EXPRO National Manual for Projects Management

Volume 7, Chapter 3

Project Estimate Methodology / Development Procedure

Document No. EPM-KPE-PR-000003 Rev 003

Document Revisions History:

Revision:	Date:	Reason For Issue
000	29/01/2018	For Use
001	25/12/2018	For Use
002	25/02/2019	For Use
003	23/08/2021	For Use

THIS NOTICE MUST ACCOMPANY EVERY COPY OF THIS DOCUMENT

IMPORTANT NOTICE

This document, ("Document") is the exclusive property of Government Expenditure & Projects Efficiency Authority.

This Document should be read in its entirety including the terms of this Important Notice. The government entities may disclose this Document or extracts of this Document to their respective consultants and/or contractors, provided that such disclosure includes this Important Notice.

Any use or reliance on this Document, or extracts thereof, by any party, including government entities and their respective consultants and/or contractors, is at that third party's sole risk and responsibility. Government Expenditure and Projects Efficiency Authority, to the maximum extent permitted by law, disclaim all liability (including for losses or damages of whatsoever nature claimed on whatsoever basis including negligence or otherwise) to any third party howsoever arising with respect to or in connection with the use of this Document including any liability caused by negligent acts or omissions.

This Document and its contents are valid only for the conditions reported in it and as of the date of this Document.

Table of Contents

1.0 PURPOSE

This procedure provides guidelines for the methodology used in the development of construction cost estimates. It defines essential estimating processes in order to promote uniformity estimate development. This procedure applies to works performed under all Government construction projects executed throughout the Kingdom of Saudi Arabia.

2.0 SCOPE

This section provides an understanding of the typical estimating requirements for the capital cost of a project. It outlines the best practice for the preparation of capital costs estimates and enables the understanding of the requirements within major capital projects.

3.0 DEFINITIONS

Definitions	Description
Bulk Materials	Those commodities, such as concrete, formwork, reinforcing steel, embedded metal, wire, cable, conduit, cable tray, pipe, fittings, valves, instruments, general building materials, etc., that, for the most part, are purchased in quantity and fabricated or assembled in the field. Generally, they are interpreted to mean all materials that are not defined as equipment. For the purpose of forecasting categories, bulk materials exclude materials that are supplied and installed by subcontractors.
Contingency	The amount of money, job hours, and time that must be included in an estimate, forecast, and schedule to provide for uncertainties in quantity, pricing, productivity, activity duration, and timing that lie within the defined scope of the project.
Consumer Price Index (CPI)	The Consumer Price Index measures changes in the price level of market basket of consumer goods and services purchased by households.
Direct Field Costs	Direct Field Costs include the cost of all materials and improvements forming a permanent part of the finished project and of all contractor and subcontract labor engaged in installing or erecting such materials or performing such improvements.
Direct Labor	All labor engaged in erecting or installing equipment and materials and performing improvements that form a permanent part of the finished plant. All direct labor is manual labor, including General Foremen, Foremen, Journeymen, and Apprentices.
Distributable Field Costs / Indirect Field Costs	Material and labor costs that cannot be identified with specific direct operations in the construction of a plant and are either supporting services by nature or apply in such a way to several direct operations that a logic allocation to each separate operation cannot readily be made. This includes the cost of construction equipment and the cost of materials and labor to construct temporary facilities and perform supporting services relating to the construction of a facility such as temporary utilities, sanitation, and cleanup services.
ENR	Engineering News Record (ENR) is an industry publication, providing news and features about

Definitions	Description
	projects, products and people in construction, architecture and engineering.
Escalation	Changes in the basic cost of materials and services that may occur from the base date of an estimate or forecast to the time when the material is purchased or delivered or the service is performed. Escalation generally relates to the price trends occurring in a given segment of the industry, while inflation is the aggregate average of a large number of changing prices and costs throughout the economy. The two are related but rarely equal to one another.
Foremen	A Foremen is a person with specialist knowledge of a given trade who has focused on an overall supervision of a trade and work crew.
General foreman	A General Foreman is a person who is responsible in supervising and managing Foremen depending on the project size.
IHS Global Insight	IHS Global Insight in economic and financial analysis, forecasting and market intelligence firm
Journeymen	A Journeyman is a skilled worker who has successfully completed an official apprenticeship qualification in a building trade or craft.
Lightering	The use of barges for short-distance transport is referred to Lightering.
Material Equipment	Those components completely shop-assembled before delivery to the jobsite and that provide storage such as HVAC systems.
NP	Normalized productivity. The normalized productivity is equivalent standardized productivity. It is used in the reconciliation of an estimate
NPP	New Proposed Productivity. The productivity of the current proposed estimate when reconciling two estimates
NW	The New Manual Wage rate utilized during the reconciliation of two estimates.
Other Cost	Other Costs include items such as freight, duties, taxes, insurance, bonds, etc.
Payroll Additives	Refers to money paid by an employer in addition to base salary, such as medical benefits, paid time off, allocation, insurance, and any other contributions.
PCD	Productivity cost differential. The costs associated due to difference in productivity when reconciling two estimates.
Pilferage	Reduction in inventory resulting from petty thievery by employees.
PP	Project Pricing. The pricing of a current project estimate; calculated during reconciliation of two estimates.
PPI	The Producer Price Index is a weighted index of prices measured at the wholesale, or producer level. The PPI shows trends within the wholesale markets manufacturing industries and commodities markets.
PPW	Proposed Project Wage. The wage rate of the current proposed estimate calculated during the reconciliation on an estimate.

Definitions	Description
Richardson	Richardson industry publication of construction cost information.
RJH	Reference Job Hours. The job hours of the reference estimate when reconciling two estimates.
RP	Reference Pricing. The pricing of a reference project; calculated during reconciliation of two estimates.
RPDH	Reference Project Direct Job Hours. The quantity of direct job hours in the reference project calculated while reconciling a proposed estimate to a reference estimate.
RPP	Reference Project Productivity. The productivity of the reference estimate when reconciling two estimates.
RPW	Reference Project Wage. The wage rate of the reference project calculated during the reconciliation on an estimate.
RFP	Request for Purchase
RS Means	RS Means is industry publication of construction cost information.
VPA	Vendor Pricing Adjustment. The adjustment used during reconciliation of two estimates noting the difference in price.
WRA	Wage Rate Adjustment. Adjustment calculated during the reconciliation on an estimate.

4.0 REFERENCES

1. EPM-KPC-PR-000012 - Project Historical Cost Reporting Procedure
2. EPM-KPE-PR-000001 - Project Estimate Types Procedure
3. EPM-KPE-PR-000002 - Project Estimating Coding Procedure
4. EPM-KPE-PR-000004 - Project Estimate Review Procedure

5.0 RESPONSIBILITIES

A completed construction cost estimate is a jointly developed work product representing the best judgment of all the participating team members. The Project Estimator leads the estimate preparation effort.

The Engineering Manager has overall responsibility for the preparation, definition, quantification and documentation of the design basis and scope of work. The work scope sets the limits of costs represented in the estimate.

The Project Estimator should confirm that engineering has properly assembled and reviewed the physical quantities that represent the estimate scope of work.

The Construction Manager provides construction and installation input regarding craft labor availability, wage rates, productivity information, the contracting plan, the construction equipment list, and other input consistent with the type of estimate under development.

The Procurement Specialist furnishes prices quoted by vendors, current market pricing data, inland and ocean freight rates, import duties, vendor representative rates and expenses, and other pertinent information upon request from Estimating, and makes a recommendation as to the price to be included in the estimate.

Other functional departments may also be involved:

- Human Relations for employment conditions, salary, and benefits data.
- Labor Relations for construction craft labor rates and work rules.
- Risk Management for payroll based insurance premiums, other insurance requirements and costs.
- Health, Safety, Security and Environment for support costs.

To enhance communication among team members and avoid later confusion and ambiguity, the proposal or project team, led by the Engineering Manager or his delegate, should clearly explain to the estimating team what the design basis and scope definition assumptions are and who is responsible for them. The Project Estimator should document all assumptions, so that during the project planning and execution phases all functional departments have an estimate basis document for use in developing the work plan.

6.0 PROCESS

Techniques and methodologies used to prepare construction cost estimates will depend on the information available and what the estimate will be used for. Typically, for Indicative / Conceptual, Feasibility / Order of Magnitude, and some Preliminary Estimates (Estimate Class 5, 4, and 3; refer to procedure EPM-KPE-PR-000001; Project Estimate Types Procedure), construction cost will be estimated parametrically using one or more of the following techniques:

- Cost vs Capacity correlations.
- “All-in” cost per lineal meter of Right of Way for roads, rail and pipelines; square meter for structures, etc. for buildings and heavy civil projects.
- Escalate and adjust actual cost data based on capacity/size/location from a similar project.
- Estimate the cost of the process / utility equipment and use correlations of total project cost to equipment cost to estimate the total cost based on the estimated equipment cost.

For estimates that require more accuracy (Class 1, 2 and perhaps 3), the methodology described below will be used.

