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PROGRESS MEASUREMENT FOR CONSTRUCTION WORK

ENGINEERING TECHNICAL STANDARDS & PROCEDURES

PT KILANG PERTAMINA INTERNASIONAL

DIREKTORAT PROYEK INFRASTRUKTUR

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1. INTRODUCTION

1.1 This document describes Progress Measurement for Construction Works in Contract EPC / EPCC / EPCIC.

2. SCOPE

2.1 This document covers the progress measurement procedure which is to be applied to PROJECT EPC / EPCC / EPCIC.
This procedure describes the way for measuring and calculating progress of Construction activities.
When CONTRACTOR's scope is changed due to contract changes and the changes have significant impact on progress weight factors, CONTRACTOR will consult OWNER how the changes will be treated with this procedure.

3. CONFLICTS AND DEVIATIONS

3.1 Any conflicts between this standard and other applicable Engineering Technical Standards & Procedures (ETSP), or OWNER standards, codes, and forms shall be resolved in writing by OWNER.

3.2 All direct requests to deviate from this procedure (ETSP), CONTRACTOR shall request in writing to OWNER for approval and shall follow internal OWNER procedure.

4. ABBREVIATIONS

4.1 Abbreviations used for this document shall have the following definitions:

CPMS	Construction Progress Measurement System.

1. PENGANTAR

1.1 Dokumen ini menjelaskan Pengukuran Progress untuk Pekerjaan Konstruksi pada kontrak pekerjaan EPC / EPCC / EPCIC.

2. LINGKUP

2.1 Dokumen ini mencakup prosedur pengukuran progress yang diaplikasikan pada Kontrak Pekerjaan EPC / EPCC / EPCIC.
Prosedur ini menjelaskan langkah untuk pengukuran dan perhitungan progress untuk aktivitas Konstruksi.
Ketika lingkup KONTRAKTOR berubah karena perubahan kontraktual dan berdampak sangat signifikan pada factor pembobotan Progress, KONTRAKTOR akan melakukan konsultasi kepada PEMILIK, bagaimana perubahan akan dikelola terhadap prosedur ini.

3. KONFLIK DAN DEVIASI

3.1 Apabila terdapat konflik antara standar ini dengan *Engineering Technical Standards & Procedures* (ETSP) yang berlaku lainnya, atau standar PEMILIK, *codes* dan formulir, maka harus diselesaikan secara tertulis oleh PEMILIK.

3.2 Semua permintaan langsung penggunaan standar yang berbeda dari standar ini (ETSP), KONTRAKTOR harus meminta secara tertulis kepada PEMILIK untuk persetujuan dan harus mengikuti mengikuti prosedur internal PEMILIK.

4. SINGKATAN

4.1 Singkatan yang digunakan pada dokumen ini harus memiliki definisi sebagai berikut:

CPMS	*Construction Progress Measurement System.*

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5. DEFINITIONS

5.1 The following words shall have these special meanings when used herein:

OWNER	Owner of the Plant is defined as PT Kilang Pertamina Internasional and subsidiary.
CONTRACTOR /CONSULTANT	Defined as The Organization to which PT Kilang Pertamina Internasional assign the work.
EPC CONTRACT	EPC / EPCC / EPCIC Contract awarded to CONTRACTOR by OWNER
LICENSOR	Licensor Name
Productivity Norms	Productivity Standards agreed by the OWNER and CONTRACTOR in the project procedure document.
Shall	The word 'Shall' indicates a requirement.
Should	The word 'should' indicate a recommendation.
May	The word 'may' is to be understood as indicating a possible course of action

6. CODE, STANDARD AND DOCUMENT REFERENCES

a. Work Breakdown Structure

5. DEFINISI

5.1 Penggunaan kata-kata berikut harus memiliki arti khusus sebagai berikut:

PEMILIK	Pemilik Kilang didefinisikan sebagai PT Kilang Pertamina Internasional, anak perusahaan dan afiliasinya.
KONTRAKTOR/ KONSULTAN	Didefinisikan sebagai Organisasi yang ditunjuk oleh PT Kilang Pertamina Internasional untuk melakukan suatu pekerjaan.
EPC CONTRACT	Kontrak EPC / EPCC / EPCIC yang diberikan oleh PEMILIK kepada KONTRAKTOR
LICENSOR	Nama *Licensor*
Produktifitas *Norms*	Standard Produktifitas yang disepakati oleh PEMILIK dan KONTRAKTOR dalam dokumen prosedur project.
Shall	Kata "Harus" menunjukkan persyaratan.
Should	Kata "Seharusnya" menunjukkan rekomendasi.
May	Kata "Mungkin" agar dipahami sebagai indikasi kemungkinan tindakan.

