BCE Guidance

Sacramento Area Sewer District

Version 2.0

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Contents

1.0 Introduction

1.1 Purpose

The purpose of this guidance is to standardize the development and presentation of Business Case Evaluations (BCEs). BCEs are a comprehensive approach to identifying and evaluating alternatives at all stages of a Project. They will be integral parts of the engineering evaluations performed by Sacramento Area Sewer District (SacSewer/District) and Design Consultants and will be the primary documentation of critical technical decisions that affect the design, construction and operation of the wastewater treatment facility and delivery system.

The goals of this BCE guidance are to standardize BCE development to meet the Project requirements and to ensure alternatives are fully and appropriately evaluated. Specific objectives for meeting these goals include:

- Modifying relevant Sacramento Area Sewer District (SacSewer) procedures for application to this Project;
- Providing guidance to consultants who are not familiar with District procedures or BCE templates; and
- Being a reference for standard factors and costs for use in the BCEs.

1.2 Context

SacSewer has well-developed BCE procedures that are used for developing balanced, business case-based decisions on a variety of projects and alternative evaluations. Depending on the nature and dollar magnitude of the solutions under consideration, existing procedures require the development of a BCE or a Project Development Plan (PDP). For the purposes of all evaluations related to this Project, this guidance consolidates all relevant procedures under a single set of procedures, to be referenced as BCE processes or procedures. The BCE guidance in this document will be used to guide the development and analysis of all Project alternatives expected to result in significant financial outlays.

1.3 BCE Overview

A BCE is a rigorous methodology for evaluating alternatives. It is applied at most levels of alternative analysis: from decisions between major equipment types, to selection of the types and numbers of assets used on a preferred alternative. In most cases, a BCE considers all aspects of asset ownership, including levels of service, capital costs, operations and maintenance costs, and risks. It also incorporates non-cost factors to ensure the most appropriate alternatives are selected and the selection process is well documented. This BCE guidance is focused on developing and evaluating alternatives for meeting the Project requirements at the lowest lifecycle cost while managing risk and maintaining performance.

Historically, SacSewer has used BCEs to address a wide range of problems, including operational issues. The existing SacSewer BCE procedures identify four failure modes and each problem is associated with one or more failure mode. The failure modes are levels of service, capacity, mortality, and efficiency. To help stay focused on these needs, BCE guidance requires SacSewer staff and subsequent design teams to identify specific drivers, which may include one or more of these failure modes for each analysis.

1.4 Project Template for BCE

The nature, size, and complexity of each Project will vary, and thus the BCE development and documentation process needs to be structured to respond to these variations in facilitating decisions. The documentation also needs to facilitate the review process through a structure which progressively moves from the summary information to a more detailed background analysis. The template to accommodate these objectives will have the following elements:

1. BCE Documentation: Includes the financial, risk, and sensitivity analysis for the alternatives considered as potential solutions to the "problem" being addressed. Screened alternatives are presented in a summary form. BCE-based conclusions and recommendations are delineated. Depending upon the size and complexity of the document, an Executive Summary is included at the beginning of the BCE document.
2. Technical Memorandum (TM): Presents detailed alternative descriptions and evaluations, and provides exhibits, analyses, and all supporting data justifying the conclusions and recommendations included in the BCE. TMs are attached as appendices to the BCE document.
3. The BCE.

2.0 BCE Initiation

Problem initiation is the critical step that forms the basis for the remainder of the BCE process. During problem initiation, the problem drivers are identified and the problem statement is developed. Other initial steps in the BCE process are also performed.

2.1 Goal Statement

The goal statement is based on the drivers for the problem in question. The goal statement should concisely describe the drivers for the facilities under consideration. It should focus on the function that the asset(s) will perform rather than the physical asset. A specific solution should not be identified in the goal statement. The goal statement should narrow the focus of the work and allow for a wide range of possible solutions.

3.0 Functional Requirements and Basis of Design

Key functional requirements for the proposed solution are outlined, and the proposed performance and numerical criteria developed in the relevant TM(s) are summarized. Potential constraints to meeting the objectives are identified.

4.0 Alternatives

Alternative development is a three-step process that identifies potential alternatives, screens potential alternatives, and develops alternatives for the BCE analysis. The BCE includes summary information on the alternatives considered as part of the evaluation process. A detailed discussion on all alternatives is presented in the relevant TM, attached as an appendix to the BCE document. The goal of the alternatives development is to have three to five alternatives for the BCE, including a "no project" alternative. Limiting the number of alternatives that are considered in the BCE saves time and budget and allows the alternatives to be more fully developed, which should minimize the need to reconsider the BCE as the design advances. If at the end of the fatal flaw analysis too many alternatives are still under consideration, a preliminary cost effectiveness analysis is performed to select the most viable.