See **Attachment 1** for process flow chart

6.1 Approach

The standard cost estimating approach for projects is shown on the flowchart in Attachment 1 and consists of the following:

- Define the scope of work and quantify that scope.
- Determine labor requirements, such as the correct installation job hour rates, to perform the direct construction work. Working with the Construction Representative, ensure the proper standard job hour unit rates of placement are used prior to the application of the regional labor productivity factor(s). Apply these base job hour installation rates to the quantified scope of work to determine standard total job hours. Note that for pipelines, demolition and heavy civil work, construction/installation costs are often “crewed out” by estimating the time required to perform the work operation and then multiplying by the cost per day of the crew needed to do the work. Often the cost per day will include the cost of construction equipment, tools and consumables in addition to the payroll cost of the crew.
- Apply regional labor productivity factor(s) to the standard total job hours, to calculate project-specific total installation job hours.
- Determine current wage rates and payroll additives applicable to the specific project location.
- Calculate labor costs to perform the construction work (installation job hours multiplied by hourly rates of pay).
- Plan and schedule the defined work on a time and logic basis and resource-load the project job hours from the estimate to verify achievability.
- Calculate, or acquire pricing information from the Procurement department, the cost of the engineered permanent equipment, direct materials, and subcontracted work elements.
- Calculate, or acquire pricing information from the Contracts department, any subcontracted work elements.
- Calculate the installation cost of other physical items or activities required to perform the construction work.
- Incorporate field indirect costs to support direct construction. Obtain this input from staffing plans and the support lists of temporary facilities, materials, and mobile construction equipment provided by the Construction Representative.
- Determine appropriate escalation, insurance, bonding, licensing and permits, miscellaneous fees, freight, duties, and appropriate taxes.
- Determine an appropriate level of contingency.

- If required, update cost and pricing data, as appropriate, throughout the initial proposal phase, negotiation phase, and best-and-final-offer phase.
- To ensure accuracy, have the estimate analyzed by the Project Estimator through comparison with the actual costs of past similar projects. The Project Estimator should verify that the following cost data sources, to the extent practical, were used for estimate development:
- Historical Cost Reports (HCR's) for historical project cost information. (see Project Historical Cost Reporting Procedure EPM-KPC-PR-000012)
- Job hours for development of craft hour estimates.
- Published databases such as RS Means, Aspen, RBOOKS, and Icarus Project Manager for material and installation cost estimates, location factors, etc.
- Accumulate a list of applicable qualifications and assumptions that document the values provided in the estimate and justify the use of those values.

The application selected will depend on the size, class, and type of project, methodology used.

Escalation is applied using a time phased expenditure of total project funds.

Contingency is applied to all estimates. Contingency reflects the level of confidence in an estimate.

A checklist is provided in **Attachment 2** that contains a comprehensive list of items that should be reviewed to promote completeness of the cost estimate.

Independent math checks of estimates should be performed if programs other than database software are used, and the checks may be evidenced by recording the checker's initials and the date on spreadsheets and calculation sheets.

Estimate review is an integral part of the standard estimating process (see EPM-KPE-PR-000004, Estimate Review Procedure).

6.2 Estimate Plan

Before the estimate kickoff meeting, the Project Estimator formulates a basis for the estimating plan with the Project Manager and Engineering Manager. They first determine the estimate classification or the type of estimate and level of accuracy required. The Project Estimator then prepares the estimate plan to secure commitments for the methods and resources needed to support the estimate classification. A sample estimate plan is provided in **Attachment 3**.

The plan should include the following components:

- Project data sheet summarizing key project information, including Entity name, project title, project number and location, brief description of the project, type of estimate to be provided, key project dates, and other significant data. This sheet is similar to the project data sheet in an estimate presentation and should be brief (preferably one page).
- Description of the study or project.
- Scope of work for the project.
- Classification and expected accuracy of the estimate.
- Definition of estimate deliverables:
    - Internal deliverable required to support estimate review and approval
    - External deliverables requirements of the Entity

- Estimate preparation elements:

    - Methods and tools to be used for quantity development and pricing
    - Major categories contained in the estimate such as process blocks, work breakdown structure, RFP- Request for Purchase dictates, etc.
    - Code of accounts – (equal to level of detail planned for control requirements)
      (see procedure EPM-KPE-PR-000002 - Project Estimating Coding Procedure)
    - Estimate summary formats
    - Format and means of transmittal of estimate deliverables
    - Scope and responsibility matrix, also known as the division of responsibility matrix

- Project execution strategy (contracting plan)
- Organization chart (for significant efforts)
- Estimate schedule and budget
- Qualification and assumption narrative and checklist for standard issues
- Management directives and assumptions to be used

Guidelines directed specifically to the members of the estimating team may be included in a separate estimating guideline package.

A sample estimate preparation schedule is shown in **Attachment 4**.

6.3 Kickoff Meeting

Once the estimate plan is finalized, a kickoff meeting is held to communicate the estimate plan and to coordinate proposal or project team estimating efforts. The meeting acquaints participants with the features of the project and with each other, and it helps to ensure that the estimating team members understand what must be done, who will do it, and when each step will be completed. Minor estimates and subcontract proposal evaluations may not require a formal plan or kickoff meetings, but basic procedural principles should be observed for all estimates.

The kickoff meeting addresses the following topics:

- Introduction of the team members.
- Project orientation, project type and location, scope, key dates, etc.
- Distribution of the estimate plan, followed by an explanation of its contents. Topics requiring particular emphasis are identified along with the division of responsibilities, dates for completion of key estimate and proposal milestones, and formats required for transmittal of data to estimating.
- A question and answer period for clarification purposes.

6.4 Scope Definitions and Documentation

The scope of work is defined through the design basis narrative, plans and specifications, site visits (if applicable), milestone schedule, and work plan. The work is segregated into logical groupings (e.g., by process block, geographic area, category, work discipline, task) and structured via a code of accounts (see EPM-KPE-PR-000002 Project Estimating Coding Procedure) to yield a consistent pattern for collecting and assembling the data.

Technical volumes generated by the project team, especially engineering, form the basis for scope definition and documentation used in the cost estimate. Quantity development in the estimate is based upon the data and assumptions contained in the scope documents. A formal scope review should occur before pricing is applied.

6.5 Quantity Development

For detailed estimate preparation, Estimating uses the permanent equipment list and bulk material quantities as the foundation for applying prices and determining installation job hours.

The technical teams are responsible for the equipment list of all process, utility, and site-specific support equipment. Estimating may also need design data, design allowance percentage for quoted items, and a list of required spare parts.

Estimate basic design data and scope data include:

- design basis narrative;
- outline of scope of work;
- site plans;
- soils reports and geophysical data;
- general arrangement drawings;
- permanent or production and utility equipment list

Cost estimates for major equipment based on the items listed above are identified by item or tag number and summarized by account.

To the extent practicable, Engineering develops bulk commodity quantities in a format provided by Estimating. Working with the technical team, Estimating agrees to the level of quantity definition that will provide a reasonable basis for an estimate and associated estimate accuracy class. As a minimum, Estimating must meet with the technical team to ensure that both parties agree on design basis assumptions.

While Engineering is responsible for quantifying the scope, Estimating should test the accuracy of the quantity development. For some estimates (depending on who takes the quantity growth risk) it may be appropriate to add quantity growth allowances, especially if vendor information isn't yet available to incorporate into the design. Thus, an Engineering / Estimating review and reconciliation of the quantities is required to ensure Engineering buy-in of the quantities contained in the estimate.

6.6 Equipment and Quantity Pricing

To increase the accuracy of an estimate and reduce the risk, the pricing of major permanent or engineered equipment and bulk materials should be based on an actual commitment or current quotations whenever this information is available. Remaining pricing may be obtained by using current experience on other projects or appropriately escalated historical information.

A division of responsibility document and code of accounts are prepared under the direction of the Project Manager to delineate what work is to be performed by each contractors, and whether the equipment will be erected in the field or fabricated in the shop and installed by field craftsmen.

Pricing sources are documented for future reference. It should be noted whether the price used includes freight, or other additives. Although most vendor contacts are managed by the Procurement department, budget quotations may be obtained from vendors by Estimators or Engineers, and are generally used in support of Class 4 and 5 estimates.

For standard equipment, the Estimator may employ current pricing information based on current projects, published pricing information, or pricing based on historical analysis.

The Project team (Estimating, Procurement, and Engineering, as a minimum) must review historical pricing and erection unit rates to identify any recent trends in the industry (e.g., eroding labor productivity, material scarcity).

For projects involving preparation of engineering specifications, Procurement obtains budget or firm price quotes. For standard construction materials, the Estimator may use current project pricing, published pricing, or pricing derived from historical analysis. After specialty subcontract work is defined and packaged, Procurement solicits quotations.

6.7 Field Manual (Craft) Labor Development and Pricing Manual (Craft) Labor Job Hour Development

Field manual labor consists of all craft labor man-hours, including time for the foreman and general foreman.

Project Controls establishes and updates field installation labor hour standards. Estimating and Construction jointly evaluate project manual labor productivity, wage rates, and craft mixes, which are then approved by Construction. If requested by Construction, the Project Estimator must be able to provide full-time equivalents for all craft manpower.

The labor productivity factor adjusts standard installation hours for a particular work operation to a site-specific installation job hour rate for that operation. The Construction department establishes productivity factors for each account based on experience in the area, type of work, availability of labor, construction schedule, regional weather conditions, environment, etc. to reflect the specific site and project conditions. The evaluation should be documented using the form shown in **Attachment 5**. The factors are then subject to Construction Management approval.

Labor hours for field erection subcontracts should be indicated on the estimating worksheet; however, subcontract hours must be clearly identified and summarized separately from the direct-hire labor hours. The

subcontract hours may be estimated by applying labor-to-material ratios to the pricing supplied by the subcontractor or from historical data, and by dividing the labor portion by a fully burdened subcontract wage rate.

