

Developing Program-Based WBS and Schedule

An Integrated Mega Refinery & Petrochemical Complex
in Malaysia

About Us

- 30 years of working experience in undertaking major turnkey projects involving oil & gas development, high speed railways, steel processing plant and major infrastructural projects.
- Expert in project planning and scheduling specifically in the schedule management area including setting-up project planning system, management & control during project execution and schedule contingency quantifications through schedule risk management.
- Provides advisory and consultancy services to projects as well as contributes to the talent and competency development by the introduction of best practices.

MOHD NIZAZWAJIDI HASSAN

Technical Professional - Planning & Scheduling
PETRONAS



- More than 14 years' experience in undertaking complex projects from Front End Loading to Execution
- Provides advisory and consultancy in Project Planning and Control as Business Technical Authority.
- SME in Forensic Schedule Delay Analysis, Schedule Risk Assessment, 4D Scheduling, Advanced Work Packaging and Project Control Work Process improvement.

MAZWAN ABDUL JALAL

Technical Professional - Planning & Scheduling
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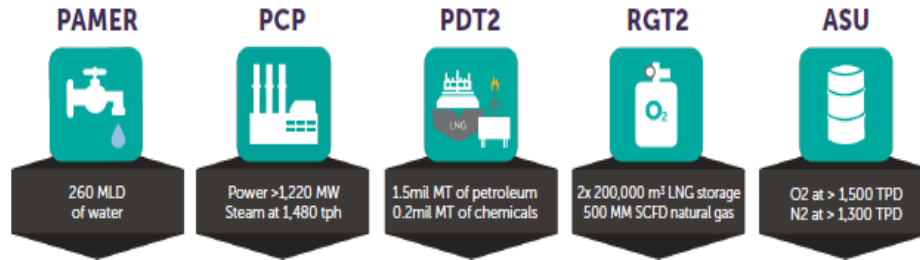
- ❑ RAPID Project Background
- ❑ Program-Based WBS
- ❑ Program-Based Schedule
- ❑ Project Challenges

Background

- ❑ In 2010, as part of PETRONAS continuous effort to sustain growth in the refining and petrochemical businesses, Project RAPID was initiated under PETRONAS Downstream to study the feasibility of having an optimum **integrated refinery and petrochemical complex**.
- ❑ A greenfield land of about **8,600 acres** spanning 7 km by 5 km, formerly used to be a mixed of palm oil estates and small villages had been transformed into an oil and gas hub. Its strategic location allows the movements of oversized and heavy lift equipment including feedstock of cargo to the site.
- ❑ At the initial stage of scope definition, a total of **more than 30 plants** had been identified in collaborations with multiple technology partners and licensors producing refined oil products, steam crackers, specialty chemicals and other support facilities including a 1,200 MW power generation plant, centralized utilities, storage tanks, solid product jetty, LNG regassification terminal, raw water supply and treatment plant, workers accommodation camps, etc. at an **estimated total project cost of USD27 billion**.
- ❑ This presentation intends to share our experience in planning and structuring this massive work, developing the WBS and EPCC Schedules for project of this mega-scale and complexity using an **integrated program-based approach**.

