



M&E Railway System Construction Project Management



อนุพล สอนเฟือก

ประธานกรรมการฝ่ายพัฒนาอุตสาหกรรม

สมาคมวิศวกรรมระบบขนส่งทางรางไทย



ประธานเจ้าหน้าที่ฝ่ายปฏิบัติการ
Trans Thai Railway Co., Ltd.



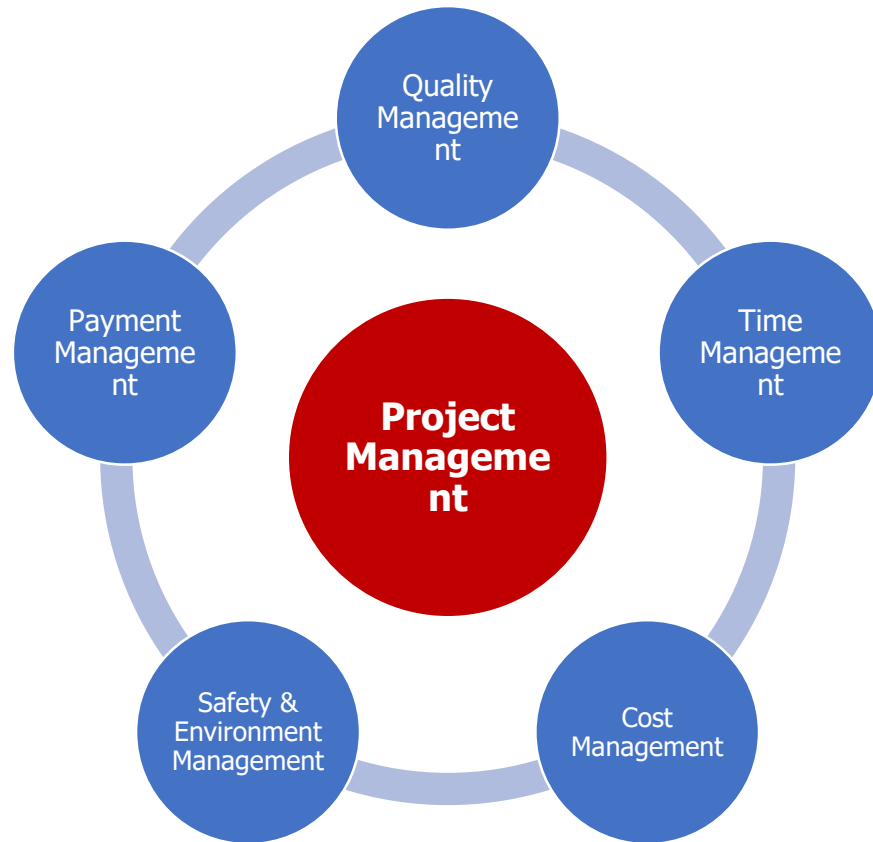
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Introduction to Project Management

Project management is the discipline of managing all the different resources and aspects of the project in such a way that the resources will deliver all the output that is required to complete the project within the **defined scope, time, and cost constraints**.



Introduction to M&E Railway System



Project Implementation

Key:

- Verification task: (Green circular arrow)
- Validation task: (Grey arrow)
- Risk Assessment (Hatched background)
- Implementation and demonstration of compliance with RAMS requirements (Blue background)
- Operation, maintenance and decommissioning (Dotted background)

Tasks and Flow:

- 1 Concept** (Risk Assessment)
- 2 System definition and operational context** (Risk Assessment)
- 3 Risk analysis and evaluation** (Risk Assessment)
- 4 Specification of system requirements** (Risk Assessment)
- 5 Architecture & apportionment of system requirements** (Risk Assessment)
- 6 Design and implementation** (Implementation)
- 7 Manufacture** (Implementation)
- 8 Integration** (Implementation)
- 9 System validation** (Implementation)
- 10 System acceptance** (Implementation)
- 11 Operation, maintenance, performance monitoring** (Operation)
- 12 Decommissioning** (Operation)

Control of RAMS requirements (Left box) feeds into tasks 1, 4, and 6.

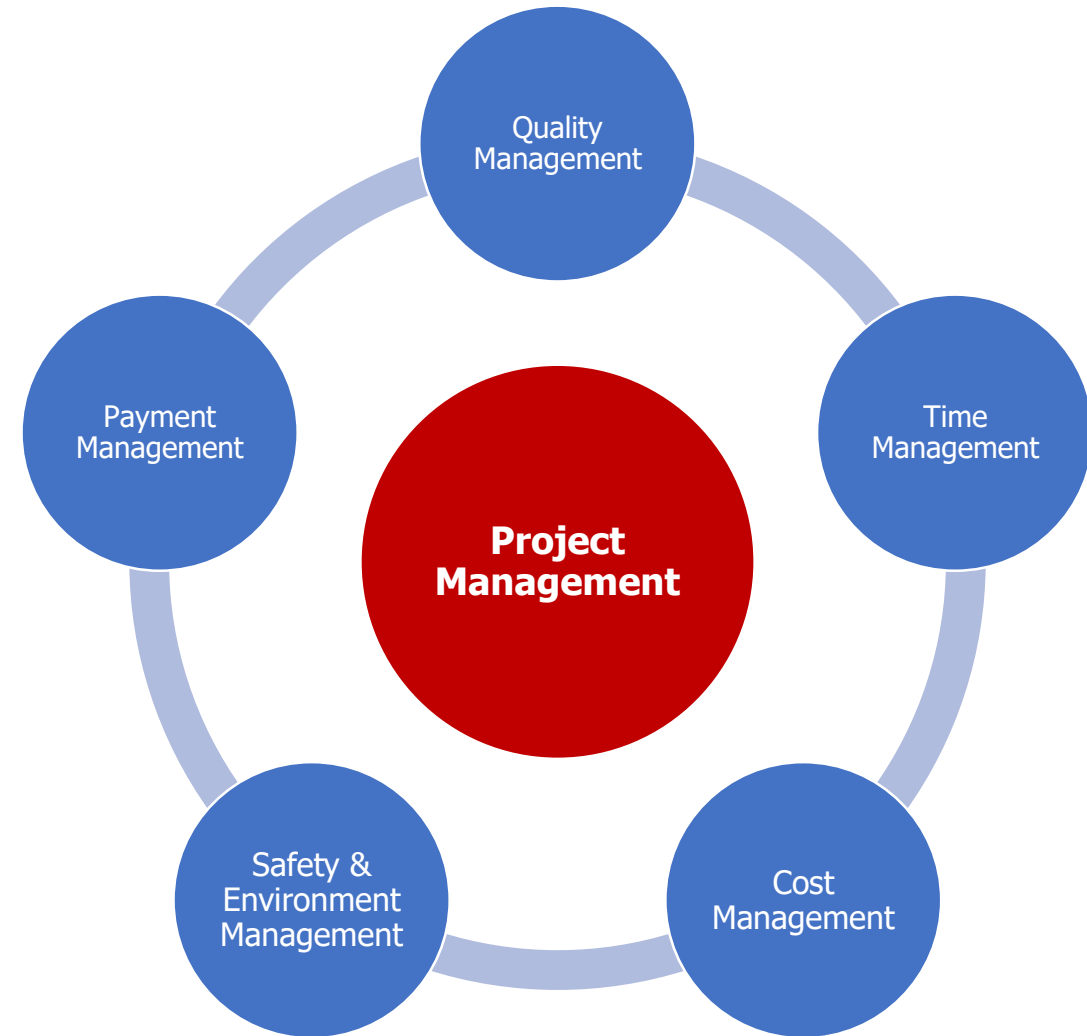
Feedback on RAMS into risk analysis (Top box) receives input from task 10 and feeds back into task 1.

Validation (Arrow) connects task 9 back to task 4.

To: Operation, maintenance and decommissioning (Arrow) points from task 6.

Project Life-Cycle

1. **Contract review**
2. **Project cost and budget estimation**
3. **Project planning and Organizing**
4. **Engineering and Design**
5. **Procurement**
6. **Manufacturing**
7. **Installation**
8. **Testing and Commissioning**
9. **Operation and Maintenance Training**
10. **Project delivery and handover**



