Information G-TEAM

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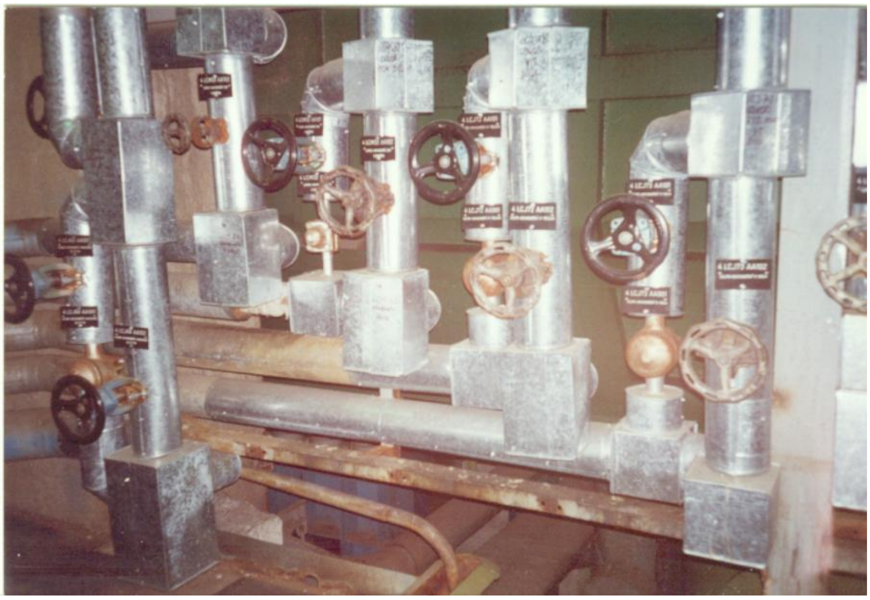
ENERGY SAVING

DEHYDRATION OF TURBINE



DEHYDRATION OF TURBINE

Each turbine should be dehydrated. The kind of dehydration and warming through turbine generator (TG) influences not only the safety but also the effectivity, speed of setting into operation and slow down of turbine, service life of the turbine and accomponied equipment, difficulties of maintenance on the condensate system and minimalization of operators. Dehydration is a very important regulating process during the production of electric power.

The most of turbines set into operation up to appr.1985 use two dehydration systems :

a) **a cheaper one –** with help of orifice plates
b) **relatively more expensive** - dehydration with remote controlled closing valves

a) DEHYDRATION WITH ORIFICE PLATES

Dehydration with orifice plates is an artificially created permanent leakage, its size is calculated for condensating output during alternative operation, setting into operation and/or slowing down of the turbine. Practically no condensate is created in the area of steam above the curve of saturation during the permanent operation of the turbine. The orifice plate system of dehydration does not influence this and continue with passing not only live steam of very high energy content but also steam condensate mixture in the area of wet steam fully independent on the real production of condensate.

For analysing of possible savings we will use a TG with an output of 100 MW, temperature of 535°C , pressure of 110 bar , boiler output of steam 360t/h, price of heat 2 USD/GJ and price of electric energy 22,50 USD/MWh .

According to the design of the turbine it is possible to propose 15-20 dehydration places. At turbines for heat process approximately half of dehydration will occure as the absolute loss on both no-produced electrical energy and heat, because of direct connecting to the area of the condensator. At all other kinds of dehydration, which are cascade-linked into lower pressure extractions it is with a loss of no-produced electrical power.

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For a calculation of the real erection dimensions of orifice plates are used. In accordance with the real data an expansion line of the turbine is constructed in the i-s diagram, from which you can subtract the polytropical drops from the individual orifice plates. After the subtraction of the individual heat drops and calculation of passing quantity of steam it is possible precisely to calculate the loss of heat and no-produced electrical power

When the dehydration of the operating turbine is carried out by the new orifice plate system (individual orifice plates have not been running more than 3000 h), the caused loss of no-produced electrical power is appr.185 kWh , that means we can aquire 1387,5 MWh per year when operating 7500 working hours. The direct heat loss during to dehydration elements which are connected to the condensator is appr. 4000 GJ.

Total loss while running the new orifice plates:

31 219 USD for no-produced electrical power
8 000 USD for heat lost

The loss while using the new dehydration can get up to appr. 40 000 USD per year in total. On recpect of the fact that the most orifice plates has to deal with the overcritical pressure ratio inside the twophase environment, erosion occures and the cross section of orifice plates are uncontrolled enlarged which also increases the influence on the thermodynamical effectivity of the equipment. Losses caused by these worn out orifice plates can reach at least doubled value, that means 80 000 USD per year.