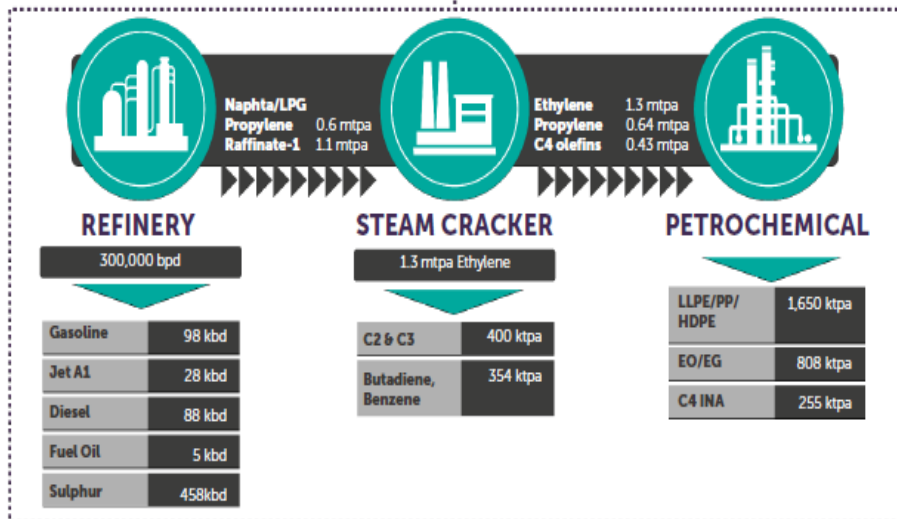
RAPID Project Information

The PIC project is the largest fully integrated petrochemical complex in **PETRONAS**



UTILITIES & FACILITIES

USD **27** BILLION
IN INVESTMENT



RAPID COMPLEX

~**160** million m³ of Earthwork

Equivalent to **3x** Kuala Lumpur International Airport

~**4,450** km of Piping

Equivalent to distance from **KL** to **Pakistan**

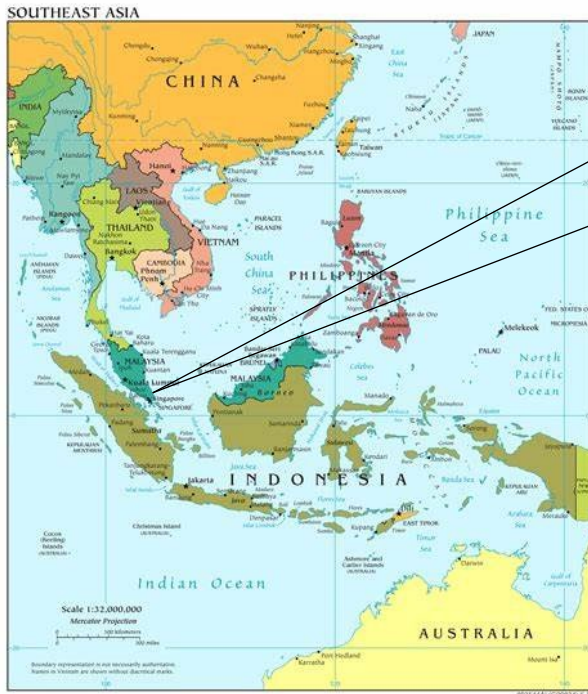
~**10** mill DI of AG piping

620 km of UG piping

24,000 km of Electrical & Instrumentation Cables

Equivalent to distance from **North Pole** to **South Pole**

RAPID Project Overview & Location



REFINERY PROCESS PLANTS

1. Crude Distillation Unit, CDU
2. Saturated Gas Plant, SGP
3. Atmospheric Residue Desulfurization Unit, ARDS
4. Residue Fluidized Catalytic Cracking, RFCC
5. Propylene Recovery Unit, PRU and LPG Treating Unit, LTU
6. Cracked Naphtha Hydrotreaters, CNHT
7. Naphtha Hydrotreating, NHT
8. Continuous Catalytic Reforming, CCR
9. Kerosene Hydrotreating, KHT
10. Diesel Hydrotreating, DHT
11. Sulphur Recovery Unit, SRU
12. Hydrogen Production Unit, HPU
13. Tertiary Amyl Methyl Ether, TAME
14. Isomerization Unit, Isom

STEAM CRACKER PROCESS PLANTS

1. Steam Cracker Unit, SCU
2. Pygas Hydrotreater, PGH
3. Benzene Unit, BZU
4. Butadiene Unit, BDU
5. Methyl Tertiary Butyl Ether, MTBE

PETCHEM PROCESS PLANTS

1. Polypropylene Spherizone Unit, PP (SPZ)
2. Polypropylene Spheripol Unit, PP (SPH)
3. High Density Poly Ethylene, HDPE
4. Linear Low Density Poly Ethylene, LLDPE
5. Ethylene Oxide, Ethylene Glycols, EOEG
6. Isononanol Unit, INA