Project Management



Quality Management



Time Management



Plan & Progress

Master
Schedule

Monthly
Schedule

Weekly
Schedule

Daily
Schedule

Resource

Manpower
Schedule

Equipment
Schedule

Material
Schedule

Financial
Schedule

Site Access

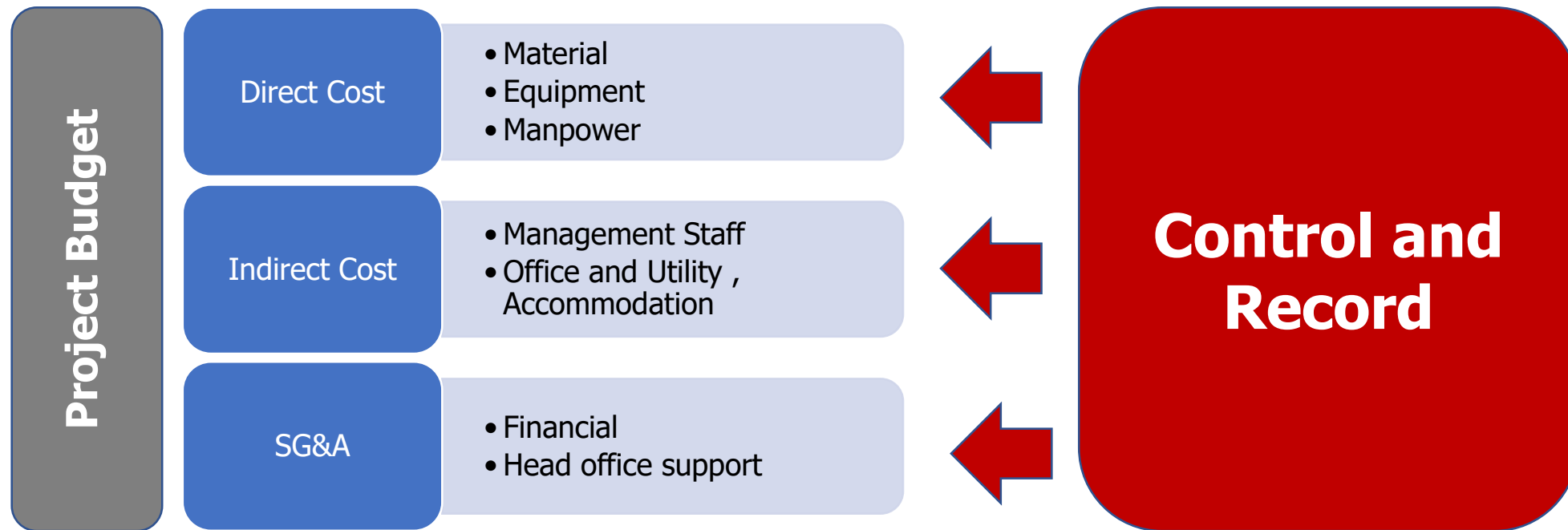
Indoor
Status

Wayside
Area
Status

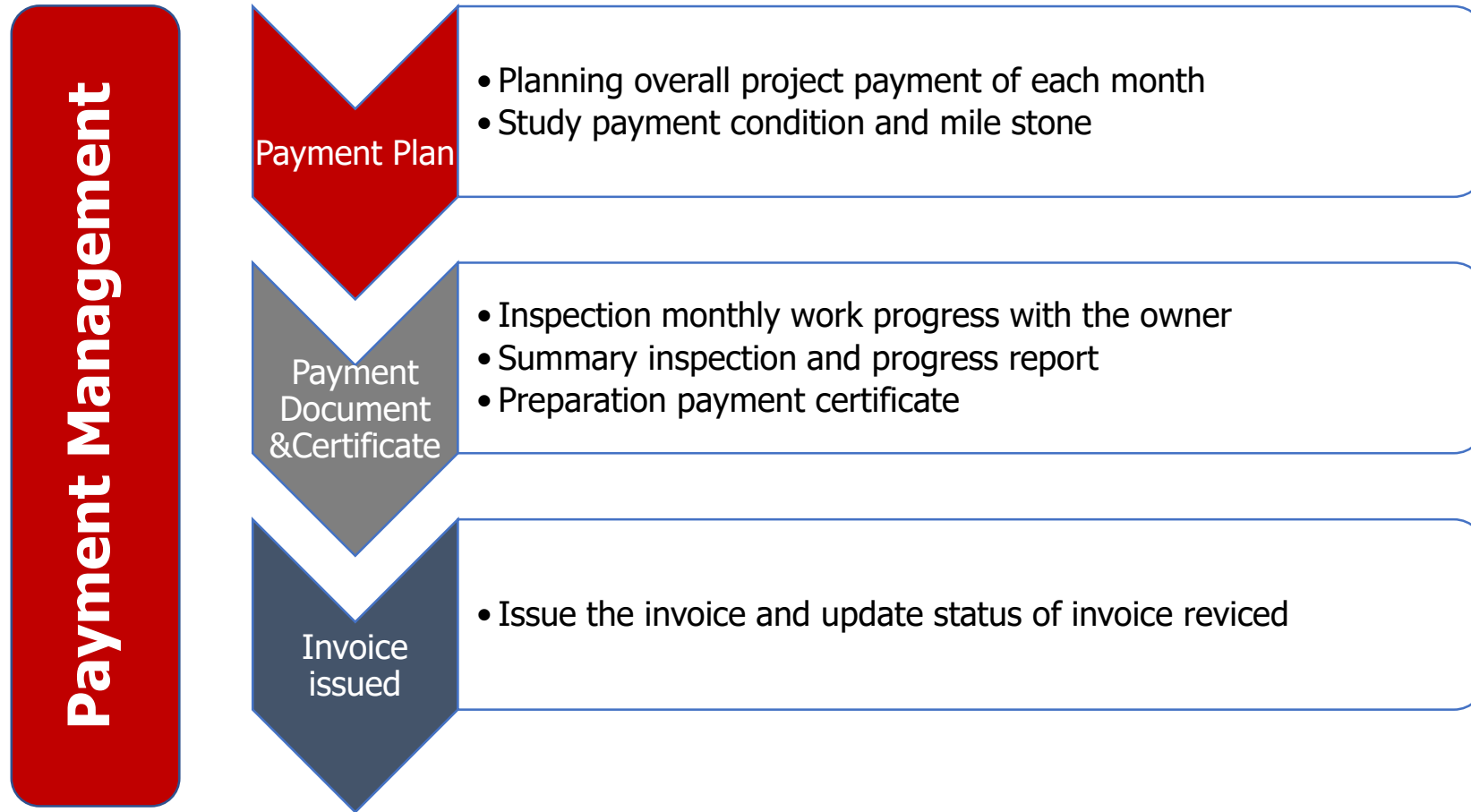
Other
interface
area



Cost Management



Payment Management



Safety & Environment Management



1.Contract review

- Part1 Contract Agreement
- Part2 Condition of Contract
 - General Condition
 - Particular Condition
- Part3 Bill of Quantity
 - Preamble
 - BOQ
- Part4 Specifications
 - General Specification
 - Particular Specification
- Part5 Drawing



2. Project cost and budget estimation

Item	Description	Budget	
		%	MB
A	Estimated Cost		
A.1	Direct Cost		
A.2	Indirect Cost + Staff		
	Sub-Total A		
B	Overhead Base on Total Cost		
B.1	Financial		
B.2	H.O. Overhead		
B.3	Contingency		
B.4	Exchange Rate Risk		
	Sub-Total B		
C	Overhead Base on Price		
C.1	Stamp Duties		
C.2	WithHolding Tax		
C.3	Bond		
C.4	Insurance		
C.5	Risk Management		
C.6	Profit		
	Sub-Total C		
D.1	Total Price = A+B+C		
D.2	Provisional Sum		
D.3	Total Price		



2. Project cost and budget estimation

Summary Sheet of Direct Cost					
Item	Subjob	Description	Material	Labour	Total
D1000 PDS					
1	D1010	Bulk Substation			
1.1	D1011	System Equipment			0.00
1.2	D1012	Cable Containment			0.00
1.3	D1013	Cable and Termination			0.00
		Sub-Total	0.00	0.00	0.00
2	D1020	Depot Buildings			
2.1	D1021	System Equipment			0.00
2.2	D1022	Cable Containment			0.00
2.3	D1023	Cable and Termination			0.00
		Sub-Total	0.00	0.00	0.00
3	D1030	Depot Yard			
3.1		System Equipment			0.00
3.2		Cable Containment			0.00
3.3		Cable and Termination			0.00
		Sub-Total	0.00	0.00	0.00
4	D1040	Traction Power from BSS to C2			
4.1		System Equipment			0.00
4.2		Cable Containment			0.00
4.3		Cable and Termination			0.00
		Sub-Total	0.00	0.00	0.00
5	D1050	High Mast Lighting System			
1.1		System Equipment			0.00
1.2		Cable Containment			0.00
1.3		Cable and Termination			0.00
		Sub-Total	0.00	0.00	0.00
6	D1060	C1 North Line 2 Stations			
1.1		System Equipment			0.00
1.2		Cable Containment			0.00
1.3		Cable and Termination			0.00
		Sub-Total	0.00	0.00	0.00
7	D1070	C1 North Line Wayside			
1.1		System Equipment			0.00
1.2		Cable Containment			0.00
1.3		Cable and Termination			0.00
		Sub-Total	0.00	0.00	0.00

1.3		Cable and Termination			0.00
		Sub-Total	0.00	0.00	0.00
1		System Equipment	0.00	0.00	0.00
2		Cable Containment	0.00	0.00	0.00
3		Cable and Termination	0.00	0.00	0.00
		Total - PDS	0.00	0.00	0.00
D2000 COM					
1	D2010	C1 Area Wayside			
1.1		System Equipment			0.00
1.2		Cable Containment			0.00
1.3		Cable and Termination			0.00
		Sub-Total	0.00	0.00	0.00
		Total - COM	0.00	0.00	0.00
D3000 SIG					
1	D3010	Depot Buildings			
1.1		System Equipment			0.00
1.2		Cable Containment			0.00
1.3		Cable and Termination			0.00
		Sub-Total	0.00	0.00	0.00
2	D3020	Depot Yard			
1.1		System Equipment			0.00
1.2		Cable Containment			0.00
1.3		Cable and Termination			0.00
		Sub-Total	0.00	0.00	0.00
3	D3030	C1 North 2 Stations			
1.1		System Equipment			0.00
1.2		Cable Containment			0.00
1.3		Cable and Termination			0.00
		Sub-Total	0.00	0.00	0.00
4	D3040	C1 North Wayside			
1.1		System Equipment			0.00
1.2		Cable Containment			0.00
1.3		Cable and Termination			0.00
		Sub-Total	0.00	0.00	0.00
1		System Equipment	0.00	0.00	0.00
2		Cable Containment	0.00	0.00	0.00
3		Cable and Termination	0.00	0.00	0.00
		Total - SIG	0.00	0.00	0.00
1		System Equipment	0.00	0.00	0.00
2		Cable Containment	0.00	0.00	0.00
3		Cable and Termination	0.00	0.00	0.00
		Grand Total	0.00	0.00	0.00



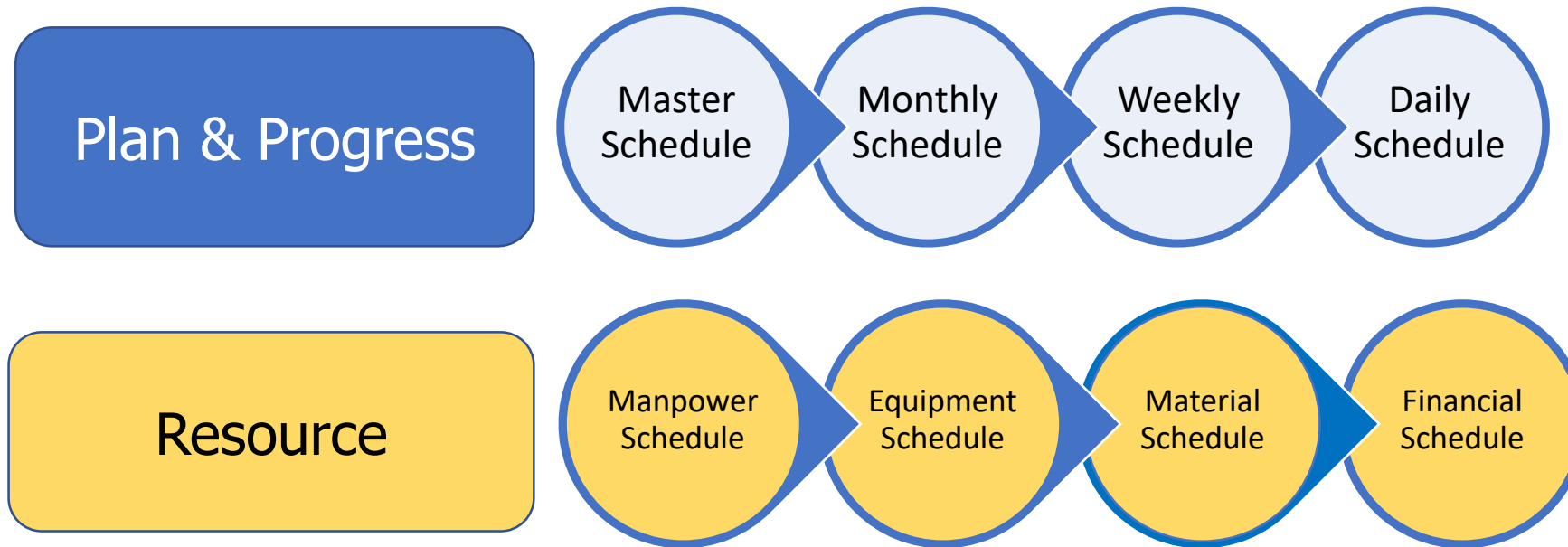
2. Project cost and budget estimation

INDIRECT COST							
			ระยะเวลาโครงการ		30	month	
			ระยะเวลาช่วงก่อสร้าง		30	month	
Item	Description	Unit	Budget At Tender				Remark
			Qty	Q'ty-Time	Unit Rate	Amount	
1	Non-Productive Manpower						
A	Project Management						
	Project Engineer Zone 1	Man-Mth				-	
	Project Engineer Zone 2	Man-Mth				-	
	Electrical Engineer	Man-Mth				-	
	Mechanical Engineer	Man-Mth				-	
B	Document Control						
	Document Control	Man-Mth				-	
	Technical Support	Man-Mth				-	
	EE Technician	Man-Mth				-	
	ME Technician	Man-Mth				-	
	CAD Operator	Man-Mth				-	
C	Common Support						
	Project Management	Man-Mth				-	
	QS & Cost	Man-Mth				-	
	Admin	Man-Mth				-	
	Store	Man-Mth				-	
	Accountant	Man-Mth				-	
	Personal & Payroll Staff	Man-Mth				-	
D	Other						
	Checker	Man-Mth				-	
	Security	Man-Mth				-	
	Driver	Man-Mth				-	
Total Item 1						-	
2	Site Office						
2.1	Office Construction					-	
	ค่าเช่าพื้นที่ออฟฟิศ	Sq.m				-	
	Warehouse	Sq.m				-	
	ค่าเช่า Work Shop	Sq.m				-	
2.2	Utility Construction					-	
	- ค่าขอใช้โทรศัพท์พร้อมอินเตอร์เน็ต พร้อมเดินสาย	Ls				-	
2.3	Furniture & Equipment					-	
	- Desk + Chair	Set				-	
	- Other Furniture & Accessories	Set				-	
	- Office Equipment						
	Computer (Server)	Set				-	Store 1, Cost 1, Clerk 2, Draft 1
	Printer A4	Set				-	
	Telephone	Set				-	
	Fax	Set				-	
	Digital Camera	Set				-	

