EXPRO National Manual for Projects Management

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Project Quantity Tracking Procedure

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1.0 PURPOSE

This procedure provides guidelines for quantity tracking on Government Entity projects. Quantity tracking encompasses the identification, quantification, and status updating of project scope and provides visibility of scope during all phases of a project. Quantities provide a means of measuring project scope in terms common to Engineering, Construction, and the supporting services. Quantity tracking provides visibility of project scope, scope growth, progress and performance.

This procedure also defines the work process for the take-off of construction quantities and the reporting of installed quantities used in determining construction progress and performance.

This procedure applies to works performed under all Government construction projects executed throughout the Kingdom of Saudi Arabia.

2.0 SCOPE

This procedure applies to projects requiring quantity tracking for the following:

- Scope definition during Design phase and design progress measurement
- Quantity reporting and performance measurement during Construction phase

This procedure does not apply to projects where the Contractor retains quantity responsibility, but may be used as a guideline to ensure that basic quantity reporting requirements are met.

3.0 DEFINITIONS

Definitions	Description
3D	Three dimensional
A/E (Architect/Engineer)	Architect & Engineer organization that undertakes studies and/or design of projects.
COA (Code of Accounts)	A unique lettering or numbering system in which letters or numbers are assigned to each unique component of the work breakdown structure.
CV	Check Valve
Entity	A Saudi Government organization which is responsible for the delivery of government funded infrastructure construction projects.
FCE	Field Cost Engineer
FV	Flow Valve
HVAC	Heating Ventilation and Air-Conditioning
Installed Quantities	Quantities reported as installed are materials that are required to construct the designed facility and do not include quantities installed of construction convenience, overage, error or waste.
IFC	Issued for Construction
LV	Level Valve
PV	Pressure Valve
PSV	Pressure Safety Valve
PSE	Pressure Safety Element
PM	Project Manager
PCM	Project Controls Manager

Definitions	Description
PFC	Project Field Engineer
PE	Preliminary Engineering
PMC (Project Management Consultant)	An external consultant engaged by the Entity to deliver capital expenditure infrastructure projects.
PMT (Project Management Team)	The team deployed by the Entity to manage the Project.
P&IDs	Piping & Instrumentation Diagrams
Quantity Reporting	The identification, quantification, and weekly status updating of all equipment/materials included in the project scope.
QTS (Quantity Tracking System)	Refers to the set of tracking applications as a whole that track the quantities during design, procurement and installation progress of specific commodities.
RFE	Responsible Engineer
RFP	Request for Proposal
Rules of Credit	Various task milestones and associated percentage complete established to provide partial or full installation credit for permanent plant equipment/materials.
Take-off	A summarization of separate, field-installed items or quantities prepared from Issued for Construction (IFC) design documents.
To-Go Quantities	Quantities defined as to go are materials not yet installed that are required to construct the designed facility.
UoM (Unit of Measure)	The unit used to measure a particular commodity (e.g. linear meters (m) for cable, or cubic meter (m3) for concrete).
WBS (Work Breakdown Structure)	Is breakdown of scope elements based on location/sections/discipline to a manageable level for control and reporting purposes

4.0 REFERENCES

1. EPM-KPP-PR-000001 - Project Planning and Scheduling Definitions and Concepts Procedure
2. EPM-KPP-PR-000002 - Project Schedule Development Procedure
3. EPM-KPP-PR-000003 - Project Schedule Curves Procedure
4. EPM-KPP-PR-000005 - Project Contractor Requirements for Planning & Scheduling Procedure
5. EPM-KPP-PR-000006 - Project Schedule Standards and Quality Procedure
6. EPM-KPC-PR-000005 - Project Engineering Tracking Procedure
7. EPM-KPC-PR-000001 - Project Cost Coding Structures Procedure
8. EPM-KPC-PR-000004 - Project Forecasting Procedure
9. EPM-KPC-PR-000007 - Project Trend Program Procedure
10. EPM-KPC-PR-000010 - Project Earned Value Management System Procedure
11. EPM-KPC-PR-000011 - Project Weekly Quantities Report Procedure
12. EPM-EQ0-PR-000001 - Project Stage Gate Procedure

5.0 RESPONSIBILITIES

Responsibility for quantity development and tracking varies throughout the life of the project, as shown below:

Quantity Information	Group Responsibility
Initial Planning	Consultant
Detailed Design	A/E
Detailed Estimate	A/E

Quantity Information	Group Responsibility
Purchased	Contractor
Received	Contractor
Installed	Contractor
Released for Commissioning	Contractor

Project Controls maintains the responsibility for overall coordination and management reporting of quantity information and should support the owners of the quantities to optimize and track both cost and schedule impacts associated with the quantity lifecycle. Detailed responsibilities are as follows:

5.1 Design Phase

The following responsibilities are applicable during Design Phase which has to be carried by selected Entity or Consultant during Initial Planning stage and Designer A/E during Detailed Design stage.

5.1.1 Project Estimator

The Project Estimator is responsible for:

- Initial development and organization of project quantities during preparation of the estimate and bid.
- Turning over the quantity and UoM information in an organized manner upon award of the project for Construction.

5.1.2 Project Engineering Manager

The Engineering Manager is responsible for:

- Initial quantity verification of the estimate
- Constant and consistent updating of design quantities (estimated, designed, and released) as the design process moves forward
- Loading Budget and Issued for Construction (IFC) quantity data into computerized databases
- Working with Construction to optimize designs (reduction of quantities and/or installation costs)

5.1.3 Project Controls Manager (PCM)

The PCM is responsible for:

- Overall coordination of quantity tracking, interface with other departments regarding tracking and reporting quantity information
- Providing direction to the Project Controls personnel involved in quantity tracking
- Issuing quantity tracking management reporting documents in accordance with project requirements

5.1.4 Project Cost Engineer

The Project Cost Engineer is typically responsible for:

- Establishing and maintaining the project cost coding structure and loading the initial quantities into the cost control systems.
- Interfacing closely with Engineering and Procurement/Contracts to establish and maintain open communication and transfer of data between groups

5.2 Construction Phase

The following responsibilities are applicable during Construction Phase which has to be carried-out by the selected Contractor.

5.2.1 Project Manager (PM)

The PM is responsible for:

- Ensuring that the requirements of this procedure are properly implemented.

5.2.2 Project Trend Engineer

The Trend Engineer must have a thorough understanding of the project budget and scope to monitor project development. The Trend Engineer is responsible for:

- Challenging design changes and recommending ways to optimize cost and schedule impacts and to mitigate unnecessary quantity growth.
- Working closely with Procurement/Contracts, Construction, Commissioning, and other support services as necessary to be aware of and have time to analyze and evaluate potential trends/scope changes.
- Actively attending review meetings on a regular basis to understand changes in the to-go design quantities.

In certain instances that smaller scale of project has to be executed and the position of Trend Engineer is not warranted, the Cost Engineer assumes the responsibility of the Trend Engineer in this procedure.

5.2.3 Project Controls Manager

The Project Controls Manager is responsible for:

- Coordination of the Quantity Tracking System (QTS), interfacing with other departments regarding tracking, and reporting quantity information
- Directing the Project Controls personnel involved in quantity tracking
- Issuing quantity tracking management reporting documents in accordance with project requirements
- Providing periodic audits to confirm accuracy of the reported progress and cost coding activities

5.2.4 Project Cost Engineer

The Cost Engineer is responsible to confirm the reasonableness and completeness of all data and is responsible for:

- Compiling and reporting the installed quantities during the construction phase of the project
- Maintaining the Project Controls systems involved in tracking quantities
- Coordinating closely with Procurement to collect relevant quantity data in a timely manner
- Being familiar with the responsibilities, procedures, and problem areas regarding quantities (i.e., takeoffs, reporting, forecasting, and control)
- Spot checking the takeoffs because this assists in:
  - Understanding forecast quantities
  - Settling questionable coding problems
  - Updating the cost control tool
  - Generating and analyzing the Progress and Performance dashboard
- Running periodic spot checks to confirm installation progress and verify that the timekeeping cost codes are accurate and consistent
- Performing visual inspections of installed quantities, budget versus actual installation unit rate comparisons, and takeoff spot checks are also necessary
- Communicating any deviations between the earned quantities and the actual installed quantities

5.2.5 Lead Project Planner

The Lead Project Planner is responsible for:

- Setting up and maintaining the delivery and installation curves.
- Identifying and quantifying schedule impacts

5.2.6 Project Engineering Manager (during site supervision)

The Engineering Manager is responsible for:

- Loading installed and certified quantity data into computerized databases
- Working with Construction to optimize quantities (for example: recycle and reuse)

5.2.7 Site Supervision Engineering

Site Supervision Engineering is responsible for:

- Assigning Rules of Credit by commodity
- Validating quantity takeoffs issued during Bid stage
- Monitoring and coordinating design requirements and progress in various physical facility areas and craft disciplines
- Tracking installed quantities and reporting this information to Project Controls in a timely manner
- Producing timely takeoffs of non-engineered commodities to ensure delivery in time to support the installation plan
- Resolving any questions or problems regarding installed quantities

5.2.8 Site Supervision Engineer

The Site Supervision Engineer is part of the A/E (Architect Engineer) organization that establishes a site presence to supervise that construction and installation is performed according to design. As owners of the quantities, they are also responsible for:

- Quantity takeoffs, quantity tracking, knowledge of job scope, technical issue resolution, and quality verification by means of inspection and testing.

5.2.9 Procurement Manager

The Procurement Manager is responsible for:

- Initiating and maintaining a purchased-quantity database
- Notifying vendors and contractors of quantity changes
- Tracking quantities from fabrication to site delivery
- Initiating and maintaining a database for received quantities
- Reporting this information to Project Controls.

5.2.10 Construction Contractors

The Construction Contractors are responsible for:

- Reporting weekly quantities installed to the Site Supervision Engineer
- Report Weekly Hours spent per commodity
- Optimize quantity installation (reduction of overage, rework, etc.)

NOTE: In certain instances, for smaller scale projects, positions listed in this section do not exist in the Organization. Project is required to identify the responsible persons who will handle the tasks specified in this section.

6.0 PROCESS

6.1 Quantity Tracking System

Quantity Tracking System (QTS) shall be implemented in Project Stage Gate 4 – Design which will be carried out by A/E and Stage Gate 6 – Construction which will be carried out by Contractor as outlined in Project Stage Gate Procedure (Document No. EPM-EQ0-PR-000001).

Quantities drive both cost and schedule, the sooner cost and schedule impacts are recognized and optimized, the better. During the Design phase, a good quantity tracking program allows the project functions to proactively evaluate impacts and deviations from the Initial planning. It is during the Design phase that the project can affect the greatest benefit. Engineering and Estimating (under A/E's function) need to work together to proactively look for ways to optimize the design and optimize the quantities. The earlier in the project's life that impacts to cost and schedule are recognized and mitigated, the greater the benefit that can be achieved.

Quantity Tracking System refers to the set of tracking applications as a whole that track the quantities during Design phase and installation progress of specific commodities during Construction phase. It is important that QTS reporting represents the total scope of the project. If separate systems are being used during Design and Construction phases to maintain quantities, the appropriate information is integrated using the project code of accounts structure. The following criteria must be met for quantity reporting purposes:

- Quantities should be reported against pre-loaded quantity takeoffs by drawing number, equipment tag number, or other control number that specifically identifies the work and can be audited at a later time. Quantity reporting at only the cost code level is generally not recommended due to volume of cost codes required to adequately track progress.

- The quantity reporting database should contain:

    - Cost Code/Cost Account
    - Item Number
    - Drawing Number
    - Description
    - Budget Quantity
    - Unit of Measure (UoM)
    - Forecast Quantity
    - Subdivision
    - Take-off Quantity
    - Location/Facility
    - To-Date Installed Quantity
    - Last-Week Installed Quantity
    - Equipment Number (if applicable)

Input for the total budget quantities and total forecast quantities in the QTS come primarily from Engineering prior to the Construction phase of the project. Primary sources of information from Engineering are Piping & Instrumentation Diagrams (P&IDs), equipment and instrument lists, valve lists, the 3D model, etc. Any deviation from the baseline must be trended and reported.