6.7.1 Field Manual (Craft) Labor Development

Manual labor can be categorized as Direct or as Distributable. Direct manual labor installs the permanent equipment, bulk materials, and associated support facilities, including buildings, structural supports, utilities, process and utility piping, electrical distribution, foundations, etc. The indirect or distributable manual labor hours are developed for temporary facilities, temporary construction services, and other operations listed in the standard cost code of accounts, and are based on the construction execution plan, construction schedule, or manual personnel staffing schedule provided by Construction.

- Direct manual hours are developed using a unit hour approach applied to the summarized equipment and bulk materials quantities supplied by Engineering. The hours are adjusted with a productivity factor to reflect the labor and site-specific conditions for the project.

- For work operations that are not covered by labor hour standards, the “crew-up” method is used to determine the labor hour requirement.

During the construction phase of the project, indirect or distributable manual labor is the labor required to support the direct installation activities that cannot be specifically identified and charged to a permanent item. These hours are normally considered as a percentage of direct labor costs, or are developed as a level-of-effort staffing plan needed to support the project field installation. Both labor hour standards and crew-up methods are used for indirect labor hour development.

6.7.2 Manual (Craft) Labor Wage Rate Development

The Project Estimator and Construction Manager establish composite wage rates and the proper application of standard labor hours and productivity. Current manual labor rate information is obtained from Labor Relations, which should be contacted as the source for all wage and fringe benefit cost information.

The manual labor wage rate, defined as a composite unit rate for each account (commodity), includes the craft mix, crew make up, spot (unscheduled) overtime pay premiums, fringe benefits, and payroll additives (payroll taxes, insurance and holiday/vacation if applicable), etc. Estimators responsible for manual labor wage rate calculation should use the latest estimate templates to ensure that the latest wage rate calculation process is applied and to provide the execution team with a seamless handoff regarding the wage rate calculation basis. As a minimum, overtime and shift work should be analyzed for each craft.

The costs of show-up time, welding tests, craft training, travel time, and other time off shall be incorporated in the field indirect or distributable cost under the "Other Operations" account.

The following pricing data are used to develop composite unit wage rates:

- Labor bulletins—consisting of current wages per hour, contract durations, fringe benefits, shift differentials and other conditions by craft—obtained from the Labor Relations department via Construction.
- Insurance rates for workers compensation and liability are obtained from the Risk Management Department.
- Payroll tax rates are obtained from the Financial Accounting organization.
- Crew mix (within a trade, e.g. apprentice/helper, journeyman, foreman, general foreman) is established by Estimating and Construction.
- Craft mix (mix of trades, eg. Laborers, Operators, Pipefitters) for each major category of work is established by Estimating and Construction.
- Work week (number of work hours per week) is established by Construction.
- Spot (unscheduled) overtime (a percentage or number of hours allowed) established by Construction.
- Labor source is provided by Construction.

- Construction schedules and craft staffing levels.

- Craft labor rates may be used directly in some estimating software based on crew-up techniques. Alternatively, the estimate may require that composite labor rates be developed by estimate category or commodity (refer to **Attachment 6**). Composite labor rates may be developed using the following steps:

- Composite craft wage rates are based on the labor wage bulletin or local surveys and staffing schedule.
- Identify the labor contract effective date, wage rate, and labor hour expenditure for each contract period.
- Calculate a weighted average journeyman rate by craft for the duration of the project, estimating beyond contract expiration using current escalation forecast.

The wage rates (bare) shall be brought forward to calculate the composite craft wage unit, which includes craft make up of general foreman, foremen, journeymen, and apprentices, spot overtime allowance, payroll taxes, insurance, and fringe benefits to arrive at a total composite wage rate for each craft (refer to Attachment 6, “Wage Rate by Craft”). Account labor rates (craft mixes by commodity) are calculated based on the composite craft rate, which reflects the craft mix (craft distribution) for each account (refer to **Attachment 7**, “Composite by Category”).

6.8 Field Distributable Costs

Field distributable costs are costs not directly attributable to the installation of equipment or commodities. Indirect and distributable cost descriptions are treated here as synonymous.

The term “Field Distributable Costs” has two contexts. There is a broad definition which means any project cost which isn’t a Direct Cost or an Entity Office Cost. The term is also used in a narrower context to mean on site construction support costs (defined in more detail below).

Field distributable costs (narrow definition) consist of the following major accounts:

- temporary construction facilities;
- miscellaneous construction services;
- construction equipment, tools, supplies, and utilities;
- field office and non-manual costs
- field manual — other costs (taxes, workers compensation, mobilization/demobilization, employment expenses/awards);
- field testing and commissioning manual labor and materials; and
- field testing and commissioning non-manual.
- camp facilities;
- aircraft and maintenance operations;
- local expenses;
- special security equipment and staff
- personnel recruiting;
- local transportation;
- communications; and
- other (oxygen and acetylene manufacturing, concrete batch plant, rock quarrying, site pipe or steel fabrication).
- insurance and performance bonds,
- permits,
- licenses and royalties,
- freight,
- warranty-related costs,
- internal finance and currency costs,
- external finance and currency costs, and
- miscellaneous other costs.

6.9 Contingency

Contingency shall be assessed for every capital cost estimate to allow for additional costs that will be incurred for unallocated cost exposure inherent in the basic estimate.

Theoretical analysis shows that the possible range of outcomes of a capital cost estimate has a skew distribution, with a significantly greater chance (and magnitude) of cost over-run than under-run. The history of major projects endorses this analysis. The contingency adjustment magnitude is determined from a review/analysis/assessment of the expected distribution of values (outcomes) for all the key parameters of the estimate. The key parameters are those that have a significant impact on the estimate value either because of their magnitude or their wide range of possible values.

Schedule Contingency: Schedule contingency is a time allowance added to the bare schedule duration. It provides for uncertainties associated with variables within the project schedule and within the project scope. The amount of contingency required is directly related to the probability of these uncertainties occurring, and reflects a targeted probability of achieving the project completion date. Schedule contingency is an essential element in realistic, achievable schedules, and in the normal course of events it will be expended during the life of a project.

Cost Contingency: Cost contingency is the amount of money and job hours which must be added to an estimate to account for uncertainties in quantity, pricing, and productivity that are controllable by the Entity and are within the defined project scope. Cost contingency is an essential element in realistic, achievable cost estimates, and in the normal course of events it will be expended during the life of a project.

Total Contingency: Total contingency is the result of the integrated cost and schedule contingency analysis process.

Contingency does not cover costs associated with the following:

- Scope changes
- Redesigns due to major design failures
- Unlikely events such as wars, crimes, and sabotage;
- Commercial changes
- Schedule slippages outside of the Entity's control such as strikes
- Cost impacts associated with potential risk events
- Extraordinary changes in escalation rates.
- Major changes associated with subcontracting strategy.

Contingency Analysis: The contingency analysis process starts with the most likely values from the project cost and schedule, captures the uncertainty ranges for those components and produces distribution results reflecting the amount of cost and time associated with probabilities of overrun/underrun.

Contingency is not to be hidden within the estimate to cover any perceived estimating inaccuracy. Work is to be measured as shown on the drawings, and quantities are not to be inflated. There should be no excess deliberately built into the estimate to account for inaccuracies. Estimators shall properly include provisional amounts and allowances in the direct costs. The only contingency monies in the estimate as a whole are to be those set out above, and are to be included as one lump sum at the end of the estimate. Contingency does not cover changes (during project execution) in the project scope from that upon which the estimate is based.

Below is a table of the expected level of contingency for each type of estimate as shown in EPM-KPE-PR-000001 Project Estimate Type Procedure. It is included as a guide only, and will depend upon many factors which need to be evaluated when the contingency amount is being determined.

Estimate Class - Description	Expected Range of Contingency as % of Project Cost
Class 5 - Indicative / Conceptual	> 30%
Class 4 - Feasibility / Order of Magnitude	> 25%
Class 3 - Preliminary	15% to 25%
Class 2 - Engineer's	5% to 15%
Class 1 - Definitive	5% to 10%

6.10 Escalation

Project estimates are prepared based on the economic and market conditions prevailing at the time the estimates are developed. Implementation, however, takes place over a future timeframe during which the conditions may change. Escalation is an amount provided in an estimate to cover anticipated variations in the cost of project elements/inputs from the base date of the evaluation to completion of the project. Escalation results from changes in wages, raw materials costs, manufacturing costs, market supply/demand conditions, economic conditions, etc. Rates of escalation are influenced by historical, current and future economic trends. The estimate shall include the expected escalation during the construction period of the project, based on the construction schedule and the expected cash flows.

It is essential to note the distinction between Escalation and Inflation,

- Escalation is the variation in costs of specific elements or inputs used in the implementation of a particular project
- Inflation is the variation in costs of a specific basket of consumer goods, services and supplies.

In cost estimating, escalation has two main functions:

- Historical escalation is calculated to update historical costs to current.
- Predictive escalation is calculated to address anticipated future cost increases.

Most cost estimates are prepared in current value and then escalated in alignment with the project schedule. Current estimate pricing is based on costs and prices in effect at the time of estimate preparation - the estimate base date. Predictive escalation is added to address the escalation in costs that are anticipated to occur between the estimate base date and the time when the costs are planned to be committed or incurred. Historical costs are, at times, used as the basis for estimated costs, or they can serve as reference values, for validation purposes; with historical escalation added to these costs to bring to current.

Escalation rates can be established by use of escalation indices. Escalation index values for materials and labor are based upon actual historical data and on current and future economic trends. Available indices include the CPI - Consumer Price Index, PPI- Producer Price Index, ENR- Engineering News Record, Richardson, RS Means, IHS Global Insight, etc. Some data is available for free on the Internet, and some requires a subscription fee.