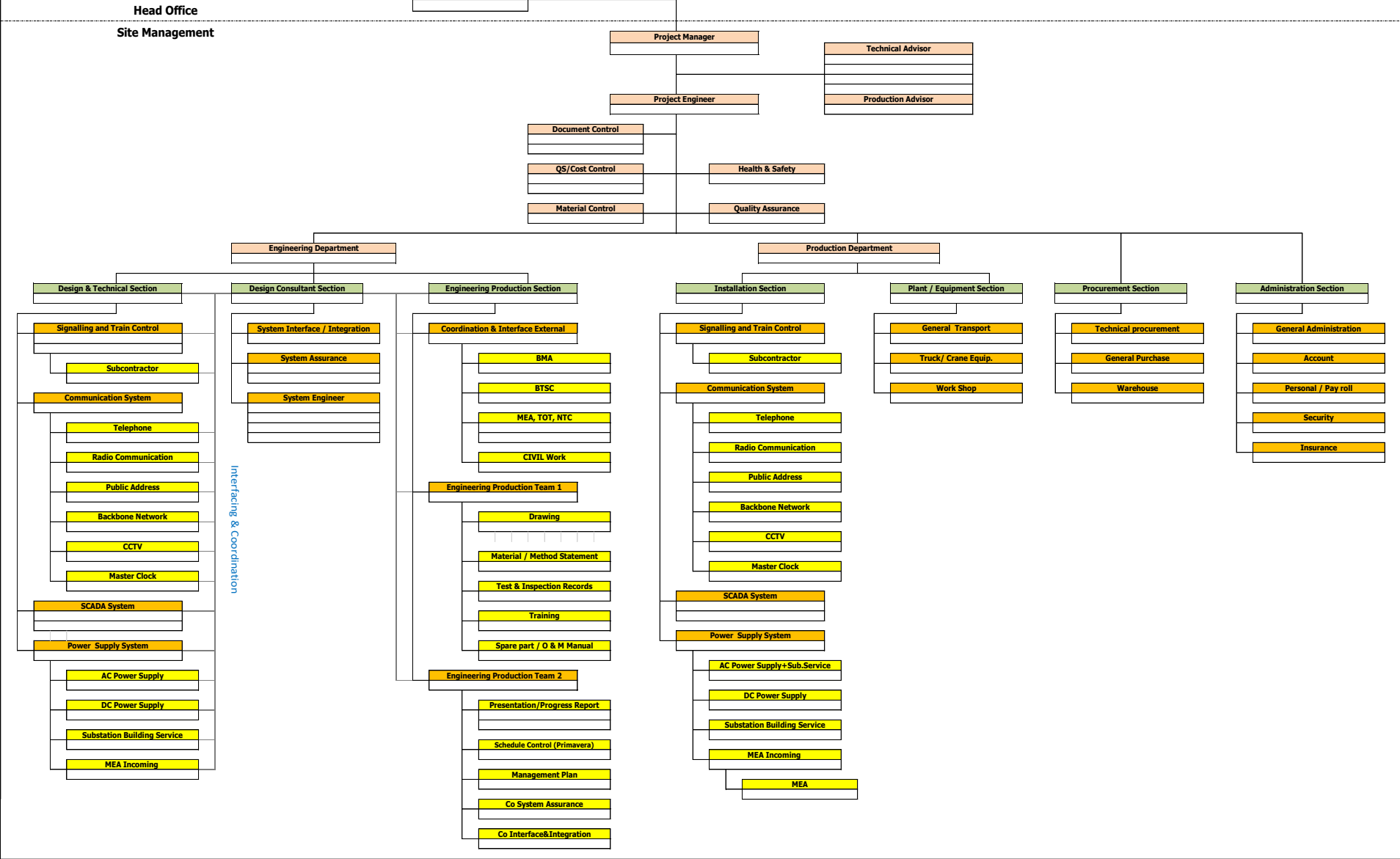
2.4	Running cost						
	- Electrical Fee	Mth				-	Workshop, Warehouse, Camp
	- Water supply Fee	Mth				-	Office, Workshop, Warehouse, Camp
	- Telephone Fee	Mth				-	
	- Promotion Mobile 4 No	Mth				-	
	- Internet Fee	Mth				-	
	- ZAP Online	Mth				-	
	- Computer (Rental)	Mth				-	
	- Stationery	Mth				-	
	- Other (Drinking Water, Medicine, Bill)	Mth				-	
	- Copy Machine (สี)	Mth				-	
	- Copy Machine (ขาวดำ)	Mth				-	
	- Copy Expense	Mth				-	
Total Item 2							-
3	Equipment						
	ค่าเช่า + น้ำมัน						
3.1	Sedan	Eq-Mth				-	
3.2	Pickup 4 Door	Eq-Mth				-	
3.3	Pickup(cap)	Eq-Mth				-	
3.4	Passenger Truck 6 Wheel	Eq-Mth				-	
3.5	Inspection Car	Eq-Mth				-	
Total Item 3							-
4	Camp (วัดโนส)						
	- ห้อง E	Room-Mth				-	
	- ห้อง F	Room-Mth				-	
	- ห้อง A	Room-Mth				-	
Total Item 4							-
5	อุปกรณ์ Safety&PPE						
	อุปกรณ์ Safety PPE (หมวก, เสื้อ, รองเท้า+แว่นตา)	คน				-	
	อื่นๆ อาทิ สังกะสี, ป้าย	LS				-	
Total Item 5							-
6	Entertain & Other Expense						
	ค่าอำนวยความสะดวก	Mth				-	
Total Item 6							-
Grand Total							-