A QTS provides a number of standard quantity reports geared toward the needs of Procurement and Construction and also provides some flexibility for user-generated reports through the use of ad-hoc reporting tools. This system also provides input to other control programs such as craft performance monitoring and reporting.

Note: Engineering is responsible for the initial quantity loads as design progresses, but during Construction phase that Contractor with the supervision of Entity Project Management Team/Project Management Company (PMT/PMC) is responsible for validating the data.

6.2 General

Quantity tracking is initiated by Engineering upon the award of a Design project scope (Project Stage Gate 4). Once the budget is established, quantity tracking continues until the Construction (Project Stage Gate 6) of the project is complete. Quantity tracking methods should be applied to civil, structural, mechanical equipment, piping,

instrumentation, and electrical commodities. On projects where it is initiated, quantity tracking becomes an integral part of the Project Controls systems.

Quantity tracking is a fundamental and significant element of cost and schedule control because quantities drive cost and schedule. One of the most important functions of cost control is the accurate and timely collection and reporting of quantities over the life-cycle of a project, from estimating and establishing the budget through Engineering until Construction. This includes quantities that are installed to-date and total forecast quantities. Below are some of the reasons why Quantity Tracking is important:

- Quantities are a measure of a project's scope and therefore serve as a guide in determining staffing, construction equipment requirements, and procurement activities.
- Cost and jobhour information does not reveal productivity or performance unless it is related to quantities, i.e., assessment of labor performance is accomplished by relating jobhours and quantities.
- Accurate equipment and material cost forecasts depend directly on accurate total forecast quantities and to-date installed quantities.
- Maintenance of the project schedule, and measurement and forecasting of project progress depends on good quantity information.

Note: A good quantity tracking program will allow the project functions to proactively evaluate impacts and deviations from the Initial Planning during Design phase prior to award Construction scope so that cost and schedule can be optimized.

Forecasted quantities provide the basis for determining what work must be done. Installed quantities provide the measure and progress of work that is in-progress or has been completed. Without reasonable quantity reporting accuracy, project management team will not know the construction status of a project, where it is going, or the rate at which it must proceed to complete the work on schedule.

Prior to initialization of a QTS, develop a general plan for identifying the commodities that will be tracked, and how the system will be implemented. Determine the type of QTS that will be used and assign organizational responsibilities for the input and maintenance of data.

Generally, the number of commodities that are tracked individually to identify the project scope is in the range of 6 to 15; however, the number and type of commodities tracked varies by project. Each project identifies which and how many commodities will be tracked to meet project goals and requirements. Example commodities and the typical Unit of Measure (UoM) are as follows:

Discipline	Commodity	Units of Measurement Metric
Civil works & major structures	Structural excavation	cubic meters
	Earth walls	cubic meters
	Concrete piles – preparation, handling	each
	Driving of piles	linear meters
	Bored piles – excavation in steel pile casing	cubic meters
	Bored piles - concreting	cubic meters
	Formworks	square meters
	Steel reinforcement	metric tons
	Concrete	cubic meters
	Prestress Concrete – anchorages, couplers, grouting	each
	Prestress Concrete – tendons	linear meters
	Structural steelwork	metric tons
Earthworks	Topsoil removal	square meters
	Removal of unsuitable material	cubic meters
	Excavation	cubic meters
	Backfill	cubic meters
	Subgrade	cubic meters

Discipline	Commodity	Units of Measurement Metric
Drainage	Surface Drains	linear meters
	Culverts	linear meters
	Manholes	each
	Floodway edge wall	linear meters
Pavement & Surfacing	Subbase Course	cubic meters
	Base Course	cubic meters
	Tack Coat, Prime coat	square meters
	Asphalt (varying thickness)	metric tons
Traffic Facilities	Traffic signs	each
	Guide post	each
	Pavement markings	linear meters
	Bollards	each
Electrical & lighting	Lighting poles	each
	Conduits & cabling	linear meters
	Connection to consumer mains	each

Each commodity has a set of associated data elements, which are required for complete identification and status updating. A standard list of associated data elements showing recommendations for each type of commodity has been developed and is provided in ***Attachment 1 - Quantity Tracking Associated Data***.

Attachment 2 - Quantity Tracking System Development Flow Chart – *Summary Level,* presents a high level overview of this process.

Note: If required by the project, Quantity Tracking can also be performed for contractors. However, reporting requirements must be anticipated and included in both the Request for Proposal (RFP) and the contract.

6.3 Design Phase

Throughout the Design phase, the project team (Entity PMT, PMC and A/E) must proactively work together to optimize the design, mitigate cost and schedule impacts, and minimize quantities as much as reasonably possible. The earlier this is implemented on the project, the greater the benefit that will be realized by the project.

The level of detail available for each commodity increases as the design evolves. During the design of the project, there are distinct phases of quantity development and tracking – 1st initial planning and 2nd detailed design. The level of detail and techniques for identifying and quantifying commodities varies with each stage of design.

The initial planning quantities are developed during the preparation of the proposal, typically using historical data from similar projects and adjusting or factoring them based on differences in the current proposed scope. Because the proposal estimate becomes the basis for trending and forecasting upon award of the project, care must be taken during quantity development to ensure that sufficient data is available for turnover of the estimate to a project team if the project is awarded. The detail of initial planning quantity is usually by commodity within a project facility or engineering system. After initial planning quantities are developed, they are linked to activities on the project milestone summary schedule to verify schedule durations and provide a basis for estimating labor.

The objective of defining designed quantities (initial planning and detailed) is to provide a more exact definition of the project scope. This level of commodity quantification is associated with design drawings and specifications, and it facilitates identification by the appropriate engineering coding system. These quantities can then be associated with specifications or material requisitions, engineering and construction intermediate schedules, engineering systems, and cost accounts/cost codes.

As the detailed design process for each commodity progresses, identification of quantities should include the lowest level of detail for that commodity, which should be compatible with the needs of the project team and the requirements of the QTS. ***Attachment 3 - Quantity Tracking Standard Identifiers***, provides a listing of typical key quantities, along with their typical UoMs that are tracked by commodity and that reflect a normal lowest level of detail. Standard identifiers can vary from Entity to Entity and from project to project line.

Note: Engineering (A/E) owns and is accountable for the Engineering jobhour budgets; however, A/E's Project Controls should attend model review and design review meetings on a regular basis to be aware of design changes/evolution and evaluate them as potential trends for cost and schedule impacts and scope changes.

6.4 Construction Phase

6.4.1 Quantity Tracking Plan

Upon completion of the optimized detailed design, identification and quantification of project scope is essentially complete. Quantity tracking at this point becomes a means for Contractor to provide visibility to Procurement, Construction and Commissioning of the status of each component and commodity. This is achieved through the development and establishment of a Quantity Tracking Plan. The plan should include the:

- Primary take off method for each major commodity
- Method of reporting units including the necessary Rules of Credit
- Cut-off date for weekly reporting
- Source of take-off information to be used to monitor quantity forecast and installation progress
- Level of detail and coding breakdown required for tracking and reporting forecast and installed quantities
- Definition of materials to be included in the Progress and Performance dashboard for bulk material productivity reporting
- Identification of Key Quantities by project so that quantities recorded at the detailed level are correctly summarized at higher cost code levels. ***Attachment 4 - Key Quantities****,* shows how key quantities are indicated in the cost control tool. When the "key flag" is not checked, the quantities associated with that commodity are not included in the subtotal/total.

Once the plan requirements have been established, Contractor's Field Cost Engineer (FCE), Project Planner, and Project Field Engineer (PFE) should meet with the Construction Superintendent and the field engineer responsible for each craft or facility area to review the plan and seek their agreement.

6.4.2 Stages of Quantity Status

During Construction phase, these are major stages of quantity status updating:

- Budget quantities
- Forecast quantities
- Purchased quantities
- Received quantities
- Installed quantities
- Released for Commissioning

All material items for which the detailed design is complete are cross-referenced by A/E to an Engineering specification. These items can then be summarized by specification to provide the total required purchase quantities.

Detailed quantities, drawings, codes, and other data should be identified in the QTS. Using this system, Construction Contractor can continuously compare designed and procured quantities, and Contractor's Procurement team can monitor the status of purchased materials for the project. It is critical that the quantity tracking process will ensure quantities are designed, procured, and delivered in accordance with Construction's established installation schedule.

Upon receipt of equipment and material at the site, quantity tracking by status updating is initiated in the field. Each of the field status levels (received, installed, released) may have additional levels of status required by Construction. For example, a pump may be statused as set-in-place, aligned, grouted, and tested. The QTS should be flexible enough in format to accommodate the construction status requirements.

6.4.3 Quantity Tracking Work Process

The Contractor's craft foreman is responsible for producing the daily jobhour reports that correspond to the installed

quantities for the reporting period and for providing this information to the responsible discipline/field engineer.

The Contractor's discipline/field engineer collects, verifies, and summarizes quantity data in accordance with the Quantity Reporting Plan.

The Contractor's discipline/ field engineer verifies incremental and cumulative quantities against the appropriate project cost accounts/cost codes and UoM.

The responsible Contractor's field engineer reports the quantities to the Site Supervision Engineer on a weekly basis. (Refer to ***Attachment 5 - Quantity Tracking Work Process Diagram during Construction***).

The Site Supervision Engineer loads the partial quantities (for example, equipment) are also reported using the established rules of credit to allow performance monitoring during the installation process and before completing all related work for a given commodity.

The Site Supervision Engineer periodically performs spot checks on the actual installed quantities to validate that the partial quantities earned via the Rules of Credit are reasonable. Once the reports are generated, the FCE compares the installed quantity totals to the budget and forecast.

The Contractor's discipline/ field engineer reviews construction status and quantity tracking during installation.

Note: Only quantities that are included in the takeoff quantities should be reported as installed. Additional quantities should be reported as a potential trend and/or scope increases.

6.4.4 Errors in Quantity Reporting

When an error is discovered in previously reported quantities, a correction must be made in the database. Any variance discovered should be investigated and significant adjustments (as determined by the project) explained via a note on all affected reports, which should also be noted in the transmittal letter.

The most common error in quantity reporting is incorrect craft time charges. Other common errors in quantity reporting may be due to the following:

- Contractor's discipline/ field engineer not keeping accurate, current, or complete quantity ledgers
- Lack of awareness of budget or forecast quantities
- Reporting weekly quantities without checking to-date values
- Not reporting at a detail level compatible with Project Controls requirements
- Using the wrong Quantity Reporting UoM
- Reporting quantity at the wrong installation stage (too early or too late)
- Reporting rework quantities (double counting)
- Reporting quantities submitted previously or by another engineer
- Not reporting contract quantities

It is critical that teams responsible for the quantities during the installation process review progress, check for the above errors, correct and provide on-going forecasts (including labor and materials) and schedule impact for that commodity.

Note: Never make adjustments in prior periods in the cost control tool.

6.5 Quantity Curves

Quantity Curves are governed by EPM-KPP-PR-000003 - Project Schedule Curves Procedure. They are included here to add clarity.

During Detailed Design phase, the total commodity quantities are determined and at the start of Construction stage the Contractor's Planner sets up the related quantity curves. These curves include delivery (if in contractor's scope) and installation curves.

Quantity curves by major commodity are very effective control tools for selected major bulk material items. Depending on the duration of the project, they may be set up either weekly or monthly. Two techniques that can be used alone or in combination as curves are developed are:

- Plan vs. Actual Delivery of Quantities - this curve shows the cumulative planned and actual delivery of quantities at the construction job site. Slippage in delivery dates indicates Construction may have to implement work-around activities to maintain progress.
- Plan vs. Actual Installation of Quantities - this curve shows the cumulative planned installation of quantities (work to be completed by Construction) vs. the cumulative actual installation of quantities.

