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Example 2:

Load diagram and load indicators of Electric Power System (EPS)

Task:

For DLD (daily load diagram) of EPS part given by the following table 2.1 determine:

a) by computing

b) graphically

- Total electric energy produced (numerically both of the methods)
- Middle (central) power output
- Load factor
- Maximum utilization time
- Fulltime losses (only the calculation, but in two different ways)

In conclusion, it is necessary to compare the values read from the graph and the calculated values.

Table 2.1:

t [h]	0	1	2	3	4	5	6	7	8
P [MW]	6553	6607	6513	6287	6084	6092	5823	5829	5651

t [h]	9	10	11	12	13	14	15	16	17
P [MW]	6009	6220	6607	6598	6951	6903	7095	7154	7587

t [h]	18	19	20	21	22	23	24
P [MW]	7415	7508	7308	7207	6876	6729	6553

Solution:

ad a)

Total electric energy produced [kWh, MWh]

- of the daily load diagram

$$W_C = \int_0^T P dt = \sum_{i=1}^{T} P_i t_i$$

Middle power output [MW]

$$P_{stř} = \frac{\int_0^T P dt}{\sum_{i=1}^{T} t_i} = \frac{\sum_{i=1}^{T} P_i t_i}{24}$$

Load faktory [-]

$$z = \frac{P_{stř}}{P_{max}}$$

Total produced energy by using Wolf curve

$$W_C = \int_0^T P_{sk} dt = P_{max} \cdot 24 \cdot \left[m + (1 - m) \frac{1}{k + 1} \right]$$

where: $m = \frac{P_{min}}{P_{max}}$

$$k = \frac{1 - z}{z - m}$$

Time utilization of the maximum load [h]

$$T_m = \frac{W_C}{P_{max}}$$

Fulltime losses [h]

$$T_z = \frac{\int_0^T P^2 dt}{P_{max}^2} = \frac{\sum_{i=1}^{T} P_i^2 t_i}{P_{max}^2}$$

- or by using empirical relationship (as the standard)

$$T_z = T \cdot \left[0{,}2 \cdot \frac{T_m}{T} + 0{,}8 \cdot \left(\frac{T_m}{T} \right)^2 \right]$$

ad b) graphically

- plotting diagram of daily load (DLD) on graph (mm) paper
- plotting the load duration diagram (drawing the power outputs by ordering from the maximum to the minimum)
- implementation graphical integration of the diagram of load duration and mark and determine of W_c, T_m, z, $P_{stř}$ values