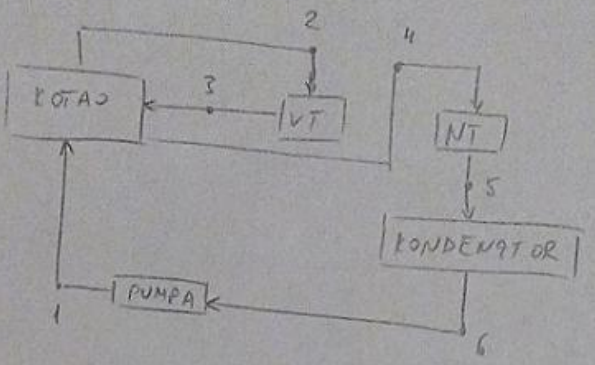
(11.) IDEALNI RKP (međupregrijanje)



$P_t = 300$ MW

$p_2 = 8$ MPa ; $t_2 = 480°C$

$p_3 = 0{,}8$ MPa

$t_4 = 440°C$

$p_5 = 8$ kPa

$h_2 = 3350$ kJ/kg ; $s_2 = 6{,}662$ kJ/kgK

$s_3 = 6{,}662$ kJ/kgK ; $h_3 = 2770$ kJ/kg

$h_4 = 3352$ kJ/kg ; $s_4 = 7{,}695$ kJ/kgK

$h' = 174$ kJ/kg ; $h'' = 2577$ kJ/kg

$s' = 0{,}593$ kJ/kgK ; $s'' = 8{,}23$ kJ/kgK ; $v' = 0{,}001$ m³/kg

η_t, $\dot{m} = ?$

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2 → 3 ekspanzija

4 → 5 ekspanzija

$p_1 = p_2 = 8$ MPa

$p_3 = p_4 = 0{,}8$ MPa

$p_5 = p_6 = 8$ kPa

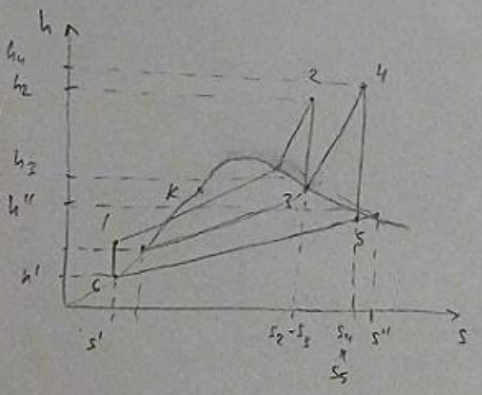
$s_4 = s_5 = 7{,}695$ kJ/kgK

$h = h' + x(h'' - h')$

$x = \frac{s - s'}{s'' - s'}$ $\quad h' = h_6 = 174$ kJ/kg

$\eta_t = \frac{w}{q_{dov}} = \frac{w_t - w_p}{q_{dov}} = \frac{w_{VT} + w_{NT} - w_p}{q_{dov_1} + q_{dov_2}}$

$\dot{m} = \frac{P_t}{w_t}$



$w_{VT} = w_{23} = h_2 - h_3 = 580$ kJ/kg

$w_{NT} = w_{45} = h_4 - h_5 =$

$w_p = w_{61} = v(p_1 - p_6) = \frac{1}{\rho}(p_1 - p_6) = h_1 - h_6$

$q_{dov} = h_2 - h_1 + h_4 - h_3$

$x_5 = \frac{s - s'}{s'' - s'} = \frac{s_5 - s'}{s'' - s'} = \frac{7{,}695 - 0{,}593}{8{,}23 - 0{,}593} = 0{,}9299$

$h_5 = h' + x_5(h'' - h') = 174 + 0{,}9299(2577 - 174) = 2408{,}66$ kJ/kg

$w_{NT} = 3352 - 2408{,}66 = 943{,}339$ kJ/kg

$\dot{m} = \frac{300 \cdot 10^6}{580 \cdot 10^3 + 943{,}339 \cdot 10^3} = 516{,}4 \frac{kg}{s}$

