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Standard Practice for Life-Cycle Cost Analysis of Corrosion Protection Systems on Iron and Steel Products[1]

This standard is issued under the fixed designation A1068; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This practice covers a procedure for using life-cycle cost (LCC) analysis techniques to evaluate alternative corrosion protection system designs that satisfy the same functional requirements.

1.2 The LCC technique measures the present value of all relevant costs of producing and rehabilitating alternative corrosion protection systems, such as surface preparation, application, construction, rehabilitation, or replacement, over a specified period of time.

1.3 Using the results of the LCC analysis, the decision maker can then identify the alternative(s) with the lowest estimated total cost based on the present value of all costs.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E917 Practice for Measuring Life-Cycle Costs of Buildings and Building Systems

2.2 *Other Documents:*

TM-5-802-1 Economic Studies for Military Construction Design—Applications (12/86)

Federal Office of Management and Budget Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs and state documents for guidelines or requirements.

3. Terminology

3.1 *Definitions:*

3.1.1 *common costs, n*—costs common to all alternatives in nature and amounts such as initial planning fees or future annual inspection costs.

3.1.2 *discount rate, n*—the investor's time value of money, expressed as a percent, used to convert the costs occurring at different times to equivalent costs at a common point in time.

3.1.3 *corrosion protection project, n*—a project having a definable, functional corrosion protection requirement that can be satisfied by two or more systems.

3.1.4 *future costs, n*—costs required to keep the system operating that are incurred after the project is placed in service, such as surface preparation, maintenance, rehabilitation, or replacement costs.

3.1.5 *inflation, n*—the general trend or rising prices that result in reduction of the purchasing power of the dollar from year to year over time.

3.1.6 *initial cost, n*—the total of all costs, such as surface preparation, material purchase costs, and construction and installation costs, that are specific to each alternative and are incurred to bring each alternative to a point of functional readiness.

3.1.7 *material service life, n*—the number of years of service that a particular material, system, or structure will provide before rehabilitation or replacement is necessary.

3.1.8 *project design life, n*—the planning horizon for the project, expressed as the number of years of useful life required of the iron and steel product.

3.1.9 *rehabilitation cost, n*—the total of all costs incurred to extend the material service life of a specific alternative.

4. Summary of Practice

4.1 This practice outlines a procedure for conducting an LCC analysis of two or more corrosion protection alternatives over a specified project design life. It identifies the project data

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[1] This practice is under the jurisdiction of ASTM Committee A05 on Metallic-Coated Iron and Steel Products and is the direct responsibility of Subcommittee A05.13 on Structural Shapes and Hardware Specifications.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

and general assumptions necessary for the analysis and the method of computation.

5. Significance and Use

5.1 LCC analysis is an economic method for evaluating alternatives that are characterized by differing cash flows over the designated project design life. The method entails calculating the LCC of each alternate capable of satisfying the functional requirement of the project and comparing them to determine which has (have) the lowest estimated LCC over the project design life.

5.2 The LCC method is particularly suitable for determining whether the higher initial cost of an alternative is economically justified by reductions in future costs (for example, rehabilitation, or replacement) when compared to an alternative with lower initial costs but higher future costs. If a design alternative has both a lower initial cost and lower future costs than other alternatives, an LCC analysis is not necessary to show that the former is the economically preferable choice.

6. Procedure

6.1 The procedure for performing an LCC analysis for corrosion protection systems is summarized in the following steps:

6.1.1 Identify the project objectives, alternatives, and constraints (6.2).

6.1.2 Establish the basic assumptions (6.3).

6.1.3 Compile data (6.4).

6.1.4 Compute the LCC for each alternative (6.5).

6.1.5 Evaluate the results (6.6).

6.2 *Project Objectives, Alternatives, and Constraints:*

6.2.1 Specify the design objective that is to be accomplished, identify alternative systems or designs that accomplish that objective, and identify any constraints that may limit the options to be considered.

6.2.2 An example is the design of a parking garage for a residential development project. The system must satisfy mandated objectives such as specified construction schedule, load factors, and clearance height. Available alternatives, such as different objectives such as specified construction schedule, load factors, and clearance height. Available alternatives, such as different corrosion protection systems or materials, may have different initial costs as well as expected future costs. The system design may be constrained by access for future maintenance, number of footers, etc.

6.3 *Basic Assumptions:*

6.3.1 Establish the uniform assumptions to be made in the LCC analysis of all alternatives. These assumptions include the selection of discount rate, treatment of inflation, general inflation rate, project design life, and desired comprehensiveness of the analysis.

6.3.2 *Discount Rate*—The discount rate selected should reflect the owner's time value of money. That is, the discount rate should reflect the interest rate that makes the owner indifferent about paying or receiving a dollar now or at some future time. The discount rate is used to convert the costs occurring at different times to equivalent costs at a common point in time.

6.3.2.1 No single correct discount rate exists for all owners. Selection of the discount rate should be guided by the rate of return on alternative investment opportunities of comparable risk (that is, the opportunity costs of capital) or, in the case of some public organizations, on mandated or legislated federal or state requirements.

6.3.2.2 The discount rate may include general price inflation over the study period. This discount rate is referred to as the nominal discount rate in this practice. The discount rate may also be expressed as the real earning power of money over and above general price inflation, referred to as the real discount rate.

6.3.2.3 A nominal discount rate (d_n) and its corresponding real discount rate (d_r) are related as follows:

$$d_r = \frac{1+d_n}{1+I} - 1 \quad (1)$$

or

$$d_n = (1+d_r)(1+I) - 1$$

where:

I = rate of general price inflation.

6.3.2.4 The same discount rate should be used when evaluating each design alternative. Table 1 contains a procedure to follow when developing the discount rate. This procedure can be applied by those who wish to select their own values as well as those required to follow mandated or legislated requirements.

6.3.3 *Inflation*—This practice is designed to accommodate only a uniform rate of general inflation. The LCC can be calculated in constant dollar terms (not including general inflation) or current dollar terms (including general inflation). If the latter is used, a consistent projection of general price inflation must be used throughout the LCC analysis, including adjustment of the discount rate to incorporate the general inflation (6.3.2.2). The percentage change in the GNP deflator and producers' price index are two broad indicators of general inflation.

6.3.3.1 If the user desires or is required to treat inflation on an incremental (differential) basis, or uniquely to each individual cost component (for example, energy costs), he or she should consult either TM-5-802-1 or Practice E917, respectively.

6.3.4 *Project Design Life*—The project design life (3.1.8) should be established from mandated public policy, legislated requirements, or selection by the owner based on situation requirements. The same design life must be used for each alternative under comparison and for all cost categories under consideration. The potential for future obsolescence, that is, the potential that future changes may modify corrosion protection system requirements, should be considered when selecting a project design life.

6.3.5 *Comprehensiveness*—The appropriate degree of precision and detail to use in an LCC analysis is dependent on the intended use of the analysis. A less comprehensive or detailed analysis may be sufficient for ranking many alternatives roughly, whereas a more comprehensive analysis may be necessary for selecting from among a few close alternatives. In