Using escalation indices, the escalation rate between two points in time is computed as a percentage, by dividing the index value of the newer date by the index value of the older date.

- Historical escalation - escalation to bring historical costs to (usually) current—is calculated by determining the appropriate escalation index value in the year when the historical costs were incurred and the corresponding index value for the year to which the historical costs need to be adjusted (usually, the present). The escalation rate between the two dates is multiplied by the base costs to yield the historical escalation.

- Predictive escalation – that is, the escalation to bring current costs to a point in the future (usually date of expenditure)—is calculated in a similar manner by determining the appropriate escalation index value for the estimate base date and the corresponding (forecast) index value for the future date. The escalation rate between the two dates is multiplied by the base costs to yield the predictive/future escalation.

Escalation rates can also be published as an annual percentage (e.g. 3.0% per annum). This is the format adopted by some data providers. And, in the absence of escalation indices, or other data, assumptions regarding escalation will be made (and qualified) in this format.

To calculate the total escalation rate, E%, over a given number of years, n, at an annual percent escalation rate of e%pa

$$E\% = [(1 + e\%pa)^{n} - 1] \text{ X } 100$$

As such, the total escalation rate for a 7 year period at an annual escalation rate of 2.5% per year.

$$E\% = [(1.025)^{7} - 1] \text{ X } 100 = 18.9\%$$

Attachment 8 presents an example scenario employing the above method. The calculation is less straightforward when the annual escalation rate varies by year over the period in question. **Attachment 9** presents an example of this scenario.

To compute predictive escalation:

- Determine the estimate base date.
- Establish project schedule start and completion dates.
- Separate the estimate into major cost components, grouped to match Estimating department guidelines or the predictive escalation indices to be used, for example:
    - Awarded purchase orders (review for escalation clauses)
    - Commodity groups
    - Direct labor
    - Major subcontract groups
    - Common distributables
    - Camp costs
    - EPCM services
- Determine the centroids of expenditure for the scheduled components (this is the mid-point of start and completion dates only if costs are evenly distributed over the period).
- Apply the appropriate escalation rate to each cost component.
- The sum of the component escalation costs equals the total escalation.

The basis of escalation should be clearly stated and future escalation should be presented as a separate line item.

6.11 Reconciliations

If applicable for a given estimate, the team selects a reference project as the basis for the technical and commercial scope. Before the estimate kickoff meeting, the project or proposal team agrees on the project selected for the estimate reconciliation.

The Project Estimator, with the estimating team develops the estimate reconciliation and submits it for senior management review. Estimating should work with the executing project team to resolve questions and discrepancies. In support of the reconciliation, each team member confirms that his/her department's information reflects the appropriate pricing, scope, and design or construction progress.

6.11.1 Similar Reference Reconciliation

The similar reference reconciliation, developed during the cost estimating cycle, is part of the estimate presentation package. This reconciliation aligns the estimate and facility scope with a selected reference project, and it identifies the scope and cost differences. This analysis helps to determine the accuracy of the estimate for the proposed facility.

A sample format for a reconciliation is shown in **Attachment 10**. Each Estimator performs reconciliation as follows.

6.11.1.1 Wage Rate Adjustment

Wage rate adjustments are accomplished by multiplying the reference project's manual direct hours by the difference between the reference project's actual wage rate and the proposed project's forecasted wage rate. This calculation accounts for labor cost differences between the reference project and the proposed project as follows:

$$WRA = (PPW - RPW)\ X\ RPDH$$

Where:

WRA = Wage rate adjustment
PPW = Proposed project wage
RPW = Reference project wage
RPDH = Number of reference project direct manual hours

6.11.1.2 Productivity

Labor productivities for both the reference project and the proposed project must be normalized before further adjustments can be made. Normalization is accomplished by dividing the reference project job hours by the reference project productivity. The normalized hours are then multiplied by the new proposed productivity:

$$NP = \left(\frac{RJH}{RPP}\right) X\ NPP$$

Where:

NP = Normalized productivity
RJH = Reference Job Hours
RPP = Reference productivity
NPP = New proposed productivity

The Project Estimator also provides the new productivity multipliers to be used for the proposed project estimate. These new multipliers are used to adjust the reference project labor units to arrive at the proposed project job hours. To calculate the productivity cost differential, reference project job hours are subtracted from the normalized reference project hours and then multiplied by the new manual wage rate:

$$PCD = \left[\left[\left(\frac{RJH}{RPP}\right) X\ NPP\right] - RJH\right] X\ NW$$

Where:

PCD = Productivity cost differential
RJH = Reference Job Hours
RPP = Reference productivity
NPP = New proposed productivity
NW = New wage

6.11.1.3 Direct Level Reconciliation

Estimators, with assistance from the Engineering team, identify cost differences from the reference facility. Discipline Estimators also identify why the change is being made; for example, steel supplied by a vendor rather than procured by a contractor would account for a difference in cost.
Estimators reconcile major bulk commodity quantity changes.

6.11.1.4 Escalation/Pricing Adjustments

If the proposed facility is similar in capacity or design basis to the reference unit, the differences in price are noted. Should the capacities or design basis change, the cost will be shown either as scope changes or as design progress.
Sample calculation:

$$VPA = \left(\frac{PP}{RP}\right)$$

Where:

VPA = Vendor pricing adjustment
PP = proposed project pricing
RP = referenced project pricing

6.11.1.5 Scope

The Project Estimator, with assistance from the Engineering team, categorizes scope differences between the reference project and the proposed project. The total installed, direct-level cost (TIC) is shown, including labor, material, and subcontract pricing. The Project Estimator provides a brief description of the change with an explanation. For example:

Added A-frame storage facility ..... SAR 600
(Entity management approved)

Deleted gypsum storage facility .....SAR (240)
(Entity will use an existing facility)

6.11.1.6 Design Progress

Design progress recognizes design basis changes between the reference project and the proposed project, such as capacity or rate changes. As an example:

Increased capacity of the ash handling system ..... SAR 600
(Change in design based on lessons learned from reference project)

6.11.1.7 Estimate Refinement

Estimate refinements cover the balance of the reconciliation. The intent is to identify changes from the reference project that have not been accounted for in other reconciliation categories. Changes may result from constructability issues or a discovered error or omission noted in the reference facility Final Trend Report. For example.

Added allowance for well-point dewatering..... SAR 600
(Reference project used localized dewatering, which proved inadequate)

Increased area allowance for field painting..... SAR 100
(Lessons learned from constructed facilities: increase square footage for field painting)

6.11.1.8 Reconciliation Summary

The Discipline Estimator confirms that all categories of the reconciliation are accounted for and that they properly represent the changes to the reference project. The Project Estimator collects the discipline reconciliations, combines similar changes, and readies the reconciliation for a review. The Project Estimator prepares the indirect cost reconciliation. This is a comparative reconciliation and is intended to display cost variances in the indirect categories between the reference project and the proposed project.

6.11.2 Project Reconciliation

Reconciliation for estimate types review may be developed after the cost of the project has been estimated at two phases on a project. Engineering, and Project Controls jointly develop the project reconciliation. This type of reconciliation is intended to cover changes made to cost after estimate submittal but before contract signing.

Many of the same categories used for similar reference reconciliation also apply to the project reconciliation. Scope, design progress, and estimate refinement changes may occur during the transition from one estimate type to another.

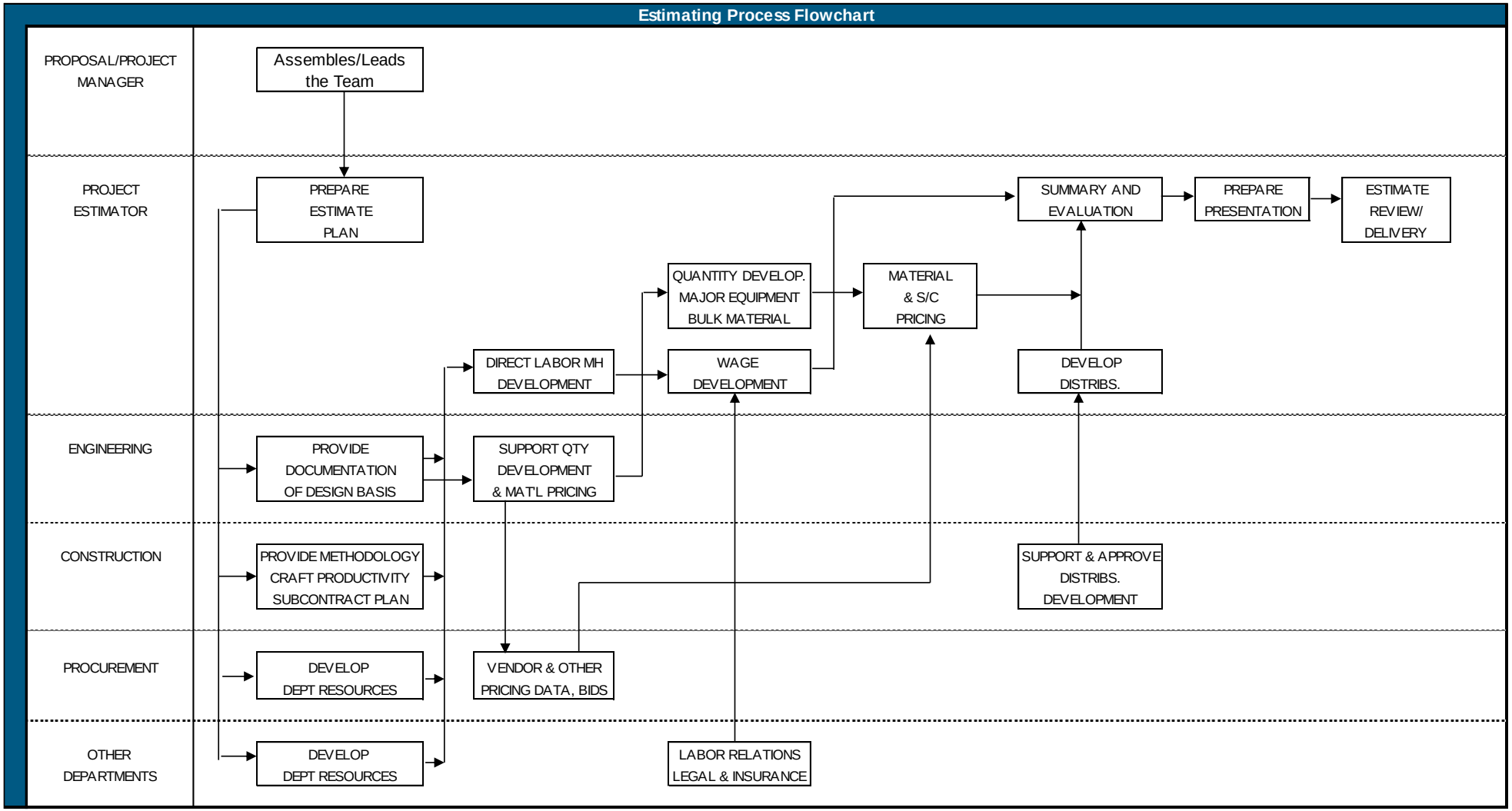
The Project Estimator confirms that all departments affected by the change have calculated their individual cost elements.