$w_p = 0{,}001 \cdot (8 \cdot 10^6 - 8 \cdot 10^3) = 7{,}992$ kJ/kg

$h_1 = w_p + h_6 = 7{,}992 + 174 = 181{,}992$ kJ/kg

$q_{dov} = 3350 - 181{,}992 + 3352 - 2770 =$

$= 3750{,}008$ kJ/kg

$\eta_t = \frac{580 + 943{,}339 - 7{,}992}{3750{,}008} = 0{,}404$

(12) $\eta = 15\ \%$

α raspad Am-241 $\qquad t = ?$

$P_e = 17\ W$

$m = 1\ kg$ (Am-241) $= 1000\ g$

$\lambda = 51 \cdot 10^{-12}\ s^{-1}$ (konst. radioakt. raspada)

$E = 5,6\ MeV = 5,6 \cdot 10^6\ eV = 5,6 \cdot 10^6 \cdot 1,6 \cdot 10^{-19}\ J$

(en. dobivena 1 raspadom)

$$\eta = \frac{P_e}{P}$$

$$P = \frac{P_e}{\eta} = \frac{17}{0,15} = 113,33\ W \quad \text{(topl. snaga nakon god. dana)}$$

$$N = \frac{P}{\lambda \cdot E} = \frac{113,33}{51 \cdot 10^{-12} \cdot 5,6 \cdot 10^6 \cdot 1,6 \cdot 10^{-19}} = 2,48 \cdot 10^{24} \quad \text{(atoma Am-241)}$$

(broj jezgara nakon god. dana) $= N(t)$

$$N(t) = N_0 \cdot e^{-\lambda t}$$

$$e^{\lambda t} = \frac{N_0}{N(t)} \quad / \ln \quad / : \lambda$$

$$t = \ln\left(\frac{N_0}{N(t)}\right) \quad / \lambda$$

$$n = \frac{N_0 \cdot M}{N_A}$$

$$N_0 = \frac{m N_A}{M} = \frac{1000 \cdot 6,022 \cdot 10^{23}}{241} = 2,5 \cdot 10^{24} \quad \text{(atoma Am-241)}$$

$$t = \frac{\ln\left(\frac{2,5 \cdot 10^{24}}{2,48 \cdot 10^{24}}\right)}{51 \cdot 10^{-12}} = 14772788 9,8\ (s) \ / : 60 \ / : 60 \ / : 24 \ / : 365$$

$$= 4,68\ god$$

(13.) $Q_i = 550\ m^3/s$

$H_{brane} = 60\ m$

$H_{gore} = 250\ m$

$H_{dole} = 90\ m$

$H_{Gv} = Q/12\ m$

$H_{Dv} = Q/60\ m$

$\eta = 0,9$

a) $H_{vode} = 50\ m = H_{Gv}$

$Q = 50 \cdot 12 = 600\ m^3/s$

$H_{Dv} = 600/60 = 10\ m$

$H_n = 250 - 90 + 50 - 10 = 200\ m$

$P = \rho \cdot g \cdot H_n \cdot Q_i \cdot \eta = 10^3 \cdot 9,81 \cdot 200 \cdot 550 \cdot 0,9 = \underline{971,19\ MW}$

- za snagu se u računu koristi Q_i jer je $Q > Q_i$ iz tehničkih razloga

b) $Q = 650 - 50t$

$Q_{max} = Q_i = 550\ m^3/s$

$H_{n\,max} = 250 - 90 + \frac{650}{12} - \frac{650}{60} = 203,3\ m$

$Q_{min} = 650 - 12 \cdot 50 = 50\ m^3/s$

$P_{max} = \rho \cdot g \cdot H_{nmax} \cdot Q_i \cdot \eta = \underline{987,21\ MW}$

$H_{n\,min} = 250 - 90 + \frac{50}{12} - \frac{50}{60} = 163,3\ m$

$P_{min} = 163,3 \cdot 10^3 \cdot 9,81 \cdot 50 \cdot 0,9 = \underline{72,089\ MW}$

c) $650 - 50t = 550 \Rightarrow t = 2$ (2 mjeseca radi sa Q_i)

$$W_{god} = \frac{8760}{12} \cdot H_{neto} \cdot g \cdot \eta \cdot \rho \cdot \left(2 \cdot Q_i + \int_2^{12} (650 - 50t)\,dt\right)$$