4.1 Alternative Screening

Potential alternatives identified above are subjected to a fatal flaw analysis and screening, leading to a short list of preferred alternatives for a more detailed development and analysis. The screening analyses are summarized (preferably in a tabular format).

4.1.1 Fatal Flaw Analysis

Fatal flaw analysis should consider that ability of potential alternatives to meet the project drivers and the project constraints. The alternatives are considered to be fatally flawed if they do not resolve the problem statement or if they meet any of the fatal flaw criteria. The failing alternatives are then removed from further evaluation.

Examples of fatal flaw criteria are:

- Level of service:
  - ❖ Does not provide capacity when required by users
  - ❖ Project components are in conflict with District's established Levels of Service
- Schedule:
  - ❖ Project cannot be completed by the required delivery date

4.1.2 Qualitative Analysis

A qualitative analysis may allow for a fast screening and elimination of potential alternatives that have significant drawbacks but not fatal flaws. Example criteria could include process reliability, size of facilities (if related to construction costs), power requirements for major equipment, and construction schedule. Qualitative analysis can be performed using a 1 to 5 rating scale where 1 and 2 are considered low impact, 3 is considered moderate impact, and 4 and 5 are considered high impact.

4.1.3 Quantitative Analysis

A preliminary cost-effectiveness analysis can be performed on the potential alternatives. The cost-effectiveness analysis is similar to the analysis discussed in Section 4.3 below but with less activities. Estimates for power and chemical consumption should be estimated.

Other factors such as risks and environmental impacts and mitigations can be considered qualitatively on a non-economic basis if costs are not available.

4.2 Description of Preferred Alternatives

Each of the preferred alternatives is described in a summary form. More detailed information on these alternatives, including additional explanatory material, exhibits, data and cost and risk information is presented in the relevant TM, attached as an exhibit to the BCE document.

4.3 Findings

The life cycle cost (LCC) analyses for the preferred alternatives are presented here. The LCC analysis includes capital costs, annual operations and maintenance costs and estimated refurbishment costs during the life of the assets, all presented in terms of total present worth (or present value).

4.3.1 Capital Costs

Capital costs are required for the BCE. Capital costs are the actual anticipated costs to the District for the implementation of each alternative and include:

- Construction – This includes the probable cost for construction of the project, startup and testing, and spare parts. These costs will be updated routinely as the projects move through their various phases and increasingly accurate information becomes available. Refer to Project level cost estimating procedures for additional information, including the contingency allowances to be used during various Project phases.
- Environmental Mitigation Cost - This cost includes only mitigation of environmental features required for the construction of the project. If environmental mitigation costs are identified to be significant and to vary between alternatives, they will need to be included in the BCE.
- Right of Way (ROW) – No ROW costs are not expected to vary significantly between potential BCE alternatives. If significant costs are identified, they will be need to be included in the BCE.

Design and construction acceleration may be required for projects in order to meet the overall schedule. Each alternative shall have a design and construction schedule with sufficient detail to determine if construction can be completed within the time constraints of the Project schedule. If the alternative cannot be completed within the project schedule constraints, the design and/or construction will need to be accelerated. Accelerating the design and/or construction schedule could include pre-purchasing equipment/materials, or requiring longer added construction shift or changes in construction methods. The construction costs associated with acceleration need to be included in the capital cost. Risk costs associated with acceleration need to also be considered.

4.3.2 Operation and Maintenance (O&M)

The checklist of activities to be considered for O&M cost estimates should include:

- Labor, including supervisory labor (planning, organizing, scheduling and dispatching).
- Regular monitoring for performance, etc.
- Electricity, chemicals, materials, supplies and equipment.
- Periodic inspections and repairs.
- Major periodic overhaul and component replacements.

4.3.2.1 Labor

The Project may require additional labor to operate and maintain the new facilities. Information on labor impact estimates should include the following information:

- Description of the types of labor support activities required for O&M and monitoring.
- Schedule of annual and additional periodic maintenance.
- Hours per year required.

Labor costs will be calculated using a standard rate of $175 per hour. All sources used to derive O&M costs should be cited and referenced.

(**Note:** Some projects may effectively reduce existing maintenance costs, which should be included as a benefit in comparison to other project alternatives. In general, however, labor savings related to existing facilities cannot be taken into account unless positions are reduced or until 5 years has passed.)

4.3.2.2 Electricity Costs

Certain Project alternatives will require electric power. These costs are identified separately. Consideration should be given to variations in electrical costs during peak demand and other times. Costs are in kilowatt-hour. Depending on the project being evaluated, the uncertainty of the cost of power generation should be considered. If power costs are significant and could make a difference in the comparison between alternatives, a sensitivity analysis of the impact of their potential variation should be performed.