7.0 ATTACHMENTS

1. Estimate Process Flowchart
2. EPM-KPE-TP-000001 - Estimate Checklist
3. EPM-KPE-TP-000002 - Estimate Plan Template
4. EPM-KPE-TP-000003 - Estimate Preparation Schedule Template
5. EPM-KPE-TP-000004 - Construction Job Hour Checklist
6. EPM-KPE-TP-000005 - Wage Rate Build-up by Craft Template
7. EPM-KPE-TP-000006 - Wage Rate Build-up by Category Template

8. Sample Escalation Calculation
9. EPM-KPE-TP-000007 - Escalation Calculation for Different Rates per Year Template
10. Sample Proposal Reconciliation

Attachment 1 - Estimating Process Flowchart



Attachment 2 - EPM-KPE-TP-000001 - Estimate Checklist

1. Will this estimate be used for comparative studies and is there a need to use consistent parameters?
2. Is the site identified and is it adequately prepared? Have all hazardous materials been removed? Are the right-of way (ROW) or other expenses included?
3. Is the site clear, level, and free of structures or any items requiring dismantling or demolition?
4. Will grubbing be required?
5. Are there known underground obstructions? What was the previous use of the site?
6. Check cut and fill quantities.
7. What is the composition of the excavated material? Can it be used for fill? If not, how will it be disposed of? Are the costs included?
8. Is piling required? Does the design used for the estimate basis include proper earthquake, wind load, and other criteria?
9. Are building plan areas correct? Are these multi-floor buildings? Is each and every building shown?
10. Are the capital costs for utilities, maintenance and other building services included?
11. Review the quantity development methods used. If standard details or assemblies were used, are they appropriate for this job?
12. Make quantity checks of key items. Compare with estimate takeoff quantities and metrics.
13. Is there a summary of Key Quantities?
14. What is the status of design engineering?
15. Review the construction schedule for the project to insure reasonableness. Are there any special milestones?
16. What are the schedule constraints? Long lead items? Resources?
17. What was the source for equipment lead times?
18. Should the schedule be modified to reflect seasonal considerations?
19. Is the construction manpower buildup reasonable? Are all crafts and specialty skills available? Is there other work in the area competing for available manpower?
20. What type of permits will be required? Will permit delays impact the project cost?
21. Is there a permitting plan and is it compatible with the schedule?
22. Will an environmental impact report be required? What are the environmental concerns at the site?
23. Are there environmental regulation changes expected or already in process?
24. If required, is the cost of environmental offsets included?
25. Was there a site survey and are the results available? Are they being incorporated into the design?
26. What is the terrain of the proposed site? Desert, etc.?
27. What is the access to the site? Road, rail, barge? Can heavy loads or construction congestion be accommodated?
28. What is the climate at the site? Does the design reflect the site climate? Does the schedule?
29. What are the basic parameters of the facility to be estimated (capacity, feed rate, output, length, etc.)?
30. Be sure that the scope documents which were used as the basis of the estimate are available or filed for future reference.
31. To what codes will the new facility be built?
32. Review the specifications for materials of construction or unusual requirements or items to be excluded.
33. Are there any limitations regarding purchases from foreign countries?
34. Is ocean freight included for foreign purchases? Are other related costs included?
    a. Freight Forwarding
    b. Brokerage Fee
    c. Ocean Freight
    d. Containerization
    e. Export Packing
    f. Inland Freight
    g. Air Freight
    h. Lightering / Barges
    i. Dock Loading / Unloading

j. Marshalling Yards
k. Duties and clearance costs
l. Warehousing
m. Pilferage
n. Port Charges
o. Customs Delays

35. Have all the required insurance policies and riders been obtained?
    The following are usually required:
    a. Bid Bond
    b. Payment Bond
    c. Performance Bond
    d. Workers Compensation
    e. Disability Insurance
    f. Public Liability / Public Damages Insurance
    g. Equipment Floater
    h. Builder's Risk (if the building is damaged prior to completion)
    i. Wrap Around
    j. Deductibles for Public Liability / Public Damages Insurance and others – be sure to put into estimate
    k. Indemnification of owner and related parties (landowner, etc.)
    The following may be required depending on job requirements:
    l. Environmental work
    m. Airport facility
    n. War Risk
    o. Kidnapping insurance
    p. Fire protection performance bond
    q. Liquidated Damages – may be able to purchase at reasonable price
    r. Marine Insurance (for items being transported)
    s. Insurance for assessed repair, towing, or similar charges during marine transport
    t. Aircraft Operation Insurance
    u. Marine Operation Insurance
    v. Railroad Operation Insurance
    w. Utility Indemnity (when tying into or working around utilities owned by 3rd parties)
    x. Encroachments, Property Title Insurance
    y. Adjacent Structures
    z. Warrantees
36. Does the construction plan identify what scope will be performed by subcontractors?
37. Have contractors indirect costs been included for:
    a. Temporary Buildings / Shelters
    b. Warehouses
    c. Parking
    d. Utilities
    e. Material Handling
    f. Misc. Manual Labor Services
    g. Security and Health
    h. Construction Equipment
    i. Craft Training
    j. Safety Clothing
    k. Equipment Maintenance
    l. Tools
    m. Scaffolding
    n. Consumables
    o. Construction Office
    p. Labor Supervision
    q. Office Clerical
    r. Welder Training
    s. Site Cleaning
38. Have allowances been included for contractor's overhead and fee?
39. What is the public outreach program? Will there be a contribution towards community facilities?
40. Who provides security? Is it adequate? Should the estimate include higher than normal?

41. Is the customers expected accuracy in line with the purpose of the estimate? Is there sufficient information available to support this expectation?
42. Is there a list of assumptions and is the customer aware of the major estimate assumptions?
43. Is there agreement on the future escalation rate to be used?
44. Is the escalation calculation compatible with the schedule?
45. Does the estimate include field purchased materials?
46. Are previous study costs included?
47. Has the estimate received an arithmetic check?
48. What is the probably business climate during the period of this project? Does the estimate reflect this?
49. Make sure that client furnished items are listed and shown as such.
50. Will any special maintenance equipment be required?
51. Will the new facilities be of modular construction? Are additional costs included at the module site to accommodate this work?
52. Has the assessment of labor productivity been incorporated into this estimate? What is the basis for the assessment?
53. Will there be an impact on labor productivity because of weather? Has labor showup time been included?
54. Does the estimate include an allowance for spot overtime? If scheduled overtime is contemplated, does the estimate reflect both the increase in wages and the loss of productivity?
55. Is there an adequate supply of skilled labor available locally?
56. Have the labor wage rates been calculated to include crew makeup and craft mix?
57. Will there be welder training or other training at the jobsite?
58. Is the construction non-manual / manual labor ratio reasonable?
59. Was a reconciliation prepared?
60. Has the estimate been adequately reviewed? Who has/will participate?
61. Has a risk analysis been made? Who provided input? What are the two or three main contributors?

Parametric Estimate Checklist:

1. What is the operating factor for the facility? If a referenced project is being used as the estimate basis, has a correction been made for differing operating factors?
2. When applying the factors, has consideration been given to equipment quotes that include erection? Capitalized Spares? Mobile Equipment? Others?
3. Are the ratios up to date? Have they been adjusted for:
    a. Site sensitivities
    b. Escalation
    c. Unusual features
    d. Labor productivity and cost
    e. Projected commercial environment
4. Has a modernization factor been applied?
5. Are there foreign purchases requiring special adjustment to the ratios.
6. Are there any unusual elements to the equipment estimate, such as owner supplied equipment items which would impact the remainder of the estimate?
7. Is the labor / material ratio reasonable?