6. KODE, STANDAR DAN REFERENSI DOKUMEN

a. Struktur Perincian Kerja

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b. Schedule Control Procedure
c. Progress Reporting Procedure

d. Project Calendar
e. Schedule of Payment of Contract Price
f. Project Schedule

7. WEIGHT PERCENTAGE FOR EPC CONSTRUCTION WORK

7.1 Weight Percentage for Each Discipline

Weight percentage for each discipline is calculated based on the total Man-hours per discipline divided by the total manhour for all construction activities. Man-hour per discipline is calculated estimated quantity divided by productivity for aggreed activities with the following notes:

a. Productivity estimate can consider the following:
   - Work location: Green area or Brown Area.
   - Level of difficulty.
   - Utilization of technology and tool.
   - And other factors that can affect productivity.
b. Productivity that used for manhour calculation shall be submitted by CONTRACTOR for approval by OWNER.

Since weight percentage is based on quantities at the beginning of Project, as the Project progressing the total quantity can change, therefore the original quantity is no longer suitable for construction progress measurement. This condition need quantity revision for construction progress measurement.

b. Prosedur Kontrol Jadwal
c. Prosedur Pelaporan Kemajuan Pekerjaan
d. Kalender Proyek
e. Jadwal Pembayaran Harga Kontrak
f. Jadwal Proyek

7. PERSENTASE BOBOT UNTUK KONSTRUKSI

7.1 Persentase Pembobotan untuk setiap discipline

Persentase bobot untuk setiap *discipline* dihitung berdasarkan jumlah *man-hour* pada disiplin tersebut dibagi dengan total *man-hour* untuk konstruksi. *Man-hour* per disiplin dihitung dari (Estimasi *Quantity*) dibagi Produktifitas *Norms* untuk aktifitas yang disepakati dengan catatan sebagai berikut:

a. Estimasi produktifitas dapat mempertimbangkan:
   - Lokasi pekerjaan di area *green* atau area *brown*.
   - Tingkat kesulitan pekerjaan.
   - Penggunaan teknologi atau alat.
   - Dan faktor lainnya yang mempengaruhi produktifitas.
b. Produktifitas yang digunakan untuk perhitungan *manhour* harus diajukan oleh KONTRAKTOR untuk mendapatkan persetujuan dari PEMILIK.

Karena persentase bobot didasarkan *Quantities* pada awal Proyek, seiring berjalannya proyek *Total Quantity* dapat berubah sehingga *total quantity* awal tidak sesuai dalam pengukuran progress konstruksi. Hal ini memerlukan revisi *quantity* untuk pengukuran progress konstruksi proyek.

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Flow of Quantity calculation for construction is as follow:

a. Each discipline, e.g. civil, mechanical, instrument and so on, estimates Quantity using all the available information and CONTRACTOR shall submit to OWNER.

b. OWNER reviews/approves Quantity from each discipline for construction progress measurement.

c. CONRACTOR utilize approved Quantity to establish the construction plan.

Weight for each discipline as per example below:

Alur dari perhitungan *quantity* untuk konstruksi sebagai berikut:

a. Setiap disiplin, misalnya sipil, mekanikal, instrument dan sebagainya, memperkirakan *Quantity* dengan menggunakan semua informasi yang tersedia dan kemudian KONTRAKTOR harus menyerahkan kepada PEMILIK.

b. PEMILIK meninjau/menyetujui *Quantity* dari setiap disiplin untuk pengukuran progress konstruksi.

c. KONTRAKTOR menggunakan *Quantity* yang telah disetujui oleh OWNER untuk perencanaan konstruksi.

Pembobotan per disiplin sesuai contoh dibawah:

Discipline *Disiplin*	**Weight per Discipline** *Bobot per Disiplin*
Civil	(Based on Calculation) *(sesuai dengan perhitungan)*
Building	
Temporary Facility	
Mech	
Electrical	
Instrument	
Piping	
Insulation	
Paint	
Steel Structure	
Precomm	
Others	
Overall	**100%**

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Calculation of Weight Percentage for each discipline

Man-hour per discipline = Estimated Quantity / Productivity Norms

Weight per discipline (%) =WVc Disc.