Taking into consideration the investment costs of a new automatic dehydration, appr. 60 000-100 000 USD including design, engineering, delivery , installation and setting into operation, it is taken as unbeatable investment in the heavy power plants field.

b) REMOTE CONTROLLED DEHYDRATION WITH CLOSING VALVES

Due to the high investment costs this kind of dehydration is used for turbines with very high outputs (appr. 200 MW), only. Losses with the new dehydration systems are caused only due to late closing, respectively premature opening of valves during setting into operation or slowing down of the plant. Control of these valves is carried out by the operator of TG mostly as remote control, exceptionally locally by hand. The most of valves have to work with overcritical pressure conditions in and a doublephase environment which causes erosion

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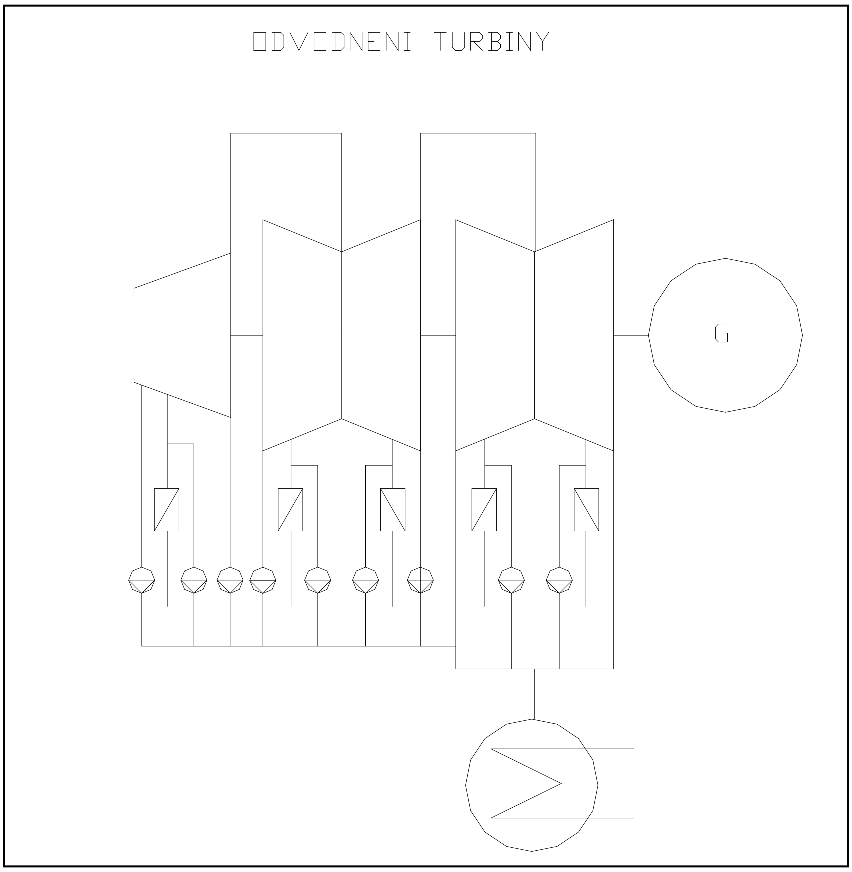
and hard wearing of sealing valve surfaces. After a few repeated openings leakage appears, that are increasing fastly. Because these leakages are not considered in the connection, each of the dehydrating place causes direct losses on no-produced electrical power and heat.



In comparison with the orifice plate system this kind of dehydration is at the beginning nearly lossless, but after one-year-operating, without changing of valves, the loss will get over an amount of 100 000 USD per year.

This kind of dehydration systems can only be used for TG of higher outputs implemented in a stabile complex under permament and none fall out conditions. Because of increasing demand of flexibility for the individual TG this system is unsuitable not only for the economical operating – loss for TG 200 MW will get over an amount of 150 000 USD per year, but also for safety, difficulties during operating and maintenance.

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World known producers of TG are still inclining to use more and more controlled dehydrations with sensing units and regulated valves which are absolute sealed when closed and react flexibly on changing while running. The direct return on investment of the system is over three years but from the point of view of a modern operating of TG with a higher output (over 200 MW) it is necessary to have some parts of dehydration as remote controlled.

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