Attachment 3 - EPM-KPE-TP-000002 - Estimate Plan Template

TABLE OF CONTENTS

(The guidelines, headings, list of attachments etc. should be customized to meet the specific needs of the estimate.)

1.0 Project Data

Expro	Project No.-Package
Entity	ABC City Name, Province Contract No. DE-1234
Project Location	Design – City Name Construction – City Name
Project Scope	Describe the project, key quantities etc.
Estimate Scope	Describe scope of the estimate
Type of Estimate	State the type and class (Class 3 – Preliminary etc.) (See EPM-KPE-PR-000001)
Purpose of Estimate	State what is estimate is being used for: Response to Proposal, Trade Study, etc.
Pricing level	Describe the basis for pricing - 4th quarter of (Year). Escalation is included or excluded.
Project Schedule	Describe the major project milestones:

NTP	Day/Month/Yr
Process Design Frozen, 30% Design Complete	Day/Month/Yr
Start of Construction (First Concrete Pour)	Day/Month/Yr
Complete Design	Day/Month/Yr
Complete Construction	Day/Month/Yr

2.0 Description of Project

This section should include a general description of the Project. If available, this section should include the following types of information:

- Intended project or facility purpose
- Typical operational characteristics
- General discussion work force

3.0 Site Information

This section should include relevant project site data such as:

- Soil characteristics
- Water availability and quality data
- Climate
- Precipitation
- Ground cover –trees, shrubs, etc.

4.0 Responsibilities for Estimate Development

This section should clearly define the estimate's division of responsibility (DoR). As a minimum, this section should address the following:

- Party responsible for consolidating the estimate.
- Identifying team members and their specific responsibilities to develop the estimate, including what information they are responsible and to whom they need to provide it to. This is especially important for proposal with multiple technical and commercial sections.
- Identifying specific responsibilities to support events leading up to the multiple estimate review meetings.
- Identifying internal estimate deliverable required for internal review and approval. External estimate deliverables as request/required by the Entity.
- Identifying estimate review meeting presentation responsibilities
- If available, identifying post-estimate submission responsibilities.

The Division of Responsibility (DOR) for the estimate will be in accordance with Attachment 1.

This section should also include a table of all key personnel associated with the effort and their associated title. As a minimum all estimating leads and key personnel must be identified.

When there is a detailed WBS estimate classification breakdown available, the Project Estimator must use that format and assign proposal or project team members sections to manage each WBS section. A listing of the WBS breakdown structure should be included as Attachment 2.

5.0 Estimate Schedule

This section is intended to address the estimate development schedule with a reference to Attachment 1 to review the actual preparation schedule.

Key milestones must also be highlighted in this Section and they include:

- Date of estimate Kickoff meeting
- Date when Engineering input is due to Estimating.
- Date when Non-manual services estimates are due from the departments
- Date when Construction and Procurement input is due to Estimating

In this section, the Project Estimator must address how late changes to estimates will be handled– for example, "Changes following this date will be controlled. Any changes following this date shall be evaluated

for impact to the estimate (e.g.; greater than 1 million SARs), captured as an open item, and discussed with the project/proposal development leads prior to being incorporated into the estimate.

6.0 Basis of Estimate

Here, the Project Estimator must discuss how Basis of Estimate document will be handled. As a minimum, the following should be discussed:

- Maintained as a living document by individual Team Members as they develop their estimates.
- How to submit and revise their BoE documents
- Review and revision process
- Where to find specific information regarding the process to create the BoE documents. Specifically, template format and recommended wording.

Additional information underpinning the estimate basis and included in this package are:

- (Refer to Attachments)

Project specific Basis of Estimate development guidelines will be issued separately by the Project Estimator.

7.0 Qualifications and Assumptions

Here direction should be given to the Project Team regarding the following:

- How to describe assumptions made where information was not available from the scope basis documents (e.g. facility estimates - thickness of walls if not shown on drawings, services estimates - where and how the design work will be performed).
- List and number all boundary conditions and other clarification assumptions pertaining to the estimate.
- Describe the major elements which have been excluded from the estimate and the reasons for doing so e.g. work will be done by others, equipment will be provided by the government etc.
- Where to compile assumptions and when the Project team needs to receive all team member input.
- In this section, the Project Estimator can include a section/discussion regarding any special cost codes to be implemented for this estimate. If necessary, an additional Reference Attachment can be used.

Attachments (revise list as appropriate)

1. Complete Estimate Division of Responsibility (DOR) – Recommend a narrative format with supplemental DOR matrix
2. WBS Breakdown Schedule
3. Estimate Schedule
4. Basis of Estimate – Additional Information
5. Cost Codes for Facility Cost Estimates (as applicable)

SAMPLE NARRATIVES FOR SELECTED ATTACHMENTS

ATTACHMENT 1

A similar description should be provided by each Team Member documenting the in-house estimate review and approval process.

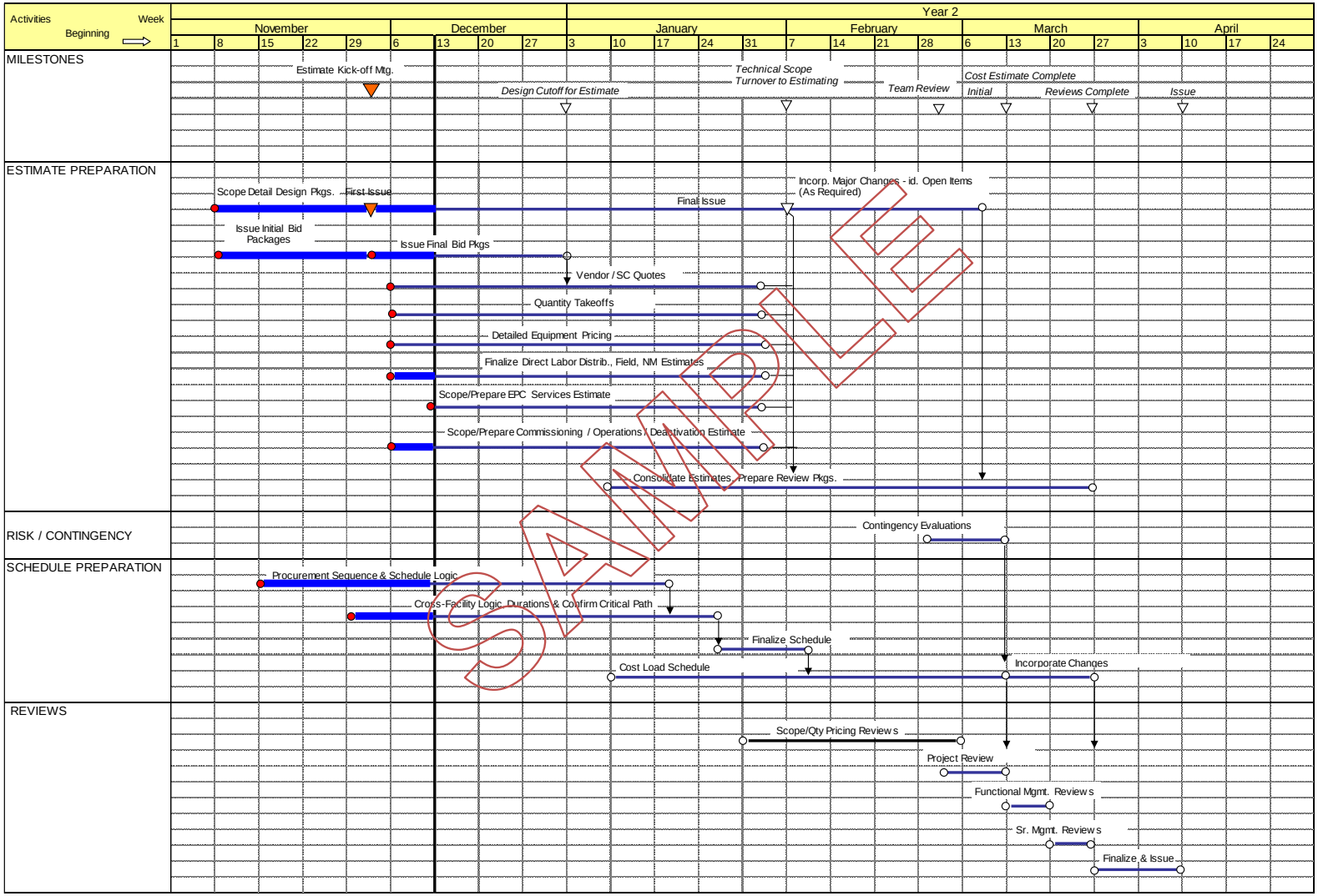
The Division of Responsibility (DOR) for the estimate will be as follows:

- Engineering will be responsible for quantities and to ensure that the forecast is complete and accurate. This includes ownership of the quantities throughout the estimate preparation process.
- Procurement will review estimating equipment and subcontract costs and update with current awards, bids, and obtain pricing information for outstanding major equipment/MRs.
- Construction will provide Division of Responsibility (DOR) between Entity and (Sub)Contracted work, Labor Pricing and Productivity basis, and review/develop field non-manual and distributable costs.
- Project Controls/Estimating will coordinate estimate development, perform quantity take-offs, support quantity take-offs by Engineering, perform pricing studies, update pricing data, consolidate the estimate into Excel or ESP, and prepare reconciliations and presentation packages.
- Project Management will review the total estimate for reasonableness/quality and provide approvals prior to submittal to theEnity for consolidation for Project Team Review.

