8-1

This is a list of potential costs and benefits for a nuclear power plant.

|  |  |
| --- | --- |
| **Costs** | **Benefits** |
| Land acquisition | Environment   * No greenhouse gas * No leakage * No combustion |
| Site preparation | Jobs and economy   * At enrichment plants * At power plant * Increase tax base |
| Cooling system   * Reservoir dams * Reservoir cooling | Increase demand   * Uranium plants |
| Construction   * Reactor vessel/core * Balance of plant * Spent fuel storage * Water cleaning |  |

8-4

Cost of building the overpass = $1.8 million

Life of the overpass = 30 years

Salvage value at the end of the life = $100,000

Rate of interest to be considered = 6%

**Annual benefit to the public:**

Trucks = (Number of trucks) × (Saving of time in minutes) × ($ savings for 1 minute)

= 400 × 2 × 18/ 60

= 800 × 18/60

= 800 × 0.3

= $240/day

Others = (Number of other vehicles) × (Saving of time in minutes) × ($ savings for 1 minute)

= 600 × 2 × 5/60

= 1,200 × 0.083

= 99.99 = $100/day

Total = Trucks + Other vehicles

= $240 + $100

= $340/day

Thus, annual benefit = $340 × 365 = $124,100

**Annual benefit to the province:**

Annual investigation cost (due to accidents) = $6,000

**Annual benefit to the railway:**

Annual guarding expenses = $48,000

Annual accident claim = $60,000

Total annual benefit = $108,000

Combined benefit to all the three = Benefits to (Public + Province + Railways)

=$124,000 + $6,000 + $108,000

= $238,000

To assess the feasibility of the construction of the overpass, we must compute the B/C ratio using the PW approach.

PW of benefits = Annual benefit (*P/A*, 6%, 30) + Salvage (*P/F*, 6%, 30)

= $238,100 (*P/A*, 6%, 30) + $100,000 (*P/F*, 6%, 30)

= $238,100 (13.765) + $100,000 (0.1741)

= $3,277,446.50 + $17,410

= $3,294,856.50

PW of costs = $1,800,000

B/C ratio = PW of benefits/PW of costs

= $3,294,856.5/$1,800,000

= 1.8305

Since the B/C ratio is greater than 1, **the overpass should be built.**

The cost should be shared in the proportion of the benefits.

PW of the cost = $1,800,000 − $100,000 (*P/F*, 6%, 30)

= $1,800,000 – $100,000 (0.1741)

= $1,782,590

**Amount the railway should pay** = 1,782,590 × (108,000/238,100)

= 1,782,590 × 0.4536

= $**808,567**

8-21

(a) To find the justified capital expenditure, we first need to find the present worth of the benefits and the present worth of the costs.

PW of benefits= $600,000 (*P/A*, 5%, 10) + $640,000 (*P/A*, 5%, 10) (*P/F*, 5%, 10) +

$660,000 (*P/A*, 5%, 10) (*P/F*, 5%, 20) + $660,000 (*P/A*, 5%, 10)

(*P/F*, 5%, 30) + $700,000 (*P/A*, 5%, 10) (*P/F*, 5%, 40)

= $600,000 (7.722) + $640,000 (7.722) (0.6139) + $660,000 (7.722)

(0.3769) + $660,000 (7.722) (0.2314) + $700,000 (7.722) (0.1420)

= $4,633,200 + 3,033,942 + 1,920,878 + 1,179,334 + 767,566

= $11,534,922

For a benefit-cost ratio = 1, PW of benefit = PW of costs

The justified capital expenditure = PW of benefit – PW of costs

= $11,534,922– $15,000 (*P/A*, 5%, 50)

= $11,534,922– $15,000 (18.256)

= $11,534,922– $273,840

= **$11,261,082**

(b) PW of benefits= $600,000 (*P/A*, 8%, 10) + $640,000 (*P/A*, 8%, 10) (*P/F*, 8%, 10) +

$660,000 (*P/A*, 8%, 10) (*P/F*, 8%, 20) + $660,000 (*P/A*, 8%, 10)

(*P/F*, 8%, 30) + $700,000 (*P/A*, 8%, 10) (*P/F*, 8%, 40)

= $600,000 (6.710) + $640,000 (6.710) (0.4632) + $660,000 (6.710)

(0.2145) + $660,000 (6.710) (0.0994) + $700,000 (6.710) (0.0460)

= $4,026,000 + $1,989,166 + $949,934 + $440,202 + $216,062

= $7,621,365

The justified capital expenditure = PW of benefit – PW of costs

= $7,621,365 – $15,000 (*P/A*, 8%, 50)

= $7,621,365 – $15,000 (12.233)

= $7,621,365 – $183,495

= **$7,437,870**

8-37

1. Municipal solid waste has a density of 800 kg per cubic meter. So the waste flow rate of 120 × 106 kg per year corresponds to

120× 106 / 800 = 150,000 cubic meters per year.

The landfill has a capacity of 1,000,000 cubic meters, so it will be full after

1,000,000/150,000 = **6.67 years**

1. We are told that the landfill is designed to hold municipal solid waste. 1,000 kg of municipal solid waste generates 90 m3 of landfill gas, though we’re not told how long it takes to do this. We will assume that it’s evenly spread out over the landfill’s lifetime and the subsequent 15 years.

So we have a total of 120 × 106 kg a year of waste, continuing for 6.67 years, and the total gas generated is released over approximately 22 years. So the average annual rate of generation is

120 × 103 × 90 × 6.67 / 22 = 3.274 × 106 m3 of landfill gas per year

But only 50% of this landfill gas consists of methane, so the average annual rate of methane generation is

3.274 × 106/2 = 1.637 × 106 **m3 of methane per year**

1. Taking into account furnace efficiency of 88%, this gas corresponds to

0.88 × 1.637 × 106 × 40 MJ/year, which is equivalent to

57.62 × 106 MJ/year = 16 × 106 kw-h/year = 16,000 MW-h/year

This much electricity saved has a dollar value of

$16 × 106 × 0.05 = **$0.8 million per year**