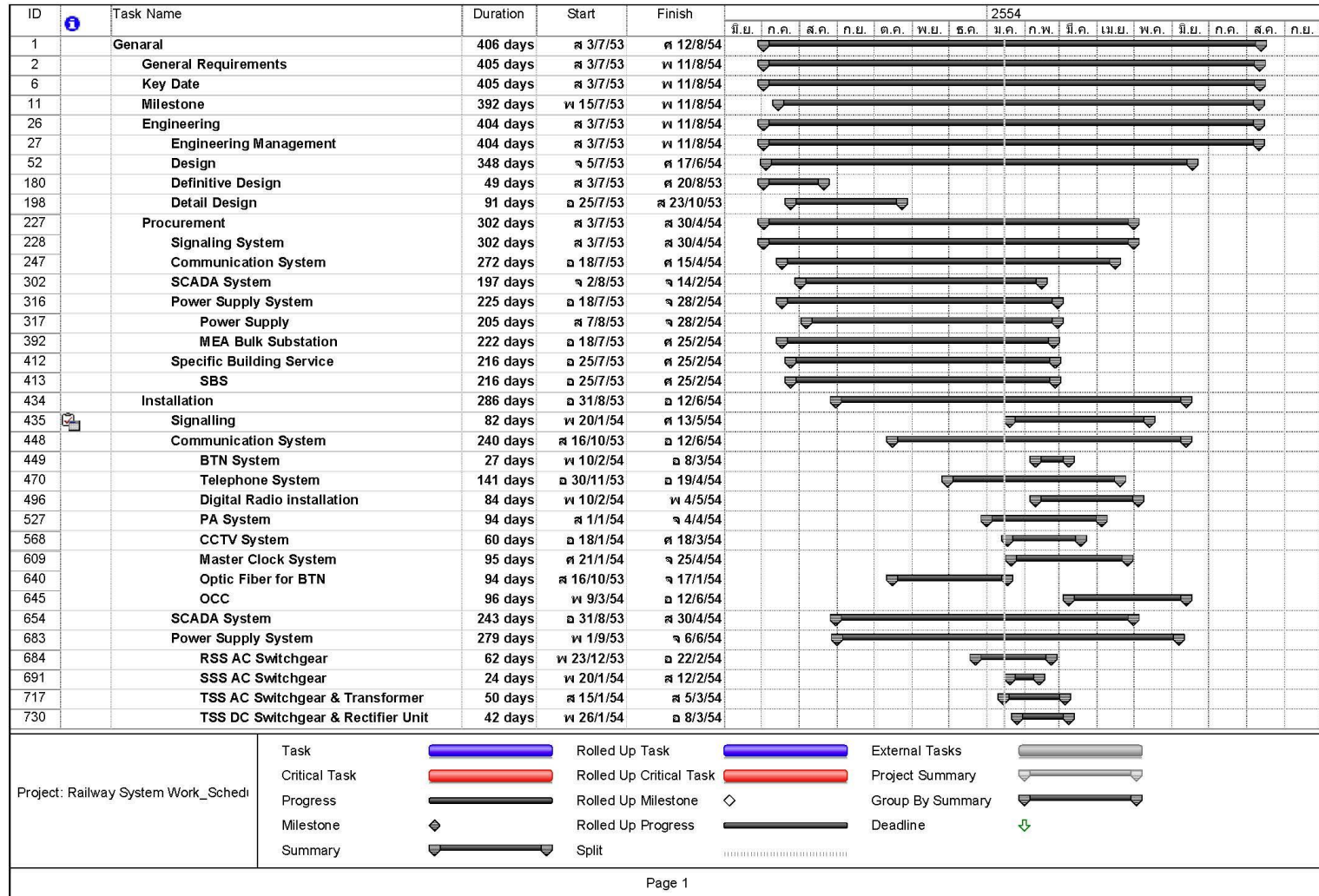
3. Project planning and Organizing



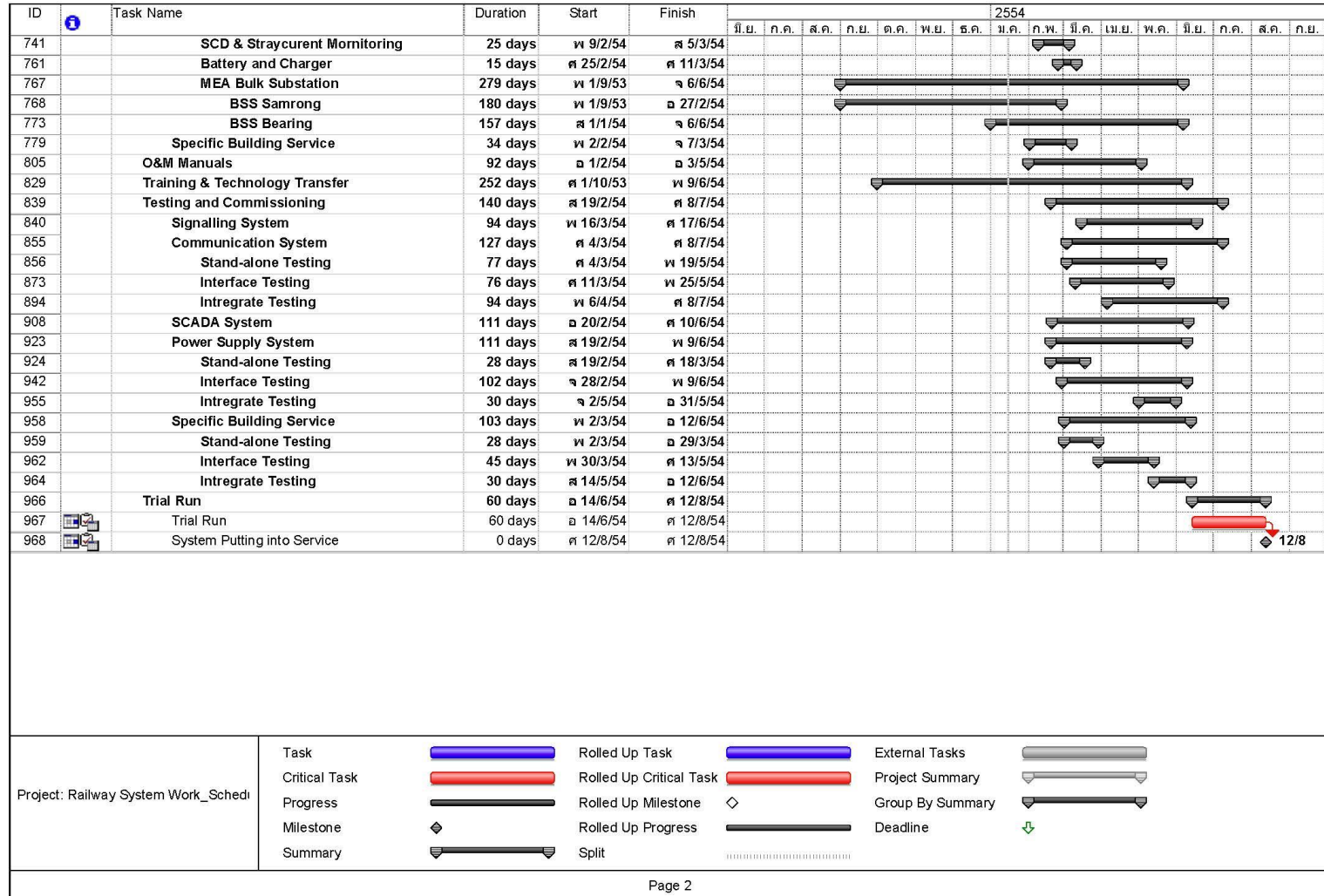
ORGANIZATION CHART



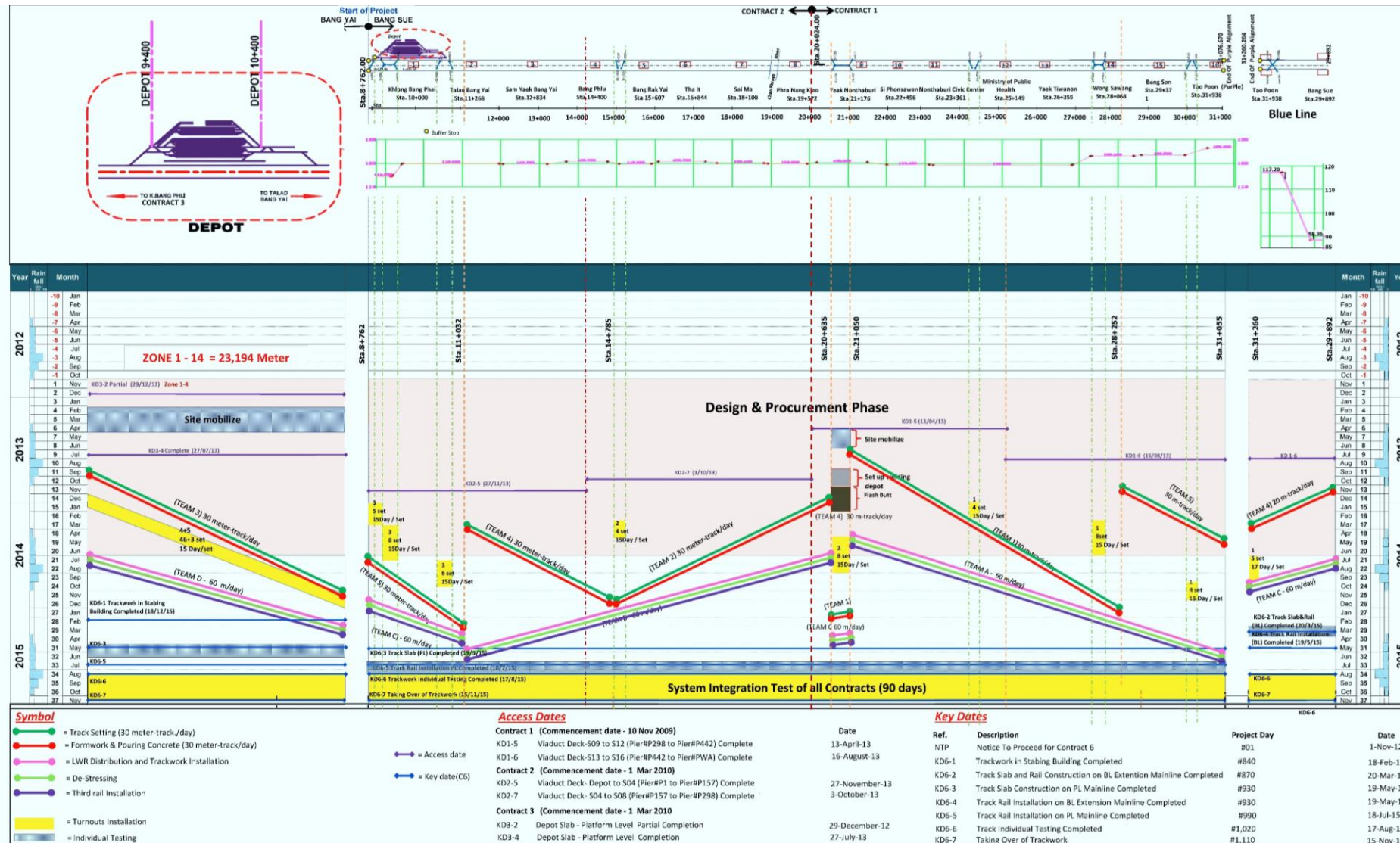
3.Master Schedule



3.Master Schedule



3.Master Schedule – Time Space Diagram Schedule

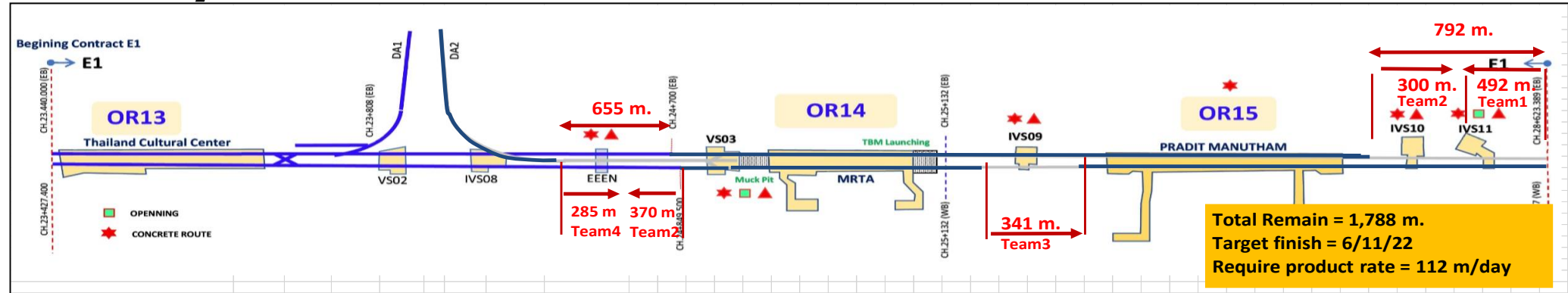


3.Monthly Schedule

Construction Schedule of PDS (1+3Months)																										
Area	Location	Description	Start	Finish	Unit	Q'ty	Plan	Jun					Jul					Aug				Sep				
							Actual	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	30	
Way side / Viaduct																										
1	Cable Trough Installation																									
Via duct	GL.8-P768 , CT-UP	(3) Open Cover Cable Trough/Drilling			Cover	834	Plan																			
							Actual																			
	GL.8-P768 , CT-DN	(4) Open Cover Cable Trough/Drilling			Cover	834	Plan																			
							Actual																			
	WSN-P783 , CT-UP	(1) Open Cover Cable Trough/Drilling			Cover	760	Plan																			
							Actual																			
	WSN-P783 , CT-DN	(2) Open Cover Cable Trough/Drilling			Cover	760	Plan																			
							Actual																			
	P768-P783 , CT-UP	(9) Open Cover Cable Trough/Drilling			Cover	600	Plan																			
							Actual																			
	P768-P783 , CT-DN	(10) Open Cover Cable Trough/Drilling			Cover	600	Plan																			
							Actual																			
		A (WSN)	Open Cover Cable Trough/Drilling	12-Jun-19	16-Jun-19	Cover		Plan																		
								Actual																		
		B (WSN)	Open Cover Cable Trough/Drilling	17-Jun-19	21-Jun-19	Cover		Plan																		
								Actual																		
	C (WSN)	Open Cover Cable Trough/Drilling			Cover		Plan																			
							Actual																			
	D (WSN)	Open Cover Cable Trough/Drilling			Cover		Plan																			
							Actual																			
	E (WSN)	Open Cover Cable Trough/Drilling			Cover		Plan																			
							Actual																			
Depot Area	CT-Yard (MWS)	Cable Trough Installation Route A	Ongoing	23-Jun-19	Pcs.	1,648	Plan																			
							Actual																			
	CT-Yard (MWS)	Cable Trough Installation Route B	10-Jun-19	30-Jun-19	Pcs.	792	Plan																			
							Actual																			
	BSS	Cable Trough Installation Route C	1-Jul-19	15-Jul-19	Pcs.	378	Plan																			
							Actual																			
	BSS	Cable Trough Installation Route D	15-Jul-19	21-Jul-19	Pcs.	144	Plan																			
							Actual																			
2	25kV Temporaly																									
CT Depot Yard	CT-Yard (MWS)	HDPE Pipe & Cabling for Depot OCS	1-Jul-19	15-Jul-19	m.	900	Plan																			
							Actual																			
		25kV Cabling for Depot (P699→Depot)	1/6/7/2019	4-Aug-19	m.	1,800	Plan																			
							Actual																			



3.Weekly Schedule



Month : Otc'22					Year : 2022		SECTION/GROUP/UNIT : TW																											
No.	ACTIVITY	WEEK				WEEK No. : 42								WEEK No. : 43								WEEK No. : 44								CONCRETE PUMP	Responsible Person			
		DAY				M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU	M	T	W	TH	F	S	SU								
		DATE				17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	1	2	3	4	5	6								
		SHIFT	UNIT	QTY.	SHIFT CAPACITY																													
	<u>POURING CONCRETE</u>		m	1,788	Plan	0	0	0	0	170	160	0	0	170	170	160	100	230	0	213	70	100	70	100	75	0		28522						
					Actual	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0								
1	E1 - OR15 TO OR16 [EB]																																	
	CH 28+632 - 28+140 [EB]	N	m	492	100/ 2 day																						IVS11	TEAM1						
	CH 27+840 - 28+140 [EB]	N	m	300	100/ 2 day																						IVS11	TEAM2						
3	E1 - OR14 TO OR15 [WB]																																	
	CH25+760 - 26+100 [WB]	N	m	341	60/day																						IVS09	TEAM3						
4	DA2																																	
	CH 1+230 - 1+170 [Cut & cover]	N	m	70	70/2day																						DA2	TEAM4						
	CH 1+170 - 0+870 [Cut & cover]	N	m	300	50/day																						DA2	TEAM2						
	CH 0+585 - 0+870 [Wall Type]	N	m	285	50/day																						DA2	TEAM4						



3.Manpower Schedule

Item	Description	Building /Area	2019								2020																								Remark		
			Nov'19				Dec'19				Jan'20					Feb'20				Mar'20				Apr'20					May'20				Jun'20				
			4	11	18	25	2	9	16	23	30	6	13	20	27	3	10	17	24	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	
1	PDS - Indoor																																				
1.1	Equipment-Team1																																				
	Plan	Heavy Equipment		10	10	10	10							10	10	10																					
	Actual																																				
1.2	Equipment-Team2																																				
	Plan	General Equipment			5	5	5				5	5																									
	Actual																																				
1.3	Equipment-Team3																																				
	Plan	Assembly Equipment					5	5	5		5	5																									
	Actual																																				
1.4	Cable Containment and Cable -Team1																																				
	Plan	BSS	10	10	10	23	23	23	23	10																											
	Actual																																				
1.5	Cable Containment and Cable -Team2																																				
	Plan	MWS , INF	7	7	7	7	7	7																													
	Actual																																				
1.6	Cable Containment and Cable -Team3																																				
	Plan	TWP	7	7	7	7	10	10	10	10																											
	Actual																																				
1.7	Cable Containment and Cable -Team4																																				
	Plan	PAC	8	8	8	8	8	8	15	15	15																										
	Actual																																				
1.8	Cable Containment and Cable -Team5																																				
	Plan	DMB			10	10	20	20	20	20	20	20	20	20	20																						
	Actual																																				
1.9	Cable Containment and Cable -Team6																																				
	Plan	SCB						7	7	7																											
	Actual																																				
1.10	MV.&LV. Cable tray and Cable -Team7																																				
	Plan	BSG - Zone1 (Chiller Plant)			8	8	8	8	8	8																											
	Actual																																				
1.11	MV.&LV. Cable tray and Cable -Team8																																				
	Plan	BSG - Zone2 (M&E Room)					5	5	5	5																											
	Actual																																				
1.12	MV.&LV. Cable tray and Cable -Team9																																				
	Plan	BSG - Zone3 (Grand Station)					18	18	18	18	18	18	18	18	18																						
	Actual																																				
1.13	Cable Containment and Cable -Team1																																				
	Plan	CTK					5	10	10	10	10	10	10	10	10	10	10																				
	Actual																																				
1.14	Cable Termination MV -Team1																																				
	Plan	ALL Area	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5																				
	Actual																																				
1.15	Cable Termination LV -Team1																																				
	Plan	BSS, MWS,INF,TWP, SCB	5	5	5	10	10	15	20	20	20	20																									
	Actual																																				
1.16	Cable Termination LV -Team2																																				
	Plan	PAC, DMB							10	10	10	10	10	10	10																						
	Actual																																				
1.17	Cable Termination LV -Team3																																				
	Plan	BSG, CTK					10	10	10	10	10	10	10	10	10	15	15	15	15																		
	Actual																																				
	Sub-Total PDS Indoor																																				
	Sub Total -Plan		42	52	75	93	134	146	166	148	113	103	78	83	83	40	30	15	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	Sub Total - Actual		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		



3.Manpower Schedule

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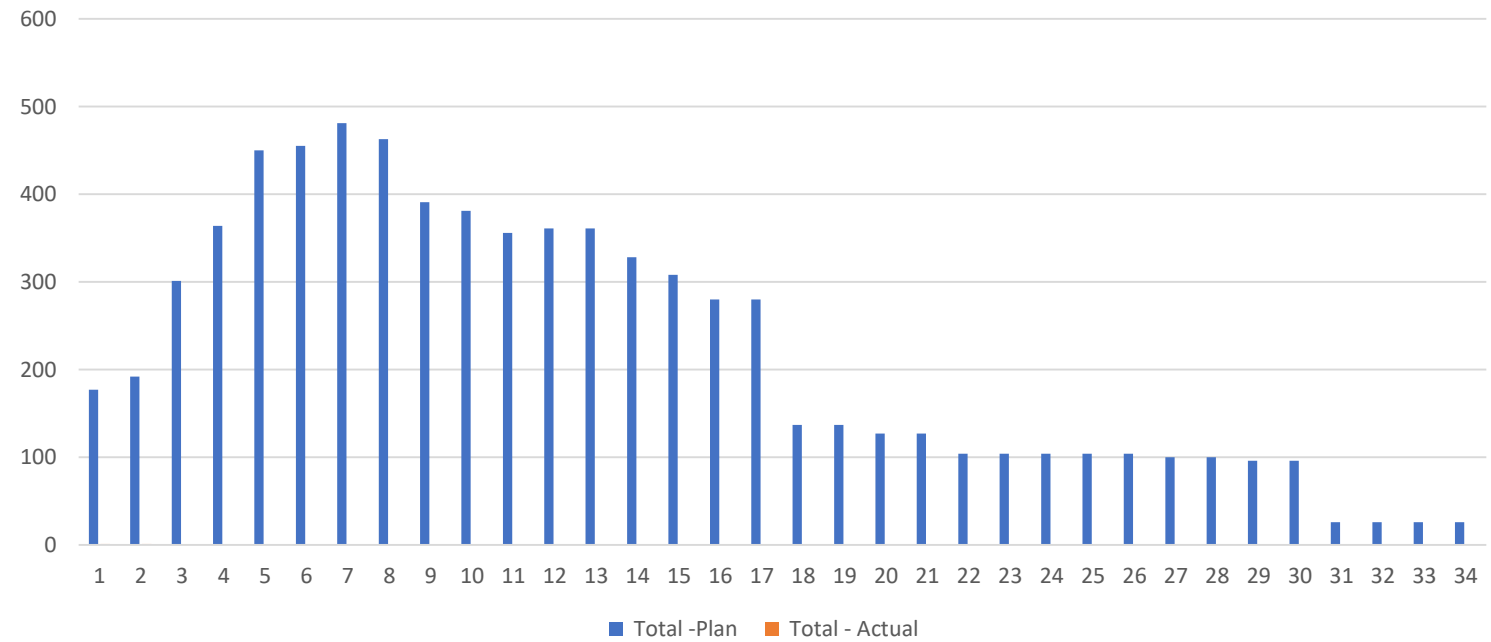
3.Manpower Schedule