GAS & POWER

1. Pengerang Cogeneration Plant (PCP)
2. Regasification Terminal 2 (RGT2)
3. Air Separation Unit (ASU)

CAMP & FACILITIES

1. The HIVE: 1,544 rooms; SPC: 2,707 beds
2. Management Offices: 1,500 capacity
3. Multipurpose Hall (1,000 seating)
4. Common Facilities: Clinic, Mini Mart, Cinemas, Mosque, Surau, Launderette, Gym, Sports Facilities
5. Contractors Site Accommodation: 40,000 capacity

STORAGE CAPACITY (RAPID + PDT2)

1. Crude: 802,000 m³
2. Petroleum: 914,000 m³
3. Petrochemicals: 284,000 m³

RAPID Project

- Work Breakdown Structure (WBS)

RAPID Project Work Breakdown Structure (WBS)

- RAPID Project WBS is based on units and geographical zones. Each zone is comprised of several Groups including one or several units.
- The geographic groups have been split in 4 levels as follows, with 4 associated digits corresponding each to a specific level:

Level 0 : Industrial Zone : no digit (only to indicate the maximum group considered). Industrial Zone is considered as grouping of independent Plants: RAPID Complex, LNG Regasification Terminal (RGT2), Pengerang Deep Water Terminal (PDWT), Pengerang Cogeneration Plant (PCP) and others.

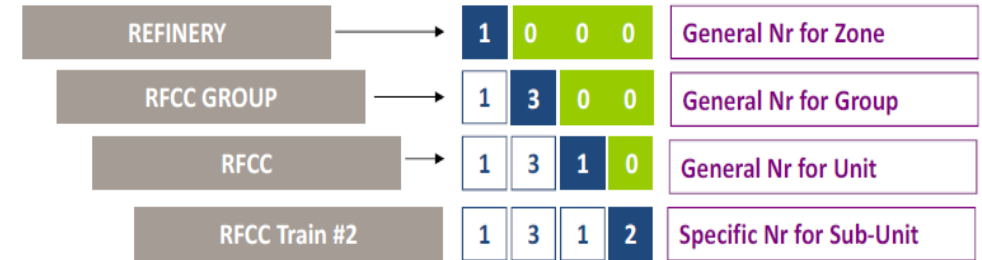
Level 1 : 1st digit : Zone (whether in RAPID Complex or not)

Level 2 : 2nd digit : Group

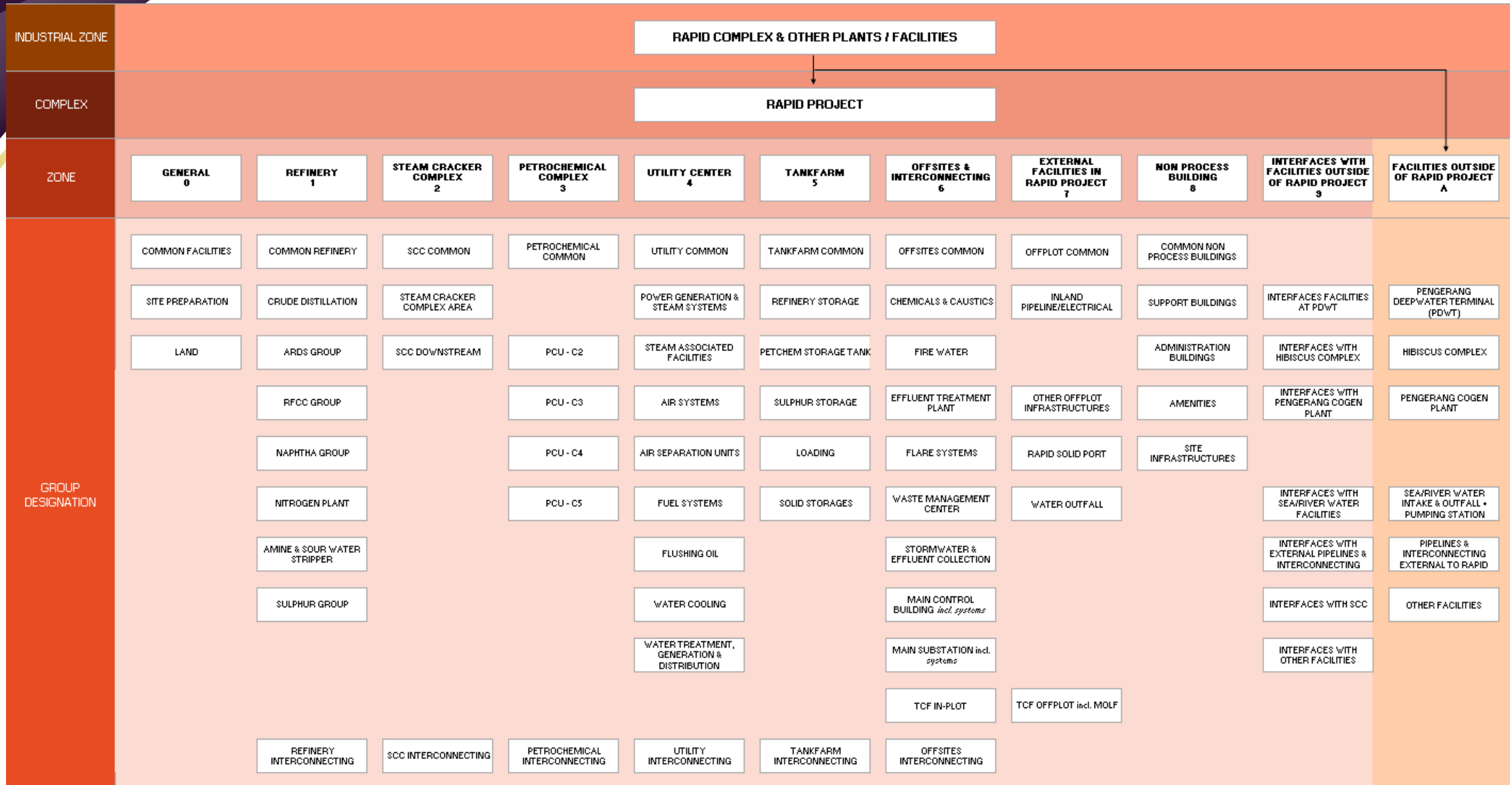
Level 3 : 3rd digit : Unit (main)

