

MODULAR OPTIMIZATION

CASE 780: Cofely Fabricom reduces man hours by over 20% at TOTAL's "OPTARA" Project.

OPTARA (Optimization of The Antwerp-Rotterdam-Amsterdam area) is a refining project worth approximately 700 million euro. The Antwerp refinery, TOTAL's largest and Europe's second largest refinery complex, required an upgrade to produce less heavy fuel oil and more diesel and gas oil with ultra-low sulfur content.

The Total Antwerp Refinery (TRA) has a total capacity of 18 million tonnes per year and 360,000 barrels per day of crude oil. Crude oil, with a low or high sulfur content, is unloaded by supertankers at the Rotterdam MET Terminal, and transported to the TRA by pipeline. The TRA produces gasoline, diesel and kerosene for the European and American markets, as well as other base products such as naphtha, butane and aromatics for the petrochemicals sector.





A new solvent de-asphalting unit and the conversion of an existing desulfurization unit into a hydrocracking unit are scheduled for final commissioning in 2016. Contracting partners include:

KBR: ROSE solvent de-asphalting technology

- ▶ Designed to split 48,000 barrels-per-stream-day of residue from a mix of crude oils into de-asphalted oil (DAO) and asphaltene. The DAO will be upgraded in a mild hydrocracking unit and the asphaltene blended into fuel oil.

Fluor: FEED

Tecnicas Reunidas: EPC

GE: Compressor supply and integration.

Fluor Identifies Need to Move From Stick-Built to a Modular Design

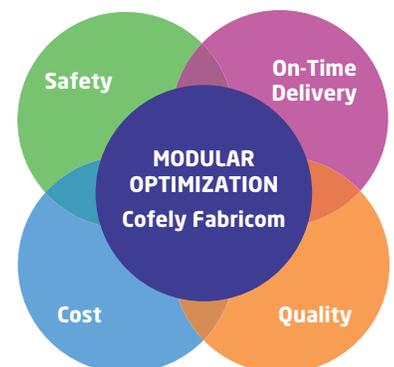
Initially, TOTAL had mandated FLUOR to undertake the FEED for the OPTARA Project. Whilst carrying out the FEED, FLUOR came to the conclusion that a basic stick-built design for this project wasn't optimal as it could result in high costs, important safety hazards and major delays. FLUOR recommended an optimization of its initial stick-built design through modularization.

TOTAL turned to Cofely Fabricom, well-known for its over 25-years experience in modularization, to understand whether an increased modularization of FLUOR's stick-built design could allow a substantial reduction in costs, safety risks and delays.

Optimization Challenge

The OPTARA Project entailed major challenges, which could not be overcome with the initial stick-built design provided, such as:

- 1. Safety** – A refinery represents a dangerous work environment. “Hot work”, such as welding, becomes particularly risky if performed directly on-site. The more interference with refinery operations, the higher the safety risks.
CHALLENGE: Reduce the safety risks.
- 2. Cost** – On-site construction generally requires temporary and partial shutdowns, in order to guarantee workforce safety. Shutdowns come at a high cost for TOTAL as they negatively impact production of the refinery.
CHALLENGE: Reduce the need for shutdown turnaround events.
- 3. On-time delivery** – Complex and dangerous on-site construction work may lead to lower work efficiency and delays in the execution schedule. For instance, obtaining all required permitting for the performance of “Hot work” at the plant can prove to be a long and complicated process.
CHALLENGE: Guarantee on-time-delivery.
- 4. Quality** – Guaranteeing the quality of work performed on-site at the refinery represents a real challenge, as controlled conditions for efficient work cannot be ensured.
CHALLENGE: Reduce the percentage of work performed on-site to increase the overall quality.



Maximize Off-Site Work Through Enhanced Plant Modularization

Cofely Fabricom implemented the initial analysis of OPTARA project with the FPMS project management system delivering TOTAL an optimized design to reduce more than half of the onsite construction work - in terms of direct on site man-hours. Modularization was maximized in order to limit on-site construction work to the following:

- All civil activities
- The transportation and installation of modules
- The piping connection/spools and Site welds
- Electrical & Instrumentation final cable pulling and connections
- Final testing and Mechanical Completion

Table 1 describes how man-hours are distributed between off-site (at module yard) and on-site work in from the initial stick built design and the new integrated modular design. In the modular design, the off-site/yard work is almost tripled in comparison to the stick built design accounting for 40% of total man-hours (or 49% of total direct man-hours) while in the stick built design, it only accounts for 14% of total man-hours, as 69% of the work is performed on-site.