6.5.1 Family of Curves

These curves are included on one graph for all commodities as well as individual commodities. Typical commodities to be tracked include but are not limited to the following.

- Structural concrete - formworks, rebars, embeds, pouring
- Structural steel – supplied, erected, aligned, bolted, inspected
- Pilings – preparation, handling, driving
- Pavement and surfacing - subbase course, base course, coating & asphalt paving
- Cable installation – excavation, cable pulling, backfilling
- Piping erection – staging, alignment, tacking & welding, testing, restoration
- Railway track – track drainage, subgrade, laying bottom ballast, anchorage, laying steel rail, top ballast, rail anchor, rail brace

Refer to ***Attachment 6 – Sample of Quantity Curves***

6.6 Quantity Reporting

6.6.1 Applicability

This section defines the work process for the take-off of construction quantities and the reporting of installed quantities used in determining construction progress and performance.

Quantity reporting has to be consistent with the Work Breakdown Structure (WBS) and with the unit of measure (UoM) in unit rates.

6.6.2 Quantity Take-off

- Contractor's Responsible Engineer (RFE) validates the take-offs prepared during Detailed Design phase and resolves with Site Supervision Engineer any deviation.

- Quantity take-offs are entered into the quantity tracking system before any progress can be reported against that item; this must be done prior to any expenditure of field labor hours on this commodity. The Site Supervision Engineer coordinates with Project Controls to code the quantities with the appropriate cost code in which they were budgeted.

- Site Supervision Engineer reviews design document revisions for quantity changes and updates take-off information accordingly, enters quantity changes into the applicable quantity tracking system, notifies Project Controls when completed and/or revised take-offs affect current forecast numbers.

6.6.3 Reporting

- Contractor reports the progress for the previous week to the Site Supervision Engineer who verifies the quantities installed are correct and to spec, and reports the incremental and cumulative quantities against the appropriate project cost codes.

- Contractor ensures that the RFE receives installation input for all quantities or marked up quantity reports on a weekly basis. These quantities should be the basis for verification and should be submitted in accordance with the project quantity reporting plan deadlines.

- Contractor and Site Supervision Engineer review the quantity reports to ensure that the correct quantities have been entered in the system for work performed in the preceding week.

- Contractor and Project Controls review the quantities claimed versus the labor code hours charged, address any discrepancies, and resolve.

  NOTE: Project Controls enters the weekly installed quantities into the project cost control system for the weekly issue of the Progress Measurement and Performance.

Refer to ***Attachment 7 – Quantity Reporting Responsibility Matrix, Attachment 8 – Elements of Quantity Reporting Take-of and Attachment 9 – EPM-KPC-TP-000026 Quantity Tracker Summary and Details template.***

6.7 Procurement Tracking

Contractor's Procurement team has to continuously monitor the status of purchased materials for the project for design quantities in contractor's scope to procure. It is critical that the Procurement tracking process will ensure quantities are procured and delivered in accordance with Contractor's established installation schedule.

Contractor is required to submit the Procurement Schedule updates showing list of Purchase Orders/Subcontract with name of the Suppliers, materials/equipment details and delivered quantities.

Refer to ***Attachment-10 EPM-KPC-TP-000027 Procurement Schedule template.***

7.0 GUIDANCE ON PRIMARY COMMODITY TAKE-OFFS AND REPORTING

7.1 General

- The following requirements are provided for most major commodities.

- Any questions or problems related to installed quantities should be resolved between the Site Supervision Engineer and the Contractor before quantities are reported. The Site Supervision Engineer reports quantities to Project Controls on a weekly basis.

- The Site Supervision Engineer should maintain updated reports of weekly installed quantity reports. Only quantities included in the take-off should be reported as installed. Any additional quantities should be reported to Project Controls as a deviation.

7.2 Site Work

7.2.1 Take-off

- Excavation (Cubic Meters)

  - Take-offs are a measure of the required excavated volume based on rough grade elevation, bottom of concrete elevation and cross section dimensions. As a general rule, the excavation should be 0.5m per side larger than the foundation footer. The 0.5m dimension will vary by project depending on site soil conditions. This dimension should be established early in the project and used consistently for all excavation take-offs thereafter.

  - If the excavation is deeper than 1.5 meters the cut should be calculated with a 45-degree angle slope beginning at a point 1.5 meters above bottom of concrete elevation. Excavation guidelines also apply to underground pipe and cable/ductbanks, with 0.5m added to the outside of the pipe wall or cable(s) on both sides.

    NOTE: Verify excavation size requirements with Environmental, Safety, and Health (ESH) personnel before performing quantity take-off calculations.

- Backfill (Cubic Meters)

- Take-offs are a measure of volume to be backfilled based on the excavation take-off minus the below grade concrete (and/or underground pipe/conduit/duct bank) volume. Backfill is not a measure of loose fill material placed to achieve compaction requirements.
- Excavation and backfill take-offs are performed in conjunction with the foundation concrete take-offs. For excavation and backfill take-offs not associated with foundations, separate ledgers are typically maintained for recording take-off quantities.
- Piping, electrical, architectural, and structural steel drawings should be reviewed for items that may require excavation and backfill, such as: underground pipe, underground ductbank, pipe supports, miscellaneous platforms, manholes, light stanchions, and guard posts.

7.2.2 Reporting

All site work quantities shall be reported as completed.

- Since excavation and backfill work activities change so rapidly, quantities are typically reported daily. Quantities are reported as the actual volume of earthwork excavated or backfilled.
- Site Supervision Engineer must typically verify by visual inspection that reported quantities are correct and properly excavated or backfilled; any questions or problems must be resolved with the responsible superintendent in a timely manner. The Site Supervision Engineer assembles the daily reports and reports quantities to Project Controls on a weekly basis as required by the project Quantity Reporting Plan.
- The Site Supervision Engineer should maintain a marked up plot plan showing excavations (typically marked in yellow) and backfills (typically marked in blue) and a weekly ledger or log of reported quantities.
- Only those quantities included in the original take-off should be reported as installed. If additional quantities are discovered, report the increase to Project Controls as a variance.

7.3 Concrete

7.3.1 Take-off

- General
  - Formwork, rebar, and concrete take-offs should be made in sufficient detail to permit reporting by pour sequence (i.e., identify footings and piers as separate items on small foundations and as pour sequences on major foundations such as compressor foundations). If the pour sequence is in question, the take-offs should be performed in sufficient detail to avoid having to interpret one-line entries on the take-off.
  - Where foundations are repetitive and likely to be worked simultaneously, such as pipe rack foundations, the foundation take-offs should be grouped together in a single take-off line by drawing number.
  - Take-offs should be organized to match the project code of accounts, which may divide the concrete into types such as foundations, sumps and basins, precast, and paving. Questions on how to classify a particular take-off item should be addressed to Project Controls prior to performing the take-off.
  - Take-offs are typically recorded by drawing number and foundation number. If no foundation number applies, a description of the item including location should be provided. Examples would include underground ductbank, piping thrust blocks, and other miscellaneous cast-in-place concrete.
  - The type of quantity tracking system adopted for the project will influence take-off methods.
- Concrete (Cubic Meters)
  - The concrete take-off is a measure of the engineered quantity of concrete. Engineered quantity is a measure of concrete volume, rounded to the nearest cubic meter as defined by the formwork

dimensions on the foundation drawings. This take-off should be *neat* with no allowances for waste or overpour. Take-offs for quantity reporting are based on the engineered quantity only.

- Formwork (Square Meters)
    - The formwork quantity take-off is a measure of the formwork to concrete contact area as defined by the foundation drawings and is rounded up to the nearest square meter
    - Where the placement execution plan requires the use of bulkheads, the concrete contact surface area should be included in the takeoff.
    - Formwork quantity should be estimated consistently, regardless of the method of construction (i.e., neat line versus formed).
- Metal Decking (Square Meters)
    - The metal decking quantity take-off is a measure of the formwork to concrete contact area for elevated slabs/decks and is rounded-up to the nearest square meter.
- Rebar (Metric Tons)
    - Whenever possible, the rebar quantities are taken from the rebar fabricator's bill of material by foundation. A detailed rebar take-off is generally not required and can be estimated by the weight of rebar per cubic meter of reinforced concrete basis (if no vendor information is available).
    - **NOTE:** If rebar is estimated by weight per cubic meter of concrete when no vendor information is available, checks shall be made to verify that the rate used is consistent with the evolving design.
    - Rebar quantities are normally rounded to the nearest 100 kilograms.
    - Projects shall separately track rebar required for planned prefabrication modularization efforts.
- Embeds (Kilograms)
    - When required for quantity reporting, embedded metal and anchor bolts are quantified in kilograms. The quantities should be taken from the fabricator's bill of material.
    - Depending on the project, embeds may be reported as part of the formwork operation when the installation jobhours are charged to the formwork account. Reporting requirements should be verified with Project Controls.
- Concrete Paving and Slabs (Cubic Meters)
    - All work associated with concrete paving and sidewalks, including forms, rebar, wire mesh and expansion joints, are normally tracked under one account and reported as concrete cubic meters installed.
- Manholes, Catch-basins (Precast or partially precast, or built with block) (Each)
    - Site work drawings, underground pipe drawings, and electrical drawings are reviewed for manholes, catch basins, and lift stations, which may be entirely precast or assembled from precast sections or cast in place.
    - These are taken off and reported as a single item with one manhole equaling one each.
- Fireproofing (Cubic Meters)
    - Fireproofing quantities are taken off according to the needs of the project.
    - When the fireproofing material is troweled on over an expanded metal base, it is taken off in square meters or linear meters of steel to be fireproofed.
    - When the fireproofing consists of concrete encasement of steel by shotcrete or a combination of precasting and casting in place, the quantity is taken off in cubic meters.

7.3.2 Take-off Methods

- A single take-off should be made for each concrete drawing (and other discipline drawings that contain concrete items). This take-off should normally capture all quantity reporting requirements and field material requisitioning requirements in one effort. However, rebar and embed quantity information may be obtained from vendor data at a later time.
- As each drawing is reviewed, take-off dimensions, item count, calculations, and sketches should be recorded and saved for future reference. As take-offs are completed, the Site Supervision Engineer should enter quantities selected for quantity reporting by cost code into the quantity tracking system.

7.3.3 Reporting

- The Site Supervision Engineer typically verifies installed quantities by visual inspection. Installation credit may be reported as shown in Tables 1a through Table 1d.
- The quantity of concrete installed is normally documented on pour cards or batch tickets. The Site Supervision Engineer should collect the pour cards after the placement is made to determine the actual quantity of concrete placed.
- The actual quantity of concrete placed should be compared to the take-off quantity to determine the amount of overpour and waste that has occurred. This information is typically logged for all concrete placements on the project and the overall percentage overpour and waste is calculated and tracked.

Table 1a – Concrete Formwork Quantity Reporting Matrix

Milestone	Percent Complete
Install formwork	80%
Strip /Clean	20%

Table 1b − Rebar Quantity Reporting Matrix

Milestone	Onsite Fabrication Percent Complete	Off Site Fabrication Percent Complete
Offload rebar	5%	10%
Fabricate rebar	45%	N/A
Install and tie rebar	50%	90%

Table 1c − Embed Quantity Reporting Matrix

NOTE: As an option, embed reporting may be combined with formwork. When this occurs, embed installation should be included as part of formwork installation.