Level 4 : 4th digit : Unit or Train

Example with RFCC unit with possible extension for a second train:



RAPID Project Work Breakdown Structure



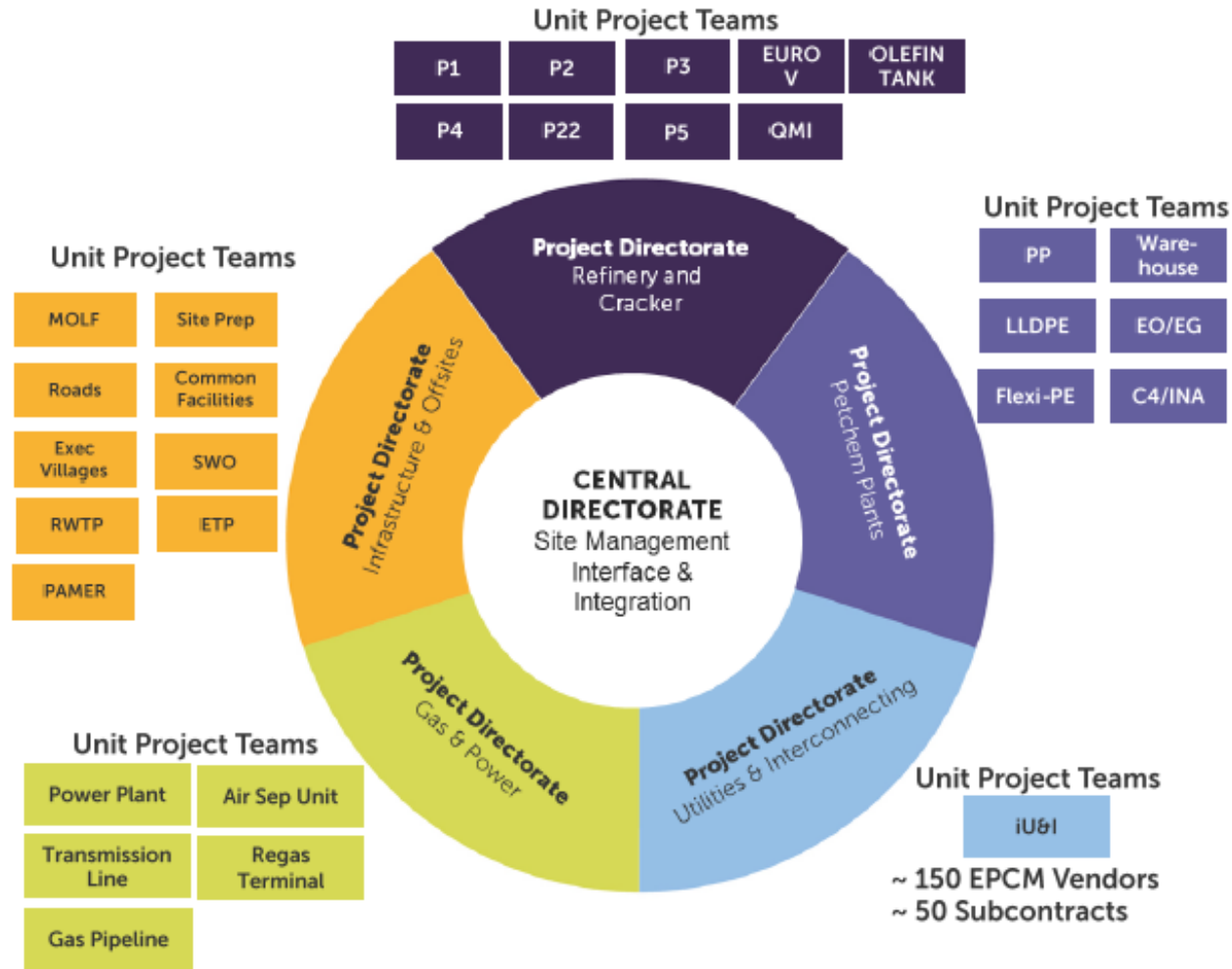
RAPID Project Work Breakdown Structure (Detailed)

