Iterative Optimization Steps for Generator

An iterative procedure for optimization for each component of the AAVAR system is followed in a similar manner described in this Appendix. Following are the steps for iterative optimization for generator.

The factor F is calculated using

$$F_G = \left(\frac{(\beta + \gamma_G) B_G n_G}{\tau c_{F,G} \dot{E}_{P,G}^{1-m_k}} \right)^{\frac{1}{(n_G+1)}} \quad \text{(E.1)}$$

For generator:

$\beta = 0.1061$, $\gamma_G = 1.092$, $B_G = 226231$ from Table 5.21,

$n_G = 0.048$, $\tau = 8000 \times 3600\ s$, $c_{F,G} = 1.72/1000$ ₹/kJ from Table 5.9,

$m_G = 0.66$, $\dot{E}_{P,G} = 1563$ kW for base case from Table 5.5.

Using Eq. E.1, F_G is found to be 0.003.

Cost optimal exergetic efficiency

$$\varepsilon_G^{OPT} = \frac{1}{1+F_G} \quad \text{(E.2)}$$

$$\varepsilon_G^{OPT} = \frac{1}{1+0.003}$$

$$\varepsilon_G^{OPT} = 0.997$$

Relative cost difference

$$r_G^{OPT} = \left(\frac{1+n_G}{n_G} \right) F_G \quad \text{(E.3)}$$

$$r_G^{OPT} = \left(\frac{1+0.048}{0.048} \right) 0.003$$

$$r_G^{OPT} = 0.061$$

Exergoeconomic factor

$$f_G^{OPT} = \frac{1}{1+n_G} \tag{E.4}$$

$$f_G^{OPT} = \frac{1}{1+0.048}$$

$$f_G^{OPT} = 0.954$$

Decision making parameters

$$\Delta\varepsilon_G = 100\times\left(\varepsilon_G - \varepsilon_G^{OPT}\right)/\varepsilon_G^{OPT} \tag{E.5}$$

$$\Delta\varepsilon_G = 100\times(0.95-0.997)/0.997$$

$$\Delta\varepsilon_G = -4.37$$

$$\Delta r_G = 100\times\left(r_G - r_G^{OPT}\right)/r_G^{OPT} \tag{E.6}$$

$$\Delta r_G = 100\times(0.058-0.067)/0.067$$

$$\Delta r_G = 28.32$$