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Project Construction Constructability Procedure



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Project Construction Constructability Procedure

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Project Construction Constructability Procedure

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Project Construction Constructability Procedure

1.0 PURPOSE

The main objective of constructability is to proactively engage construction expertise during the design process, such that when design is completed specific attributes related to constructability and preassembly are incorporated.

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

For the purposes of the Construction Management Procedures the Project Management Company is the Entity Project Management Organization (EPMO) appointed by the Entity and references prefixed with "Site", such as Site Construction Department, Site Engineering Department, represent the Project Management Company at Project level, on construction sites.

2.0 SCOPE

This procedure covers the suggestions, ideas and opportunities related to constructability including but not limited to the following:

- Determining the optimum sequence of construction
- Incorporating Best Practices while reducing construction complexity
- Integrating Safety requirements into the design and purchasing cycles
- Optimizing workforce efficiency (at workplace)
- Identifying opportunities to preassemble work offsite
- Evaluating capabilities of remote preassembly shops and yards
- Performing technical studies for heavy haul and logistics
- Supporting Materials Management through evaluation of traffic and logistics
- Evaluating options for by-product management and recycling
- Optimizing the asset reliability
- Integrating the asset operation and maintenance requirements into the design

The majority of the Constructability process and the value impact it brings, occurs during the design phase and before the construction phase. However, the process is available and should be used, where relevant, throughout the construction phase. It is important therefore that those who are or will become members of the Site Construction Department, Site Engineering Department and Site Contracts Department, are aware of the Constructability process and how it is administered pre-construction.

3.0 DEFINITIONS

Definitions	Description
Constructability	The optimum use of construction knowledge and experience in the planning, design, procurement, and field operations to achieve overall project objectives.
Category B (Budget)	An idea or suggestion to mitigate project risk which would otherwise represent an increase in total installed cost or delay in project schedule.
Category C (Construction)	An idea or suggestion which would have an impact to construction activities only. This category would (a) have no impact on engineering and (b) neither increase cost nor extend schedule.
Category D (Operability, Maintainability, and Asset life cycle cost)	Any Idea or suggestion which would have an impact to the asset operability, maintainability, or asset life cycle cost.
Category E (Engineering)	Idea or suggestion which would require changes to the project design criteria, revision of engineering specification or drawings



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Definitions	Description
	without an increase in total installed cost or delay to the project schedule.
Entity Project Management Organization (EPMO)	An Entity Project Management Organization, this is an integrated team that comprises the Entity and its PMC responsible for managing all the Entity's projects.
Enterprise Content Management System (ECMS)	An information management and collaboration platform for managing and controlling program documents and records
Site Contracts Department	Department within the Project Management Company that is responsible for administering Contracts.
Site Construction Department	Department within the Project Management Company that is responsible for Construction activities/operations.
Site Project Controls Department	Department within the Project Management Company that is tasked to undertake management of project costs, estimates, and scheduling reporting.
Site Engineering Department	Department within the Project Management Company that is responsible for Engineering or design activities/operations.
Constructability Team	The "Constructability Team" will be assembled from representatives of the Project Management Company Engineering Department, Construction Department, Project Controls Department and others as required to perform a review of a constructability suggestion and collect backup data required to support a suggestion through the approval process.
Constructability Coordinator (CC)	Person appointed by the Project Management Company, usually from within the Construction Department, who is the focal point for Constructability issues.
Designer	The Company who is responsible for undertaking the permanent works design, approval of changes during construction and amendments to the design from approved constructability suggestions. The Designer may be from within the Project Management Company Engineering Department or may be an independent Architect / Engineer Services Consultant (A/E)

4.0 REFERENCES

1. EOM-ZP0-PR-000004 - Operations and Maintenance - Projects Interface

5.0 RESPONSIBILITIES

5.1 Constructability Coordinator (CC)

The Constructability Coordinator is a member of the Site Construction Department and is the focal point of contact for Constructability issues. The Constructability Coordinator will maintain the Constructability Log, assign the appropriate categories to suggestions, disperse the suggestions to the appropriate personnel for approvals and action, interface with the Site Engineering Department, Site Project Controls Departments, and assist in ensuring all suggestions and ideas are brought to closure

5.2 Site Construction Department

The Site Construction Department is responsible for the preparation and implementation of the Constructability Program. The Site Construction Department shall prepare recommendations for the disposition of all constructability suggestions. Following the approval of a Construction or Budget constructability suggestion, the Site Construction Department is responsible for ensuring the suggestion is incorporated into the ongoing Design production (drawings, specification, design requirements) by the Designer.