$W_{god} = 5,285 \cdot 10^{12}\ Wh = 5,285\ TWh$

14. $P_n = 300 \cdot 10^6$ We

$\eta = 0{,}4$

$m = 0{,}7$

$H = 26 \cdot 10^6$ J/kg

$\omega(C) = 0{,}7$

$\omega(S) = 0{,}03$

$m(CO_2), m(SO_2) = ?$

$W = \frac{J}{s}$ $h = 3600$ s

$Wh = 3600$ J

$$P_t = \frac{P_n}{\eta} = \frac{300 \cdot 10^6}{0{,}4} = 750 \cdot 10^6 \text{ W}$$

$$W_{t\,god} = P_t \cdot m \cdot 8760 = 4{,}6 \cdot 10^{12} \text{ Wh} \cdot 3600 = 1{,}656 \cdot 10^{16} \text{ J}$$

$$m_{goriva} = \frac{W_{t\,god}}{H} = \frac{1{,}656 \cdot 10^{16} \text{ J}}{26 \cdot 10^6 \cdot \text{J/kg}} = 6369230769 \text{ kg}$$

$m(C) = 0{,}7 \; m_{goriva}$

$m(S) = 0{,}03 \cdot m_{goriva}$

$$m(CO_2) = 0{,}7 \cdot m_{goriva} \cdot \left(1 + \frac{32}{12}\right) = 16347692 \text{ 31 kg}$$

$$m(SO_2) = 0{,}03 \cdot m_{goriva} \cdot \left(1 + \frac{32}{32}\right) = 38215384 \text{ kg}$$

(15.) $P_{ne} = 100\ kW_e$

$G_v = 1\ kW/m^2$

$\eta_{FN} = 0,11$

$m = 0,2$

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a) $P_s = \frac{P_{ne}}{\eta_{FN}} = 909\ kW$

$A_a = \frac{P_s}{G_v} = \frac{909\ kW}{1\ kW/m^2} = 909\ m^2$

b) $W_{s\,god} = P_s \cdot m \cdot 8760 = 1592,568\ MWh$

$H_{popt} = \frac{W_{s\,god}}{A_a} = \frac{1592,568\ MWh}{909\ m^2} = 1752\ kWh/m^2$

$H_{horizontalno} = \frac{H_{popt}}{1,25} = 1402\ kWh/m^2$

c) $I_{maks} = 20\ A$

$F = 0,9$

$U_{PH} = 450V$

$F = \frac{P_n}{I_{k.s.} \cdot U_{PH}} \Rightarrow I_{k.s.} = \frac{P_n}{F \cdot U_{PH}} = 246,91\ A$

$n = \frac{246,91}{20} = 13$

- Za ovaj pod c) nisam 100 % siguran, al; mislim da je to ok.

16) $P_n = 1{,}5\ MW_e$, $v_n = 11\ m/s$, $t_n = 0{,}2 \cdot t_{god}$

$P_8 = 0{,}7\ MW_e$, $v_8 = 8\ m/s$, $t_8 = 0{,}4 \cdot t_{god}$

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a) $W_{god} = 8760 \cdot (0{,}2 \cdot 1{,}5\ MW + 0{,}4 \cdot 0{,}7\ MW) = 5081\ MWh$