WVc Disc. = Total Manhour per Discipline / Total Manhour for Construction

Example calculation of Weight Percentage:

- Total estimated Quantity for Discipline piping is 4,000,000 DI.
- Productivity= 1.47 DI / manhour.
- Man-hour Discipline piping = 4,000,000 / 1.47 = 2,721,000 Manhour.
- If the total manhour of all construction activities is 10,000,000, therefore

WVc disc (%)= 2.721.000 x 100% / 10.000.0000 = 27%.

Note :

Should there any changes within EPC period, in total planned Quantity for any discipline, CONTRACTOR shall inform and request OWNER approval for the changes, subsequently change will be adopted in the CPMS (Construction Progress Measurement System). The information should contain change list of quantity

Perhitungan Persentase bobot per discipline

Man-hour per discipline = Estimasi Quantity / Produktifitas Norm

Bobot discipline (%) =WVc Disc.

WVc Disc. = Total Manhour per Discipline / Total Manhour untuk Konstruksi

Contoh Perhtungan Persentase bobot:

- Total estimasi *Quantity* untuk *Discipline piping* adalah 4.000.000 DI.
- *Productivity*= 1,47 DI / *manhour*.
- *Man-hour Discipline piping* = 4.000.000 / 1,47 = 2.721.000 *Manhour*.
- Apabila total *manhour* untuk keseluruhan aktivitas Konstruksi sebesar 10.000.000, sehingga

WVc disc (%)= 2.721.000 x 100% / 10.000.0000 = 27%.

Catatan :

Jika terdapat perubahan dalam jumlah Quantity yang telah direncanakan pada suatu discipline selama periode EPC berlangsung, KONTRAKTOR harus menyampaikan dan meminta persetujuan kepada PEMILIK terhadap perubahan tersebut untuk selanjutnya digunakan pada dokumen *CPMS* (*Construction Progress Measurement System*). Informasi harus berisi daftar perubahan quantity.

7.2 Construction Progress Measurement Method

Measurement method Standard made by CONTRACTOR based on Construction activities in L3 Schedule.

Measurement method can be divided into milestones or measurement steps with detailed progress submitted by the

7.2 Metode Pengukuran Progress Konstruksi

Standar metode pengukuran yang dibuat oleh KONTRAKTOR berdasarkan aktivitas kontruksi pada schedule Level 3.

Metode pengukuran dapat dibagi menjadi milestone atau *measurement step* dengan detil progress yang diajukan oleh

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CONTRACTOR for approval by OWNER.

for example, Progress milestone / measurement step for Foundation activities as per example below:

KONTRAKTOR untuk kemudian disetujui oleh PEMILIK.

Sebagai contoh Progress *milestone* / tahap pengukuran untuk *Foundation activities* seperti berikut:

Activity *Aktivitas*	**Unit** *Satuan*	**Progress (%)** *Progress*	**Cumm (%)** *Akumulasi*
Excavation	M3	10	10
Lean Concrete or Sand Bedding (Including Final Pile Cut)	M3	20	30
Rebar	Ton	20	50
Form Work	M2	15	65
Concrete Pouring	M3	30	95
Back Fill	M3	5	100

7.3 Construction Progress Calculation Method
The following is construction progress calculation formula:

Cp = Σ [Σ {(Va/Ve) * WFws}*WVc] / Σ (WVc)

Where;

Cp : Construction Progress (%)

Va : Quantity achieved for each work

Ve : Quantity estimated for each work

WFws : Progress measurement for each sub-activity work

WVc : Weight Value assigned to each activity

7.4 Progress in Pre-commissioning phase will be gained as follows:

a. 60-80% : When pre-commissioning activities in a discipline have been completed, evidenced by a "B" Check Sheet or Inspection Test Record (ITR) signed by the OWNER.

