META PIER · GWANGYANG SAPO-1 TANKER OPTIMIZATION

Gwangyang SAPO-1 Shared Tanker Pier AI Optimization Guide

1-Berth × 3-Co-Owners Congestion Relief · Shore Tank Ullage · Urgent Feedstock · 9-Gate Lexicographic MILP V3

Physical Berth	Shared Equity	Observed Wait (41 Calls)	Core Optimizer
1 Berth (319m·120K)	3 Owners (50:31:19)	1,433.1h (Max 271h)	9-Gate + MILP V3

01. Why Single-Berth, Three-Owner Tanker Piers Suffer Severe Waiting

Gwangyang SAPO-1 Pier (319m quay, 15.7m depth, 120,000 DWT) operates **one physical berth shared by three petrochemical co-owners**. Across 47 analyzed calls, P90 waiting reaches 67.14 hours and maximum waiting hits 271.0 hours (11.3 days). Traditional First-Come-First-Served (FCFS) fails due to four coupled constraints:

- **1) Shore Tank Ullage Holds:** Even when the berth is empty, a tanker cannot discharge until its owner's assigned shore tank (e.g., 50,000 KL Naphtha tank) frees ullage via plant draw-down transfers.
- **2) Co-Owner Berth Time Quotas & Max-Wait Caps:** Distinct equity shares (50:31:19) and max-wait caps (30h/18h/12h) trigger severe scheduling conflicts in manual berth meetings.
- **3) Pipeline Compatibility & Pigging:** Multi-grade transitions across Naphtha, Caustic Soda, Alkylate, and MTBE require manifold line-up and cleaning hours.
- **4) Urgent Cracker Feedstock Priority:** Low-inventory plant feedstock vessels must bypass normal arrival queues to prevent plant shutdowns.

02. 9-Gate Readiness & Lexicographic MILP V3 Architecture

Earliest Feasible Berthing: `Start_i ≥ MAX(ETA_i, G1_StaticCap, G2_TankRelease, G3_TankAlloc, G4_LineCompat, G5_LineReady, G6_OneBerthFree, G7_Marine, G8_Commercial, G9_OwnerRule)`
Lexicographic 3-Stage MILP: Stage-1 `Minimize Urgent Feedstock Risk & Total Demurrage ($)` → Stage-2 `Minimize Total Waiting Hours` → Stage-3 `Enforce 3-Owner Max-Wait Caps (30h/18h/12h) & Quota Balance`

03. Walkthrough of the 4-Stage Interactive Digital Twin

Stage 01 · 1-Berth × 3-Owners Bottleneck & Quota Diagnostic

Benchmarks live co-owner berth share against contract quotas and decomposes historical waiting drivers (Tank Ullage 38%, 1-Berth Overlap 31%, Quota Friction 19%, Line Cleaning 12%).

Stage 02 · Interactive 9-Gate, Tank Ullage & Urgent Feedstock Lab

Adjust shore tank fill sliders and Urgent Cargo flags in real time. When an early ship faces a tank ullage hold, MILP slots ready tankers ahead so zero berth hours are wasted while shore tanks drain.

Stage 03 · FCFS vs. AI MILP V3 Dual Gantt & Meeting Decision Ledger

Demonstrates a 58.6% waiting cut (118.5h → 49.0h), $66,400 demurrage saving per 6-call window, and zero co-owner cap breaches, backed by an auditable Berth Meeting rationale table.

Stage 04 · Live 2D Harbor, Quay Manifold, Pipeline & Tank Playback

Animates outer anchorage queueing, 319m berth mooring, active manifold-to-tank pipeline flow strictly during unloading, and real-time shore tank fill/ullage gauges at 1x/2x/4x speed.

Strategic ROI: Delivers immediate demurrage reduction, plant feedstock security, and transparent 3-company berth meeting consensus with zero marine civil CAPEX.