5.3 Site Engineering Department

The Site Engineering Department is responsible for ensuring that the constructability process is worked in all design functions and the review of category Engineering or Budget constructability suggestions. Following the approval of a constructability suggestion, the Site Engineering Department is responsible for ensuring the suggestion is incorporated into the ongoing Design production (drawings, specification, design requirements).

5.4 Site Project Controls Department

The Site Project Controls Department shall provide the resources required for preparing estimates of cost and/or schedule impacts which would result from a constructability suggestion, this process shall be completed expeditiously.

5.5 Asset and Facility Management Department

The Asset and Facility Department is responsible for ensuring that all Constructability suggestions take into consideration the asset operability and maintainability and the impact on the asset life cycle cost

6.0 PROCESS/INSTRUCTIONS

6.1 Constructability Suggestion Process

6.1.1 Suggestion Process

A constructability suggestion may positively or negatively impact the budget or schedule of specific departments or disciplines. To ensure the implementation of an approved constructability suggestion, the same will then be approved as a Trend so that appropriate adjustments in affected budgets and schedules can be made.

Attachment 3 – EPM-KCC-TP-000013 – Project Construction Constructability Check List Template (Sample) provides some examples to assist the constructability suggestion process.

6.1.2 Submittal, Review and Approval Process

The "Constructability Team" will be assembled from representatives of the Project Management Company Engineering Department, Construction Department and Project Controls Department, Designer and others as required to perform a review of the suggestion and collect any backup data required to support the suggestion through the approval process. Note that during the construction phase, the above will be referred to as Site Engineering Department, Site Construction Department, Site Project Controls Department.

The Originator of a constructability idea / suggestion is to complete part 1 of the Constructability Suggestion Form as shown in the Project Construction Constructability Suggestion Form Template (Sample) Attachment 1 and submit it to the Constructability Coordinator.

The Constructability Coordinator will assign a log number and allocate the suggestion to the appropriate category. The suggestion is then entered into the Constructability Suggestion Log as shown in the Project Construction Constructability Suggestion Log Attachment 2 to track the process through the approval / disapproval phase. The Constructability Coordinator shall distribute the suggestion to the Site Construction Department, Site Engineering Department, Site Project Controls Department and other personnel as required.

Site Project Controls Department will develop an order-of-magnitude cost and schedule impact of the submitted suggestion if the Constructability Team deems that the suggestion has specific merit.



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Constructability suggestions will become the basis for trends if and when they represent a change to the budget.

The original Constructability Suggestion Form complete with supporting documents and approvals are to be returned to the Constructability Coordinator for distribution and record closeout.

The status of all open constructability suggestions will be reviewed and required actions will be determined during the regular Constructability Meetings.

6.1.3 Implementation Process

The Site Engineering Department is responsible, through the Designer, for the Implementation of all approved category Engineering, and Budget suggestions that impact engineering activities.

The Site Construction Department is responsible for the implementation of all category Construction and Budget suggestions, as well as any other suggestions that impact construction. Upon successful implementation, through the Construction Contractor, the Construction Coordinator shall be notified that the implementation is complete and the suggestion can be closed-out in the Constructability Log.

6.1.4 Documentation and Response to Reviews

The results of the constructability review will be provided and attached to the original constructability suggestion form. All comments should be documented to provide for a clear understanding as to why acceptance or rejection was determined for any given suggestion.

6.2 Review Criteria

The prioritization of constructability suggestion reviews shall be based on identifying areas with the greatest potential for cost and schedule savings. In addition, suggestions shall be reviewed for safety, operability and maintainability considerations.