Milestone	Percent Complete
Offload, build templates and set embeds	80%
Concrete placement and remove templates	20%

Table 1d − Concrete Quantity Reporting Matrix

Milestone	Percent Complete
Concrete placement	90%
Patch concrete and final cleanup	8%
Field Engineering Inspection Complete and Acceptable	2%

7.4 Structural Steel

7.4.1 Take-off

- The take-off format for structural steel must follow the project code of accounts. The Quantity Reporting Plan should identify how items such as grating, handrail and toeplate, stair tread, etc., will be quantified.
- Structural steel is taken off as metric tons and is normally organized and compiled by cost code, drawing numbers, and structure.
- In some cases, further information (such as elevation and bay) is used in the take-off and reporting of major multilevel structures such as boiler buildings.
- The Site Supervision Engineer should maintain a complete set of fabricator erection drawings showing the fabricator's piece marks used for the take-off. The Contractor should track the delivery status and installed status of each piece of steel. One method of doing this is to mark-up the erection drawings using a color code.
- In some cases, take-off quantities can be electronically developed by the steel fabricator. When this occurs, the Site Supervision Engineer should make sure quantities are accurate and updated with any changes that occur. Quantities should be available before the steel is received on site. Vendor documents are often available that list the piece marks with weights for all fabricated steel by drawing number.

7.4.2 Reporting

- The Site Supervision Engineer normally verifies installed quantities by visual inspection of the completed work. Installation credit shall be reported as shown in Table 2.
- The Site Supervision Engineer should maintain a marked-up set of drawings showing installed quantities and a log of weekly installed quantities that have been reported.
- Grouting of associated base plates is normally included in the steel account and should be considered as part of the installation (welded or bolted) milestone.

Table 2 – Structural Steel Reporting Matrix

	Offload & Haul	Erected & Tacked	Welded or Bolted	Field engineering Inspection Complete and Acceptable
Platform, stairs, ladders	5%	45%	35%	15%
Grating, checker plate	5%	45%	35%	15%
Pipe stanchions	5%	65%	15%	15%
Steel structures	5%	50%	25%	20%
Handrail systems	5%	50%	35%	10%

7.5 Buildings

7.5.1 Take-off

- The take-off for buildings should be performed for each building for major work items such as brick/block, building structural steel, siding and roofing, doors and windows, plumbing, electrical, HVAC, and architectural finishes. Building foundations should be included with the concrete accounts.
- It is important to clearly identify the boundaries of take-off responsibility between buildings and other disciplines, especially piping and electrical. The normal limit for this boundary is 1.5 meters outside the building outline.

7.5.2 Reporting

- Building installed quantities are normally reported by each discipline as outlined in each section of this procedure.

7.6 Mechanical Equipment

7.6.1 Take-off

- The mechanical equipment take-off is developed by cost code from the design engineering equipment list. The Site Supervision Engineer is responsible for setting up the appropriate quantity reporting ledger.
- The Contractor should review the vendor drawings to identify loose commodities supplied with the mechanical equipment that must be field installed. Depending on the project code of accounts, the Contractor may need to perform separate take-offs of these quantities.
- In general, mechanical equipment may be reported as anywhere from 20 to 80 percent complete when set on foundations and 100 percent complete after final alignment and grouting.
- In developing the plan for reporting installed mechanical equipment quantities, the Contractor, Site Supervision Engineer and Project Controls shall review the equipment installation procedure and schedule to determine installation milestones that can be used to monitor the installation process. This weighting should take into consideration the job hours and percentage of the budget required to achieve the milestone. Based on these weighting factors, the installation is reported as a percent complete for the overall installation.
- When the weighting factors are developed, the installation of loose commodities and special work processes, such as alignment, must be taken into account as one of the basic milestones in completing the overall installation since this effort can represent a significant portion of the budgeted jobhours.

7.6.2 Reporting

- The Site Supervision Engineer normally verifies installed quantities by visual inspection of the completed work. The complete installation of mechanical equipment should include final alignment.
- Typical examples of Major Equipment Detailed Work Operations reporting percentages are shown in Table 3.

Table 3 – Major Equipment Detailed Work Operations

Note: For Major Equipment not listed in the table, Contractor to agree with Consultant on the equipment activities and percentage weightings.

Description	Percent Complete
TANKS (SHOP FABRICATION - CONTAINING NO INTERNALS)	
Unload and store	15%
Set in place	60%
Sealed or grouted	15%
Field Engineering Inspection Complete, Acceptable, Ready to Test	10%
TANKS (SHOP FABRICATION - CONTAINING INTERNALS)	
Unload and store	5%
Set in place	25%
Sealed or grouted	10%
Internal complete	50%
Field Engineering Inspection Complete, Acceptable, Ready to Test	10%

Description	Percent Complete
PUMPS & DRIVERS (PACKAGE UNITS)	
Set in place	5%
Secured and grouted	25%
Alignment check - include pipe stress	35%
Bump motors, final align and couple	15%
Load Run	5%
Field Engineering Inspection Complete, Acceptable and Ready to Test	15%
PUMPS & DRIVERS (SEPARATE UNITS)	
Set in place	5%
Secured and grouted	20%
Driver secured in place	15%
Alignment check - include pipe stress	40%
Bump motors, final align and couple	10%
Field Engineering Inspection Complete, Acceptable and Ready to Test	10%
BLOWERS & FANS	
Set in place	20%
Secured and grouted	25%
Alignment checked	35%
Motors bumped; final alignment complete and coupled	10%
Run-in complete and Field Engineering Inspection Complete and Acceptable	10%
PACKAGE COMPRESSORS (COMPLETE WITH DRIVER)	
Set in place	10%
Secured and grouted	25%
Alignment checked	35%
Lube oil flush completed	20%
Field Engineering Inspection Complete and Acceptable	10%
PACKAGE COMPRESSORS (WITH SEPARATE DRIVER)	
Set in place	5%
Secured and grouted	25%
Driver secured in place	5%
Alignment checked	35%
Lube oil flush complete	20%
Field Engineering Inspection Complete and Acceptable	10%
COMPRESSORS - KNOCKED DOWN	
Base set in place	5%
Base secured – ready for grout	5%
Cylinders and top head complete	15%
Final setting and grouting complete	10%
Driver in place	5%
Driver aligned, coupled, and secured	10%
Auxiliary equipment complete	20%
Flushing complete	20%
Field Engineering Inspection Complete and Acceptable	10%
AIR-COOLED HEAT EXCHANGERS	

Description	Percent Complete
Unload and store	10%
Erect vendor supplied support steel	10%
Set in place	30%
Install and align motors – perform E&I installations	40%
Test and maintain until turnover	10%
GAS HEATERS	
Unload and store	10%
Set in place	40%
Mechanical alignments – blowers	10%
Install mechanical and E&I accessories	30%
Test and maintain until turnover	10%

7.7 Piping

7.7.1 Computerized Take-off

- On projects with computerized take-off system capability, much of the labor associated with piping material take-offs can often be eliminated or reduced. However, even when automatic take-off downloads are available, the Site Supervision Engineer still retains the overall responsibility for verifying take-off accuracy and completeness. It should never be assumed that the quantity take-offs provided by vendors or design engineering is 100 percent accurate.

- When using computerized take-off system capability, the Site Supervision Engineer, in conjunction with Project Controls, should check the preloaded cost codes to ensure that they perfectly match those cost codes used by the project.

7.7.2 Manual Take-off

- Piping quantities are typically electronically generated by the 3D Model and. However, piping take-offs by the RFE may be required on all projects to some extent.

- Piping take-offs include all process piping, sewer and storm water piping, and service piping. Even though hangers/supports, valves, welds, bolt-ups, and fittings may be included in the lineal foot (lineal meter) unit rate for quantity tracking, these items should be taken off at the same time as the pipe to provide the necessary information for material requisitioning.

- Since piping take-off information is used for material requisitions, quantity tracking, manpower planning requirements, scheduling, planning warehouse and laydown areas, and reviewing invoices for payment, accuracy is essential. In addition to the take-off records themselves, the Site Supervision Engineer should maintain a marked up set of drawings reflecting the take-offs performed.

- Pipe length is taken from dimensional drawings, never from Piping and Instrumentation Diagrams (P&IDs). Changes in direction (fittings) are measured from intersection of straight centerlines.

- Footage/linear meters are measured through fittings, valves, and specialties but not equipment.

- Piping drawings and P&IDs should show all pipe line numbers. The Line Designation Table or Line List usually describes beginning and ending points for each line. P&IDs, the Line Designation Table, layout drawings, isometrics, and other project drawings are all required to make an accurate piping take-off.

- When the piping take-off is complete, the Line Designation Table, P&IDs, isometrics, and layout drawings should be compared to determine any lines not included in the take-off. The most common discrepancy is two-inch and smaller lines shown only on P&IDs with no line number assigned. These lines are typically routed at the site and the Design Engineering group should be notified to assign an appropriate line number.

- Shop fabricated pipe is a separate take-off. Depending on the project, some of the pipe will be shop fabricated and delivered in spools to the jobsite. Isometric and orthographic drawings should be clearly marked to identify field welds and pipe length to be spooled prior to vendor fabrication. This pipe is taken off by spool number. Each spool take-off should be labeled with a code corresponding to the drawing and spool number. Straight run pipe lengths that will not be vendor fabricated should be identified on the isometric drawings.

- Equipment drawings for package systems, skid mounted equipment, etc., should be reviewed to ensure that all materials, especially valves, are either vendor furnished or included in the field piping take-off. These items may be marked as supplied by others. Installation and reporting of piping supplied by an equipment vendor is normally included in the mechanical equipment accounts.

- Pipe materials for temporary construction quantities should not be included in the total installed quantities required for project quantity reporting.

- Pipe support/hanger and stanchion take-offs are required for installed quantity reporting and/or material requisitioning. Projects with uniquely designed supports are tracked in a separate account.

7.7.3 Reporting

- On projects with a computerized piping quantity tracking system in place, installed piping quantities are often reported by the craft foreman by turning in pipe installation cards/reports. Complete installation credit for a particular length of pipe cannot be given until all items included in the quantity status definition are complete. Similarly, complete installation credit for pipe routed through a valve cannot be reported unless the valve is correctly installed according to project drawings and specifications. This includes valve trim, bolting, gasket installation, and valve orientation.

- Tagged inline instruments and instrument air header reporting is the responsibility of the piping group.

- Supervision/craft to inspect all work prior to reporting as complete/ready for Site Supervision Engineer verification. No credit to be given for work that has open punchlist items tied to a specific milestone.

- The Site Supervision Engineer must determine how pre-fabricated pipe will be credited, especially if a portion is prefabricated and a portion is field fabricated. The RFE verifies that reported quantities are correct and that the piping is properly installed. Installation credit shall be given as shown in Tables 4a through 4c.

Table 4a – General Spooled Piping Quantity Reporting Milestones

Applies to projects where commodities such as supports, welds, and valves are tracked with the piping installation.

Milestone	Above Ground (Including Rack Piping)	Below Ground
Staged, sealed, and preserved as required (see Notes a and d)	5%	5%
Pipe erected, aligned, and tacked or set in place - one end; pipe protected from atmosphere as required	20%	25%
Pipe welded or bolted - one end (wrapped on u/g)	25%	60%
Pipe supports and valves complete	30%	N/A
Pre-test and Post-test punchlist items work complete (see 2nd bullet Note)	20%	10%

Note: Refer to Table 4c for additional pipe testing milestones.

Table 4b – General Field Fabricated Piping Quantity Reporting Milestones

Applies to projects where commodities such as supports, welds, and valves are tracked with the piping installation.

Milestone	Above Ground (Including Rack Piping)	Below Ground
Staged, sealed, and preserved as required (see Notes a and d)	5%	5%
Pipe field fabrication	20%	35%

Milestone	Above Ground (Including Rack Piping)	Below Ground
Pipe erected, aligned, and tacked or set in place - one end; pipe protected from atmosphere as required	20%	20%
Pipe welded or bolted – one end (wrapped on u/g)	25%	30%
Pipe supports and valves complete	20%	N/A
Pre-test and Post-test punchlist items work complete (see 2nd bullet Note)	10%	10%

Note: Refer to Table 4c for additional pipe testing milestones.

