ZADATAK 1
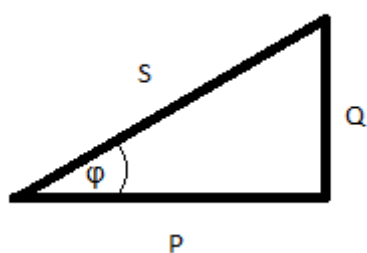
a)

$$t = br_s = 367 \, [h]$$

$$\cos \varphi_k = 0{,}97$$

$$W_{Rv} = 87000 \, [kWh]$$

$$W_{Rn} = 39000 \, [kWh]$$

$$W_{Qv} = 76000 \, [kWh]$$

$$W_{Qn} = 32000 \, [kWh]$$

$$ce_{Qv} = ce_{Qn} = 0{,}15 \left[\frac{kn}{kVArh} \right]$$

$$\cos \varphi = \frac{P}{S}$$

- srednja radna snaga

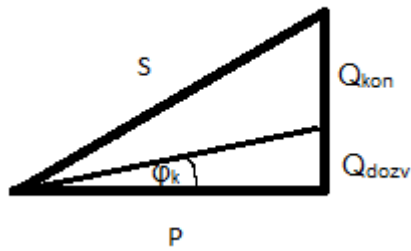$$P = \frac{W_{Rv} + W_{Rn}}{t} = \frac{87000 + 39000}{367} = 343,324 \, [kW]$$

- faktor snage

$$\cos \varphi = \frac{P}{S} = \frac{P}{\sqrt{P^2 + Q^2}}$$

$$Q = \frac{W_{Qv} + W_{Qn}}{t} = \frac{76000 + 32000}{367} = 294,278 \, [kW]$$

$$\cos \varphi = \frac{P}{\sqrt{P^2 + Q^2}} = \frac{343,324}{\sqrt{343,324^2 + 294,278^2}} = 0,759$$

- potrebna jalova snaga koju treba kompenzirati

$$Q_{kon} = Q - Q_{dozv}$$

$$tg\,\varphi_k = \frac{Q_{dozv}}{P}$$

$$\boldsymbol{Q_{dozv} = P * tg\varphi_k} = 343{,}324 * tg\,(arc\cos 0{,}97) = \boldsymbol{86,045}\,[\boldsymbol{kVAr}]$$

$$\boldsymbol{Q_{kon} = Q - Q_{dozv}} = 294{,}278 - 86{,}045 = \boldsymbol{208,233}\,[\boldsymbol{kVAr}]$$

- mjesečni troškovi za jalovu energiju kod više tarife

$$\boldsymbol{T_v = W_{Qv} * ce_v} = 76000 * 0{,}15 = \boldsymbol{11400}\,[\boldsymbol{kn}]$$

- mjesečni troškovi za jalovu energiju kod niže tarife

$$\boldsymbol{T_n = W_{Qn} * ce_n} = 32000 * 0{,}15 = \boldsymbol{4800}\,[\boldsymbol{kn}]$$

- ukupni mjesečni troškovi za jalovu energiju

$$\boldsymbol{T_{uk} = T_v + T_n} = 11400 + 4800 = \boldsymbol{16200}\,[\boldsymbol{kn}]$$

b)

$$W_{Q1} = 33\% W_R = 0{,}33 W_R$$

$$\frac{W_{Q1}}{W_R} = \frac{Q_1}{P} = 0{,}33$$

- faktor snage

$$tg\varphi = \frac{Q_1}{P} = 0{,}33$$

$$\boldsymbol{\cos\varphi} = \cos(arc\ tg\ 0{,}33) = \boldsymbol{0{,}95}$$

- mjesečni troškovi za jalovu energiju više tarife

$$W_{Qv1} = 0{,}33 * W_{Rv} = 0{,}33 * 87000 = 28710\ [kVArh]$$

$$\Delta W_{Qv} = W_{Qv} - W_{Qv1} = 76000 - 28710 = 47290\ [kVArh]$$

$$\boldsymbol{T_{v1}} = \boldsymbol{\Delta W_{Qv}} * \boldsymbol{ce_v} = 47290 * 0{,}15 = \boldsymbol{7093{,}5\ [kn]}$$

- mjesečni troškovi za jalovu energiju niže tarife

$$W_{Qn1} = 0{,}33 * W_{Rn} = 0{,}33 * 39000 = 12870\ [kVArh]$$

$$\Delta W_{Qn} = W_{Qn} - W_{Qn1} = 32000 - 12870 = 19131\ [kVArh]$$

$$\boldsymbol{T_{n1}} = \boldsymbol{\Delta W_{Qn}} * \boldsymbol{ce_n} = 19131 * 0{,}15 = \boldsymbol{2869{,}5\ [kn]}$$

- ukupni mjesečni troškovi za jalovu energiju

$$\boldsymbol{T_{uk1}} = \boldsymbol{T_{v1} + T_{n1}} = 7093{,}5 + 2869{,}5 = \boldsymbol{9963\ [kn]}$$

c)

- ožujak

razdoblje odstupanja	odstupanej s pozitivnim predznakom	odstupanje s negativnim predznakom
0 - 6 h	110	25
6 - 17 h	66	120
17 – 23 h	0	15
23 – 24 h	44	80