INDUSTRIAL ZONE	COMPLEX	ZONE	GROUP DESIGNATION	GROUP No.	UNIT No.	UNIT CODE	UNIT DESIGNATION	EPCC Package as per OCS		
RAPID COMPLEX & OTHER PLANTS / FACILITIES	RAPID COMPLEX OVERALL PROJECT	GENERAL 0	COMMON	0001		-	COMMON FACILITIES			
			-RESERVED-	0031 to 0039		-	RESERVED			
			SITE PREPARATION	0010		-	SITE PREPARATION			
			LAND	0100	0100	-	LAND for Complex			
					0130	-	LAND for Camps/ Temporary Areas			
		REFINERY 1	REFINERY COMMON	1000	1000	-	Common Refinery Facilities			
			CRUDE DISTILLATION GROUP	1100	1110	CDU	Crude Distillation	EPCC 2		
					1120	SGP	Saturated Gas Plant	EPCC 3		
			ARDS GROUP	1200	1210	ARDS	Common Atm. Residue Desulphurization		EPCC 2	
					1211		ARDS Unit 1			
					1212	ARDS Unit 2	EPCC 3			
					1220	DHT		Diesel Hydrotreating		
					1230	KHT		Kerosene Hydrotreating		
			RFCC GROUP	1300	1310	RFCC	Common Residue Fluid Catalytic Cracking		EPCC 1	
					1311		RFCC Unit 1			
					1312	RFCC Unit 2				
					1320	LTU	LPG Treating Unit			
					1330	PRU	Propylene Recovery			
					1340	CNU	Caustic Neutralization			
			NAPHTHA GROUP	1400	1410	CNHT	Cracked Naphta Hydrotreating		EPCC 3	
					1420	NHT	Naphtha Hydrotreating			
					1430	CCR	Continuous Catalytic Reformer			
			HYDROGEN PLANT	1500	1510	HPU	Common Hydrogen Production		EPCC 3	
					1511		HP Unit 1			
					1512		HP Unit 2			
					1513		HP Unit 3			
					1520	HCDU	Hydrogen Collection & Distribution			EPCC 2
					1530	RPSA	Common Refinery Pressure Swing Absorption			EPCC 3
					1531		CCR RPSA			
					1532		ARDS RPSA			
			1533	SGP RPSA						
			AMINE & SOUR WATER GROUP	1600	1610	ARU	Common Amine Regeneration		EPCC 4	
					1611		Amine Regeneration Unit 1			
					1612		Amine Regeneration Unit 2			
					1620	SWS	Common Sour Water Stripping			EPCC 4
					1621		Sour Water Stripping Unit 1			
					1622		Sour Water Stripping Unit 2			
			SULPHUR GROUP	1700	1710	SRU	Common Sulphur Recovery & TGT		EPCC 4	
		1711			SRU Unit 1					
		1712			SRU Unit 2					
		1713			SRU Unit 3					
		1714			Tail Gas Treatment 1		NA (Future Expansion)			
		1715			Tail Gas Treatment 2					
		1716			Tail Gas Treatment 3					
		1730			LSSU	Liquid Sulphur Feed Storage		EPCC 4		
		1740			SSU	Common Sulphur Solidification				
		1741				Sulphur Solidification Unit 1				
1742	Sulphur Solidification Unit 2									
1743	Sulphur Solidification Unit 3									
1744	Sulphur Solidification Unit 4									
REF. INTERCONNECTING	1300	1900	REI	Refinery Interconnecting		EPCC 3				