The following is a partial list of those items which will be factored into the constructability review of suggestions generated by various disciplines and departments:

6.2.1 Common Considerations

- Safety and Health
- Environmental compliance
- Quality
- Cost-effectiveness
- Schedule optimization
- Compliance with Project Design Criteria
- Regulatory Compliance
- Safe Operability and Maintenance

6.2.2 Site Planning and Equipment and Material Layout

- Logical location of structures and equipment
- Construction access (largest cranes, biggest piece of equipment, etc.)
- Maintenance access
- Provisions for indoor and outdoor storage
- Location of temporary facilities and laydown areas (both on site and off site) to maximize construction efficiency



6.2.3 Procurement and Material Management

- Delivery dates, delivery 'just in time' (minimize double-handling)
- Vendor document submittal of installation manuals before equipment shipment to avoid installation delays
- Vendor document submittal of operation and maintenance manuals at the time of equipment shipment.
- Maximize use of standard manufactured or modular items
- Inclusion of rigging requirements with shipment.
- Special tools required
- Spare parts required (construction and operational)
- Inclusion of key procurement milestones
- Material delivery should support field erection sequence
- Consider pre-assembly of components in vendors' shops into largest transportable modules (including painting & insulation); confirm that all information required to complete a module are provided in purchase order
- Sequence shipments and how loaded/unloaded

6.2.4 Construction and Equipment Installation

- Maximize ground level construction and pre-assembly
- Rigging
- Welding
- Construction sequence
- Availability of materials and labor
- Level of difficulty
- Alternative construction options
- Minimize hazardous waste generation

6.2.5 General Engineering

- Assuring that design is complete at time of issue for Construction
- Use of reasonable tolerances, compatible with final installation requirements and specified where needed
- Determined if permanent structures and equipment can be installed early for use during construction
- Minimize the number of different materials used
- Maximize use of pre-cast concrete for items such as manholes, catch basins, duct banks, etc. where cost effective.
- Document revisions should be flagged to facilitate review
- Design underground piping and grounding work early for installation with civil foundations
- Use the same scale for drawings of various disciplines where practical
- Basic design criteria, standard installation details, etc. should be issued early in the job
- Sequence the release drawings in accordance with the project schedule and construction priorities
- Minimize the number of required welding procedures and welder qualification procedures
- Minimize the use of hazardous materials



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6.2.6 Architectural

- Materials of construction
- Use of custom-designed versus modular pre-engineered or fabricated buildings where permitted
- Maximize use of standard architectural items (doors, lighting fixtures, primer and paint, etc.)

6.2.7 Civil

- Determine the need for fireproofing
- When heavy lifts are involved, review rigging loads identified by Construction and determine the impact of such loads on civil design and work scope
- Minimize construction under the water table
- Include construction loads in the design of structures
- Keep the number of different structural sizes and shapes to a minimum
- Minimize the number of piles.
- Minimize foundation formwork by avoiding unusual shapes or non-standard dimensions. Use single large foundations instead of multiple small foundations close to one another where economically viable
- Maximize the use of field-bolted joints to expedite erection
- Minimize ultrasonic and radiographic testing requirements of structural weld elements,

6.2.8 Electrical

- Presentation of information that best facilitates site installation
- Target early release of permanent lighting and street lighting
- Termination drawings clearly marked to match vendors' equipment and entered in the database
- Review of duct bank and manhole layouts and cable type selection to maintain ease of cable pulls
- Provide adequate space for termination of cable, motor termination boxes, etc.
- Eliminate multiple runs of conduit by replacement with an equivalent tray to improve sequencing
- Provide clear identification systems for raceway, circuits and connections
- Design and purchase long lead time items early to support the construction schedule
- Review raceway routing
- Determine grounding (earthing) requirements that need to be included in civil work
- Determine the need and type of cathodic protection required and procure early if location under foundations

6.2.9 Instrumentation and Controls

- Make sure that vendor furnished package units provide job standard instrumentation hardware and job standard identification tag number, specification sheets, etc.
- Make sure that instrument details provide all necessary information including instrument numbers, support stand details, and air, process and electrical requirements
- Check supplier drawings to ensure that the information is complete and has been cross checked with engineering drawings
- Issue complete instrument index as early as possible
- Clearly specify where conduit seal fittings are required
- Issue complete loop diagrams promptly so that checkout can be started early
- Identify long run multi-pair cable on the individual spools when they are shipped



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- Complete Control & Signaling instrumentation data base and issue as soon as possible
- Provide adequate information in ladder logic drawings so the project can complete start up
- Purchase pre-assembled analyzers houses fully equipped, with analyzers and sample systems, dressed and shop tested
- Specify pre-insulated tubing rather than hand insulated tubing for steam tracing and analyzer supply and return lines
- Include vendor technical assistance during installation and start up where needed

6.2.10 Mechanical

- Fire protection
- Insulation
- Equipment redundancy
- Inclusion of lifting lugs
- Maximize module and spool prefabrication into the largest practical units which can be moved into their final Installed locations
- Storage and maintenance requirements
- Procurement of required spare parts
- Vendor technical assistance for erection, start-up and run-in