[illegible]

3.Manpower Schedule



Manpower Schedule : PDS, SIG, COM



3. Equipment Schedule

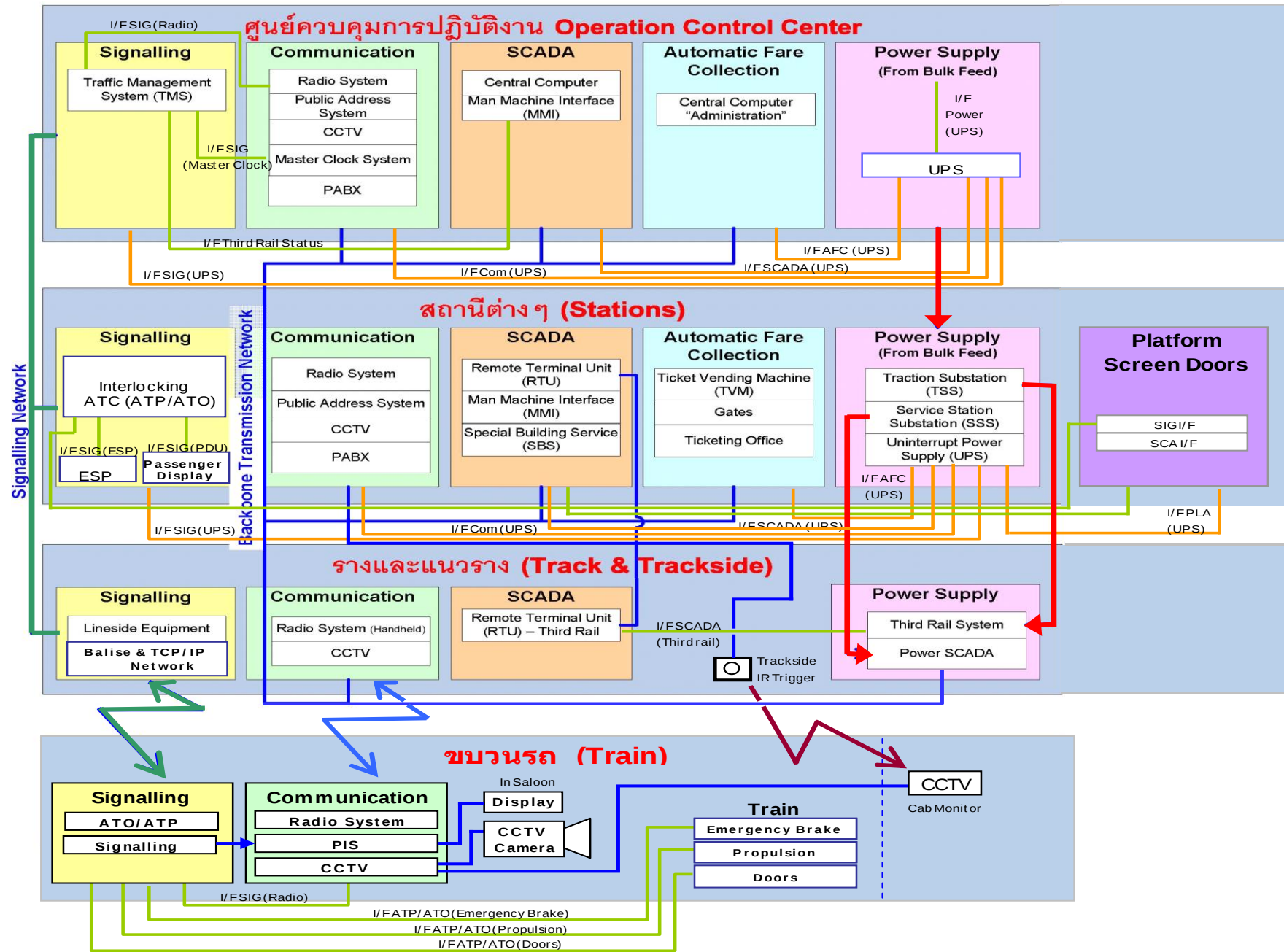
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4.Engineering and Design

- Preliminary Design
- Detail Design
- Interface



Railway Systems Diagram



Rolling Stock



Technical Train Data (3-car train)

Track gauge	1,435 mm.
Length over couplers	65,100 mm.
Width of car	3,200 mm.
Number of seat	126
Max. speed	80 kph
Power supply	750V DC/Third rail

Technical Train Data (3-car train)

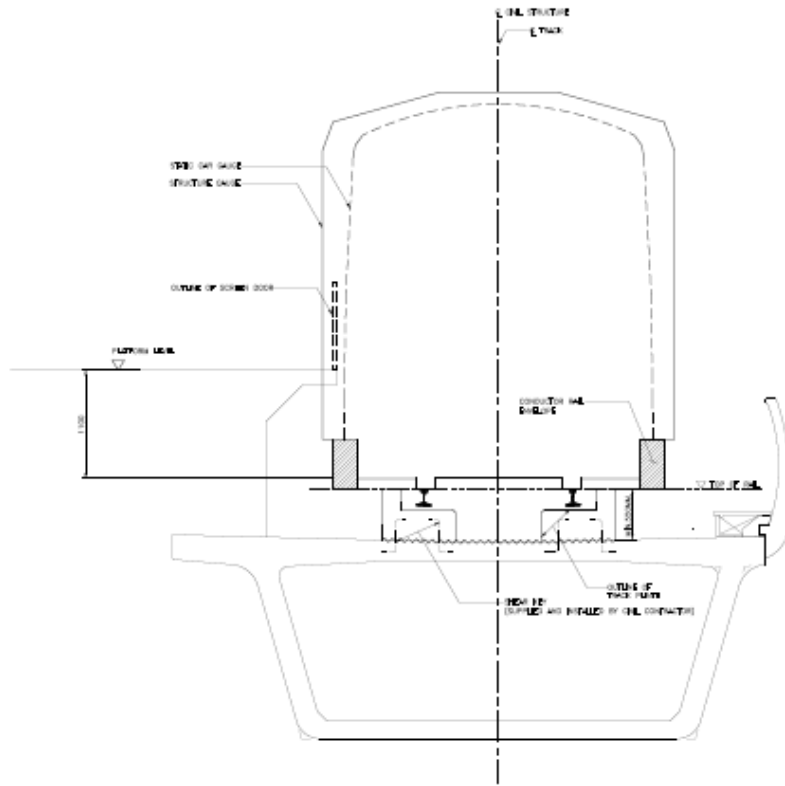
Track gauge	1,435 mm.
Length over couplers	61,020 mm.
Width of car	2,700 mm.
Number of seat	150
Max. speed	120 kph
Power supply	25 kV AC/OCS

Technical Train Data (2-car train)

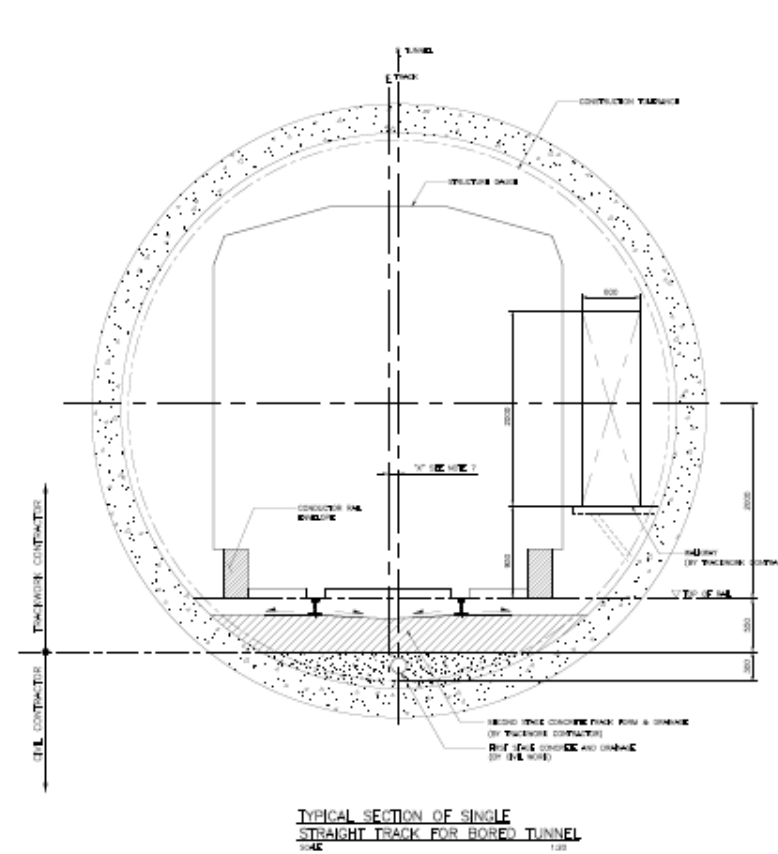
Track gauge	Guide Way
Length over couplers	11,200 mm.
Width of car	2,800 mm.
Number of standing Passenger	116
Max. speed	80 kph
Power supply	750 VDC / Power



