5-8

*P* = $100 (*P*/*A*, 6%, 6) + $100 (*P*/*G*, 6%, 6)

= $100 (4.917) + $100 (11.459)

= $1,637.60

5-9

Determine the cash flow:

|  |  |
| --- | --- |
| **Year** | **Cash Flow** |
| 0 | $–4,400 |
| 1 | $220 |
| 2 | $1,320 |
| 3 | $1,980 |
| 4 | $1,540 |

NPW = PW of Benefits – PW of Cost

= $220(*P*/*F*, 6%, 1) + $1,320(*P*/*F*, 6%, 2) + $1,980(*P*/*F*, 6%, 3) + $1,540(*P*/*F*, 6%, 4) − $4,400

= $220(0.9434) + $1,320(0.8900) + $1,980(0.8396) + $1,540(0.7921) − $4,400

= −$135.41

NPW is negative. Do not purchase equipment.

5-18

(a) PW Costs = $700,000,000 + $10,000,000 (*P*/*A*, 9%, 80)

= $811,000,000

PW Receipts = ($550,000) (90) (*P*/*A*, 9%, 10) + ($50,000) (90) (*P*/*G*, 9%, 10) + ($1,000,000) (90) (*P*/*A*, 9%, 70) (*P*/*F*, 9%, 10)

= $849,000,000

NPW = $849,000,000 – $811,000,000 = $38,000,000

This project meets the 9% minimum rate of return as NPW is positive.

(b) Other considerations:

Engineering feasibility

Ability to finance the project

Effect on trade with Brazil

Military/national security considerations

5-22

P

$120 $120 $120

$50

$50

$50

P = $50 (*P*/*A*, 10%, 6) (*P*/*F*, 10%, 3) + $70 (*P*/*F*, 10%, 5) + $70 (*P*/*F*, 10%, 7) + $70 (*P*/*F*, 10%, 9)

= $50 (4.355) (0.7513) + $70 (0.6209 + 0.5132 + 0.4241)

= $272.67

**Alternative Solution**

P = [$50(*P*/*A*, 10%, 6) + $70(*P*/*F*, 10%, 2) + $70(*P*/*F*, 10%, 4) + $70(*P*/*F*, 10%, 6)](*P*/*F*, 10%, 3)

= [$50 (4.355) + $70 (0.8264 + 0.6830 + 0.5645)] (0.7513)

= $272.66

5-27

PW of CostA = $1,300

PW of CostB = $100 (*P*/*A*, 6%, 5) + $100 (*P*/*G*, 6%, 5)

= $100 (4.212 + 7.934)

= $1,215

To minimize PW of Cost, choose B.

5-31

Since the necessary waste treatment and mercury recovery is classed as “Fixed Output,” choose the alternative with the least Present Worth of Cost.

**Foxhill**

PW of Cost = $35,000 + ($8,000 − $2,000) (*P*/*A*, 7%, 20) − $20,000 (*P*/*F*, 7%, 20)

= $35,000 + $6,000 (10.594) − $20,000 (0.2584)

= $93,396

**Quicksilver**

PW of Cost = $40,000 + ($7,000 − $2,200) (*P*/*A*, 7%, 20)

= $40,000 + $4,800 (10.594)

= $90,851

**Almaden**

PW of Cost = $100,000 + ($2,000 − $3,500) (*P*/*A*, 7%, 20)

= $100,000 − $1,500 (10.594)

= $84,109

Select the Almaden bid.

5-36

Compute the PW of Cost for a 25-year analysis period.

Note that in both cases the annual maintenance is $100,000 per year after 25 years. Thus after 25 years all costs are identical.

**Single Stage Construction**

PW of Cost = $22,400,000 + $100,000 (*P*/*A*, 4%, 25)

= $22,400,000 + $100,000 (15.622)

= $23,962,000

**Two-Stage Construction**

PW Cost = $14,200,000 + $75,000 (*P*/*A*, 4%, 25) + $12,600,000 (*P*/*F*, 4%, 25)

= $14,200,000 + $75,000 (15.622) + $12,600,000 (0.3751)

= $20,098,000

Choose two-stage construction.

