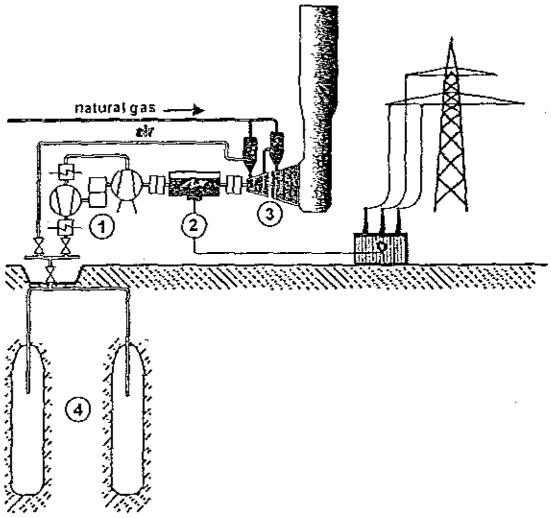

Fig. 2: Main components of a CAES plant

During low-cost off-peak load periods, a motor consumes power to compress and store air in the underground salt caverns. Later, during peak load periods, the process is reversed; the compressed air is returned to the surface; this air is used to burn natural gas in the combustion chambers. The resulting combustion gas is then expanded in the 2-stage gas turbine to spin the generator and produce electricity.

In a pure gas turbine power station, around 2/3 of the output are needed for compressing the combustion air (100 MW net output + 200 MW compressor consumption = 300 MW gross output). In a CAES power station, however, no compression is needed during turbine operation because the required enthalpy is already included in the compressed air. This has 2 advantages: (1) during off-peak periods cheaper excess power can be used for compression; (2) the gas turbine can generate 3/3 (or 300 MW in the above mentioned example), instead of 1/3 (= 100 MW).