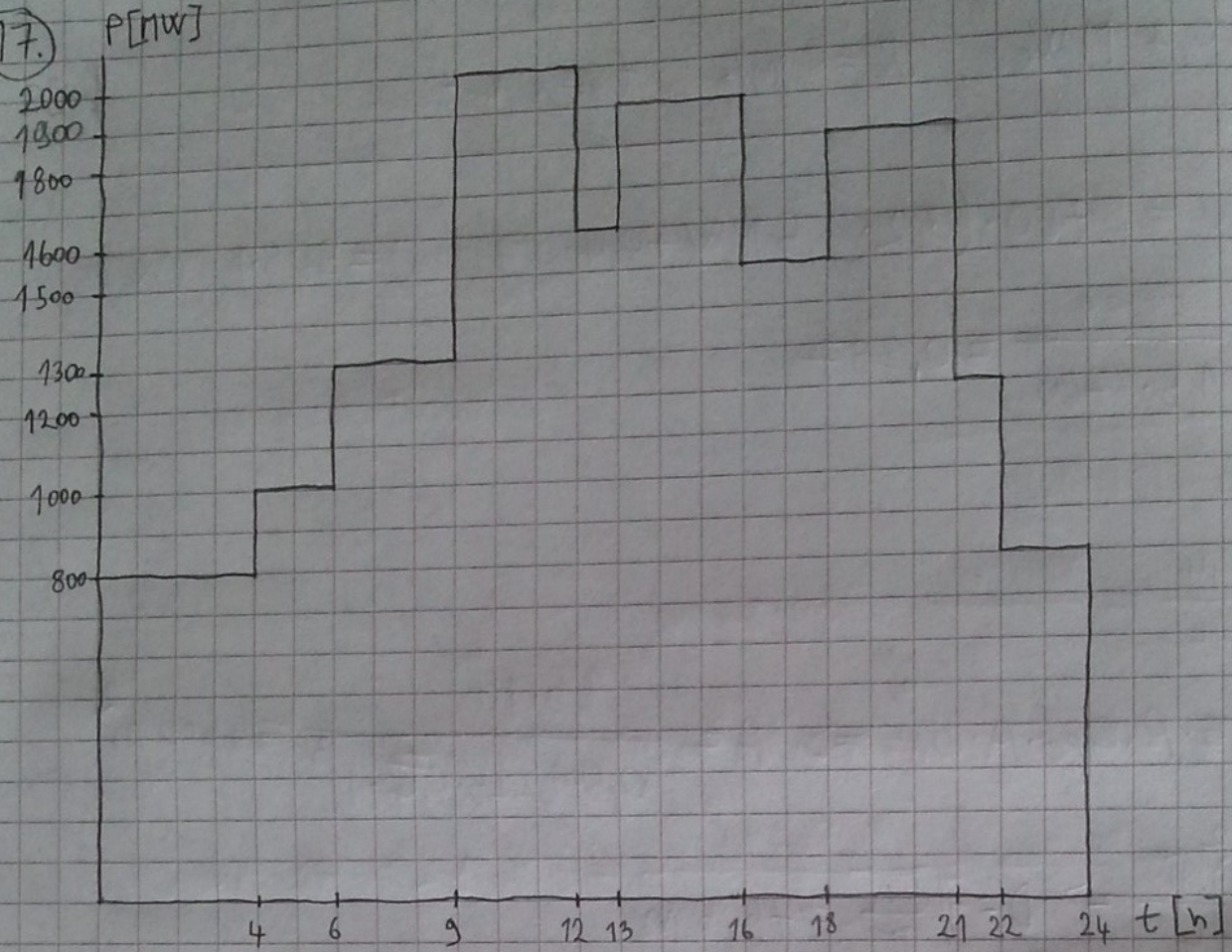
b) $m = \frac{5081}{1{,}5 \cdot 8760} = 0{,}387$

