13-23

First Cost = $1,050,000

Salvage Value = $225,000

Maintenance & Operating Cost = $235,000

Maintenance & Operating Gradient = $75,000

MARR = 10%

EUAC = $1,050,000 (*A/P*, 10%, *n*) + $225,000 (*A/F*, 10%, *n*) − $235,000 − $75,000 (*A/G*, 10%, *n*)

**Try *n* = 4 years:**

EUAC = $331,275 + $48,488 − $235,000 − $103,575 = −$621,362

**Try *n* = 5 years:**

EUAC = −$276,990 + $36,855 − $235,000 − $135,750 = −$610,885

**Try *n* = 6 years:**

EUAC = −$241,080 + $29,160 − $235,000 − $166,800 = −$613,720

Thus, Year 5 has the minimum EUAC, hence the most economic life is 5 years.

13-26

(a) The minimum cost life is where the EUAC of ownership is minimized for the number of years held. Since the costs are increasing, the minimum cost occurs at 1 year for the defender, where EUAC = $3,000.

(b) The minimum cost life of the challenger is 3 years, where the EUAC = $3,300.

(c) Given these costs for the defender and the challenger, we should replace the defender with the challenger after 2 years, and plan to keep the challenger for 3 years. (Since keeping the defender for a third year would have a marginal cost of $3,400, whereas the cost of the challenger for the third year would only be $3,300.)

13-29

**Defender**

Upgrade Equipment

Cost of upgrade = $12,000

Value of robot in other areas of plant = $15,000 (9 years left)

\*The implied assumption is that if we keep the defender, the other area of the plant will incur a cost of $15K to obtain an equivalent asset.

EUAC = ($12,000 + $15,000)(*A/P*, 15%, 9) = $27,000 (0.2096) = $5,659

**Challenger**

Switch to Labour

Labour = $3,500/yr

Expense = $3,500(0.6)/yr = $2,100

Overhead = ($3,500 + $2,100)(0.4)/yr = $2,240

Total = $7,840/yr

EUAC = $7,840

Decision: Upgrade the robotic transfer machine.

13-31

Interest rate = 10%

EUAC*n* = [Cost *n* − 1 (*A/P*, *i*%, *n* − 1) + Cost (*A/P*, *i*%, *n*)] (*P/F*, *i*%, *n*)

|  |  |  |
| --- | --- | --- |
| **Year** | **Marginal Cost Defender** | **EUAC Challenger** |
| 1 | $2,500 | $4,500 |
| 2 | $2,400 | $3,600 |
| 3 | $2,300 | $3,000 |
| 4 | $2,550 | $2,600 |
| 5 | $2,900 | $2,700 |
| 6 | $3,400 | $3,500 |
| 7 | $4,000 | $4,000 |

1. The lowest EUAC of the defender is **$2,300 at 3 years**.
2. The minimum cost life of the challenger is **4 years**, where EUAC is $2,600.
3. Using replacement analysis, assuming that the defender and the challenger costs will not change over the next 4 years, we should keep the defender for 4 years and then re-evaluate the costs of the challenger at that time. This decision is arrived at because we are comparing the minimum marginal cost of the defender with the minimum EUAC of the challenger. In the 5th year, the marginal cost of the defender is greater than the EUAC of the challenger. Hence, **we should replace the defender in the 5th year.**

13-33

Before-Tax Analysis

|  |  |  |  |
| --- | --- | --- | --- |
| **Year** | **New Machine BTCF** | **Existing Machine BTCF** | **New Machine rather than Existing Machine BTCF** |
| 0 | −$3,700 | −$1,000 | −$2,700 |
| 1 | +$900 | $0 | +$900 |
| 2 | +$900 | $0 | +$900 |
| 3 | +$900 | $0 | +$900 |
| 4 | +$900 | $0 | +$900 |

Compute Rate of Return

PW of Cost = PW of Benefit

$2,700 = $900 (*P/A*, *i*%, 4)

(*P/A*, *i*%, 4) = $2,700/$900 = 3.0

Rate of return = 12.6%

13-35

**Alternative I:** Retire the 4 old machines and buy 6 new machines.

Initial Cost: 6 new machines at $32,000 each $192,000

Training Program at 6 ($700) +$4,200

Total = $196,200

Savings: Annual Labor Saving $12,000

Less Maintenance $3,600

Total =$8,400

Compute Equivalent Uniform Annual Cost (EUAC)