Structure Gauge

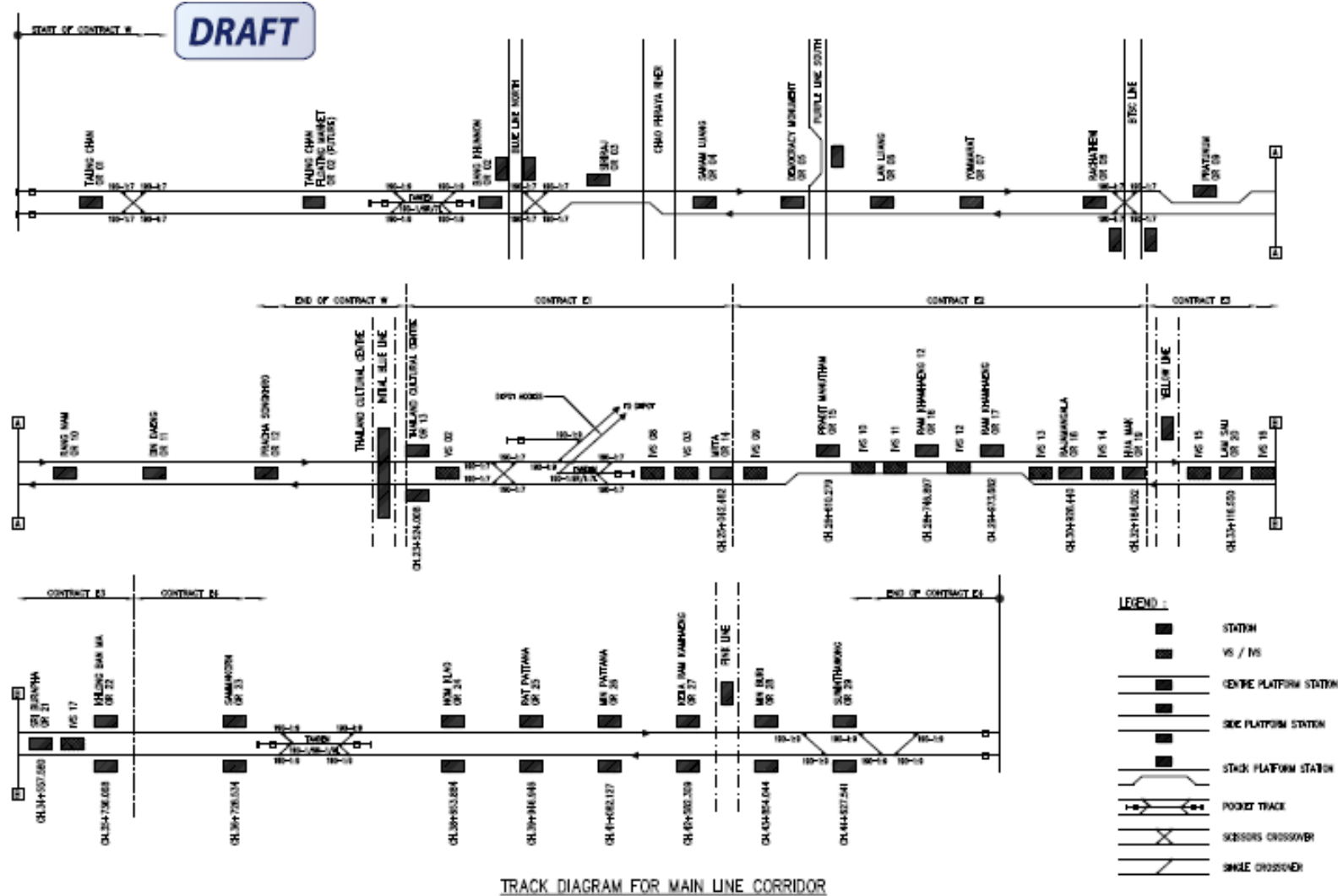


Structure Gauge - Viaduct

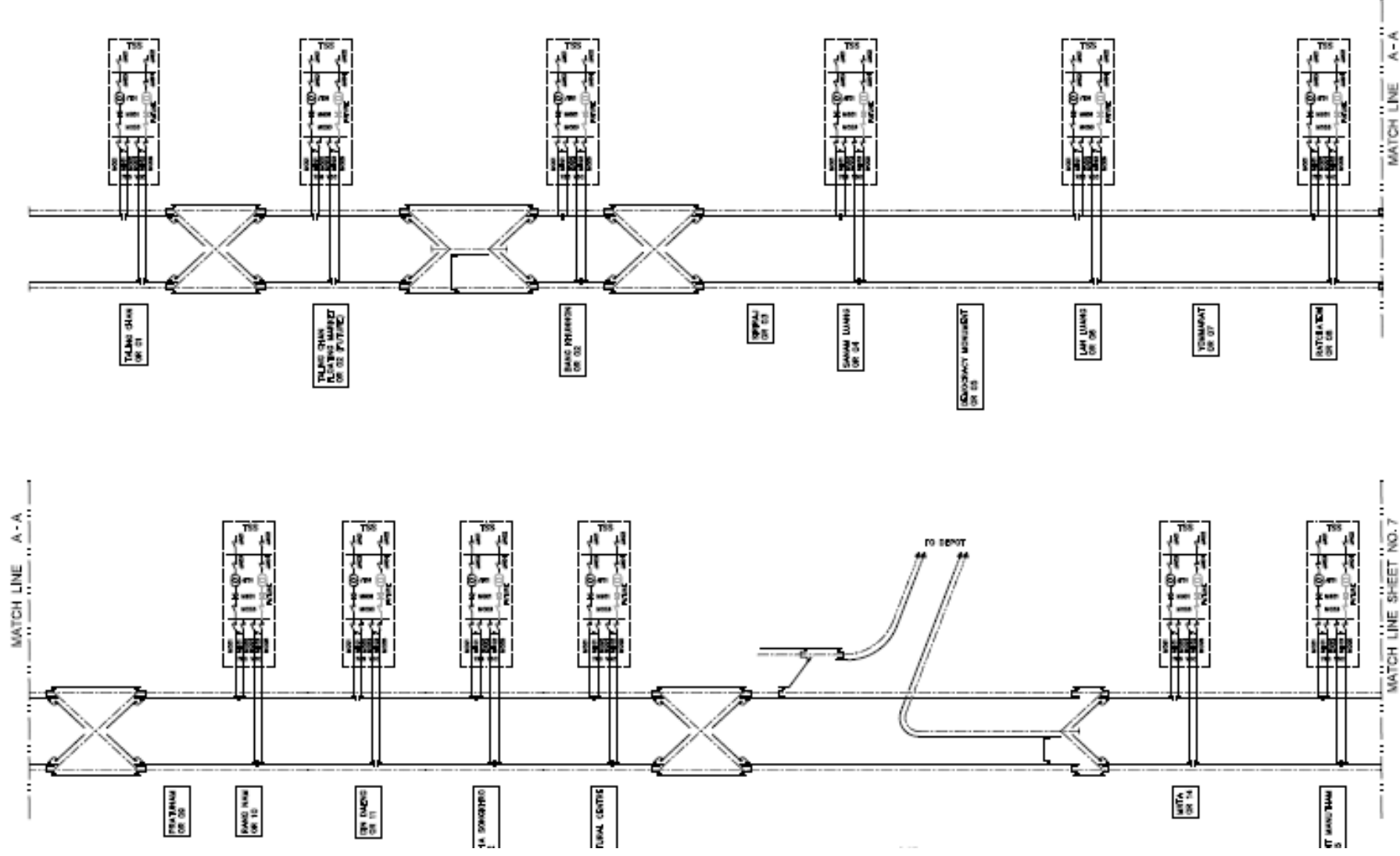


Structure Gauge - Tunnel

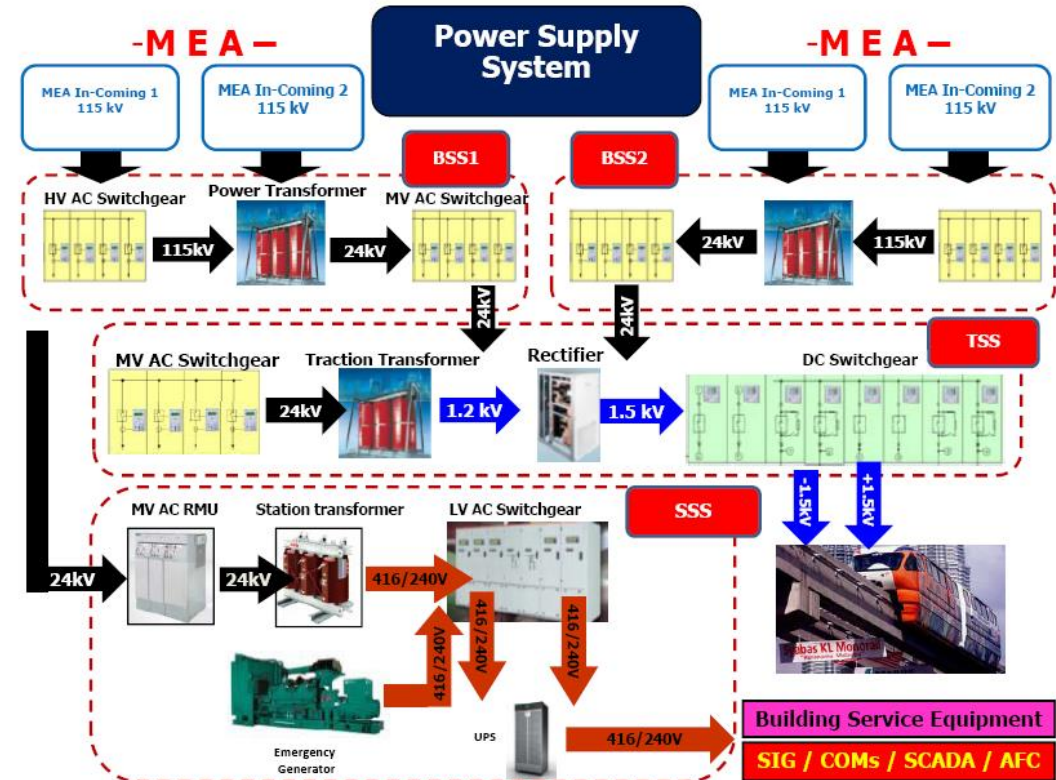
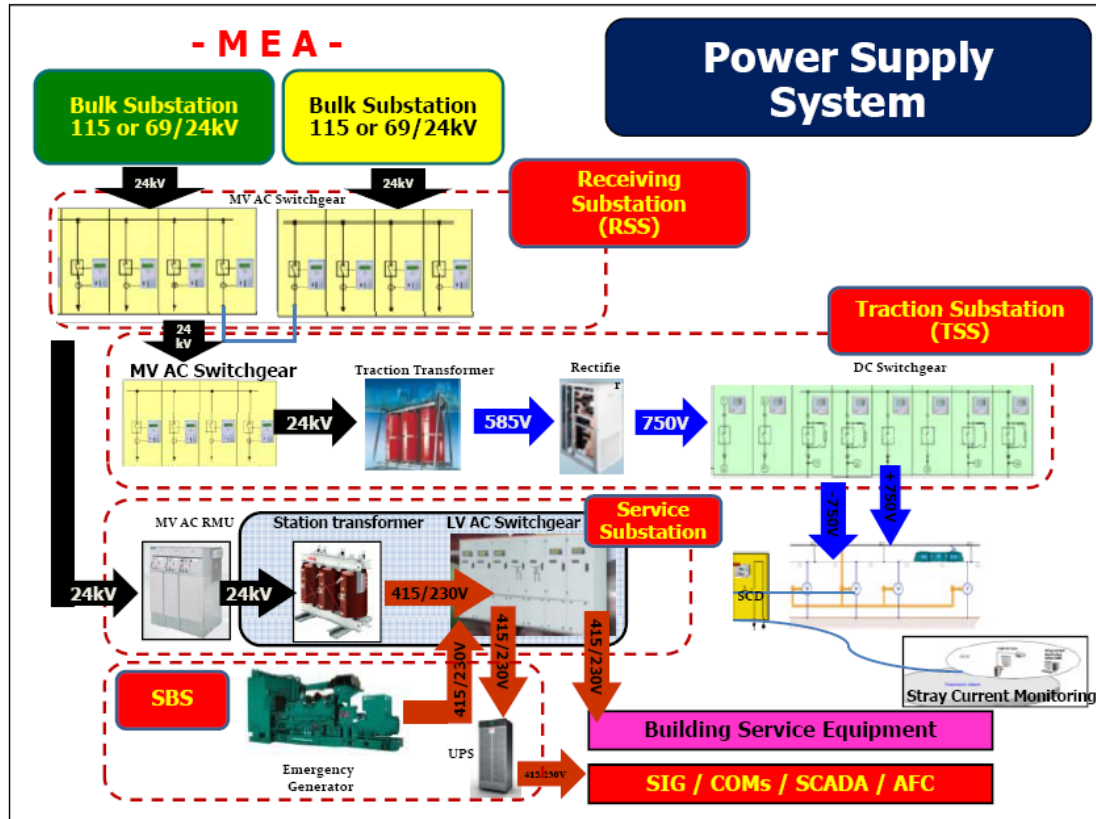
4. Track work