Some key contracting strategies considered :

- Technical and complexity of packages
- Clear battery limits and geographical arrangement to minimize interfaces
- Intellectual Property Licensing restrictions
- Package size (Between USD 1 to 2 billion) to minimize competition among EPCC bidders

RAPID Project Management Concept for Delivery



Central Directorate

- Leadership for Overall Complex Interface & Integration
- Management of Common Infrastructure & Services
- HSSE, Technical & Quality Assurance
- Regulatory Approval

Project Directorate

- Leadership of project delivery under the cluster

Unit Project Team

- Management & delivery of individual EPCC Packages

RAPID Project

- Integrated Master Schedule

RAPID Integrated Master Schedule – Schedule Development Basis



RAPID Integrated Master Schedule – Key Interfaces

Construction Interfaces

- Site Preparation
- MOLF (Marine Off-Loading Facilities) & Haul Road
- Temporary Camp Facilities (TCF)
- HV Power Supply
- Water Supply
- Fuel Gas Supply
- Effluent Treatment
- Export Terminal

Design Interfaces (Required From EPCC Packages)

- Utility consumption freeze for design
- Power Consumption
- Effluent Production
- DCS Input To MAC (Main Automation Contractor)
- Flare Load
- Interface points at package battery limits

RAPID Integrated Master Schedule – Schedule Development Process

Statistic Evaluation Method

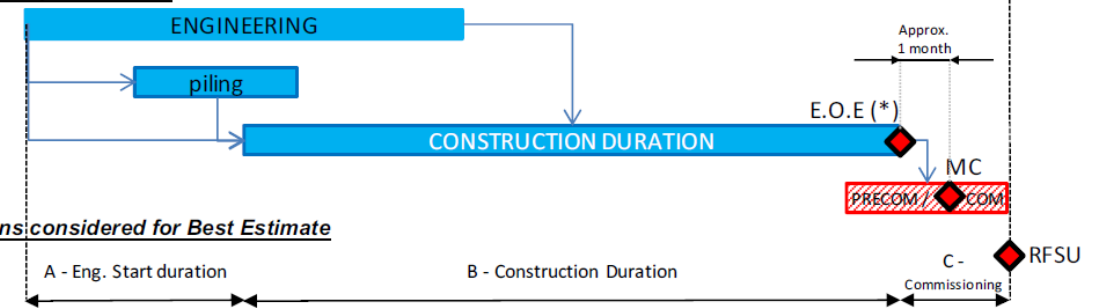
- Statistical past performed projects
- Similar mega size projects
- Excluding night shift and fast track projects