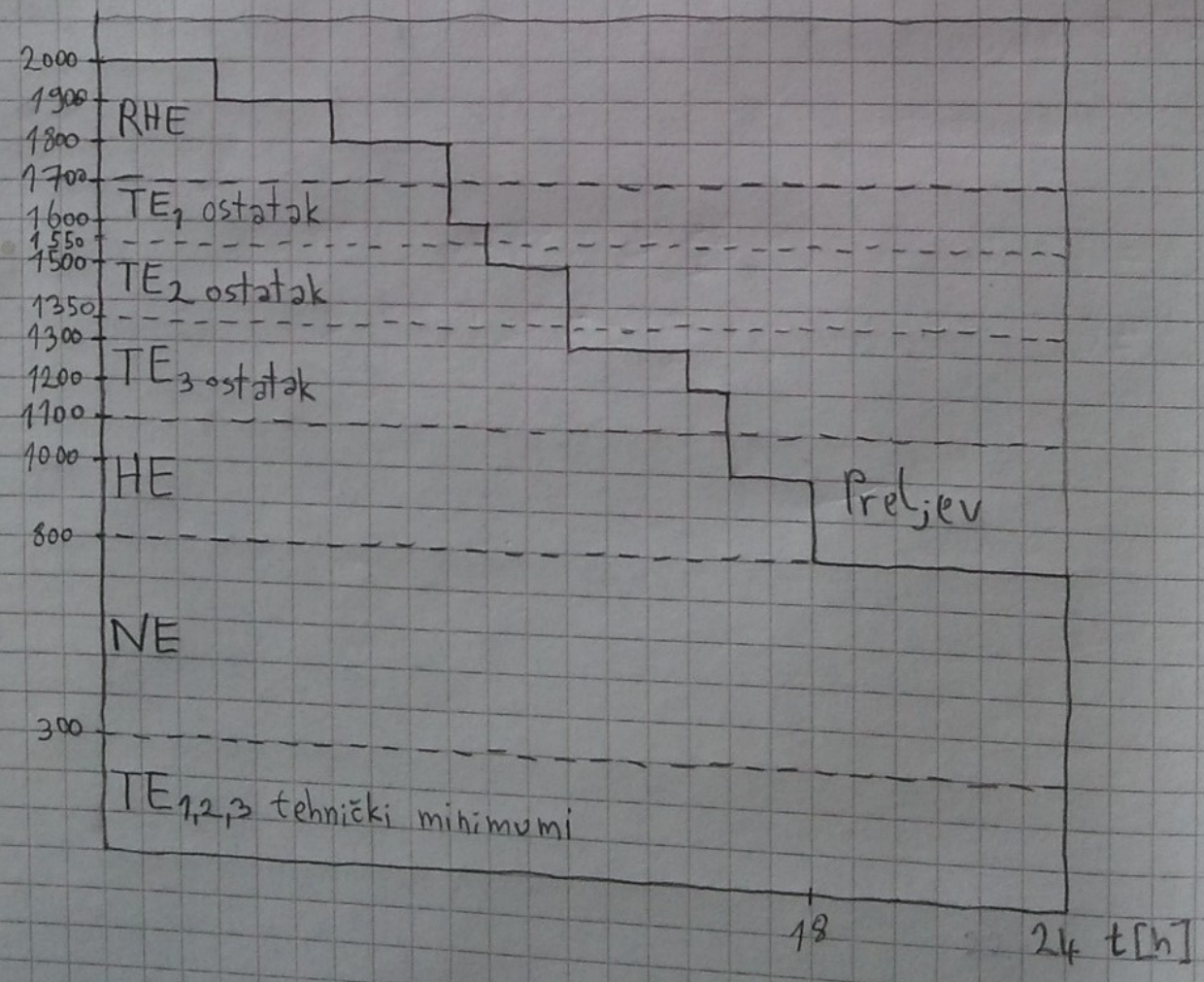
c) $c_{pe} = 0{,}4$

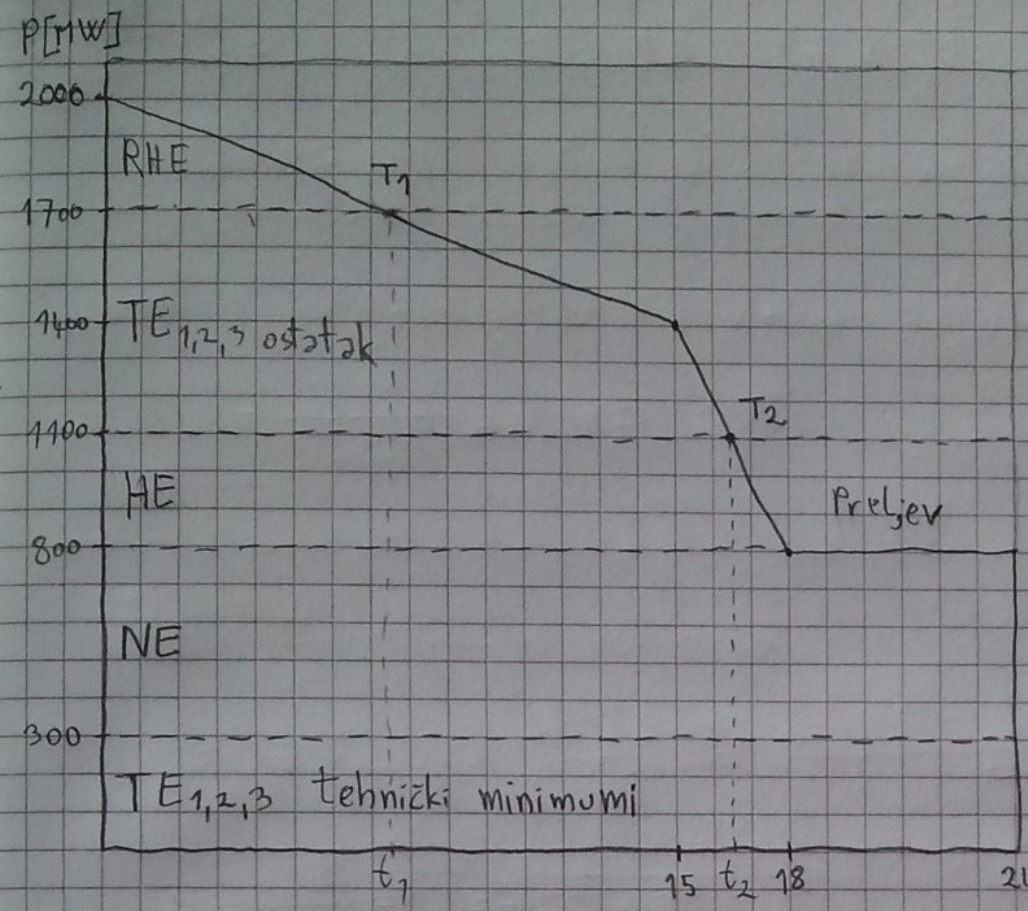
$$P_n = 0{,}5 \cdot \rho \cdot c_{pe} \cdot A \cdot v_n^3 \Rightarrow A = \frac{1{,}5 \cdot 10^6}{0{,}5 \cdot 1{,}225 \cdot 0{,}4 \cdot 11^3} = 4600\ m^2$$

$$A = \frac{D^2 \pi}{4} \Rightarrow D = \sqrt{\frac{4A}{\pi}} = 76{,}5\ m$$

17.


P[MW]
2000
1900
1800
1600
1500
1300
1200
1000
800
4
6
9
12
13
16
18
21
22
24
t[h]


2000
1900
1800
1700
1600
1550
1500
1350
1300
1200
1100
1000
800
300
RHE
TE1 ostatak
TE2 ostatak
TE3 ostatak
HE
NE
TE1,2,3 tehnički minimumi
Prelijev
18
24
t[h]



ovo za $TE_{1,2,3}$ ostatak crtajte ko na dnevnoj, ovo sam ja ovak radi preglednosti ovdje nacrtao.

b) $W_{UK} = 2000 \cdot 3 + 1900 \cdot 3 + 1800 \cdot 3 + 1600 + 1500 \cdot 2 + 1300 \cdot 3 + 1200 + 1000 \cdot 2 + 800 \cdot 6$