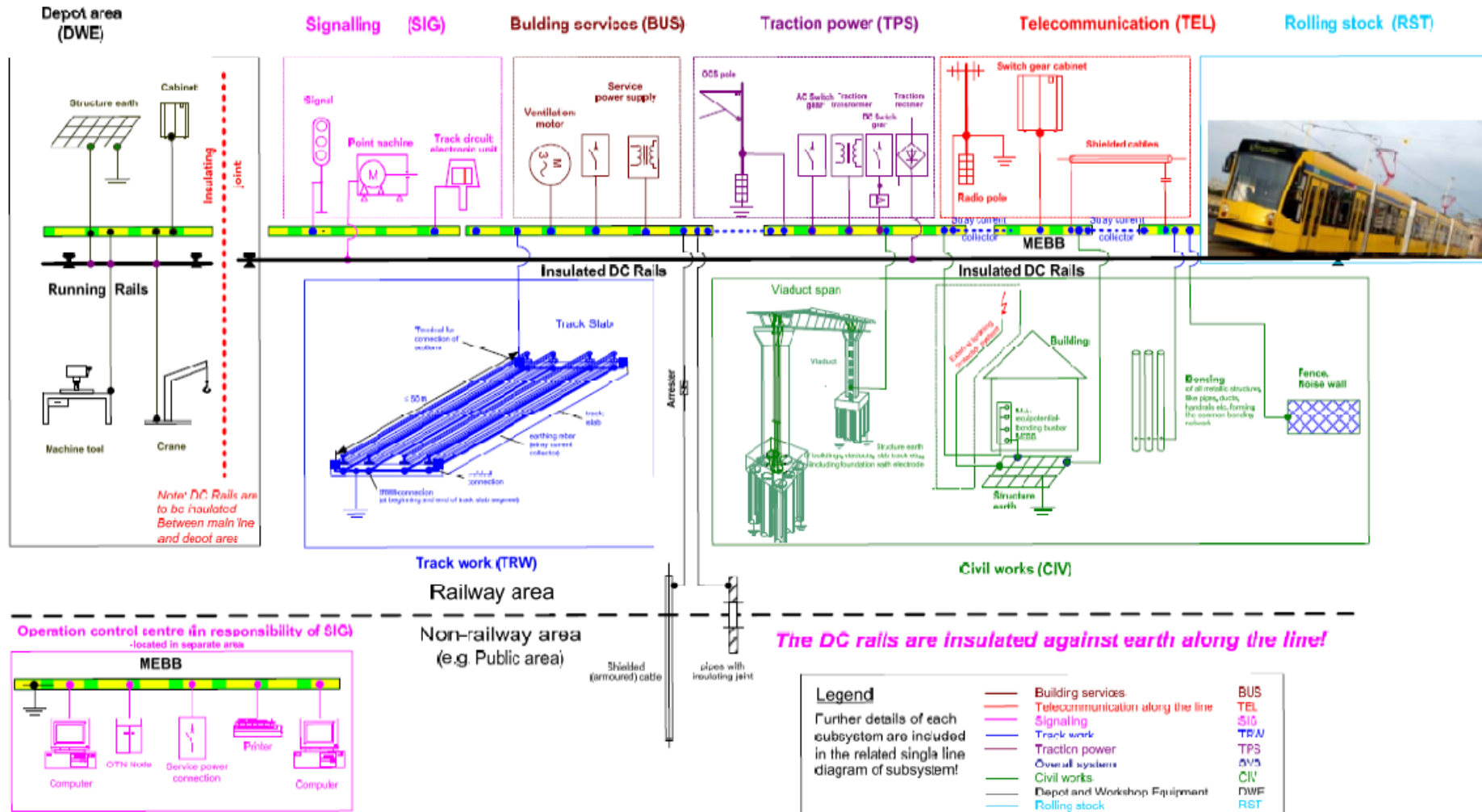
Third Rail



Power Supply



Earthing & Bonding

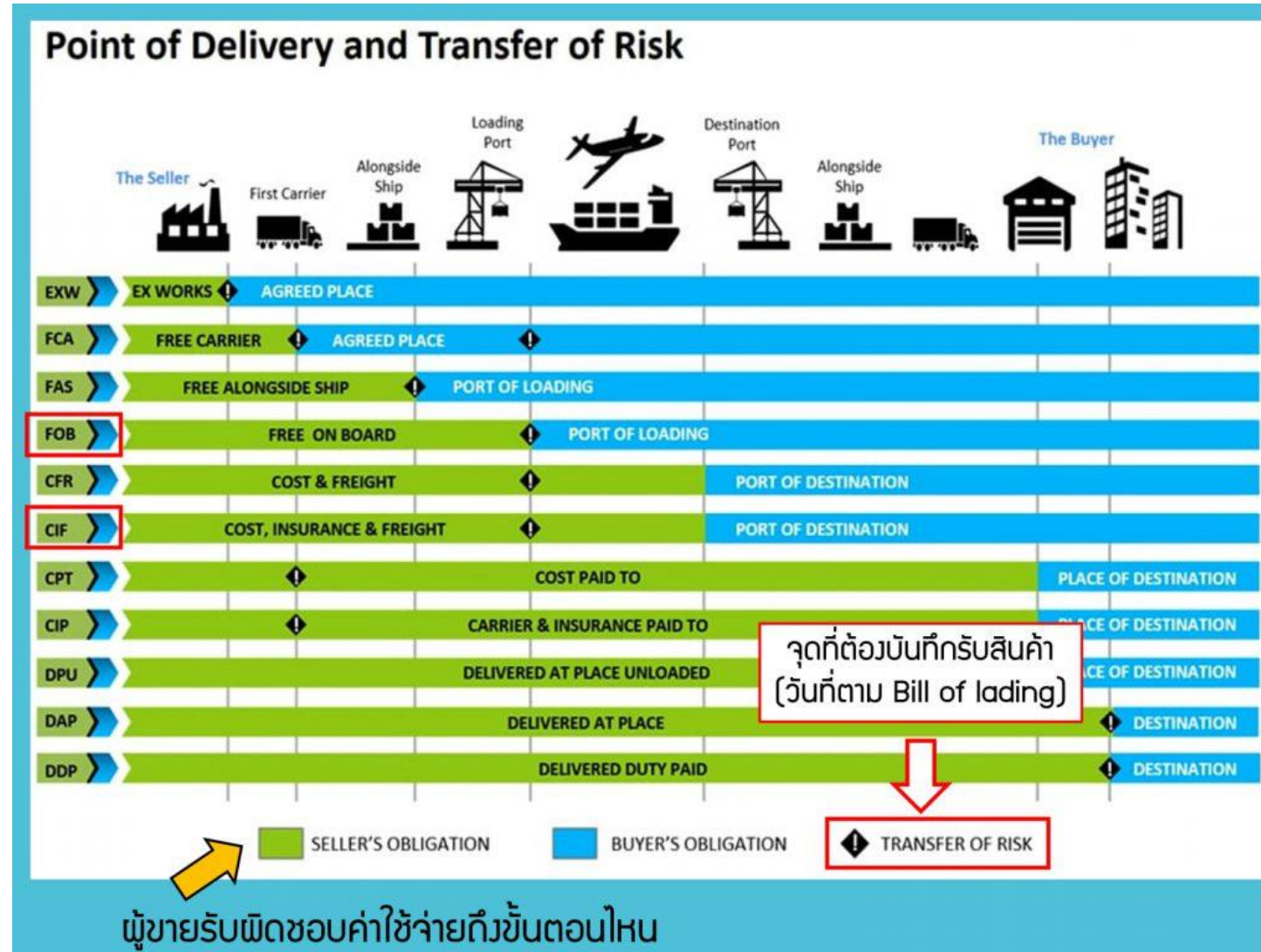


4. Interface Matrix

Railway System: Internal Interface Matrix		Railway Systems				
		SIG	COM	SCA	PSY	SBS
Railway Systems	SIG		×	×	×	×
	COM	×		×	×	×
	SCA	×	×		×	×
	PSY	×	×	×		×
	SBS	×	×	×	×	



5.Procurement



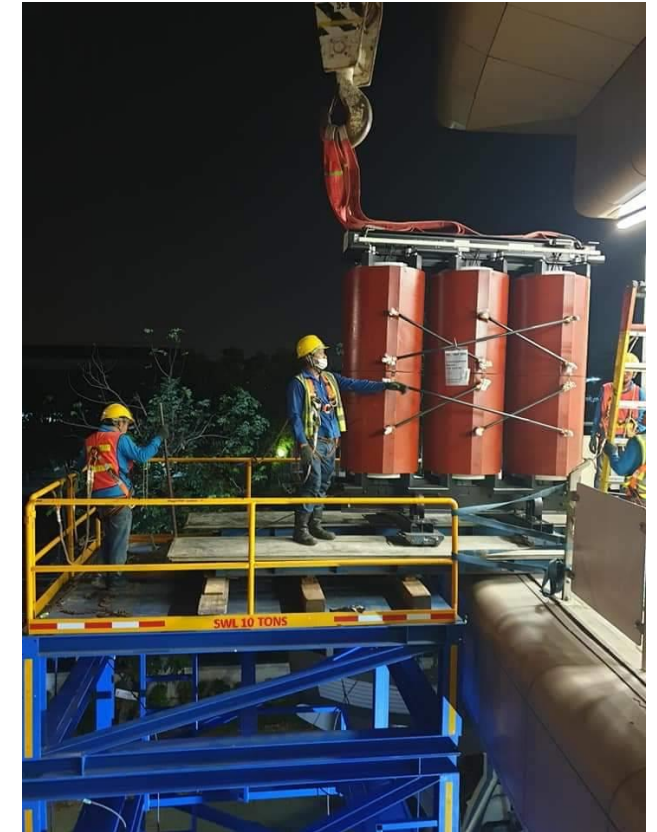
6. Manufacturing and Factory test



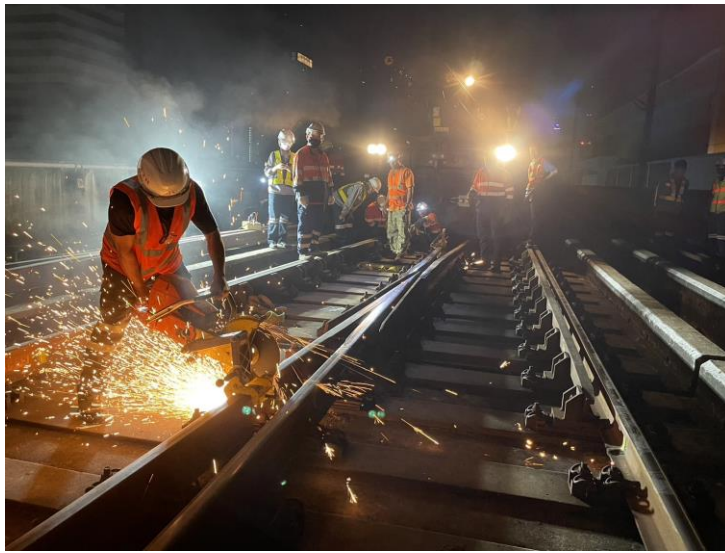
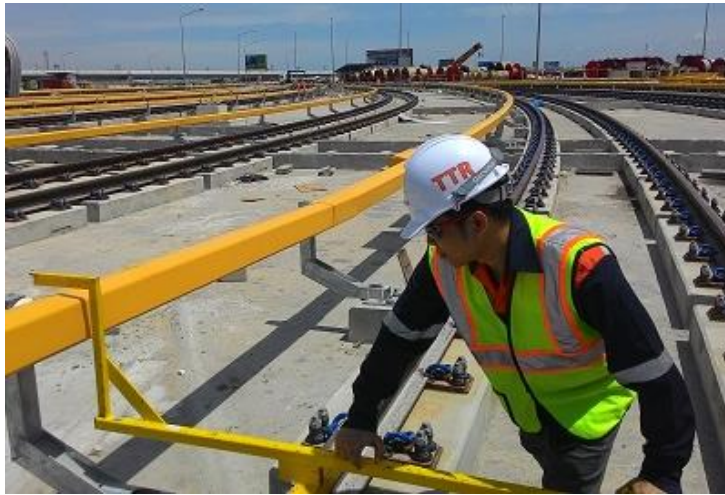
7. Installation – Transportation and Loading