EPCC Package	Description	Construction Month Start (A)	Construction Duration (B)	Duration (EOE to MC) (C)	Commission Duration After Last MC (D)	Overall EPCC (A)+(B)+(C)+(D)
#1	RFCC, PRU, LTU	9	32.5	1	2.5	45
#2	CDU, ARDS, HCDU	9	32	1	2	44
#5	Steam Cracker Complex	9	32	1.5	2	44.5
#6	LDPE, LLDPE	10.5	27	1	2	40.5
#11	EOEG	9	27.5	1	2	39.5
#14	Utilities & Interconnecting	7	39	0.5	0.5	47
#16	Effluent Treatment	10	19	1	3	33
#22	Refinery Storage	8.5	28	1	0.5	38

Summary Representation



Detailed Representation



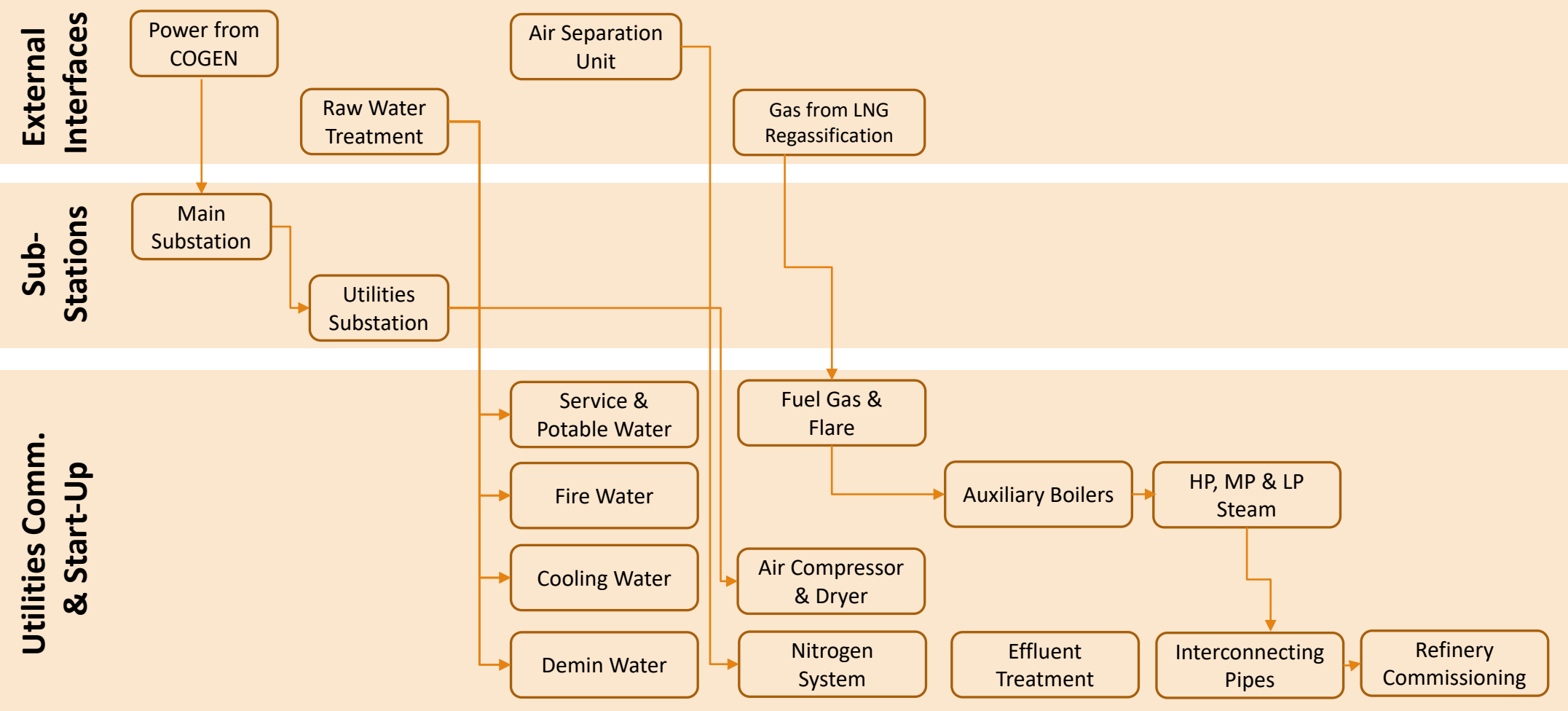
Durations considered for Best Estimate

Note (*): End Of Erection, corresponding to the completion of all equipment, piping, electrical and instrumentation, excluding precom testing