Table 4c – Pipe Testing Reporting Milestone

Milestone	Above Ground (Including Rack Piping)	Below Ground
Test preparation, testing, drying (as applicable), sealing, and applicable preservation (see Notes c and d)	65%	65%
Pipe restored (see Note f)	35%	35%

Notes:

- Staging includes either moving material from the Laydown Yard/Warehouse to the area of installation, or offloading delivered material at the point of installation.
- Milestone includes permanent plant pre-test and post-test punchlist items. Milestone does not include pipe test restoration work such as removal of temporary test materials such as test blinds and rebolting flanges after testing.
- Credit should not be claimed for this reporting milestone until any required drying, sealing, and preservation activities have been completed to minimize the lag. Drying, sealing, and preservation activities are to be implemented as required per Engineering, Contract, or Vendor documents.
- Preservation of spooled piping to be completed as required by Engineering and/or Vendor requirements.
- Installation rates normally exclude scaffolding and material handling – this shall be confirmed depending on the Code of Accounts set-up.
- Milestone to include work associated with incomplete pipe test restoration items identified during RFE post-test walkdown (i.e. removal of temporary test materials such as test blinds and rebolting flanges after testing). Milestone does not include permanent plant post-test punchlist items, refer to Tables 4a and 4b.

7.8 Electrical

7.8.1 Take-off

- Power and control conduit is taken off by drawing, size, and type. Individual conduit runs are listed by electrical device such as motor, panel, or control station.
- Lighting and instrument conduit is taken off by drawing, size, and type. Conduit runs are listed by geographical area, junction box, elevation, or equipment number. Conduits should be numbered to provide easier quantity tracking.
- When a computerized quantity tracking program is not available at the project site, or if the commodity is unscheduled, the Site Supervision Engineer should maintain a complete set of take-off drawings reflecting the take-off performed. Any allowances for omitted dimensions, such as elevation changes, should be indicated on the marked-up take-off drawings.
- Cable tray, tray hangers, and tray covers are taken off by drawing and size. The take-off should include fittings by type and size. The Site Supervision Engineer should maintain a set of marked up drawings reflecting the take-off. Wire and cable take-offs are based on the project circuit and raceway schedule.

The circuit schedule must be reviewed carefully to ensure that it includes all instrument wire circuits, special vendor wire requirements, communication systems, lighting circuits, and electric heat tracing circuits. The take-off boundaries between building accounts and electrical accounts must be clearly defined so that all building circuits are taken off.

- Nonscheduled wire and cable (typically lighting circuits and instrument wiring from junction boxes to field mounted devices) are taken off or estimated by wire and cable type by lighting or instrument location drawings.

- The wire and cable take-off quantity is the "pulled" linear meters including tails. The normal tail length is 1.5 meters per end on 5 kV and larger cable and 3 meters per end on all other wire and cable. For scheduled wire and cable, the “Engineered” cable length is to be used as the take-off quantity. This Engineered length is effectively the “pulled” linear meters including tails, calculated by summing the length of the raceway in which the cable is routed, and adding on a default tail end length to each cable end. The raceway lengths used to calculate the cable “Engineered” length (e.g. the take-off length) is either the “Engineered” (estimated) raceway length or the actual installed raceway length, depending on the status of the raceway installation.

- Terminations are normally taken off at the same time as the wire and cable. The termination take-off equals the number of conductors in the cable times two, less spares. The termination take-off should also include the ground wire as a conductor. Lighting system terminations are not normally included in the take-off.

- Power and control equipment such as pushbutton stations, junction boxes, distribution panels, and receptacles are normally taken off by drawing and grouped by device type. As with other take-off activities, a set of marked up drawings should be maintained documenting the take-off performed.

- Lighting equipment including light fixtures, lighting contactors and switches, lighting panels, lighting transformers, and receptacles on lighting circuits is normally taken off by drawing and grouped by device type.

- Grounding is taken off by drawing, conductor, size, and type. The grounding drawings are marked up as take-offs are done and maintained in the Site Supervision Engineer s file. Ground rods are taken off in “eaches” and included in the take-off. If they are not shown on the drawings, include allowances for pigtails to motors and electrical equipment. All raceway (Tray and Conduit) and misc. equipment grounds are included in the quantity reporting for each of those specific commodity installations and unit rates, therefore they are not required to be tracked and reported separately.

- ISO-Phase quantities are taken off using the issued IFC drawing, (Vendor) by number of bus sections individually for Main Bus and Auxiliary Bus. Main Bus is identified as the sections between the Transformer to Generator Breaker to Exciter and Generator. Auxiliary Bus is identified as the section drops from the Main Bus to the individual components or equipment. ISO-Phase is considered Electrical Equipment and shall be credited as installation progresses and reported by bus type (Main and Auxiliary) to the Project Field Controls department as defined in Table 5. As with other take-off activities, a set of marked up drawings should be maintained documenting the take-off preformed and highlighted as components are completed to track installation status.

7.8.2 Reporting

- The electrical craft foreman normally reports installed quantities by completing and submitting an installation card documenting the work performed. The credit linear meters of wire and cable installed, terminations completed, or devices set. Installation of raceway is not complete unless all trays are secured and all supports, caps, and plugs are in place.

    - Engineered Length – a length calculated based upon the length of the raceway the cable is routed within

    - Actual Length – the final installed length (e.g. trimmed length) as reported by feedback on the cable installation card by Construction

    - Cut Length – tracked against the cable reel quantity, the actual length cut from the associated cable reel as reported by feedback on the cable installation card by Construction

- The Site Supervision Engineer should verify that reported quantities are correct and that cable, terminations, and equipment are properly installed. Credit shall be given for electrical equipment installation as shown in Table 5.

- All electrical/instrument bulk quantities are reported on an as-installed basis. Milestones for quantity reporting are to be established on a project-specific basis. Quantity credit for installed cables shall only be taken up to the length of cable that will not have to be re-pulled. That is, no credit shall be taken for that portion of cable that is coiled for future pull through downstream raceway. Final credit for the entire cable length shall not be taken until the circuit is in place and ready to be terminated.

- Field Engineering should maintain a set of marked up drawings showing the take-offs performed and quantities installed to-date. Field Engineering is responsible for the verification of all reporting quantities. In the case of scheduled cable, field verification of the installed cable quantities is not required, since the engineered lengths will document quantity of cable installed. However, these engineered cable lengths are based upon the raceway lengths, therefore it is very important that raceway lengths are accurate. Discrepancies between the engineered and actual lengths of cables shall be resolved between the Construction Contractor and Site Supervision Engineer. Field Engineering shall verify 100 percent of reported cable tray and underground conduit quantities, PRIOR to including those quantities in the weekly quantity report to Project Controls. Similarly, Field Engineering shall verify at least 10 percent of all reported above ground conduit quantities, PRIOR to providing any above ground conduit quantities to Project Controls.

- If there are discrepancies in any raceway quantities, these shall be resolved with the Field Superintendent. For aboveground conduit quantities, if there are more than 10 discrepancies in any week, then the inspection sample shall be increased to 100 percent verification for that week's quantities. If the sample is required to be extended on more than three occasions, 100 percent verification of raceway quantities shall be required for the remainder of the project.

- Reported quantities should be measured against take-off quantities only. Quantities installed in excess of the take-off could indicate a project scope increase and should be reported to Project Field Controls prior to being reported.

Table 5 – Electrical Equipment Quantity Reporting Matrix

Milestone	Transformers	General Equipment	Medium Voltage Equipment	Low Voltage Equipment	DC Equipment	ISO-Phase Main & Auxiliary per bus section
Receive and handle	10%	10%	10%	10%	10%	5%
Set in place, secure	20%	20%	20%	20%		50%
Weld out complete						20%
Set racks in place					20%	
Hookup internals		50%	50%			15%
Dress out complete	50%					
Complete installation				50%	50%	
Checkout/Field Engineering Inspection complete, Acceptable and Ready to Test	10%	10%	10%	10%	10%	5%
Testing complete	10%	10%	10%	10%	10%	5%

7.9 Instrumentation

7.9.1 Take-off

- Field-mounted instrument take-off is a count of instruments that are shipped loose and must be individually mounted. As a general rule, the take-off should not include tagged instruments such as control valves (Check Valve (CV), Flow Valve (FV), Level Valve (LV), or Pressure Valve (PV)) orifice plates ((RFE) or

Preliminary Engineering (PE)), pressure relief valves, and rupture discs ((Pressure Safety Valve (PSV), Pressure Safety Element (PSE)). These are normally shown on piping isometrics and are installed with the piping. The take-off should not include panel-mounted instruments that are installed by the panel fabricator.

- Field mounted instrument take-off is normally generated from the project instrument index and P&IDs.
- Tubing requirements are taken off by tubing size, service, and drawing(s). The take-off is based on the instrument location drawings and instrument detail sheets for all instrument air users. Instrument air users would normally consist of air-operated valves and pneumatic instruments. The instrument air sub-header plan (field routed) should be sketched on the instrument location drawing prior to the tubing take-off. Instrumentation sub-header piping should be reported as part of the piping account.
- Bench calibration take-off is a count of all tagged instruments and includes control valves that require bench calibration. For projects using manual quantity tracking, the take-off should be recorded. The date shall be recorded when the item is calibrated.
- Loop checks are preferably taken off from loop diagrams and vendor panel drawings. However, a thorough review of P&IDs and the Instrument Index should also be made so that pneumatic loops and other loops not shown elsewhere will get counted. The electronic loops are taken off from loop diagrams. Additional loops will be identified for pneumatic instruments that must be taken off from P&IDs. The loop check take-off should be recorded by loop number.

7.9.2 Reporting

- The Site Supervision Engineer should verify the quantities installed and that the instruments and instrument tubing is properly installed.
- Installed quantity credit for mounting instruments is shown in Table 6. All other items are tracked on an “as installed” quantity basis, including tubing.
- The Site Supervision Engineer should maintain a set of marked up drawings showing the take-offs performed and installed quantities.

Table 6 – Instrument Mounting Quantity Reporting Matrix

Milestone	Field Mounted Instruments	Local Racks	Panels/Integrated Controls	Packaged Instrument Systems
Unload and store	10%	10%	10%	10%
Calibration (see Note below)	15%			
Complete installation	50%	10%	75%	60%
Connections complete	15%			25%
Checkout/Field Engineering Inspection complete, Acceptable and Ready to Test	10%	80%	15%	5%

Note: In cases where instruments do not require calibration, the credit will be claimed once installation is complete.

7.10 Insulation

7.10.1 Take-off

- Insulation is taken off for piping, instruments, and mechanical equipment and is required for evaluating bids and monitoring contractor progress.
- Piping insulation take-off uses the same take-off measurements as the piping requiring insulation. The take-offs should be sorted by piping system, line number, piping diameter, insulation type and thickness. Changes in direction at pipe fittings are measured from the intersection of straight centerlines, not curved centerlines. The take-off footage of insulation is measured through fittings, valves, and specialties, but not through equipment. An allowance is normally made for an effective footage of insulation for fittings, valves, and other in line devices. The Site Supervision Engineer should consult with Field Supervision or Field

Contracts to determine the appropriate allowance. When a line number is partially insulated for personnel protection, the take-off for insulated footage is determined by the Site Supervision Engineer based on the pipe routing and the insulation criteria.

- Spooled pipe insulation quantity take-offs must be verified by the Site Supervision Engineer.
- Instrument insulation take-offs should be done by system, instrument number, insulation type, and thickness. As with piping insulation, the take-off length is measured through tubing connections, instrument valves, and specialty items.
- Mechanical equipment insulation is taken off by equipment tag number, insulation type, and insulation thickness. The value of the contract pay item for equipment insulation by tag number is normally used as the basis for reporting percent complete.