Reviews will be held in three stages:

- Project Team Review to ensure completeness of scope. This includes review of the basis, quantities, qualifications and exclusions.
- Entity Line Review includes an overview of the estimate, funding and staffing requirements.
- Senior Management Review concentrating on the overall execution plan, business strategy, gross margin, risks and liabilities.

Attachment 4 - EPM-KPE-TP-000003 - Estimate Preparation Schedule Template



Attachment 5 - EPM-KPE-TP-000004 - Construction Job Hour Checklist

Job Number: _____ Date: _____

Project Name: _____ Prepared By: _____

Location: _____ Comparison Basis (Reference Plant etc.): _____

Item	Evaluation Factors	Structural Earthworks	Concrete	Structural Steel	Piping
		Rate in this Estimate is xx MH/CM vs. yy MH/CM from Comparison Basis	Rate in this Estimate is xx MH/CM vs. yy MH/CM from Comparison Basis	Rate in this Estimate is xx MH/MT vs. yy MH/MT from Comparison Basis	Rate in this Estimate is xx MH/LM vs. yy MH/LM from Comparison Basis
SITE /AMBIENT CONDITIONS					
	Location				
	Existing land use				
	Summer temperature, humidity				
	Summer precipitation				
	Wind, dust, mud				
	Noise				
	Lighting				
	Ventilation				
CONSTRUCTION REQUIREMENTS					
	Quality Class				
	Permit to work arrangement				
	Erection Tolerances				
	Welding NDE Testing				
	Specifications				
	Tool Automation				
	Tool Availability & Quality				
	Equipment/Materials Availability				
	Prefab Vs Stick				
	Construction Procedures				
	QA/QC				
	Hold Points Level of Inspection				
	Security				
	Fire Hazards				
	Safety Regulations				

Item	Evaluation Factors	Structural Earthworks	Concrete	Structural Steel	Piping
		Rate in this Estimate is xx MH/CM vs. yy MH/CM from Comparison Basis	Rate in this Estimate is xx MH/CM vs. yy MH/CM from Comparison Basis	Rate in this Estimate is xx MH/MT vs. yy MH/MT from Comparison Basis	Rate in this Estimate is xx MH/LM vs. yy MH/LM from Comparison Basis
SITE AND PLANT LAYOUT					
	Portal to Portal travel time				
	Materials receipt and storage				
	Traffic & Unloading				
	Material Storage				
	Material & Engineering Supply				
	Proximity of laydown to workfront				
	Site and Congestion				
	Accessibility				
	Congestion				
	Interference - Other Crews				
	Size of Project				
	Number of levels				
	Plant height				
	Elevated / Flat				
	Scaffolding				
	Trenches				
	Work space				
	Complexity				
SCHEDULE / WORKWEEK					
	Work week				
	Shifts				
	Excess Work Force				
	Duration of Project				
	Timing / Schedule				

Item	Evaluation Factors	Structural Earthworks	Concrete	Structural Steel	Piping
		Rate in this Estimate is xx MH/CM vs. yy MH/CM from Comparison Basis	Rate in this Estimate is xx MH/CM vs. yy MH/CM from Comparison Basis	Rate in this Estimate is xx MH/MT vs. yy MH/MT from Comparison Basis	Rate in this Estimate is xx MH/LM vs. yy MH/LM from Comparison Basis
CRAFT LABOR					
	Labor Relations				
	Craft Availability				
	Supervision:Craft ratio				
	Foreman Experience / Skills				
	Supervision Experience / Skills				
	Supervision on Job (Front Line)				
	Labor Availability				
	Competing projects				
	Unemployment				
	Subcontractors				
	Worker Experience / Skills				
	Craft Incentive				
	Craft Motivation				
	Workmanship				
	Safety				
OTHER (SITE SPECIFIC)					
	R&R Cycle Impacts				
	Equipment Utilization				
	Mechanization				
	Piece Size				
	Design Information				
	Design Change				
	Repeatability				
	Stage of Project				
	Constructability				

Instructions: The purpose of this checklist is to document the reasoning behind selection of multipliers to Standard Jobhours. Cell entires do NOT have to be numeric.

Attachment 6 - EPM-KPE-TP-000005 - Wage Rate Build-Up by Craft Template

MANUAL WAGE RATE CALCULATION
AVERAGE WAGE RATE BY CRAFT

CRAFTS	CREW MIX					Worker Comp	WAGE RATE SAR/HR				AVERAGE BASE WAGE RATE	TOTAL FRINGES/ BENEFITS	WORKER'S COMP. / Emply Lia	TAXES	SPOT O/T PREMIUM PAY FACTOR	PREMIUM OVERTIME PAY	AVERAGE RATE BY CRAFT
	GF	F	J	A	TOT	Class	GF	F	J	A							
BOILERMAKER	1%	9%	81%	9%	100%	3726	34.29	33.29	31.29	23.47	SAR 30.80	SAR 16.91	SAR 2.89	SAR 3.62	5.0%	SAR 1.54	**SAR 55.76**
CARPENTER	2%	9%	84%	5%	100%	5213	19.08	18.83	17.83	13.37	SAR 17.72	SAR 7.94	SAR 3.86	SAR 2.08	5.0%	SAR 0.89	**SAR 32.49**
CEMENT MASON	1%	9%	85%	5%	100%	5213	23.25	22.25	21.00	15.75	SAR 20.87	SAR 7.50	SAR 4.54	SAR 2.45	5.0%	SAR 1.04	**SAR 36.41**
ELECTRICIAN	1%	9%	85%	5%	100%	5190/6325	29.10	28.07	25.75	19.31	SAR 25.67	SAR 9.81	SAR 2.32	SAR 3.02	5.0%	SAR 1.28	**SAR 42.10**
IRONWORKER	1%	10%	84%	5%	100%	5057/5059	26.68	25.68	23.68	17.76	SAR 23.61	SAR 13.50	SAR 10.52	SAR 2.77	5.0%	SAR 1.18	**SAR 51.58**
LABORER	1%	9%	90%	0%	100%	5213	18.98	17.98	16.98	15.48	SAR 17.09	SAR 7.12	SAR 3.72	SAR 2.01	5.0%	SAR 0.85	**SAR 30.79**
MILLWRIGHT	2%	9%	84%	5%	100%	3724	23.20	21.70	20.70	15.53	SAR 20.58	SAR 11.24	SAR 2.62	SAR 2.42	5.0%	SAR 1.03	**SAR 37.89**
OPER. ENGR	3%	14%	78%	5%	100%	3724/5183	22.75	21.75	21.25	15.94	SAR 21.10	SAR 10.40	SAR 2.15	SAR 2.48	5.0%	SAR 1.06	**SAR 37.18**
PIPEFITTER	2%	10%	83%	5%	100%	5183	26.00	25.00	23.00	17.25	SAR 22.97	SAR 10.79	SAR 1.75	SAR 2.70	5.0%	SAR 1.15	**SAR 39.36**
SHEETMETAL	2%	9%	84%	5%	100%	5536/5538	29.60	28.60	26.65	19.99	SAR 26.55	SAR 11.52	SAR 2.90	SAR 3.12	5.0%	SAR 1.33	**SAR 45.42**
TEAMSTER	1%	9%	85%	5%	100%	6217	18.45	18.20	17.95	17.67	SAR 17.96	SAR 9.95	SAR 2.28	$2.11	5.0%	SAR 0.90	**SAR 33.19**
PAINTER	0%	9%	86%	5%	100%	5474	18.50	18.25	18.00	13.50	SAR 17.80	SAR 4.15	SAR 3.28	$2.09	5.0%	SAR 0.89	**SAR 28.21**
INSULATOR	0%	9%	86%	5%	100%	5183	23.53	22.78	22.03	16.52	SAR 21.82	SAR 9.49	SAR 1.67	$2.56	5.0%	SAR 1.09	**SAR 36.63**

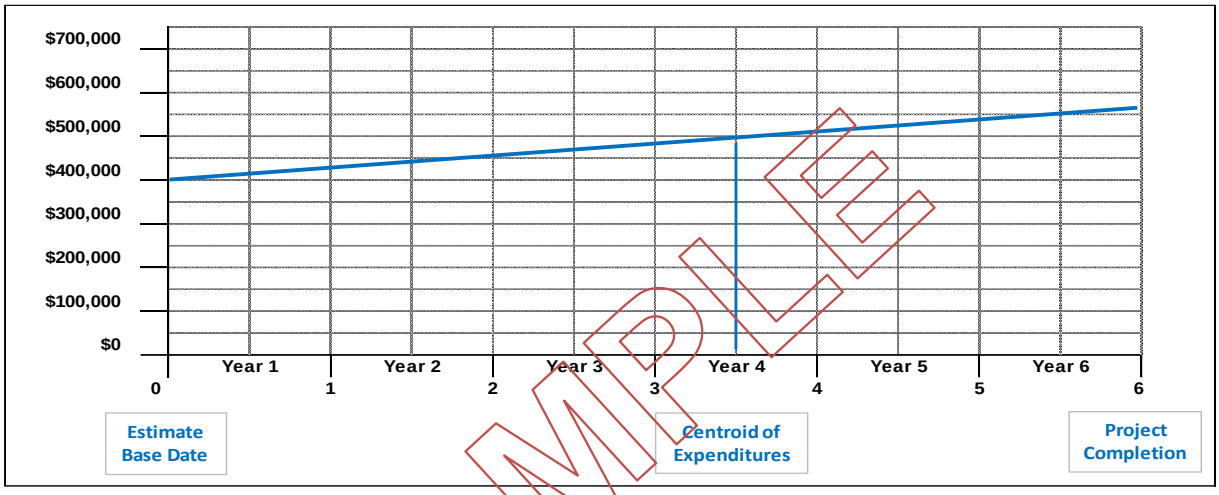
NOTES:
1. Journeyman rates are from 4th Qtr '05 wage bulletins X area
2. Apprentices get 75% of Journeyman's Wage for each craft.
3. Worker's Compensation rates were taken from tabulation of rates provided by Internal Specialists