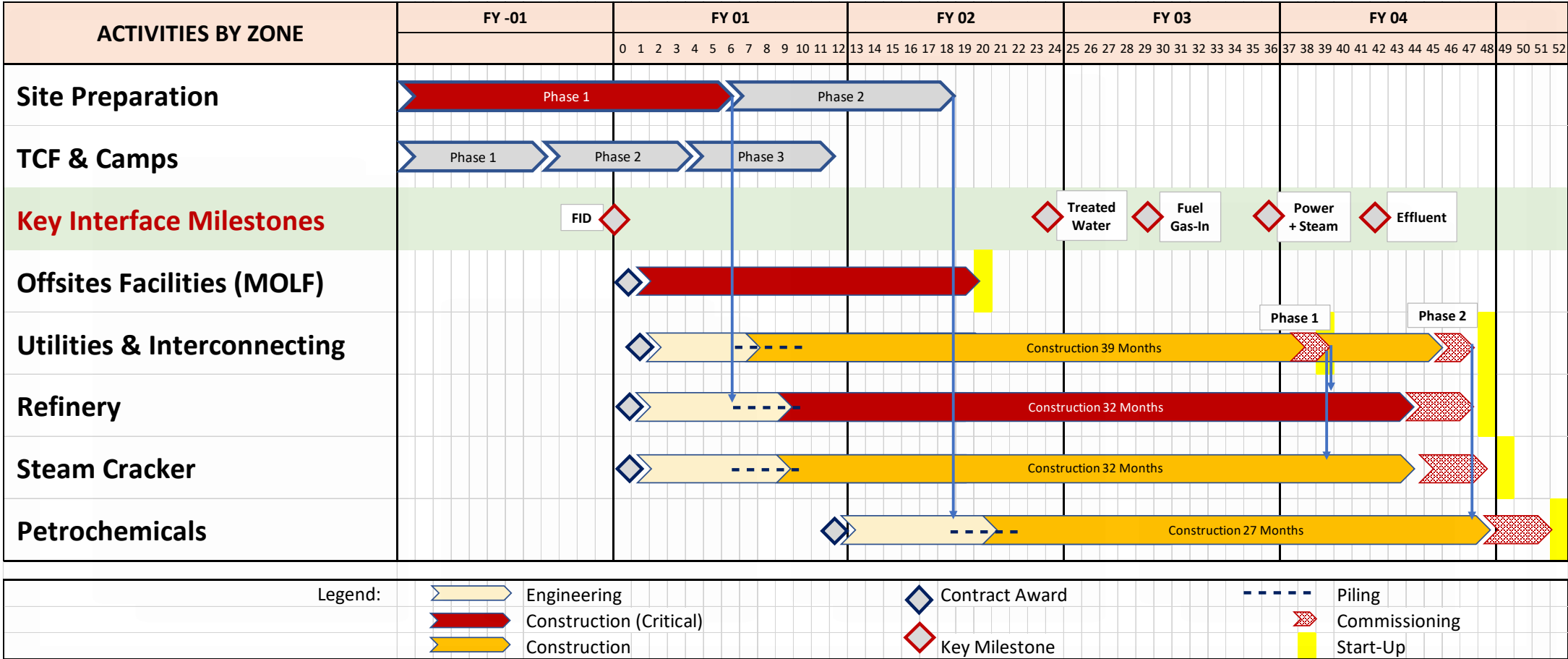
EPCC “Best Estimates” duration breakdown

- A – Engineering lag duration to support start of Construction
- B – Significant start of Construction to end of erection
- C – Commissioning duration to reach Ready-For-Start-Up

RAPID Integrated Master Schedule – Utilities Commissioning & Start-Up Sequence



RAPID Integrated Master Schedule – Best Estimates Summary Schedule



RAPID Integrated Master Schedule – Project Challenges

- Multiple bidding and contract awards
- Intellectual Property Licensing restriction
- Finalization of Utility Demand
- Delay in villages relocation
- Local and specialized market overload
- Early power & water requirement
- Material offloading facility and haul road congestion

THANK YOU