Problem 6-24

In Fig. 6-35, the voltage at the point of common coupling on a per-phase basis is

$$(V_{pcc})_h = (\omega h L_{s1}) I_h$$

$$\text{THD} = \frac{\left[\sum_{h\neq 1} (V_{pcc})_h^2\right]^{1/2}}{V_1}$$

$$\text{THD} = \frac{I_1 \omega L_{s1}}{V_1} \left[\sum_{h\neq 1} (h\, I_h/I_1)^2\right]^{1/2}$$

$$= \frac{I_1}{V_1}\, 27.6 \times 10^{-3}\, [1.82]^{1/2} = 0.0373\, \frac{I_1}{V_1}$$

$$V_1 = \frac{460}{\sqrt{3}} = 266 \text{ V}$$

$$I_1 = \frac{\sqrt{6}}{\pi} I_d = \frac{\sqrt{6}}{\pi} (47.6) = 37.1 \text{ A (rms)} \qquad \text{(from Eq. 6-44)}$$

(approximate here)

$$\therefore \text{THD} = \frac{37.1}{266}\, 0.0373 = 5.2 \times 10^{-3} = 0.52\%$$

Note that the THD = 0.52% in this problem is much smaller than 4 % calculated in Problem 6-23(a) and 1.61% in Problem 6-23(b). This suggests that the typical harmonics given in Table 4-1 correspond to a system with a larger value of L_{s2} compared to that in Problem 6-21 or Problem 6-22.