$= 33600$ MWh

$W_K = 24 \cdot 800 = 19200$ MWh $\quad W_V = W_{UK} - W_K = 14400$ MWh

$m = \frac{W_{UK}}{24 \cdot P_{max}} = \frac{33600}{24 \cdot 2000} = 0{,}7 \quad t_{max} = m \cdot 24 = 16{,}8$ h

c) $\beta = 0{,}5$

$\alpha + \beta = 2 \frac{W_V}{T_V \cdot P_V}$ $\quad T_V = 18$ h

$P_V = P_{max} - P_{min} = 1200$ MW $\quad \alpha = \frac{5}{6}$

$T(\alpha \cdot T_V, \beta \cdot P_V + P_K) \quad \alpha \cdot T_V = 15$ h $\quad \beta \cdot P_V + P_K = 1400$ MW $\quad T(15, 1400)$

d) $\frac{2000 - 1700}{1700 - 1400} = \frac{t_1}{15 - t_1} \quad t_1 = 7{,}5$ h

$\frac{1400 - 1100}{1100 - 800} = \frac{t_2 - 15}{18 - t_2} \quad t_2 = 16{,}5$ h

$W_{Pr} = 8 \cdot 300 + 1{,}5 \cdot 300/2 = 2625$ MWh

$W_{spr} = W_{Pr} \cdot 0{,}7 = 1837{,}5$ MWh

$W_{potrebno} = 7{,}5 \cdot 300/2 = 1125$ MWh