Moreover, as off-site work is performed at the module yard, in a safe and controlled environment, working efficiency is increased, and overall man-hours decreased: In the OPTARA Project, the modular design requires 352,800 man-hours less (i.e. ~ 20% less man-hours) than the stick built design. As a result, *thanks to Cofely Fabricom's modularization strategy*, the overall cost of the project is significantly reduced and greater safety and quality are guaranteed.

Table 1: Estimated number of man-hours in the stick-built design versus the modular design

	STICK-BUILT				MODULAR			
	Pre-fab		On-site		Yard		On-site	
	in Man-hour	in %	in Man-hour	in %	in Man-hour	in %	in Man-hour	in %
Civil	-	0%	-	0%	-	0%	-	0%
Steel	81,000	4%	80,000	4%	100,000	6%	23,000	1%
Equipment		0%	23,000	1%	11,500	1%	-	0%
Piping	128,000	7%	900,000	47%	348,000	22%	437,000	28%
Electrical & Instrumentation		0%	155,000	8%	48,000	2%	130,200	8%
Painting	62,000	3%	8,000	0%	64,000	4%	5,000	0%
Heat Tracing		0%	43,000	2%	19,000	1%	17,000	1%
Insulation		0%	100,000	5%	35,500	2%	41,000	3%
Others		0%	21,000	1%	13,000	1%	3,000	0%
Total Direct Man-Hours	271,000	14%	1,330,000	69%	639,000	40%	656,200	42%
Indirect Man-Hours			150,000	8%			135,000	9%
Staff Man-Hours			180,000	9%			148,000	9%
Total indirect & Staff Man-Hours			330,000	17%			283,000	18%
TOTAL			1,931,000	100%			1,578,200	100%

Optimize Execution Schedule

Cofely Fabricom submitted a design to optimize the overall execution schedule and guarantee on-time delivery by:

- Enabling front-end loading to fast track overall schedule
- Rescheduled civil works at site in parallel with module fabrication
- Just-in-time delivery leveraging proximity of the Cofely Fabricom module yard



Optimize Testing and Pre-Commissioning

The optimized Cofely Fabricom design changed fabrication processes for testing and pre-commissioning:

- Most systems were hydro-tested at the module yard instead of on-site
- Site welds are considered to be “Golden Welds”, i.e. that no re-testing of existing lines was needed; but 100% radiographic or ultrasonic examination

The optimization of the testing and pre-commissioning increased safety, a substantial reduction of man-hours and related risk and costs, also limiting delays and increasing quality in a controlled environment.

Proven Modular Experience Met TOTAL’s Challenge

On the OPTARA Project, an optimized design, obtained through increased modularization and off-site module yard work, allowed for:

- 1. Less interference with refinery operations** - a reduction in number of shutdowns required.
 - Limited site space as far smaller lay-down areas required
 - Limited site transports
 - Limited “Hot Work” on-site
 - Limited amount of on-site “critical” lifts
- 2. Increased safety and improved working conditions.**
 - Reduced manpower peaks on-site
 - Increased manpower at off-site module yard, a controlled and safe working environment.
- 3. Increased quality.**
 - Work performed under controlled circumstances at off-site module yard, where efficiency is proven to be 50% higher.
- 4. Scheduling optimized.**
 - Parallel workface activities compressed timelines
- 5. Controlled environment reduces weather delays.**

Charge Forward with Cofely Fabricom

Although Cofely Fabricom had extensive experience in modular construction worldwide, it was the first time for Cofely Fabricom to work on the modularization of a refinery upgrading project.

Cofely Fabricom took up the challenge and succeeded.

TOTAL was extremely satisfied by the optimized design for the OPTARA Project provided by Cofely Fabricom and adopted it as the final design for the project. Indeed, it became clear to TOTAL that modularization allowed for increased safety, reduced overall costs, on-time delivery and higher quality.