5-38

$3,000 $3,000 $3,000

$45,000

A = $2,700

n = 10

n = 10

n = 10

A = $2,700

A = $2,700

$45,000 $45,000

PW of Cost of 30 years of Westinghome

= $45,000 + $2,700 (*A*/*P*, 10%, 30) + $42,000 (*P*/*F*, 10%, 10) + $42,000 (*P*/*F*, 10%, 20) − $3,000 (*P*/*F*, 10%, 30)

= $45,000 + $2,700 (9.427) + $42,000 (0.3855) + $42,000 (0.1486) − $3,000 (0.0573)

= $92,713

$4,500 $4,500 $3,000

$54,000

A = $2,850

A = $2,850

$54,000

n = 15

n = 15

PW of Cost of 30 years of Itis

= $54,000 + $2,850 (*P*/*A*, 10%, 30) + $49,500 (*P*/*F*, 10%, 15) − $4,500 (*P*/*F*, 10%, 30)

= $54,000 + $2,850 (9.427) + $49,500 (0.2394) − $4,500 (0.0573)

= $92,459

The Itis bid has a slightly lower cost.

5-41

To equate the lives we will replace alternative A at the end of Year 10 with an identical process.

PW(A) = $18M[1 + (*P*/*F*, 9%, 10)] + $5M(*P*/*A*, 9%, 20) − $4M[(*P*/*F*, 9%, 10) + (*P*/*F*, 9%, 20)]

PW(A) = $18M[1 + (0.4224)] + $5M(9.129) − $4M[(0.4224) + (0.1784)]

PW(A) = $68.8M

PW(B) =$25M + $3M(*P*/*A*, 9%, 20) − $6M(*P*/*F*, 9%, 20)

PW(B) =$25M + $3M(9.129) − $6M(0.1784)

PW(B) =$51.3M

PW(A) – PW(B) = $69.8M – $51.3M = $17.5M

Select Alternative B, which saves $17.5M

5-44

Capitalized Cost = $2,000,000 + $15,000/0.05 = $2.3 million

5-49

*A* = $5,000, *i* = 8%

Recurring investment *R* = $150,000 every 40 years for eternity

*A* can be readily converted into *P* by dividing by *i.*

To convert *R*, we first multiply by (*A*/*F*, 10%, 40) to get an equivalent *A*, then divide by *i* to get *P.*

Thus, present cost = 150,000 + 5,000/8% + [150,000(*A*/*F*, 8%, 40)/8%](*A*/*F*, 8%, 40) = 0.00386

Present cost *P* = $219,738

5-63

Use a 20 year analysis period:

Alt. A NPW = $1,625 (*P*/*A*, 6%, 20) − $10,000 − $10,000 (*P*/*F*, 6%, 10)

= $1,625 (11.470) − $10,000 − $10,000 (0.5584)

= $3,055

Alt. B NPW = $1,530 (*P*/*A*, 6%, 20) − $15,000

= $1,530 (11.470) − $15,000

= $2,549

Alt. C NPW = $1,890 (*P*/*A*, 6%, 20) − $20,000

= $1,890 (11.470) − $20,000

= $1,678

Choose Alternative A.

5-66

It appears that there are four alternative plans for the ties:

1) Use treated ties initially and as the replacement

$6

$0.50

$6

$3

0

10 15 20

PW of Cost = $6 + $5.50 (*P*/*F*, 8%, 10) − $3 (*P*/*F*, 8%, 15)

= $6 + $5.50 (0.4632) − $3 (0.3152)

= $7.60

2) Use treated ties initially. Replace with untreated ties.

$6

$0.50

$4.50

$0.50

0

10 15 16

PW of Cost = $6 + $4 (*P*/*F*, 8%, 10) − $0.50 (*P*/*F*, 8%, 15)

= $6 + $4 (0.4632) − $0.50 (0.3152)

= $7.70

3) Use untreated ties initially. Replace with treated ties.

$4.50

$0.50

$6

$0.50

0

6 15 16

PW of Cost = $4.50 + $5.50 (*P*/*F*, 8%, 6) − $0.50 (*P*/*F*, 8%, 15)

= $4.50 + $5.50 (0.6302) − $0.50 (0.3152)

= $7.81

4) Use untreated ties initially, then two replacements with untreated ties.

