PS/ED/NOTE 81-5
4.8.1981

POWER SUPPLY FOR THE MODULATOR

Some remarks about oil immersed components

R. Mosig

The installation of the high voltage components in a common oil-filled tank facilitates isolation and component interconnection. To assure at the same time efficient cooling and heat extraction, oil circulation via oil/water heat exchanger becomes necessary. The different size of the components and their arrangement call for a sufficiently high flow rate : rather an imposed oil stream than a simple collection of warm top oil. As a consequence the heat exchanger will be somewhat overdimensioned but falling into the smallest industrial types produced anyway.

The use of oil requires normally the installation of a Buchholz relay. However, the fairly big horizontal dimensions of the tank (1 m x 2 m) and the directed oil stream make the proper functioning of the Buchholz relay doubtful. Whether the amount of gas produced due to a flash-over initiated short-circuit current of 60 A_{rms} of the HV transformer could operate the relay is highly questionable. The omission of the Buchholz relay could lead to clophen (pyralène) or silicon liquid to satisfy safety aspects, but would also permit the omission of the expansion vessel (comparatively big : $\sim$ 120 ℓ oil !) and the suppression of the expensive oil sink (depth $\sim$ 1 m !).

Nowadays only a limited number of manufacturers build clophen transformers. In addition, the difficult handling and environmental aspects of clophen should exclude its use.

./..

./..

The price difference of 5 FS/kg for silicon liquid against oil (8 kFS for the tank filling) will easily be compensated alone by the costs for the sink and drain pipes 1 m below floor level. A floor level open drain will be sufficient to collect the silicon liquid for convenient recuperation in case of an important leak. CERN SB Division is familiar with silicon liquid treatment (SPS RF System uses silicon liquid).

The use of symmetrical bushings would make filling necessary to just beneath the tank cover, eliminating the problem of tightening a 6 m long joint and facilitating modification and repairs.

To avoid penetration of humidity and oxygen in the tank which might alter the quality of the dielectric, the air cushion beneath the cover oould be replaced by nitrogen. A slight over-pressure of 0,1 ÷ 0,2 bar should suffice to ensure trouble-free operation. A common nitrogen supply and distribution for all units is inexpensive and easy to maintain.*)

Manufacturers of oil-immersed transformers and chokes are experienced in one component per tank with convection cooling. Components so dimensioned, but exposed to directed liquid circulation will be properly cooled, which should overcome manufacturers incertitude and hence reservation to quote.

The heat exchanger must be of high quality, i.e. hair pin inox tubes with leakage proof welding, to permit connection to the demineralized water system without risk of dielectric contamination. (The return pressure of the demineralized water system alone will be higher than the liquid pressure).

CERN experience has shown that heat exchangers with special requirements should be specified and bought separately by CERN, and sent to the transformer manufacturer for installation.

---

*) The effect of silicon liquid oxydation might well be negligible, which would lead to a simple silicagel cartridge installation. The problem is still under study