To underscore the importance SacSewer has placed on energy efficiency and long-term electrical power use reduction, any BCEs which show that two otherwise technically comparable alternatives are within 5 percent of each other in LCC, but the lower LCC alternative accompanies greater power use, a sensitivity analysis should be performed to assess the impact of potential future increases in power costs on alternative selection. If a plausible adjustment in the assumed escalation rate for electrical costs brings the two lowest LCC alternatives within reach of each other, the alternative with the lower electrical use should be selected.

4.3.2.3 Materials, Supplies and Equipment Cost

Some projects may require the use of chemicals or supplies. Annual chemical and supply costs should be calculated for the BCE. Chemical and supply costs should be based on actual costs at the EchoWater Facility or supplier quotes.

Equipment renovation and replacement costs should be estimated. Equipment costs also include major tools for carrying out all O&M duties.

4.3.3 Salvage Value and End-of-Life Disposal Cost

Major capital projects often incur major expenses at the end of their planned asset life. In most instances, they may be added costs; in others they may be revenues from salvage sale of the asset or parts of the asset. End-of-life impacts should be evaluated for both the Biosolids Master Plan (BMP) planning period of year 2048 and a 60-year planning period.

4.3.4 Indirect Costs

Indirect costs include risk, public impact, schedule acceleration, and permanent and temporary public impacts.

4.3.4.1 Risk Costs

Adverse events can occur anytime during construction and/or the service life of a project. These risk events, if unaccounted for, can potentially alter the life cycle value of a project to the degree that can make the project alternative less attractive compared to the alternatives discarded during the screening process. Therefore, efforts must be made to understand and, if possible, quantify risks and consider potential uncertainties. Alternatively, a risk premium can be added to alternatives with unusual risks (e.g., price escalations for certain materials beyond those included in the baseline estimate, or uncertainties associated with future procurement of specific replacement parts for newer technologies, etc.).

Risk can be defined as the potential for realizing unwanted consequences of an event or the possibility that the event has an unfavorable outcome. Risk is measurable, and refers to situations where probabilities can be known. Typically, the majority of the project risks can be categorized into the following areas:

- Accidents/Safety Issues
- Cost Volatility
- Schedule Delay
- Construction
- O&M
- Equipment Failure

When considering risk, the following basic questions should be considered for each alternative:

- What can happen?

  The Project construction can be delayed, construction and operations cost overruns occur, operation of new facilities may be difficult to optimize, facility service life is less or more than expected, input costs such as electricity are highly volatile and could increase dramatically during the life of a project.

- How likely is it to happen?

  Some events are more likely to happen than others. Certain types of projects have predictable costs while others are less so.

- What are the consequences of an event happening?

  The Project failure to provide an improvement or service on schedule may or may not result in future process and/or cost impacts..

4.3.4.2 Determining Probabilities

Uncertain project outcomes sometimes have fairly well-known probabilities, but sometimes they do not. Among the better known probabilities are those that are associated with some recurring factors that have well-documented historical variability.

Examples of recurrent probability outcomes include the following:

- Equipment and facility failure rates, which are documented and differentiated for various types of equipment. (Maintenance histories of most types of existing EchoWater Facility equipment can be queried using Maximo to calculate annual average repair costs.)
- Worker injuries for some ongoing or frequently repeated District activities.

- Environmental issues associated with construction, such as certain nesting birds or cultural resources.

For these types of uncertain outcomes, the information available on past patterns can provide a reasonable basis for projecting probabilities of future outcomes.

Other sources of project uncertainty are not supported by direct experience. Quantifying these types of risk requires the use of informed judgment. Sources of such judgmental probabilities may include:

- Experience of other agencies in similar circumstance.
- Judgment of SacSewer staff, or others who are familiar with the underlying uncertainty, and have at least an anecdotal basis for assigning probabilities.

In some cases, the sensitivity of a specific risk should be evaluated by changing the probability of the risk occurring. This can provide considerable insight into the relative importance of the risk in selecting the preferred alternative.

4.3.4.3 Quantifying Risk Costs

Risk costs are typically calculated as the probability of the risk event times the financial consequence of the event, or the expected value of the event. The risk costs can generally be quantified based on historical plant data for the following types of failures or hazards:

- Mechanical failure,
- Electrical or control systems failure,
- Hostile environment or fire,
- Structural failure from an earthquake,
- Inadequate effluent capacity

4.4 Public Impact Costs

Public impacts can be temporary, during the construction of a project, or permanent, lasting throughout the life of the project. For certain Projects, potential public impact costs such as vibration, noise, dust, odor and aesthetics should be considered. The public impacts related to traffic delays during construction due to the amount of truck traffic delivering equipment and material should be considered also. These costs are only important for the BCE if they would be significantly different between alternatives.