7.10.2 Reporting

- Piping, instrumentation, and mechanical equipment insulation quantities are normally reported by the contractor. The Site Supervision Engineer should monitor the contractor's work to ensure that the reported installation quantities are accurate and that the work is satisfactory. The Site Supervision Engineer should also maintain a set of marked up isometric piping drawings reflecting the piping insulation installed. Credit for installed quantities is normally reported as shown in Table 7.
- Most mechanical equipment insulation work activities involve the use of scaffolding, therefore installation and removal of scaffolds are a key factor in monitoring the progress of the insulation work. Weight factors for scaffolding erection are normally based on the contractor's jobhour estimate or bid. Jobhours for scaffolding erection and removal should be requested from the contractor along with the bid price.
- Credit should not be given for scaffold installation and removal for piping and mechanical equipment.
- Mechanical equipment insulation, installation credit is shown in Table 8.

Table 7 – Piping Insulation Quantity Reporting Matrix

Milestone	AS, ET, H, HF, PP (Note 2)	C, CF (Note 2)	AC (Note 2)	CAC (Note 2)	AAC, ETAC, PAC (Note 2)
Install insulation	55%	75%	75%	80%	70%
Install jacketing	30%	10%	10%	5%	15%
Insulate valves & flanges (see note 1)	10%	10%	10%	10%	10%
Final Inspection	5%	5%	5%	5%	5%

Notes:

1. In cases were spools have no valves or flanges the credit will be claimed upon completion of the insulation and jacketing
2. Where:

AS – Anti Sweat Insulation
ET – Insulation over Electric Tracing
H – Hot Insulation
HF – Hot Fireproofed Insulation
PP – Personal Protection
C – Cold Insulation
CF – Cold Fireproof Insulation
AC – Acoustic Insulation
CAC – Cold Acoustic Insulation
AAC – Anti Sweat Acoustic Insulation
ETAC – Acoustic Insulation Over Electric Tracing
PAC – Personal Prot. With Acoustical Insulation

Table 8 – Mechanical Equipment Insulation Quantity Reporting Matrix

Milestone	Hot Equipment	Cold Equipment
Install insulation	50%	50%
Install jacketing	45%	45%

Final Inspection	5%	5%

8.0 ATTACHMENTS

1. Quantity Tracking Associated Data
2. Quantity Tracking System Development Flow Chart
3. Quantity Tracking Standard Identifiers
4. Key Quantities
5. Quantity Tracking Work Process Diagram during Construction
6. Sample Quantity Curves
7. Quantity Reporting Responsibility Matrix
8. Elements of Quantity Reporting Take-Off
9. EPM-KPC-TP-000026 - Quantity Tracker Summary and Details Template
10. EPM-KPC-TP-000027 - Procurement Schedule for Critical Materials and Equipment Template

Attachment 1 - Quantity Tracking Associated Data

The following associated data is typical for all commodities:

- Identity
- Unit
- Facility
- Engineering System
- Commodity Identifier
- Area Drawing/P&ID
- Material Specification/Purchase Order
- Account Code
- Schedule Code
- Location Code
- Quantity Status/Quantity

Additional associated data is typical for individual commodities:

- Concrete
  - Concrete Class
  - Vendor Drawing

- Equipment
  - Location Drawing
  - Description
  - Weight
  - Shop Order Number
  - Storage Requirements
  - Cleanliness Requirements
  - Storage Location
  - Installation Plan Reference

- Electrical
  - Cable Source Diagram
  - Repull Indicator
  - From/To Locations
  - From/To Connection Diagram Number
  - Scheme Number
  - Reel Serial Number
  - Function/Service Level
  - Layout Drawing Number
  - Cable Code
  - Raceway Code
  - Vendor
  - Material Type
  - Storage Location
  - Schedules/Non-Scheduled

- Piping
  - Pipe Size, Class, Schedule
  - Insulation Class/Thickness
  - Fabricator Code and Drawing
  - Storage Location
  - Storage Requirements

Attachment 1 - Continued

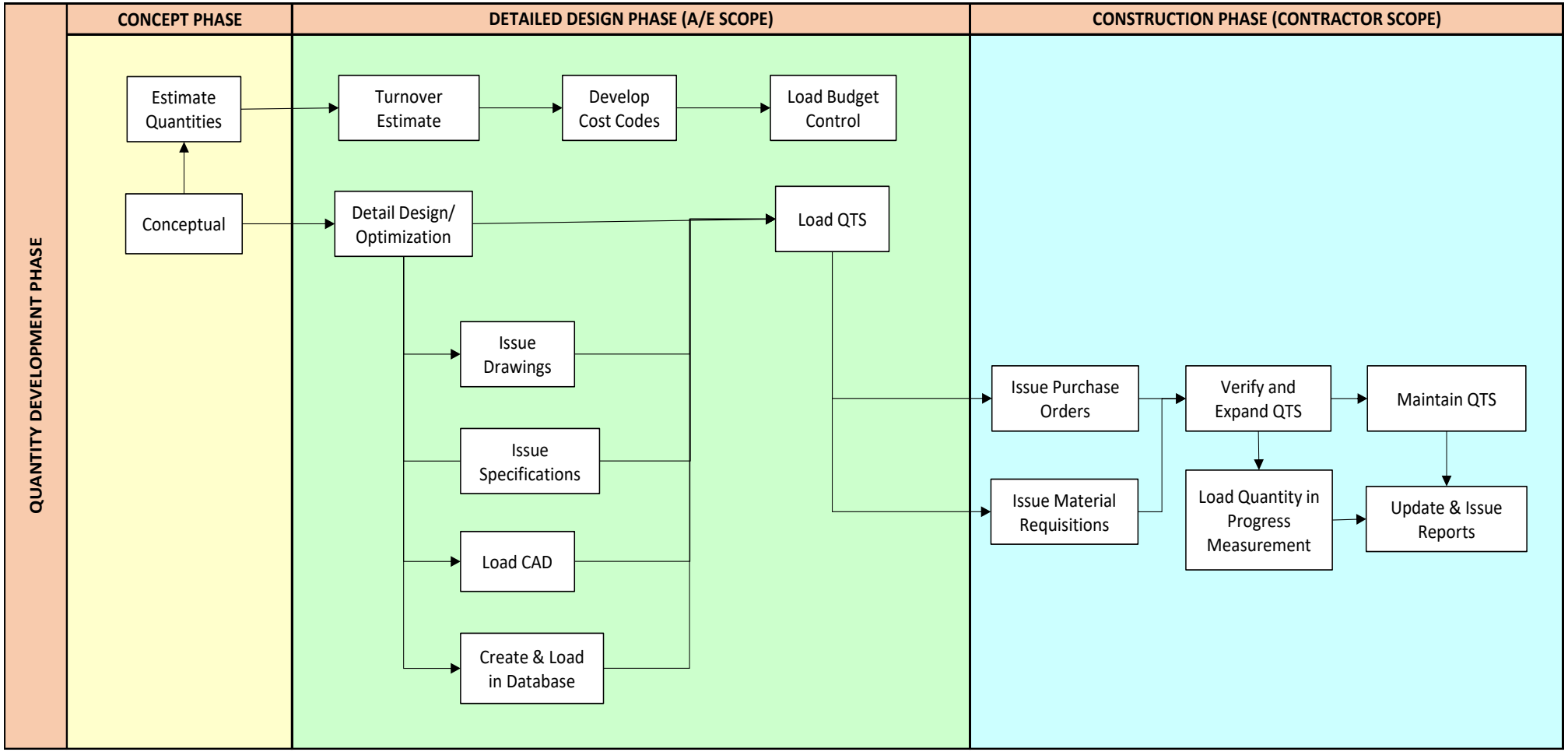
  - Cleanliness Requirements

  - Isometric Number
  - From/To Location

- Valves
  - Pipe Line Class
  - Pipe Line Service
  - Valve Size, Class, and Type
  - Valve Accessory Type/Number
  - Client Reference Number
  - Serial Number
  - Vendor Supplier Indicator
  - Valve Mark Number

- Instrumentation
  - Isometric
  - Rack Number
  - Tube Size, Length, Material
  - Pipe Size, Class, Length
  - Associated Cable and Connections
  - Vendor Drawing
  - Scheme Number

Attachment 2 - Quantity Tracking System Development Flow Chart



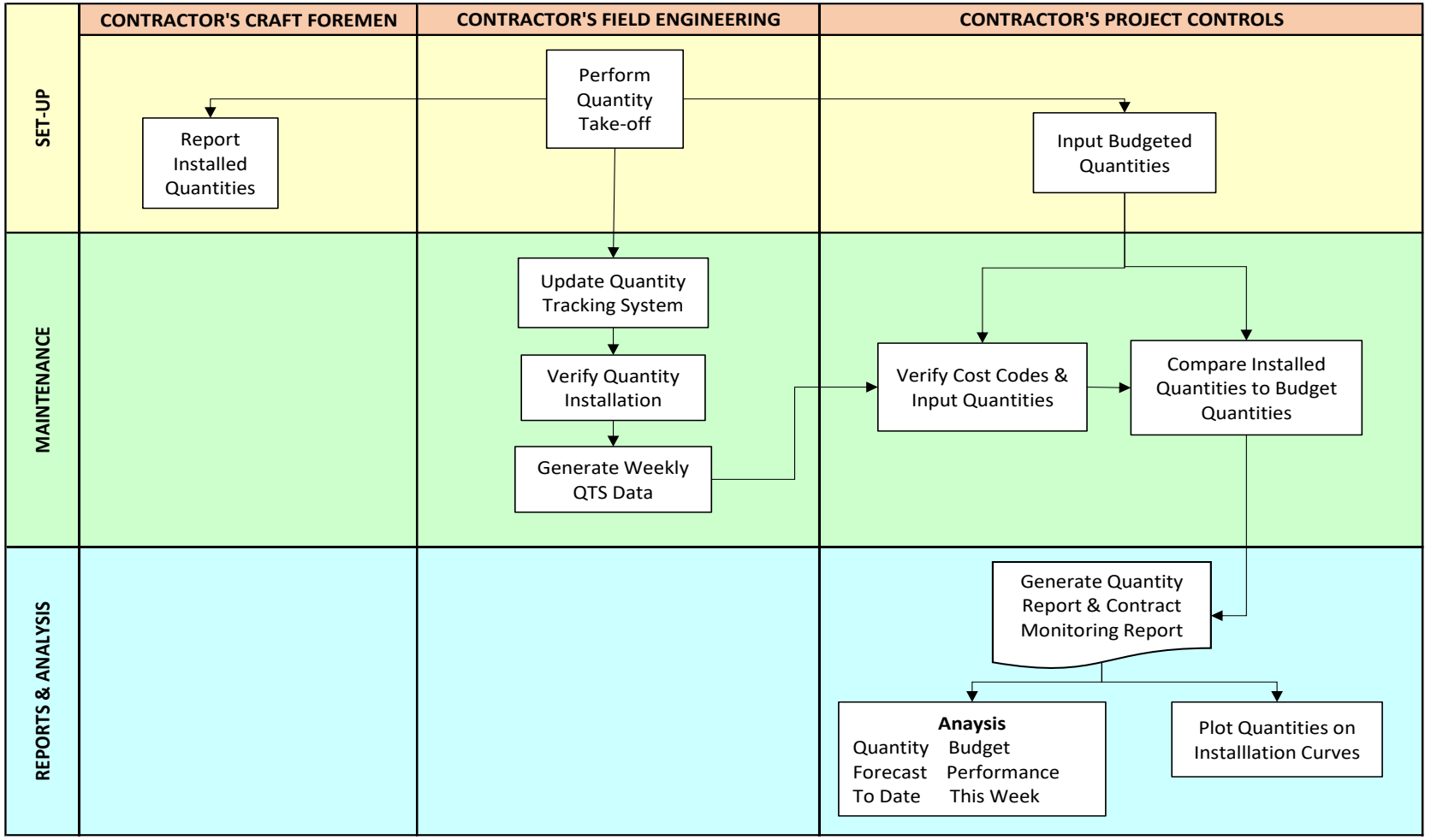
Attachment 3 - Quantity Tracking Standard Identifiers