Attachment 7 - EPM-KPE-TP-000006 - Wage Rate Build-Up by Category Template

MANUAL WAGE RATE CALCULATION
COMPOSITE WAGE RATE BY CATEGORY

Category	Craft Job Hours (hrs)	Boilermaker	Carpenter	Cement Mason	Electrician	Ironw orker	Laborer	Millw right	Operator	Pipefitter	Sheetmetal Wrkr	Teamster	Insulator	Painter	Total
		HOURLY RATE													
		SAR 52.14	SAR 30.40	SAR 33.96	SAR 39.09	SAR 48.81	SAR 28.79	SAR 35.47	SAR 34.70	SAR 36.66	SAR 42.30	SAR 31.08	SAR 34.07	SAR 26.12	
		DISTRIBUTION													
Columns & Vessels		80%							20%						SAR 48.65
Tanks	25,000	80%							20%						SAR 48.65
Exchangers									20%	80%					SAR 36.27
Furnaces	50,000	57%	3%	1%	1%	8%	4%	2%	9%	14%		1%			SAR 45.69
Pumps & Drivers			2%	4%	15%	2%	2%	30%	10%	35%					SAR 36.32
Compressors & Drivers			2%	4%	15%	2%	2%	30%	10%	35%					SAR 36.32
Material Handling Equipment						30%		60%	10%						SAR 39.39
Modules, Package Units, Oth Mech						30%		60%	10%						SAR 39.39
Instruments				2%	10%				2%	85%		1%			SAR 36.76
Piping			4%				3%		7%	84%		2%			SAR 35.93
Steel			1%		1%	80%			17%			1%			SAR 45.95
Insulation & Fireproofing		18%	24%	4%		29%	14%		1%	1%		1%	8%		SAR 39.97
Electrical Equipment			2%		65%	20%	2%		10%			1%			SAR 40.13
Electrical Bulks					95%				5%						SAR 38.87
Concrete Work			37%	17%	2%	23%	15%		4%	1%		1%			SAR 35.41
Buildings			65%	5%	1%	15%	12%		1%			1%			SAR 33.28
Site Development			5%		5%		35%		40%	5%		10%			SAR 32.37
Painting			20%				10%							70%	SAR 27.24
Temp Facilities			36%		39%	8%	8%		5%	2%		2%			SAR 35.49
Misc Constr Services		1%	17%	1%	4%	14%	25%		21%	6%		11%			SAR 34.53
Misc Operations / Prorates		1%	17%	1%	4%	14%	25%		21%	6%		11%			SAR 34.53
Total Project	**75,000**	**65%**	**2%**	**1%**	**1%**	**5%**	**3%**	**1%**	**13%**	**9%**	**0%**	**1%**	**0%**	**0%**	**SAR 46.68**

Attachment 8 - Sample Escalation Calculation



1. Establish current estimate base cost, BC. At estimate base date: SAR 400k
2. Establish project schedule. Total duration to completion: 6 years
3. Determine the centroid of expenditures, n. In this case, n = 3.5 years
4. Determine or assume escalation rate per annum, e% pa. In this case, e = 6% pa.
5. The calculation for escalation, E, is as follows:

Escalation rate E% = $[\ (1 + e\%pa)^n - 1]$ X 100

= $[(1.06)^{3.5} - 1]$ X 100

= 22.62% (rounded to two decimal places)

Escalation E SAR = Base Cost x Escalation Rate

= SAR 400,000 x 22.62% = SAR 90,480

Escalated Cost = Base Cost + Escalation

= SAR 400,000 + SAR 90,480 = SAR 490,480

The above example assumes the following:

The escalation rate is consistent over the performance period (fixed annual escalation rate).

Escalation is compounded annually. If escalation is compounded monthly, the time to the centroid of expenditures should be expressed in months.

Attachment 9 - EPM-KPE-TP-000007 - Escalation Calculation for Different Rates per Year Template

	A	B	C	D	E	F
1		**ESCALATION RATES:**				
2					2018	2019
3		Non-Manual Labor			2.800%	3.300%
4		Craft Labor			4.500%	4.500%
5		Materials			2.400%	2.400%
6						
7		**NON-MANUAL LABOR**	**Months(1)**	**Months(2)**	**2018**	**2019**
8		Base of Cost	December 31, 2017			
9		CY 2018	12	6	1.01390	1.02800
10		CY 2019	12	6		1.01637
11		TOTAL ESCALATION FACTORS			1.01390	1.04482
12						
13		**CRAFT LABOR**	**Months(1)**	**Months(1)**	**2018**	**2019**
14		Base of Cost	December 31, 2017			
15		CY 2018	12	6	1.02225	1.04500
16		CY 2019	12	6		1.02225
17		TOTAL ESCALATION FACTORS			1.02225	1.06825
18						
19		**MATERIALS**	**Months(1)**	**Months(1)**	**2018**	**2019**
20		Base of Cost	December 31, 2017			
21		CY 2018	12	6	1.01193	1.02400
22		CY 2019	12	6		1.01193
23		TOTAL ESCALATION FACTORS			1.01193	1.03622
24		(1) - Months of performance in year		(2) - Months to centroid of expenditures.		
25						
26		**FORMULAE USED:**				
27						
28		**NON-MANUAL LABOR**	**Months(1)**	**Months(2)**	**2018**	**2019**
29		Base of Cost	December 31, 2017			
30		CY 2018	12	6	=((1+E$3)^(D9/12))	=((1+E$3)^(C9/12))
31		CY 2019	12	6		=((1+F$3)^(D10/12))
32		TOTAL ESCALATION FACTORS			=D9*D10	=E9*E10
33						
34		**CRAFT LABOR**	**Months(1)**	**Months(1)**	**2018**	**2019**
35		Base of Cost	December 31, 2017			
36		CY 2018	12	6	=((1+E$4)^(D15/12))	=((1+E$4)^(C15/12))
37		CY 2019	12	6		=((1+F$4)^(D16/12))
38		TOTAL ESCALATION FACTORS			=D15*D16	=E15*E16
39						
40		**MATERIALS**	**Months(1)**	**Months(1)**	**2018**	**2019**
41		Base of Cost	December 31, 2017			
42		CY 2018	12	6	=((1+E$5)^(D21/12))	=((1+E$5)^(C21/12))
43		CY 2018	12	6		=((1+F$5)^(D22/12))
44		TOTAL ESCALATION FACTORS			=D21*D22	=E21*E22
45						
46		EXPLANATION: Using Non-Manual Labor in cells B7:F11 as an example.				
47		1. In Column C, enter months of perfrormance to-go in that year. In Column D enter the centroid of				
48		expenditures in that year from the beginning of the year. Column E provides the appropriate escalation				
49		adjustment for costs in CY 2018 (cell E9).				
50		2. Column F calculates escalation rate for to be applied to costs in CY2019 in a two-step process. The first				
51		step calculates the rate required to escalate the costs to the end of CY2018 using the CY2018 rate (cell F9).				
52		The second step calculates the rate to escalate costs to the centroid of CY2019 (cell F10). The rate for				
53		CY2019 is the multiplication of the two rates (cell F11).				
54						

Attachment 10 - Sample Proposal Reconciliation

Reconciliation Of the Direct Cost		(x SAR 1,000)
New Plant: (note project name)		SAR xxx,xxx
Base Plant: (note project name)		SAR xx,xxx
	Total Variance	SAR xx,xxx
Wage Rate Adjustment		
(Base Jbhrs x Delta between New Wages & Base Wages)		xx,xxx
Productivity Adjustments		
[(Base jbhrs/Base Prod. x New Prod.) - Base Jbhrs] x Base Wages)		xx,xxx
Escalation and, or Price Adjustment		
Steel pricing, change in base facilities purchased price and today's current quoted steel price level.		x,xxx
Steam Turbine Generator, firm lump sum quote		x,xxx
	Subtotal Escalation & Price	x,xxx
Scope		
Deleted raw water make-up line		xxx
Source of make-up water will be wells drilled on site decreasing footage of yard piping from 600 m to 200 m		
Added fuel dryer to material handling system		xxx
Fuel source is different than base supplier requiring this project to dry fuel on site.		
Change in switchyard configuration.		xxx
Interconnection to the local utility requires that a ring bus configuration be provided, rather than provide a breaker and half configuration.		
	Subtotal Scope Changes	x,xxx
Design Evolution and Estimate Refinements		
Civil related changes		
Change in the design approach from a grade beam and slab design to a design that will have a solid slab. An increase of 500 m3. This is accomplished to alleviate the concern of placing concrete over the winter months.		xxx
Material Handling		xxx
Change from an outdoor fuel storage to an enclosed storage facility. Because of the present environmental concerns an "A" Frame storage structure is provided.		
Electrical & Controls		xxx
Increase in the quantities of circuits. Lesson learned through the execution of the base facility noted that additional circuits are required for the controls of the material handling system.		
	Subtotal design & Estimate Refinements	x,xxx
	Total Direct Cost Adjustments	x,xxx