Public impacts that cannot be quantified or mitigated by the design should be listed in the non-quantifiable factors.

4.5 Non-Quantifiable Factors

Non-quantifiable costs and benefits, or intangibles, should also be considered for each alternative. The analysis can be performed using a 1 to 5 rating scale with 1 and 2 considered low impact, 3 considered moderate impact, and 4 and 5 considered high impact.

Examples of non-economic costs are as follows:

- Public relations or District image (External Customer),
- Operator preference (Internal Process and Employees), or
- Social impacts such as potential for loss of business, and/or noise (External Customer).

5.0 Analysis

The analysis step of the BCE process compares the alternatives against each other and provides the basis for selecting a preferable alternative. The analysis is based on the net positive value (NPV) and non-quantifiable factors.

5.1 Calculating Life Cycle Costs

The key variables that are used to calculate life cycle costs are duration, discount rates, inflation rate, and electricity escalation rate. The duration for Project BCEs will typically be 60 years, but for this project the BCE shall also consider the BMP planning period of year 2048. A standard discount rate of 5 percent will be used with discount rates of 3 percent and 7 percent used in sensitivity analysis. The standard inflation rate is 3 percent. The standard electricity escalation rate is 5 percent, but it can be varied as part of a sensitivity analysis for energy costs.

5.2 Sensitivity (Uncertainty) Analysis

Uncertainty can be defined as a broader set of cases in which the outcomes are recognized to be variable and not predictable and, in addition, their outcomes and probabilities may not be known or knowable in advance. Some degree of uncertainty will be associated with almost any significant capital project or utility Project. Utility capital projects tend to have long lives, which means that their life cycle cost analyses will extend far into the future, which is inherently uncertain. For this reason, a method known as sensitivity analysis is sometimes used to evaluate uncertainty.

Generally speaking, a sensitivity analysis is a method to test “what-if” scenarios of the NPV analysis by varying certain parameters. In a typical sensitivity analysis, the value of an input variable that is potentially uncertain, such as long-term power costs, is changed, while all the other project variables are held constant, and the amount of change in results is noted. The same process is repeated for other input variables that are considered uncertain. Finally, the variables chosen can be ranked according to the effect of their variability on the net present value results.

The parameters that are typically varied in a sensitivity analysis are:

- Discount and Inflation (Escalation) Rates - The discount rate is important in comparing O&M costs to capital costs. Inflation and escalation rates are the expected rate at which prices for inputs to the project increases over time. These rates typically have the most impact on the results of the sensitivity analysis. It should be noted that inflation rates sensitivity are typically assigned to construction cost estimates.
- Risk Levels- The probability of an extraordinary and/or uncertain event occurring can impact the total life cycle costs of a project. Similarly, risk levels can vary between alternatives and the use of a risk premium can provide more realistic financial comparisons between alternatives.
- Cost Estimates – This investigates whether the outcome of the NPV analysis is subject to change based on conservatism and/or optimism in developing cost estimates for capital, operations, maintenance, or other specific types of costs. Costs can be adjusted lower or higher (i.e., halved or doubled) as may be appropriate.

5.3 Recommendation of a Preferred Alternative

The selection of the preferred alternative is based on the Total Cost in NPV (in today’s dollars) and analysis of non-quantifiable factors. The project team must evaluate all results intuitively along with the economic factors and benefits to reach consensus on the preferred alternative. The case for the recommended alternative should be made clear and should stand up to scrutiny. Depending on the project, it is suggested that the stakeholders have input and agree with the selection of the recommended alternative. The recommended alternative should represent the overall best value alternative for SacSewer and the community.

The project team should also be aware of the degree of public influence on the project or specific project alternatives. The selected preferable alternative should promote the general welfare of the public and should be presented as such.

The conclusion of the BCE should provide the justification for the recommended alternative. The justification should demonstrate how the recommended solution provides the best overall value when considering level of service, economical factors, risk, and intangible factors.

6.0 BCE Documentation

The BCE process must be well documented to allow a thorough review and to record the analysis for future reference. The documentation will consist of written summaries of the steps used to develop alternatives including their costs and risks. It is anticipated that the BCE documentation will be summarized in the body of the associated Basis of Design Report or design documents and attached to the report.

7.0 Reviews and Approvals

All BCEs will be reviewed and signed off by the Project Manager before approval by the EchoWater Facility Management.