- prosinac 2009

razdoblje odstupanja	jedinična cijena c_p [kn/MWh]	jedinična cijena c_n [kn/MWh]
0 - 6 h	286,63	0
6 - 17 h	573,25	0
17 – 23 h	687,90	0
23 – 24 h	573,25	0

- iznos za pokrivanje odstupanja s pozitivnim predznakom

$$I_p = c_p * \Delta E_p = 286,63 * 110 + 573,25 * 66 + 573,25 * 44 = \mathbf{94586,8} \, [\mathbf{kn}]$$

- iznos za pokrivanje odstupanja s negativnim predznakom

$$I_n = c_n * \Delta E_n = \mathbf{0} \, [\mathbf{kn}]$$

- ukupni iznos

$$I_{uk} = I_p + I_n = 94586,8 + 0 = \mathbf{94586,8} \, [\mathbf{kn}]$$

ZADATAK 2:

$$T_{cijevi} = 167\ °C = 440{,}16\ K$$

$$T_{okoline} = 25°C = 298{,}16\ K$$

$$d_1 = d_{cijevi} = 167\ mm = 0{,}167\ m$$

$$l = 65\ m$$

$$d_2 = d_{izolacije} = 35\ mm = 0{,}035\ m$$

$$\alpha = 0{,}04\ \frac{W}{mK}$$

$$br_s = 5\ h$$

$$br_d = 150\ dana$$

$$\varepsilon = 0{,}8$$

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a) $Q_{konvekcijom}$, $Q_{zračenjem}$

d= d_1 + 2d_2 = 0,167 + 2*0,035 = 0,237 m

S = d*π*l = 0,237 * π * 65 = 48,396 m²

$$Q_{kon} = \frac{a}{b+c}$$

$$a = (T_{cijevi} - T_{okoline}) * l * br_s * br_d = (440{,}16 - 298{,}16) * 65 * 5 * 150 = 6922500\ [Kmh]$$

$$b = \frac{ln\dfrac{d}{d_1}}{2\pi\alpha} = \frac{\ln\dfrac{0{,}237}{0{,}167}}{2\pi * 0{,}04} = 1{,}393\ \left[\frac{mK}{W}\right]$$

$$c = \frac{1}{5\pi * d\left(\dfrac{T_{cijevi} - T_{okoline}}{T_{okoline} * d}\right)^{0{,}25}} = \frac{1}{5\pi * 0{,}237 * \left(\dfrac{440{,}16 - 298{,}16}{298{,}16 * 0{,}237}\right)^{0{,}25}} = 0{,}226\ \left[\frac{mK}{W}\right]$$

$$Q_{kon} = \frac{a}{b+c} = \frac{6922500}{1{,}393 + 0{,}226} = 4275787{,}523\ [Wh] * 0{,}0036 = \mathbf{15392{,}835}\ [MJ]$$

$$Q_{zrač} = 5{,}67 * 10^{-8} * \varepsilon * \left(T_{cijevi}{}^4 - T_{okoline}{}^4\right) * S * br_s * br_d * 0{,}0036$$
$$= 5{,}67 * 10^{-8} * 0{,}8 * (440{,}16^4 - 298{,}16^4) * 48{,}396 * 5 * 150 * 0{,}0036$$
$$= \mathbf{175635{,}865}\ [MJ]$$

$$Q_{uk} = Q_{kon} + Q_{zrač} = 15392{,}835 + 175635{,}865 = \mathbf{191028{,}7}\ [MJ]$$

b) v= 3 [m/s]

$$Q_{zrač} = 5,67 * 10^{-8} * \varepsilon * \left(T_{cijevi}{}^4 - T_{okoline}{}^4\right) * S * br_s * br_d * 0,0036$$
$$= 5,67 * 10^{-8} * 0,8 * (440,16^4 - 298,16^4) * 48,396 * 5 * 150 * 0,0036$$
$$= 175635,865 \, [MJ]$$

$$Q_{kon} = \frac{a}{b+c}$$

$$a = (T_{cijevi} - T_{okoline}) * l * br_s * br_d = (440,16 - 298,16) * 65 * 5 * 150 = 6922500 \, [Kmh]$$

$$b = \frac{ln\dfrac{d}{d_1}}{2\pi\alpha} = \frac{ln\dfrac{0,237}{0,167}}{2\pi * 0,04} = 1,393 \left[\frac{mK}{W}\right]$$

$$c = \cfrac{1}{\pi * d * \cfrac{\left(4,65 + 0,35 * \dfrac{T_{okoline}}{100}\right) * \left(\dfrac{v * 273,16}{T_{okoline}}\right)^{0,61}}{d^{0,39}}}$$

$$= \cfrac{1}{\pi * 0,237 * \cfrac{\left(4,65 + 0,35 * \dfrac{298,16}{100}\right) * \left(\dfrac{3 * 273,16}{298,16}\right)^{0,61}}{0,237^{0,39}}} = 0,073 \left[\frac{mK}{W}\right]$$

$$Q_{kon} = \frac{a}{b+c} = \frac{6922500}{1,393 + 0,073} = 4722032,742 * 0,0036 = 16999,318 \, [MJ]$$

$$Q_{uk} = Q_{kon} + Q_{zrač} = 16999,318 + 175635,865 = 192635,183 \, [MJ]$$