7. Installation – Transportation and Loading



7.Installation – Trackwork & Third Rail



7.Installation – Trackwork & Third Rail



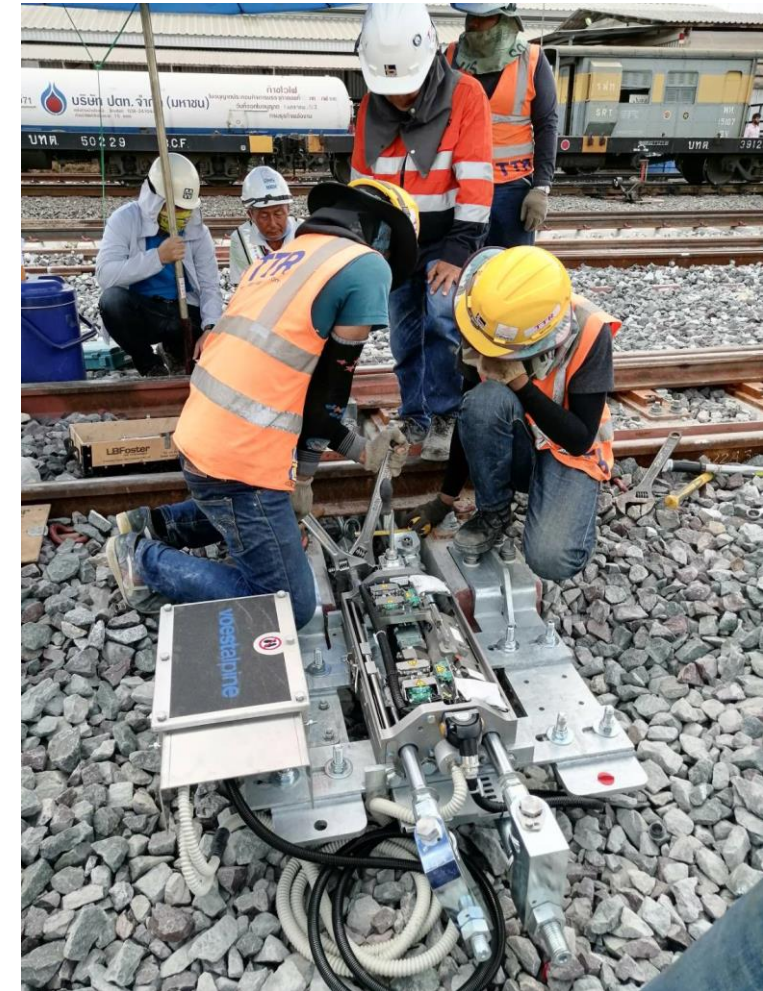
7.Installation – Power Supply



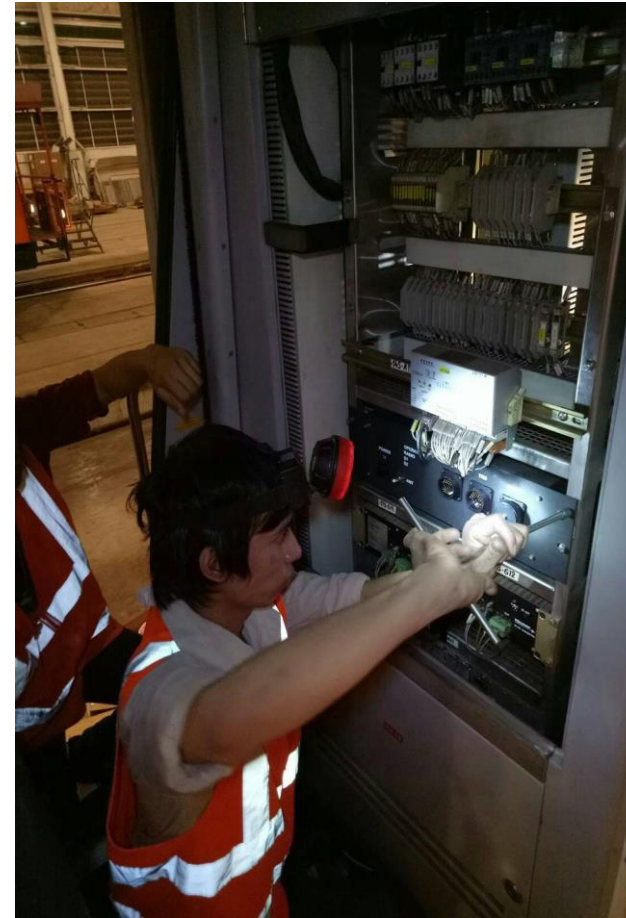
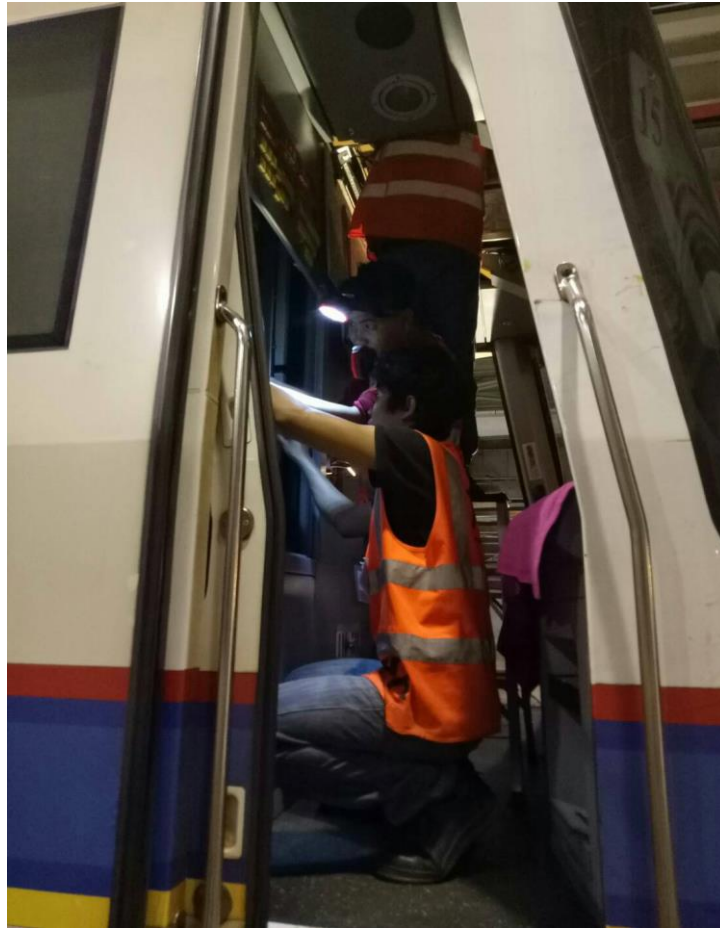
7.Installation – PSD , AFC



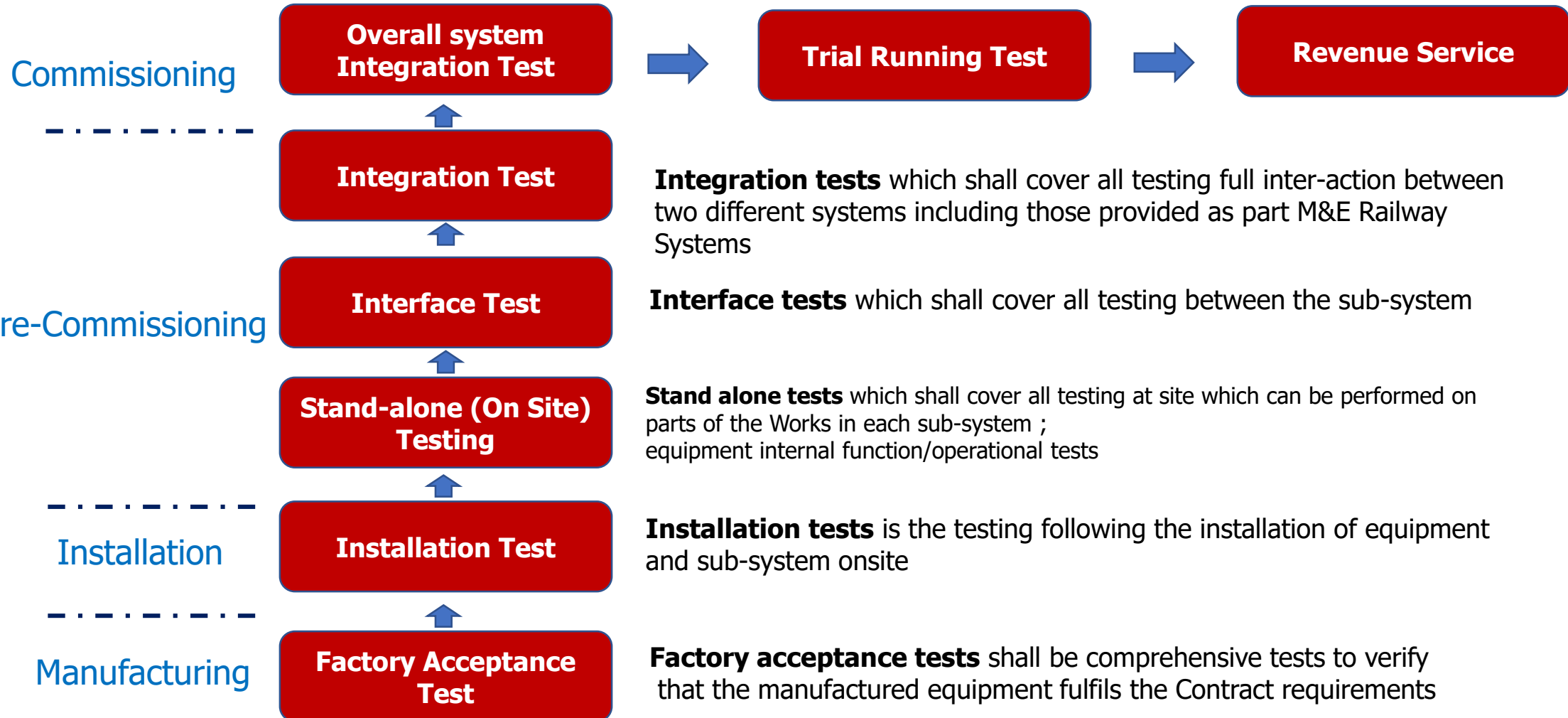
7. Installation - Signalling



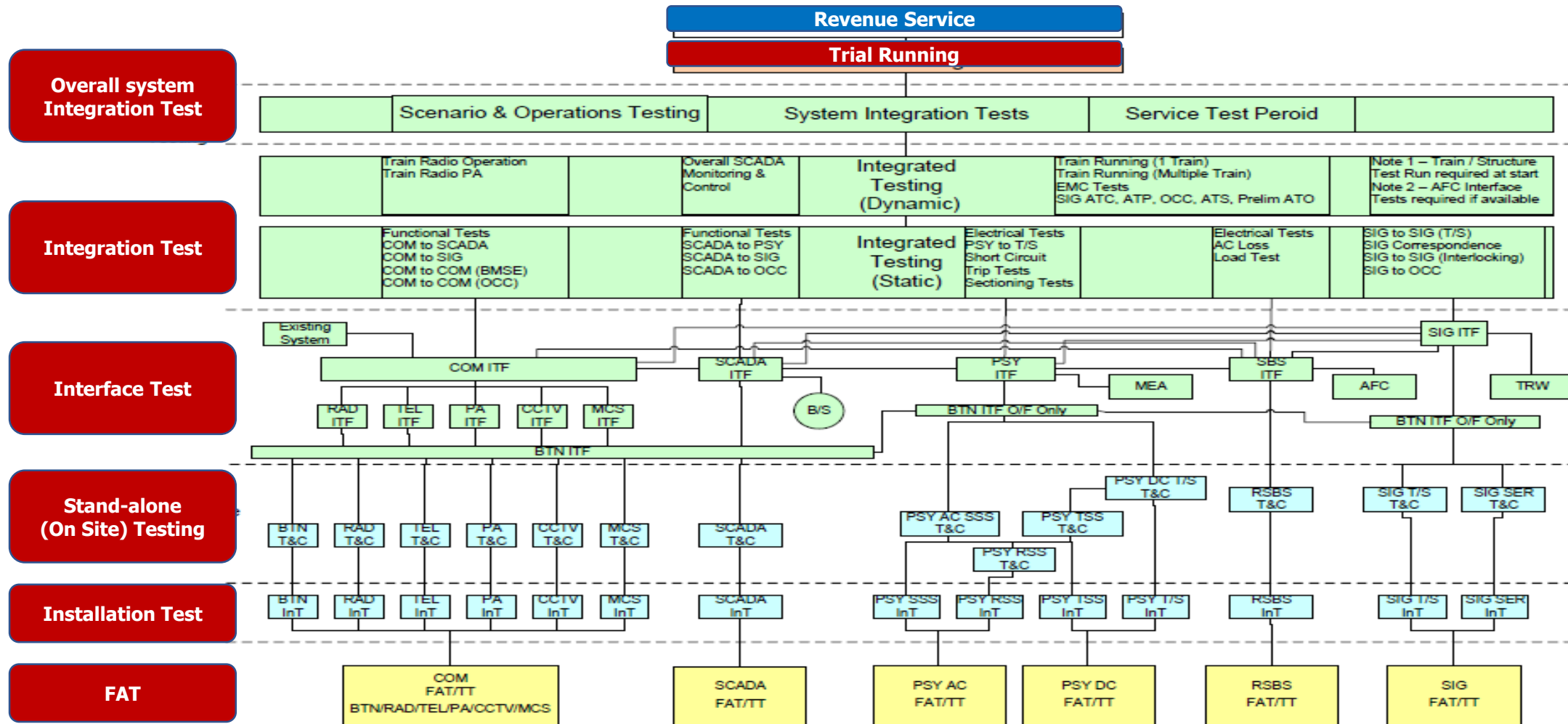
7.Installation – Rolling Stock



7. Testing and Commissioning



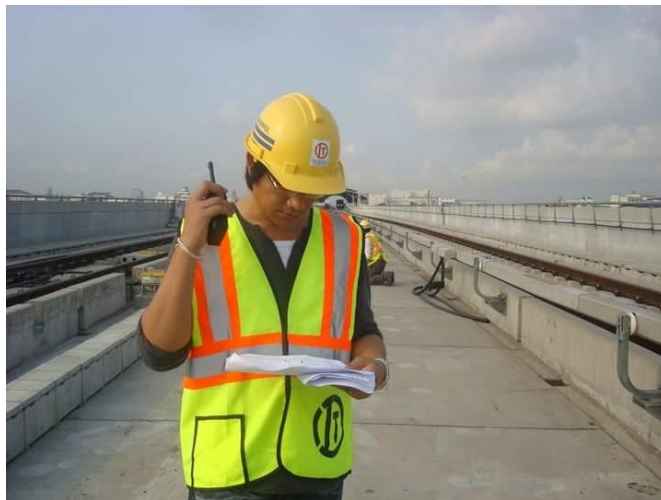
7. Testing and Commissioning



7. Testing and Commissioning



7. Testing and Commissioning



Q&A



Thank you