Quantity	Commodities	Identification	Unit
Concrete	Concrete	Drawings / Pour No.	cm/ m^3
	Formwork	Drawings / Pour No.	sm/ m^2
	Rebar	Drawings / Pour No.	mt
	Embeds	Drawings / Pour No.	kg
Steel	Structural	Drawing No.	mt
	Miscellaneous	Drawing No.	mt
Equipment	Mechanical	Equipment No.	ea
	Electrical	Equipment No.	ea
Electrical	Wire & Cable	Cable No.	lm
	Terminations	Wire No.	ea
	Tray	Raceway No.	lm
	Conduit	Raceway No.	lm
Piping	Pipe	Spool/ Iso No.	lm
	Welds	Weld No.	ea / lm
	Hangers	Hanger No.	ea
Valves	Valves	Valve No.	ea
Instruments	Instruments	Instrument No.	ea

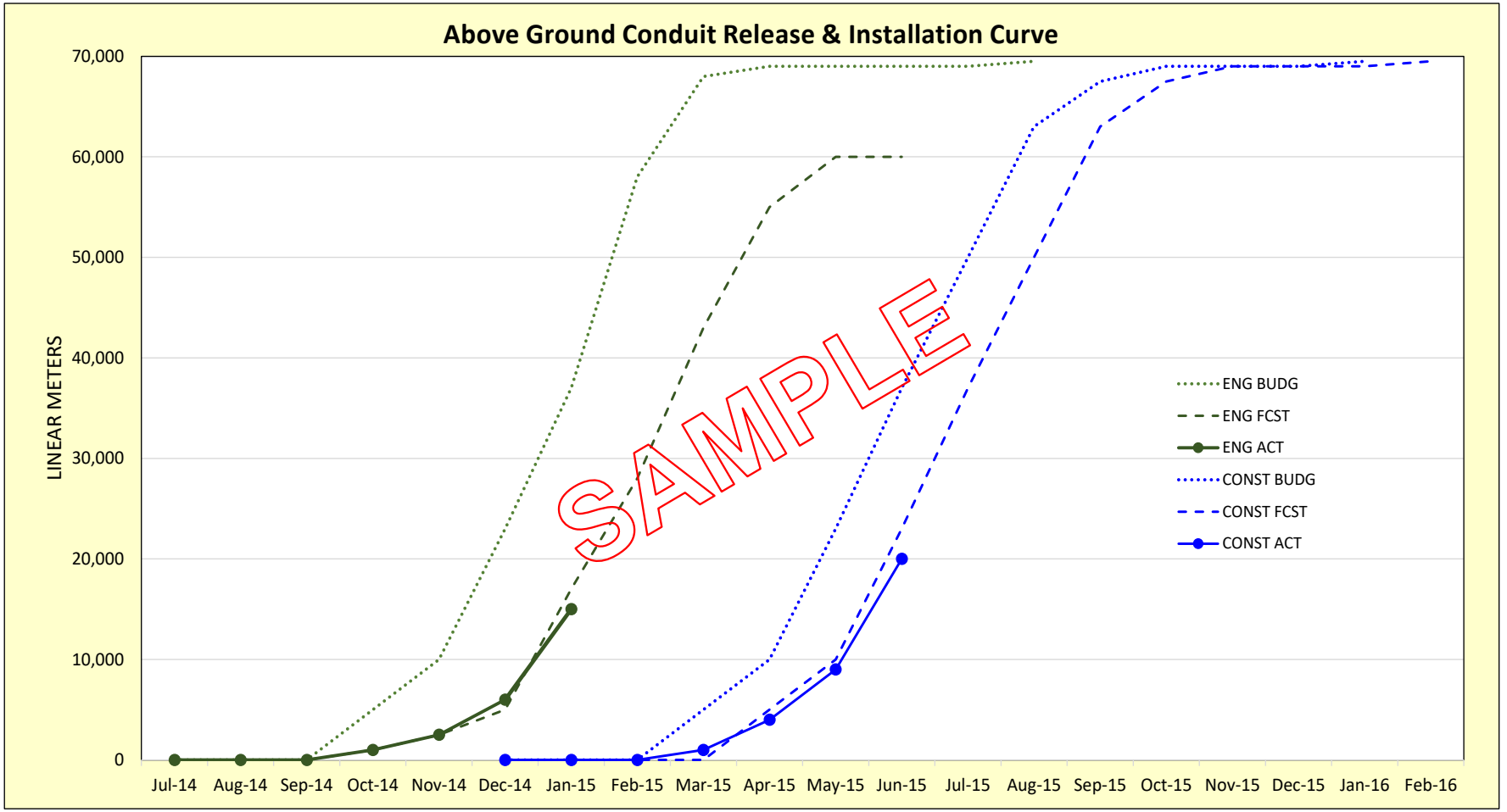
Attachment 4 - Key Quantities

Cost Code	Key Flag	Description	UOM	Quantity	Comments
		On-Site Spooled Pipe Shop Fabrication			
A21.160	✓	2.50" - 4.00" Carbon Steel Pipe	LM	1,000	
A21.161	✓	2.50" - 4.00" Stainless Steel Pipe	LM	500	
A21.16	✓	S/T < 2.50" Pipe	LM	1,500	Key quantities is true so subtotal is carried forward to next level
A21.1		S/T On-Site Spooled Pipe Shop Fabrication	LM	1,500	Key quantities is not true so subtotal is not carried forward
		Field Run Pipe In-Place Fab and Installation			
A21.270	✓	Carbon Steel	LM	10,000	
A21.271	✓	Stainless Steel	LM	2,000	
A21.27	✓	S/T Field Run Small Pipe < 2.50" Rack/Bridge	LM	12,000	
A21.280	✓	Carbon Steel	LM	9,000	
A21.281	✓	Stainless Steel	LM	4,000	
A21.28	✓	S/T Field Run Small Pipe < 2.50" Spooled	LM	13,000	
A21.2	✓	S/T Field Run Pipe In-Place Fab and Installation	LM	25,000	
		Piping Specialty Items			
A21.310	✓	Wye, S/U & Basket Strainers	EA	2	
A21.311		Fire Protection Sprinkler Pipe	M3	4,000	Quantity ignored as not flagged and not same UOM as next level
A21.31		S/T Piping Specialty Items	EA	2	
		Miscellaneous Piping Operations			
A21.320	✓	Steam Tracing Tubing (Copper Bare)	LM	1,000	
A21.321		S/T Heat Tracing	LM	1,000	Key quantity is not true so subtotal is not carried forward
A21.32		S/T Miscellaneous Piping Operations	LT	0	
A21	✓	**Total Piping**	LM	**25,000**	
Note : If a "key flag" is not checked, the amount will not appear in the sub-total/total line					

Attachment 5 - Quantity Tracking Work Process Diagram during Construction



Attachment 6 - Sample Quantity Curves



Attachment 7 - Quantity Reporting Responsibility Matrix

The Quantity Reporting Matrix identifies the rules of credit that are to be reported based on activities and material conditions for items being tracked.

Responsibility	Site Management	Field Engineering	Field Supervision	Field Project Controls	Design Engineering
Develop quantity reporting plan	**S**	**R**	**S**	**S**	
Identify quantity, scope, and prepare takeoffs		**S**			**R**
Identify quantity changes resulting from drawing revisions and field changes		**R**			
Report installed quantities		**R**	**S**		
Update and issue project quantity and unit rate report		**S**	**S**	**R**	
Perform periodic audits to assure reporting accuracy		**S**	**S**	**R**	
Assure system effectiveness, reasonableness, and accuracy		**R**		**S**	
Assure systems adherence	**R**			**S**	
Maintain system		**R**		**S**	

R = PRIMARY RESPONSIBILITY S = SUPPORT ROLE

Attachment 8 - Elements of Quantity Reporting Take-Off

Legend:

E = Design Engineering
F = Field
V = Vendor

UNITS OF QTY	ITEM	TAKEOFF BY
	CIVIL/STRUCTURAL	
HA	Clearing and grubbing (site development)	F/E
M²	Fine grading	F/E
M³	Stripping and rough grading	F/E
M²	Erosion control	F
M³	Excavation	F/E
M³	Backfill	F/E
M³	Dewatering	F
M²	Landscaping, Fencing and Roads	F
LM	Fencing	F
M²	Formwork	F
M²	Decking	E
MT	Rebar	V/E
KG	Embeds	V/E
M³	Concrete	E
M³	Misc. Concrete Items (Mud Mats, Ductbanks)	F
M²	Concrete Specialties (Fiber Board, Waterproofing)	F
M³	Precast Concrete	E
EA	Catch basins	E
EA	Precast sumps	E
EA	Manholes: electrical	E
MT	Steel Framing and Equipment Supports	V/E
MT	Steel structures	V/E
MT	Pipe racks	V/E
MT	Platform and Miscellaneous Steel	V/E
EA	Thermal and Moisture Protection	V/E
LT	Fire Protection	E
	PIPING	
LM	Field fabricated pipe (small bore)	F
LM	Small pipe	E
LM	Underground piping	E
LM	Underground piping	E
LM	Field fabricated pipe (large bore)	F
LM	Spooled pipe (large bore)	E
EA	Large Bore Supports	E
LM	Pipe testing	F
EA	Pipe materials (silencers)	E

Attachment 8 - Continued

UNITS OF QTY	ITEM	TAKEOFF BY
	ELECTRICAL	
LM	Cable Tray, Channels, and Fitting	E
LM	Scheduled Conduit and Supports	E
LM	Unscheduled Conduit, Hangers, Boxes	F
LM	Scheduled Wire and Cable	E
EA	Scheduled Connections and Splices	E
EA	Connections 5kv, 600v	E
EA	Connections - control	F
LM	Unscheduled Wire, Cable, and Connections	E/F
LM	Electric heat tracing	E
LM	Grounding	F
EA	Local Racks, Enclosures, and Shelters	E
EA	Field and Panel Mounted Instruments	E
LM	Tubing Raceway and Supports	F
EA	Panels	E
LT	Integrated Control	E
EA	Transformers	E
LM	Bus Duct and Supports	E
EA	Medium Voltage Power Distribution Equipment	E
EA	LV Power Distribution Equipment	E
EA	DC Emergency Equipment	E
EA	Misc. Protection and Control Equipment	E
EA	Lighting Systems	E
LM	Heat Tracing	E
EA	Transformers and distribution panels	E
LM	Tracing cable	F
EA	Electrical Equipment General Services	E
EA	Cathodic protection	E
LT	Communication system – PABX	E
EA	Low Voltage Switchyard Equipment	E
	INSTRUMENTATION	
EA	Other Packaged Instrumentation Systems	E
	COATINGS	
M²	Painting and Coatings	E

Attachment 8 - Continued

UNITS OF QTY	ITEM	TAKEOFF BY
	MECHANICAL	
M²	Equipment Insulation	V/E
EA	Centrifugal Pumps W/Driver	E
EA	Compressors, Blowers, Fans, and Drivers	E
EA	Feedwater Heaters	E
EA	Air Cooled Exchangers	E
EA	Condensers (ACC)	E
MT	Structural steel	V/E
LM	Welding	F
EA	Plate and Frame Exchangers, Plate Coils	E
EA	Tanks & Spheroids – Shop Fab.	E
EA	Tanks & Spheroids – Field Fab	E
EA	Other Material Handling Equipment (Hoists)	E
EA	Potable Water Treatment	E
EA	Raw Water Treatment	E
EA	Condensate Demineralizers Makeup	E
EA	Waste Water Treatment Equipment	E
EA	Chemical Feed Equipment	E
EA	Packaged Units And Modules	E
EA	Physical Processing Eqpt. Filters	E
MT	HVAC Equipment and Ductwork	E
EA	Unit Heaters and Fans	E
EA	Stacks, Flares, and Chimneys	E
PCT	Combustion Turbine – Generators	E
PCT	Gas Turbine Generator	E
PCT	Install Ductwork	V/E
PCT	CT Skid Mounted Equipment Modules	V/E
PCT	CT Misc. Work Operations	F
PCT	Steam Turbine Heavy Haul	F
PCT	Steam Turbine Generator	E
EA	Misc. Work Operations	F
PCT	HRSG	V/E
EA	Erect Steam Drums	V/E
MT	HRSG Non-Pressure Parts (Platforms and Stairs)	V/E
MT	HRSG Flues and Ducts	V/E

