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PRACTICE

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**BASIS OF ESTIMATE - AS
APPLIED IN MAINTENANCE
TURNAROUNDS FOR THE
PROCESS INDUSTRIES**

SAMPLE

AACE
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**BASIS OF ESTIMATE – AS APPLIED IN MAINTENANCE
TURNAROUNDS FOR THE PROCESS INDUSTRIES**
TCM Framework: 7.3 – Cost Estimating and Budgeting

Revised August 25, 2021

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TCM Framework: 7.3 – Cost Estimating and Budgeting



August 25, 2021

TABLE OF CONTENTS

Table of Contents1

1. Introduction3

 1.1. Scope of this Recommended Practice3

 1.2. Purpose4

 1.3. Background4

2. Recommended Practice4

3. Basis of Estimate Development Process5

 3.1. Inputs to the BoE6

4. Basis of Estimate Format & Content6

 4.1. Introduction - General7

 4.1.1. Purpose of This Document7

 4.1.2. Purpose of Estimate7

 4.1.3. Turnaround Objectives7

 4.1.4. Estimate Class and Confidence Level7

 4.2. Turnaround Scope Definition8

 4.2.1. Work-Scope Overview8

 4.2.2. Management Team8

 4.2.2.1. Turnaround Event Planning & Preparation Team8

 4.2.2.2. Turnaround Event Execution Management Team9

 4.2.3. Turnaround Financial Boundaries & Assignment of Costs9

 4.2.3.1. Assignment of Costs for Turnaround Work9

 4.2.3.2. Assignment of Costs for Material Procurement9

 4.2.3.3. Assignment of Costs for Logistics10

 4.2.3.4. Assignment of Costs for Plant Shutdown10

 4.2.3.5. Assignment of Operations & Routine Maintenance Costs During Execution10

 4.2.3.6. Payment by the Turnaround for Use of Site Utilities10

 4.2.3.7. Shared Costs for Capital Projects10

 4.2.3.8. Assignment of Costs for Startup10

 4.2.3.9. Waste Disposal Fees10

 4.2.4. Execution Strategy10

 4.2.4.1. Execution Plan10

 4.2.4.2. Contracting Strategy11

 4.2.5. Schedule Basis11

 4.3. Estimating Methodology11

 4.3.1. Estimating Tools11

 4.3.2. Coding Structures11

 4.3.3. Documentation Plan12

 4.3.4. Units of Measure12

 4.3.5. Currency Exchange Rates12

 4.3.6. Rounding12

 4.3.7. Capital versus Expense12

 4.3.8. Estimate Preparation12

 4.3.8.1. Quantity Basis12

 4.3.8.2. Cost Basis12

 4.3.8.3. Allowances13

 4.3.8.4. Planning & Preparation13

 4.3.8.5. Pre-Turnaround Field Work13

August 25, 2021

4.3.8.6. Offsite Fabrication	13
4.3.8.7. Consumables	13
4.3.8.8. Construction Equipment Rental (cranes, bundle pullers, etc.)	13
4.3.8.9. Logistics, Temporary Facilities, Waste Disposal, etc.	13
4.3.8.10. Owner Costs	14
4.3.8.11. Major Capital Project Shared Costs	14
4.3.8.12. Clarifications, Qualifications, Assumptions, and Exclusions	14
4.3.8.13. Exceptions	14
4.3.9. Escalation	14
4.3.10. Allowances for Uncertainty & Risk	14
4.4. Late Changes	15
4.5. Reconciliation with Previous Estimates	15
4.6. Estimate Quality Assurance	15
4.6.1. Comparison with Benchmarks	15
4.6.2. Review & Validation	16
4.7. Estimating Team	16
References	16
Contributors	16

SAMPLE

August 25, 2021

1. INTRODUCTION

This recommended practice (RP) is a guideline for the development of Basis of Estimate (BoE) documents for maintenance turnaround cost estimates in the process industries. It provides information specific to maintenance turnarounds and to the process industries that is not available in the general RP 34R-05, *Basis of Estimate* [1].

1.1. Scope of this Recommended Practice

This document discusses maintenance turnarounds for continuously operating units in the process industries.

For the purposes of this document, the term *maintenance turnaround* is defined using the American Petroleum Institute (API) definition, namely: “a planned, periodic shutdown (total or partial) of a process unit or plant to perform maintenance, overhaul and repair operations, and to inspect, test and replace process materials and equipment”¹. Facilities that run on a continuous rather than a batch production cycle must, every few years, shut down operations to provide access to the production units in order that essential maintenance, modification and inspection work can be carried out that could not be done while the units are in operation.

The scope of a maintenance turnaround (TA or TAR²) typically includes:

- Inspection of equipment to comply with company or government regulations.
- Inspection of pipework for corrosion and erosion damage, both internal (e.g., process weak points) and external (e.g., corrosion under insulation, or CUI).
- Cleaning, repair and maintenance of equipment, pipework and instrumentation (e.g., pulling and cleaning heat exchanger tube bundles, repairing leaks in pipework or checking of pressure relief valves).
- Minor upgrades and modifications to the facilities that are small enough to be dealt with by the maintenance team and are not stand-alone projects.

Maintenance turnarounds are not capital projects. Although they do have a beginning, middle and end and hence fulfil one criterion for a project, they are generally of shorter duration, typically funded from operational expense instead of capital expense and a host of other differences, most notably that the work done is largely inspection and maintenance or repair, with minimal installation of new components.³

Maintenance turnaround events (which are sometimes viewed as a short-interval project by contractors or owner's internal maintenance crew) typically also have traditional capital project tie-in scope which needs to be executed in the turnaround event window, as well as the standard maintenance and inspection (M&I) scopes. The cost estimates covered by this RP are for the M&I work scope only. For a discussion of BoE documents for capital projects, refer to RP 106R-19, *Basis of Estimate – As Applied in Engineering, Procurement, and Construction for the Process Industries* [2].

