**47.5 A power plant upgrade project takes two years to implement and has an initial cost of $500,000 plus an additional $250,000 at the end of year 1 and year 2. An additional $100,000 retainage will be paid at the end of the one-year defects & liability period following project completion. The life cycle of the upgrade is expected to be 20 years from completion and the salvage value will be $300,000. At an interest rate of 6%, what is the annualized cost of the venture?**

A. $83,000

B. $91,000

C. $99,000

D. $107,000

Draw a cash flow diagram or make a summary of cash flows. This solution treats costs as positive.
Year 0: $500K
Year 1: $250K
Year 2: $250K
Year 3: $100K
Year 20: -$300K

The cash flows in years 1 through 3 can be expressed as an annual cost of $100K for 3 years plus an annual cost of an additional $150K for the first 2 years only.

Use the 6% Factor Table in the Economic Analysis section to find the present value:

$$\$500,000 + \$100,000\,(P/A, 6\%, 3) + \$150,000\,(P/A, 6\%, 2) - \$300,000\,(P/F, 6\%, 20)$$

$$\$500,000 + \$100,000\,(2.673) + \$150,000\,(1.8334) - \$300,000\,(.3118) = \$948,770$$

Find the equivalent annualized cost spread over 20 years at 6%:

$$\$948,770\,(A/P, 6\%, 20) = \$948,770\,(.0872) = \$82,733$$

Alternate Approach: Discount each cash flow back to its present value individually:

$$PV_0 = \$500,000$$

$$PV_1 = \$250,000\left(\frac{1}{1+i}\right)^n = \$250,000\left(\frac{1}{1.06}\right)^1 = \$235,849$$

$$PV_2 = \$250,000\left(\frac{1}{1+i}\right)^n = \$250,000\left(\frac{1}{1.06}\right)^2 = \$222,499$$

$$PV_3 = \$100,000\left(\frac{1}{1+i}\right)^n = \$250,000\left(\frac{1}{1.06}\right)^3 = \$83,962$$

$$PV_{20} = -\$300,000\left(\frac{1}{1+i}\right)^{n} = -\$300,000\left(\frac{1}{1.06}\right)^{20} = -\$93,541$$

Take the sum to find the present value:

$$PV_0 + PV_1 + PV_2 + PV_3 + PV_{20}$$

$$\$500,000 + \$235,849 + \$222,499 + \$83,962 - \$93,541 = \$948,769$$

Use the same approach as in the original solution to find the annualized cost:

$$\$948,769\,(A/P, 6\%, 20) = \$948,770\,(.0872) = \$82,733$$

**Answer A**

**47.6 The air horsepower produced by a fan is $6.3hp$. The fan has a mechanical efficiency of 80% and the fan motor has an efficiency of 95%. The fan runs for 12 hours per day. What is annual electricity consumption for the fan?**

A. $21,000kWh$

B. $27,000kWh$

C. $36,000kWh$

D. $54,000kWh$

To find the electrical consumption, start by finding the electrical demand by dividing the air horsepower by both the fan efficiency and the motor efficiency and converting from $hp$ to $KW$.

$$\dot{W} = \frac{AHP}{\eta_f \eta_m} = \frac{(6.3hp)\left(0.7457\frac{KW}{hp}\right)}{(0.8)\,(0.95)} = 6.18KW$$

Find the annual consumption by multiplying the demand by the amount of time the fan runs throughout the year.

$$Consumption = (6.18KW)\left(12\frac{hr}{day}\right)(365days) = 27,074kWh$$

**Answer B**