6.2.11 Plant Design and Piping

- Above ground versus underground
- Sizing of structures
- Maximize pre-assembly of piping and supports
- Material selection
- Location of field welds
- Vendor piping and piping interfaces
- Provisions for testing, flushing, blowing
- Determine hydrant and Post Indicator Valve (PIV) requirements early for inclusion with underground piping in civil

6.2.12 Contracting

- Clear definition of scope, schedule, contractor-supplied materials, interface with other contractors and responsibility for start up
- Inspection and quality control requirements
- Environmental requirements
- Temporary facilities provided by owner and contractor
- Access and laydown areas (both on and off site)
- Package is complete with the latest specifications, drawings, and technical data
- Identification of bidder-supplied information needed for bid evaluations



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6.2.13 Asset and facilities

- Ensure that any Constructability suggestion targeting to reduce project cost does not have an impact of the asset OPEX.
- Ensure that the design is aligned with the operation requirements.
- Full consideration shall be given to life cycle costs during the constructability review.
- Full consideration shall be given to the suitability of access to utilities and services and to determine whether there is safe and sufficient access for maintenance and replacement of plant and equipment in plant-rooms.

7.0 ATTACHMENTS

1. EPM-KCC-TP-000011 - Project Construction Constructability Suggestion Form Template
2. EPM-KCC-TP-000012 - Project Construction Constructability Suggestion Log Template
3. EPM-KCC-TP-000013 - Project Construction Constructability Checklist



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Attachment 1 - EPM-KCC-TP-000011 - Project Construction Constructability Suggestion Form Template

CONSTRUCTABILITY SUGGESTION		
Project Number:	Project Name:	
Suggestion Number:		Date:
Contributor Name:		Drawing/Spec Reference:
Existing Condition:		
Description of Suggestion:		
Rationale/Justification:		
Comments:		
List of Attachments		
Number	Revision	Description / Comments
Brief Description of Lesson Learned from This Suggestion:		
Approximate Time (calendar days) Impact (Engr. Construction, etc.)		Approximate Cost Impact EPMO / Contractor / Project
Name:	Phone:	Date:



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Attachment 2 - EPM-KCC-TP-000012 - Project Construction Constructability Suggestion Log Template

CONSTRUCTABILITY SUGGESTION LOG										
Project No.:		Project Name:						(only if approved)		
No.	Title Description	Date Initiated	Initiated By (Name)	Category (B / C / E)	Remarks	Disposition Date	Disposition By (Name)	Est. Cost Savings	Est. Time Savings (C Days)	Agree / Reject
	Total									
									Cal. Days	

Designated the category:

B - Budget,

C - Construction

E - Engineer



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Attachment 3 - EPM-KCC-TP-000013 - Project Construction Constructability Checklist

Discipline	Commodity	Issue / Question	Possible Choices? Actions	Project Direction	Actions
General	Heavy Haul on site	Identify site heavy haul and crane crawl routes. Review location of aboveground facilities and capacity of underground facilities.	Upgrade undergrounds - heavy wall pipe, conduit encased duct banks, etc. Review manhole locations. Review overheads (e.g. pipe bridges) for crane/haul interferences. Reroute and redesign as necessary.		
General	Preassembly	What will be modularized off-site?	Review each major vendor PO to determine optimum degree of shop and field fabrication.		
Civil	Concrete	Minimizing different concrete slab thicknesses	Avoid different slab thicknesses as much as possible. Make uniformly thick if practical.		
Civil	Reinforcing Steel	Rebar standardization	Standardize sizes for bulk material purchase ordering. Avoid non-standard sizes.		
Mechanical	Equipment	Determine equipment access and removal plan.	Review model and place path on drawings for equipment - also resolve valve access and head knockers during model review.		
Piping	Fabrication	Do Construction, piping fabricator and support fabricator have coordinated fabrication process to manage deliveries?	Weekly release for fabrication curves and PO language		
Electrical	Duct banks	Providing spare conduits	4 spare conduits per run as rule of thumb		
Electrical	Lighting	Standardizing fixture and lamp types	How many different fixture types and number of lamps?		
Software	Model	What info in model to support Work Packaging?			
Procurement	Management of Material	Will link from drawings to piece mark/part number to BPS and site storage location be easily understood?			

Note : This Checklist provides a limited number of examples only for constructability suggestions