$4.50

$0.50

$4.50

$0.50

0

6 12 15 18

$0.50

$4.50

PW of Cost = $4.50 + $4 (*P*/*F*, 8%, 6) + $4 (*P*/*F*, 8%, 12) − $0.50 (*P*/*F*, 8%, 15)

= $4.50 + $4 (0.6302) + $4 (0.3971) − $0.50 (0.3152)

= $8.45

Choose Alternative 1 to minimize cost.

5-125

*P* = ?, *n* = ∞, *i* = 10%, *A* = $200,000

P = A/*i* = $200,000/0.10 = $2,000,000

5-134

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Flat Solar Panels** | | | **Mechanized Solar Panels** | | | **Solar Collector Field** | | |
| **Expense** | **Income** | **PW(net)** | **Expense** | **Income** | **PW(net)** | **Expense** | **Income** | **PW(net)** |
| 0 | $87.000 |  | –$87.000 | $101.00 |  | –$101.000 | $91.00 |  | –$91.000 |
| 1 | $2.000 | $6.900 | $4.455 | $2.30 | $8.80 | $5.909 | $3.00 | $9.70 | $6.091 |
| 2 | $2.250 | $7.452 | $4.299 | $2.60 | $9.50 | $5.706 | $3.35 | $10.48 | $5.889 |
| 3 | $2.500 | $8.048 | $4.168 | $2.90 | $10.26 | $5.533 | $3.70 | $11.31 | $5.721 |
| 4 | $2.750 | $8.692 | $4.058 | $3.20 | $11.09 | $5.386 | $4.05 | $12.22 | $5.580 |
| 5 | $3.000 | $9.387 | $3.966 | $3.50 | $11.97 | $5.261 | $4.40 | $13.20 | $5.462 |
| 6 | $3.250 | $10.138 | $3.888 | $3.80 | $12.93 | $5.154 | $4.75 | $14.25 | $5.364 |
| 7 | $3.500 | $10.949 | $3.823 | $4.10 | $13.96 | $5.062 | $5.10 | $15.39 | $5.282 |
| 8 | $3.750 | $11.825 | $3.767 | $4.40 | $15.08 | $4.983 | $5.45 | $16.62 | $5.213 |
| 9 | $4.000 | $12.771 | $3.720 | $4.70 | $16.29 | $4.915 | $5.80 | $17.95 | $5.154 |
| 10 | $4.250 | $13.793 | $3.679 | $5.00 | $17.59 | $4.854 | $6.15 | $19.39 | $5.105 |
| 11 | $4.500 | $14.897 | $3.644 | $5.30 | $19.00 | $4.801 | $6.50 | $20.94 | $5.062 |
| 12 | $4.750 | $16.088 | $3.613 | $5.60 | $20.52 | $4.753 | $6.85 | $22.62 | $5.024 |
| 13 | $5.000 | $17.375 | $3.585 | $5.90 | $22.16 | $4.710 | $7.20 | $24.43 | $4.990 |
| 14 | $5.250 | $18.765 | $3.559 | $6.20 | $23.93 | $4.670 | $7.55 | $26.38 | $4.959 |
| 15 | $5.500 | $20.267 | $3.535 | $6.50 | $25.85 | $4.632 | $7.90 | $28.49 | $4.929 |
| 16 | $5.750 | $21.888 | $3.512 | $6.80 | $27.92 | $4.595 | $8.25 | $30.77 | $4.901 |
| 17 | $6.000 | $23.639 | $3.490 | $7.10 | $30.15 | $4.560 | $8.60 | $33.23 | $4.873 |
| 18 | $6.250 | $25.530 | $3.468 | $7.40 | $32.56 | $4.525 | $8.95 | $35.89 | $4.845 |
| 19 | $6.500 | $27.573 | $3.446 | $7.70 | $35.16 | $4.491 | $9.30 | $38.76 | $4.817 |
| 20 | $6.750 | $29.778 | $3.423 | $8.00 | $37.98 | $4.456 | $9.65 | $41.86 | $4.788 |
| PW |  |  | **–$11.9** |  |  | **–$2.0** |  |  | **$13.0** |

The solar collector field is the most cost economical of the three designs and offers the most power of the three as well.