MONASH University

Australian Government
Department of Industry, Innovation and Science

Business Cooperative Research Centres Program

MONASH University Civil Engineering

Theory Manual
Module 4 – Lined Pipe Analysis
Part 4 – NPV Nominal Method

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INTRODUCTION

Monash University were tasked to provide lining innovations to enhance market uptake, including a standard and code of practice of use for CIPP liners and polymeric spray liners for pressurised pipes in the CRC-project. This was conducted by undertaking literature reviews, field trials, laboratory testing, and numerical modelling. The research findings were implemented into a standard and code of practice for use in the Australian water industry. A decision tool known as the "Monash Pipe Evaluation Platform" was developed to provide guidance in decision making for pipe rehabilitations to water utilities, applicators and liner manufacturers in the form of an online web-based platform.

The Pipe Evaluation Platform is split into four modules:

1. Pipe ranking
2. Pipe failure analysis
3. Liner selection
4. Lined pipe analysis

Each module provides tools to help the users to make decisions on pipe rehabilitation.

Module 4 – Lined pipe analysis, is used to evaluate the long-term performance of various liner type and host pipes and to estimate the service life of the system. Within the Lined pipe analysis module is a section on the Net Present Value (NPV) nominal method. The following document examines the theory used for the NPV nominal method of the lined pipe analysis.

1 NET PRESENT VALUE NOMINAL METHOD

Net present value (NPV) method estimates future net cash flows of an investment (or project), whereby the cash flows are discounted using a discount rate. The discount rate is based on the project risk level. NPV method assists in identifying the value added by a project. In NPV, inflation is a major factor. Inflation is a rise in the price of goods resulting in a decrease in the purchasing power. There are two ways inflation can be incorporated in the NPV calculations. In the NPV module, the **nominal method** has been implemented. Nominal method discounts nominal project cash flow at a nominal discount rate. The net cash flow is determined using Equation 1.

$$C_n(t) = C_r(t)[1 + (IN/100)]^t \quad (1)$$

where, $C_n(t)$ is the nominal cash flow (\$) at time t (or total cash flow for each year), $C_r(t)$ is the real cash flow (\$) at time t, and IN is the inflation rate (%). The NPV is calculated for the three options in the NPV module of the Monash Pipe Evaluation Platform. These are summarised in the subsequent subsections.

1.1 Replace Option

In the Replace Option, the initial investment (I_o) (\$) is determined as per Equation 2.

$$I_o = -(L_p \times R_{\text{cost}}) \quad (2)$$

where, L_p is the length of the pipe section (m), and R_{cost} is the cost of Replace Option (\$/m). There are two aspects to consider depending upon the period over which the NPV is to be determined and the new pipe lifetime if the pipe is replaced.

If the new pipe lifetime is less than the NPV period, the present value of all future cash flow (net benefit) from t = 0 up to the NPV period is calculated as per Equation 3.

$$C_n(t) = \left(C_{\text{nothing}}(t) - R_{\text{mis}}\right)[1 + (IN/100)]^{t+1} \quad (3)$$

where, $C_{\text{nothing}}(t)$ is the cost to do nothing ($), R_{mis} is the miscellaneous Replace cost ($). Afterwards, the net benefit beyond the NPV period is calculated as per Equation 4.

$$C_n(t) = \left(-C_{\text{nothing}}(t)\right)[1 + (IN/100)]^{t+1} \quad (4)$$

The total cash flow (C_n) ($) for each year is then used in the NPV calculation.

1.2 Rehabilitate with Liner Option

In the Rehabilitate with Liner Option, the initial investment (I_o) is determined as per Equation 5.

$$I_o = -\left(L_p \times L_{\text{cost}}\right) \quad (5)$$

where, L_{cost} is the cost of liner ($/m). There are two aspects to consider depending upon the period over which the NPV is to be determined and the liner lifetime.

If the liner lifetime is less than the NPV period, the present value of all future cash flow (net benefit) from t = 0 up to the NPV period is calculated as per Equation 6.

$$C_n(t) = \left(C_{\text{nothing}}(t) - L_{\text{mis}}\right)[1 + (IN/100)]^{t+1} \quad (6)$$

where, L_{mis} is the miscellaneous liner cost ($). Afterwards, the net benefit beyond the NPV period is calculated as per Equation 7.

$$C_n(t) = \left(-C_{\text{nothing}}(t)\right)[1 + (IN/100)]^{t+1} \quad (7)$$

The total cash flow (C_n) ($) for each year is then used in the NPV calculation.

1.3 Do Nothing Option

In the Do Nothing Option, the initial investment is zero ($0). In this option, the cash flow (net benefit) is calculated over the pipe lifetime as per Equation 8.

$$C_n(t) = \left(-C_{\text{nothing}}(t)\right)[1 + (IN/100)]^{t+1} \quad (8)$$

2 FINAL NPV CALCULATION

In each option the NPV ($) is then calculated from the sum of the cash flows in each year as per Equation 9.

$$NPV = \sum_{t=1}^{n} \frac{C_n(t)}{(1+(i/100))^t} \quad (9)$$

where, i is the discount rate (%).

NOTATION

NPV	Net present value ($)
$C_n(t)$	Nominal cash flow ($) at time t
$C_r(t)$	Real cash flow ($) at time t
IN	Inflation rate (%)
t	Time (years)
I_o	Initial investment ($)
L_p	Length of the pipe section (m)
R_{cost}	Cost of replace option ($/m)
R_{mis}	Miscellaneous replace cost ($)
L_{cost}	Cost of the liner ($/m)
C_{nothing}	Cost of do nothing option ($)
L_{mis}	Miscellaneous liner cost ($)
C_n	Total cash flow for each year ($)
i	Discount rate (%)

DISCLAIMER

1. Use of the information and data contained within the Lined Pipe Analysis Module is at your sole risk.

2. If you rely on the information in the Lined Pipe Analysis Module, then you are responsible for ensuring by independent verification of its accuracy, currency, or completeness.

3. The information and data in the Lined Pipe Analysis Module is subject to change without notice.

4. The Lined Pipe Analysis Module developers may revise this disclaimer at any time by updating the Pipe Liner Selection Module.

5. Monash University and the developers accept no liability however arising for any loss resulting from the use of the Lined Pipe Analysis Module and any information and data.

CONCLUSIONS

This document provided the theory of the Net Present Value (NPV) nominal method used in the Monash Pipe Evaluation Platform (MPEP). The method is used to compare three options:

- Replace
- Rehabilitate with liner
- Do nothing