For the purposes of this document, the term *process industries* is assumed to include firms involved with the manufacturing and production of chemicals, petrochemicals, hydrocarbon processing, energy, and utilities. One common thread among these industries is the continuous operation (as opposed to batch operation) of their process plant, thus necessitating regular maintenance turnarounds. The other common thread (for the purpose of estimate classification) is their reliance on process flow diagrams (PFDs), piping and instrument diagrams (P&IDs), and electrical one-line drawings as primary scope defining documents. These documents are key deliverables in determining the degree of scope definition, and thus the extent and maturity of estimate input information.

¹ <http://www.api.org/aboutoilgas/sectors/>

² It may also be referred to as a maintenance shutdown, or a maintenance outage.

³ For further discussion of the differences between capital projects and maintenance turnarounds, refer to the webinar presentation on RP 112R-20, given by Gordon Lawrence on 28th July 2021 and available on the AACE website.

August 25, 2021

In this document, we use the term *maintenance & inspection* (M&I) scope to describe the turnaround scope. However, be aware that some process industries use the term *operations & maintenance* (O&M) scope to describe the same thing.

1.2. Purpose

The *Total Cost Management (TCM) Framework* [3] section 7.3.4.4, *Outputs from Cost Estimating and Budgeting* highlights the need to develop a basis of estimate (BoE) document. This RP addresses the steps and issues to be considered in developing a comprehensive BoE document for a maintenance turnaround estimate. A key objective of a BoE is that the reader of the BoE is able to clearly understand the underlying basis behind the estimate, including any deficiencies in estimate preparation that may impact the estimate.

This RP is intended to provide a guideline template for a BoE document that can be applied across the process industries. But each specific industry within the overall process industries will have its own terminology and may have minor custom needs. Therefore, this RP is not intended as a standard that must be rigidly adhered to in all aspects. Rather it can be used as a guide, with the objective being to produce a BoE that allows the reader of the BoE to be able to clearly understand the underlying basis behind the estimate, including any deficiencies in estimate preparation that may impact the estimate.

1.3. Background

The BoE is characterized as a deliverable that documents the scope and cost of the turnaround, with particular emphasis on how the estimate was developed. When prepared correctly, any person with turnaround experience can use the BoE to understand and assess the estimate, independent of any other supporting documentation. A well-written BoE achieves those goals by clearly and concisely stating the purpose of the estimate being prepared, the turnaround scope, pricing basis, allowances, assumptions, exclusions, cost risks and opportunities, and any deviations from standard practices. In addition, the BoE is a documented record of pertinent communications that have occurred and agreements that have been made between the estimator and other stakeholders. The BoE document is prepared by the estimator/provider in alignment with the approved estimate plan and estimate requirements document.

The template in this document is mainly focused on deterministic estimates where the primary method of cost development is through the use of semi-detailed or detailed unit costs. Conceptual estimates for turnarounds are primarily developed through the use of historic turnaround estimate data. The BoE format will need to adjust to reflect this. For a discussion of estimate classes, both deterministic and conceptual, for maintenance turnarounds, refer to RP 112R-20 [4].

The extent to which each of the sections of the BoE document are completed will be dependent on the turnaround scope, the class of estimate, and other variables. It is recommended to keep the document concise, but to include as much relevant information as possible.

Note that the term *owner* refers to the estimate owner and may be an owner company, or a party within the provider's organization. It simply refers to the party soliciting the estimate.

2. RECOMMENDED PRACTICE

The primary intent of this RP is to provide a guideline for the topics and contents to be included in a typical BOE.

August 25, 2021

A well-prepared basis of estimate will:

- Document the overall turnaround scope on which the estimate is based
- Document the strategies on which the estimate is based, including execution strategy, contracting strategy, procurement strategy and project integration strategy.
- Communicate the estimator’s knowledge of the turnaround by demonstrating an understanding of scope and schedule as it relates to cost.
- Communicate the uncertainty associated with the estimate and alert the turnaround team to potential cost risks and opportunities.
- Align with the turnaround implementation basis, including goals, objectives, and cost strategy.
- Identify estimating team members and their roles.
- Describe the tools, techniques, estimating methodology, and data used to develop the cost estimate.
- Identify other turnarounds that were referenced or benchmarked during estimate preparation.
- Be developed in parallel with the cost estimate.
- Provide documentation of all assumptions and exclusions.
- Provide a record of key communications made during estimate preparation.
- Provide a record of all documents used to prepare the estimate, including dates and revisions. Act as a source of support during dispute resolutions.
- Supports the establishment of the baseline for scope, quantities, and cost for use in cost trending throughout the turnaround execution.
- Provide the historical relationships between estimates throughout the turnaround lifecycle.
- Facilitate the review and validation of the cost estimate.

This recommended practice is divided into two sections:

1. The *Basis of Estimate Development Process* defines the main steps and discusses issues to be considered in preparing a BOE.
2. The *Basis of Estimate Format & Content* provides a suggested format for an estimate plan along with annotations. It is designed to allow practitioners to use and modify it as needed for their specific situation.

3. BASIS OF ESTIMATE DEVELOPMENT PROCESS

This section defines the main steps and discusses issues to be considered in preparing a BOE. A separate BOE should be developed for each individual estimate.

Figure 1 highlights the requirements of BoE development process.