7.3 Metode Perhitungan Progress Konstruksi
Berikut rumus perhitungan progress konstruksi:

Cp = Σ [Σ {(Va/Ve) * WFws}*WVc] / Σ (WVc)

Where;

Cp : Progress Konstruksi (%)

Va : Actual *Quantity* yang dicapai untuk setiap aktivitas pekerjaan

Ve : *Quantity* untuk setiap aktivitas pekerjaan

WFws : Progress measurement untuk setiap sub-aktivitas pekerjaan

WVc : Bobot keseluruhan untuk setiap aktivitas

7.4 Progress pada tahapan *Pre-Commissioning* ditentukan sebagai berikut:

a. 60-80% : Ketika aktivitas *pre-commissioning* dalam suatu disiplin telah selesai dibuktikan oleh "B" *Check Sheet* atau *Inspection Test Record* (ITR) yang telah

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		ditandatangani oleh PEMILIK.	
	Weight for a: - 60% if there is a Walkdown. - 80% if there is no Walkdown. Weighting for 5 disciplines: Piping, Stationary, Rotating, Instrument & Electrical. Each disciplines would have a weight of 20% of (60% or 80%) respectively.	Bobot untuk a: - 60% jika terdapat *Walkdown*. - 80% jika tidak terdapat *Walkdown*. Pembobotan untuk 5 disiplin yakni *piping*, *stationary*, *rotating*, *instrument* & elektrikal, masing-masing diberikan bobot 20% dari (60% atau 80%).	
b. 0-20% :	When the System Walkdown has been executed and the Category A punch list for the System has been submitted to the OWNER. The System Walkdown will be implemented after the final reinstatement.	b. 0-20% :	Ketika System Walkdown telah dilaksanakan dan punch list Kategori A untuk Sistem telah diserahkan ke PEMILIK. Sistem *Walkdown* akan dilaksanakan setelah *final reinstatement*.
	Weight for b: - 20% if there is a Walkdown - 0% if there is no Walkdown		Bobot untuk b: - 20% jika terdapat *Walkdown* - 0% jika tidak terdapat *Walkdown*
c. 20% :	When all pre-commissioning activities have been completed and all category A punch lists have been completed, and Mechanical Completion has been achieved, as evidenced by a Mechanical Completion certificate signed by the OWNER.	c. 20% :	Ketika seluruh aktivitas *pre-commissioning* telah selesai dan seluruh *punch list* kategori A telah diselesaikan, serta *Mechanical Completion* tercapai, dibuktikan dengan sertifikat *Mechanical Completion* yang telah ditandatangani oleh PEMILIK.

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7.5 Calculation Formula of Pre-Commissioning

[PX] Pre-Commisioning Progress in Unit X is:

$$[\mathrm{PX}] = \left[\frac{(AX\ x\ (60-80)\%)\ +(BX\ x\ (0-20)\%)\ +(\ CX\ x\ 20\%)}{ZX}\right] x\ WTX$$

[AX]	: Total Disciplines where pre-commissioning has been completed in unit X	[AX]	: Jumlah Disiplin dimana pekerjaan *pre-commissioning* telah selesai dalam unit X
[BX]	: Total systems where punch list has been submitted in unit X	[BX]	: Jumlah sistem dimana *final punch list* telah di submit dalam unit X
[CX]	: Total systems which Mechanical Completion system has been achieved in unit X	[CX]	: Jumlah sistem dimana sistem *Mechanical Completion* telah tercapai dalam unit X
[ZX]	: Total systems in unit X	[ZX]	: Jumlah sistem dalam unit X
[WTX]	: Commissioning weight in unit X	[WTX]	: Bobot *pre-commissioning* dalam unit X
[PX]	: Progress Pre-Commissioning phase in Unit X	[PX]	: Progress fase *Pre-Commissioning* dalam unit X
X	: System Unit Name	X	: Nama Sistem Unit

[PC] Total Progress Pre-Commissioning Phase is:

[*PC] Total Progress fase Pre-Commissioning adalah:*

$$[\mathrm{PC}] = \sum^{i=n}[\mathrm{PX}]\ \mathrm{x}\ \mathrm{Wi}$$

[Wi]	: Weight of each unit	[Wi]	: Bobot masing-masing unit

7.6 Construction Progress Back-Up Document

Construction progress milestone achievement for each activity can be attached thru the following documents but not limited to:

- Construction Progress Certificate.
- Certificate of inspection.
- Daily report.

7.6 Dokumen *Back-Up* Progress Konstruksi

Pencapaian *milestone* progress Konstruksi untuk setiap aktifitas dapat dilampirkan melalui dokumen berikut namun tidak terbatas pada:

- Berita Acara Konstruksi.
- *Inspection Certificate.*
- *Daily report.*

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