Attachment 8 - Continued

UNITS OF QTY	ITEM	TAKEOFF BY
LM	HRSG Piping And Instrumentation	V/E
EA	HRSG Main Hydro	F
EA	Plate and Frame Exchangers, Plate Coils	E
EA	Tanks & Spheroids – Shop Fab.	E
EA	Tanks & Spheroids – Field Fab	E
EA	Other Material Handling Equipment (Hoists)	E
EA	Potable Water Treatment	E
EA	Raw Water Treatment	E
EA	Condensate Demineralizers Makeup	E
EA	Waste Water Treatment Equipment	E
EA	Chemical Feed Equipment	E
EA	Packaged Units And Modules	E
EA	Physical Processing Eqpt. Filters	E
MT	HVAC Equipment and Ductwork	E
EA	Unit Heaters and Fans	E
EA	Stacks, Flares, and Chimneys	E
PCT	Combustion Turbine – Generators	E
PCT	Gas Turbine Generator	E
PCT	Install Ductwork	V/E
PCT	CT Skid Mounted Equipment Modules	V/E
PCT	CT Misc. Work Operations	F
PCT	Steam Turbine Heavy Haul	F
PCT	Steam Turbine Generator	E
EA	Misc. Work Operations	F
PCT	HRSG	V/E
EA	Erect Steam Drums	V/E
MT	HRSG Non-Pressure Parts (Platforms and Stairs)	V/E
MT	HRSG Flues and Ducts	V/E
LM	HRSG Piping And Instrumentation	V/E
EA	HRSG Main Hydro	F

Attachment 9 - EPM-KPC-TP-000026 - Quantity Tracker Summary and Details Template

QUANTITY TRACKER SUMMARY

Project No. : _____
Project Descripton : _____
Project Location : _____
Entity : _____
Contractor : _____

Report Date : _____
Week Ending : _____

			JOBHOURS										PERFORMANCE									
			QUANTITIES						SPENT		EARNED		SCHEDULE		SPI		JHP		PERCENT COMPLETE			UNIT RATE (hrs/unit)			
Cost Account	Description	UOM	Current Forecast	Current Budget	To Date	This Period	Current Forecast	Current Budget	To Date	This Period	To Date	This Period	To Date	This Period	To Date	This Period	To Date	This Period	Schedule (C.B.)	Actual (C.B.)	Actual (C.F.)	Current Forecast	Current Budget	To Date	This Period
			A	B	C	D	E	F	G	H	I=C/B*F	J=D/B*F	K	L	M=I/K	N=J/L	O=I/G	P=J/H	Q=K/F	R=I/F	S=I/E	T=E/A	U=F/B	V=G/C	W=H/D
100	Sitework	M2	113,272	106,253	97,966	380	241,308	230,789	202,150	905	212,789	825	212,257	878	1.00	0.94	1.05	0.91	91.97%	92.20%	88.18%	2.13	2.17	2.06	2.38
110	Concrete	M3	43,540	40,040	39,852	80	850,106	700,157	710,807	1,150	696,878	1,199	690,875	1,185	1.01	1.18	0.98	1.22	98.67%	99.53%	81.97%	19.52	17.49	17.84	14.38
120	Steel	MT	6,062	6,384	6,060	25	252,387	260,185	259,329	985	246,989	1,019	254,143	1,015	0.97	1.00	0.95	1.03	97.68%	94.92%	97.86%	41.63	40.76	42.79	39.40
130	Architectural	M2	58,919	57,738	54,804	100	240,970	209,013	190,456	500	198,392	362	199,979	515	0.99	0.70	1.04	0.72	95.68%	94.92%	82.33%	4.09	3.62	3.48	5.00
140	Piping	LM	79,990	86,351	79,932	205	815,300	868,456	747,625	1,856	803,898	2,062	755,102	1,912	1.06	1.08	1.08	1.11	86.95%	92.57%	98.60%	10.19	10.06	9.35	9.05
150	Electrical	LM	303,440	295,668	245,096	3,000	318,612	325,235	291,174	3,350	269,606	3,300	276,615	3,451	0.97	0.96	0.93	0.99	85.05%	82.90%	84.62%	1.05	1.10	1.19	1.12
160	Instrumentation	EA	1,605	1,605	1,468	58	109,308	115,012	105,195	2,865	105,195	4,156	94,675	2,951	1.11	1.41	1.00	1.45	82.32%	91.46%	96.24%	68.10	71.66	71.66	49.40
170	Pumps & Drivers	EA	27	25	18	1	5,552	5,230	4,142	230	3,766	209	4,349	237	0.87	0.88	0.91	0.91	83.16%	72.00%	67.82%	205.63	209.20	230.12	230.00
	TOTAL						2,833,543	2,714,077	2,510,878	11,841	2,537,495	13,332	2,487,995	12,142	1.02	1.10	1.01	1.13	91.67%	93.49%	89.55%				

NOTES: UOM = Unit of Measurement

Current Budget = Original Budget + Scope Change

Current Forecast = Original Budget + Scope Change + Trends

SPI = Schedule Perfrmance Index (Good performance => 1.0 Bad performance < 1.0)

JHP = Job Hour Performance (others refer as Performance Factor) (Good performance => 1.0 Bad performance < 1.0)

Attachment 9 - continued

QUANTITY TRACKER DETAILS

Project No. : _____
Project Descripton : _____
Project Location : _____
Entity : _____
Contractor : _____

Report Date : _____
Week Ending : _____

			JOBHOURS																			
			QUANTITIES						SPENT		EARNED		SCHEDULE		PERFORMANCE SPI		PERFORMANCE JHP		PERCENT COMPLETE			UNIT RATE (hrs/unit)			
Cost Account	Description	UOM	Current Forecast	Current Budget	To Date	This Period	Current Forecast	Current Budget	To Date	This Period	To Date	This Period	To Date	This Period	To Date	This Period	To Date	This Period	Schedule (C.B.)	Actual (C.B.)	Actual (C.F.)	Current Forecast	Current Budget	To Date	This Period
			A	B	C	D	E	F	G	H	I=C/B*F	J=D/B*F	K	L	M=I/K	N=J/L	O=I/G	P=J/H	Q=K/F	R=I/F	S=I/E	T=E/A	U=F/B	V=G/C	W=H/D
100.100.100	Structural Excavation - Machine & Hand	M3##	4,461	6,459	4,461	134	2,964	3,520	4,692	86	2,431	73	2,505	74	0.97	0.98	0.52	0.85	71.16%	69.06%	82.02%	0.66	0.54	1.05	0.64
100.100.200	Backfill, Machine & Some Hand	M3##	10,177	4,713	4,200	126	25,666	16,082	16,564	350	14,332	430	15,640	326	0.92	1.32	0.87	1.23	97.25%	89.12%	55.84%	2.52	3.41	3.94	2.78
100.100.100	Trench'g Excav & Bkf'l, Excavation	M3##	3,411	3,820	3,450	104	7,260	7,397	16,211	171	6,681	202	7,370	225	0.91	0.89	0.41	1.17	99.63%	90.31%	92.02%	2.13	1.94	4.70	1.65
100.100.100	Trench'g Excav & Bkf'l, Backfill	M3##	3,646	4,394	3,646	109	7,660	8,395	7,215	201	6,905	209	7,171	232	0.97	0.90	0.97	1.04	85.41%	82.96%	90.93%	2.10	1.91	1.98	1.84
100.100.300	Bored Piles - Spoil Removal	M3	678	676	670	20	789	787	1,779	35	780	23	770	28	1.01	0.84	0.44	0.67	97.88%	99.11%	98.81%	1.16	1.16	2.66	1.74
100.100.400	Fencing, Chain Link	LM	177	231	97	3	2,782	2,860	3,018	30	1,201	36	1,050	23	1.14	1.58	0.60	1.20	36.71%	41.99%	43.16%	15.73	12.38	20.80	10.31
100.100.400	Fencing, Gates	EA	6	8	2	0	107	244	80	3	61	2	55	1	1.11	1.30	0.76	0.61	22.54%	25.00%	56.80%	17.90	30.50	40.00	50.00
100.100.500	Guard Posts	EA	110	100	90	3	480	450	350	15	405	12	446	13	0.91	0.96	1.16	0.81	99.00%	90.00%	84.38%	4.36	4.50	3.89	5.56
100.100.600	Drainage & Sewers (Gravity only) Manhls, Catch Basins & other	EA	4	4	4	0	68	68	115	4	68	2	65	2	1.05	0.83	0.59	0.51	95.59%	100.00%	99.82%	17.03	17.00	28.75	33.33
100.100.100	Structural Excavation - Machine and Hand	M3##	4,463	6,451	4,463	134	4,950	5,200	6,294	95	3,597	108	3,208	100	1.12	1.08	0.57	1.14	61.68%	69.17%	72.67%	1.11	0.81	1.41	0.71
100.100.200	Backfill, Machine & Some Hand	M3##	1,899	5,434	1,899	57	4,034	10,911	4,672	125	3,813	114	2,895	131	1.32	0.87	0.82	0.92	26.53%	34.95%	94.52%	2.12	2.01	2.46	2.19
100.100.100	Trench'g Excav & Bkf'l, Excavation	M3##	5,099	4,890	4,560	137	5,927	5,368	6,223	158	5,005	150	5,105	157	0.98	0.96	0.80	0.95	95.11%	93.25%	84.45%	1.16	1.10	1.36	1.15
100.100.100	Trench'g Excav & Bkf'l, Backfill	M3##	3,560	3,499	3,332	100	11,600	11,462	7,842	359	10,917	328	11,082	374	0.99	0.88	1.39	0.91	96.69%	95.25%	94.11%	3.26	3.28	2.35	3.59
100.100.300	Bored Piles - Spoil Removal	M3	648	648	648	19	751	751	725	35	750	23	735	27	1.02	0.83	1.04	0.64	97.87%	99.93%	99.91%	1.16	1.16	1.12	1.80
100.100.400	Landscaping Fencing & Roads - Fencing	LM	44	44	43	1	394	394	453	15	385	12	370	14	1.04	0.85	0.85	0.77	93.91%	97.73%	97.78%	8.95	8.95	10.53	11.63

Note : UOM with ## are main commodity

Attachment 10 - EPM-KPC-TP-000027 - Procurement Schedule for Critical Materials and Equipment Template

Subcontract / Purchase Order No.	Materials or Equipment	Supplier Name	In Kingdom / Foreign Procurement (K/F)	INCO Terms to Jobsite	Leadtime (Weeks from Award)	Transportation Method (Truck, Sea, Air)	Total Quantity	Delivered to Site	Contract Plan / Forecast / Actual	Issuance of Requisition for Quotation / Tenders	Receive Bids	Complete Evaluation & Submit Bid Recommendation	Bid Recommendation Approval	Placement of Purchase Order	Vendor Drawings Submission	Vendor Drawings Approval	Factory Acceptance Test	Ready for Shipment	First Delivery (Receipt of Material / Equipment at Contractor's Yard)	Last Delivery (Receipt of Material / Equipment at Contractor's Yard)	Site Acceptance Test	Comments
									Contract Plan													
									Forecast													
									Actual													
									Contract Plan													
									Forecast													
									Actual													
									Contract Plan													
									Forecast													
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