Initial Cost: $196,000 (*A/P*, 9%, 8) = $196,000 (0.1807) = $35,453

Less Salvage Value: (6 x $750) (*A/F*, 9%, 8)= $4,500 (0.0907) = −$408

Less Net Annual Benefit: −$8,400

EUAC: $26,645

**Alternative II:** Keep 4 old machines and buy 3 new ones

Initial Cost: Value of 4 old machines at $2,000 each $8,000

3 new machines at $32,000 +$96,000

3 training programs at $700 +$2,100

Total = $106,100

Annual Maintenance= 4 old ($1,500) + 3 new ($600) = $7,800 per year

Salvage Value 8 years hence= 4 old ($500) + 3 new ($750) = $4,250

Compute Equivalent Uniform Annual Cost (EUAC)

Initial Cost: $106,100 (*A/P*, 9%, 8) = $106,100 (0.1807) = $19,172

Less Salvage Value: ($4,250) (*A/F*, 9%, 8) = $4,250 (0.0907) = −$385

Add Annual Maintenance: = +$7,800

EUAC = $26,587

Decision: Choose Alternative II with its slightly lower EUAC.

13-42

(a) The defender was implemented six years ago with a cost basis (1st cost) of $5,000. The estimated salvage value for tax purposes was $1,000 and the straight-line depreciation method was used.

SL Depr. = (B − S)/*n*

$500 = ($5,000 − $1,000)/*n*

*n* = 8 years

(b) The ATCFs for defender and challenger are as follows:

**Defender:** - 3 year remaining life

- depreciated over 8 years (six in the past)

- $2,500 expensed at time 0

- present MV = $1,000

- MV in 3 years = $500

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Year** | **BTCF** | **Deprec.** | **TI** | **IT** | **ATCF** |
| Sell | 0 | $1,000 | −$1,000\* | +$350 | $1,350 |  |
| Keep | 0 | −$1,000 | $1,000 | −$350 | −$1,350 |  |
|  | 0 | −$2,500 | −$2,500 | +$875 | −$1,625 |  |
|  | 1 | −$600 | $500 | −$1,100 | +$385 | −$215 |
|  | 2 | −$750 | $500 | −$1,250 | +$438 | −$312 |
|  | 3 | −$900 | − | −$900 | +$315 | −$585 |
|  | 3 | $500 |  | −$500\*\* | +$175 | $675 |

\* TI = Taxable Inc. = Recap. Deprec.

= $1,000 − ($5,000 − 6 ($500)]

= −$1,000

\*\* IT = Income Tax = $500 − ($5,000 − 8($500)]

= −$500

**Challenger:** - 6-year useful life

- CCA depreciation at 30 %

- MV at 6 years = $1,000

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Year** | **BTCF** | **CCA** | **Taxable** | **Taxes** | **ATCF** | **PW(ATCF)** |
| 0 | –$10,000 | —— | —— | —— | –$10,000 | –$10,000 |
| 1 | –$100 | $1,500 | –$1,600 | –$496 | $396 | $336 |
| 2 | –$150 | $2,550 | –$2,700 | –$837 | $687 | $493 |
| 3 | –$200 | $1,785 | –$1,985 | –$615 | $415 | $253 |
| 4 | –$250 | $1,250 | –$1,500 | –$465 | $215 | $111 |
| 5 | –$300 | $875 | –$1,175 | –$364 | $64 | $28 |
| 6 | –$350 | $612 | –$962 | –$298 | –$52 | –$19 |
| **6** | **$1,000** | **$0** | **–$429** | **–$133** | **$1,133** | **$420** |

Thebottom row shows the salvage income and the recovered depreciation, calculated as = $1,000 – [10,000 – Accumulated depreciation]

(c) **Foggy should choose the defender (the old machine) over the challenger (the new machine).**

Use replacement analysis to verify:

AWdefender = [−$1,350 − $1,625 − $215 (*P/F*, 18%, 1) − $312 (*P/F*, 18%, 2) – ($585 − $675)

(*P/F*, 18%, 3)] (*A/P*, 18%, 3)

= –$1,530

AWchallenger = (–10,000+336+493+253+111+28–19) (*A/P*, 18%, 3)

= –(8,379) (0.4599)

= –$3,853