

# Around the World in FSRU's

LNG FLOATING STORAGE AND REGASIFICATION UNITS:  
INNOVATIONS, LESSONS AND CAUTIONARY TALES

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World Bank  
October 2015





# Egypt FSRU

Location	Ain Sokhna	Operational January 2015
Vessel Owner/Operator		Hoegh LNG "Gallant" 170,051 cu m
Chartered for 5 yrs by		EGAS

Innovation: current throughput of about 500-mmcf/d would be a world record, if maintained (would amount to over 3.5-mt/yr)



# Egypt 2<sup>nd</sup> FSRU



Location	Ain Sokhna	Operational October 2015
Vessel Owner/Operator		BW Singapore 170,000 cu m
Chartered for 5 yrs by		EGAS
Innovation: to be moored on the other side of the dolphin jetty from the Hoegh Gallant		





# Hadera Deepwater LNG Terminal

Location	Israel (offshore)	Operational in 2012
Vessel Owner/Operator		Excelerate Energy "Excellence" 138,800 cu m
Chartered for 15 yrs by		IEC and Israel Natural Gas Lines

Innovation: project was implemented in under one year; STL buoy system was re-located from US Gulf of Mexico to Israel offshore

Israel Natural Gas Lines STL Buoy





# Lesson learned: work with good advisors

**TERMINAL**

**New quay**  
New quay wall is split into two sections

1. Anchored sheet pile wall
2. Concrete deck on piles

Activities for both sections will be marine construction with a 55 x 18 meter anchored crane barge. Crane barge will be used to install the sheet piles and the piles for both sections. Some elements of the sheet pile wall may be installed from land but split land / marine installation still to be determined. Crane barge will predominantly be moored next to the works at the northern area of the area.

Following the construction of the new quay wall dredging works need to be undertaken to increase the current berthing depth. The method is not determined yet but will either be by means of an excavator or clam shell.

Activities involved:

1. Pile driving
2. Cutting and welding
3. Earthworks fill
4. Tie rod / anchor installation
5. Precast concrete elements installation
6. Concrete works for coping beam, pile plugs, beams
7. Dredging

**Existing timber jetty**  
The existing quay wall requires modification only with respect to quay wall furniture such as fenders, bollards, ladders cathodic protection etc.. Some work can be done from land but some need to be done from the waterfront and requires a small work pontoon (approximately 18 x 8 meter) and diving assistance.

Activities involved:

1. Installation of new quay wall furniture
2. Cutting and welding
3. Diving works

**NOTES**

1. ALL DIMENSIONS UNLESS OTHERWISE NOTED ARE IN METERS
2. ALL LEVELS ARE BATTERING RELATIVE TO CHART DATUM (CD) UNLESS NOTED OTHERWISE
3. ALL DEPTH CONTOURS AND BATTERS RELATIVE TO MEAN SEA LEVEL UNLESS NOTED OTHERWISE
4. ALL COORDINATES AND BATTERS RELATIVE TO JOHANNESBURG TRANSVERSE MERIDIAN UNLESS NOTED OTHERWISE

**LEGEND**

- SP (SHIELD) NO FENDER (LOPP)
- SP (SHIELD) NO FENDER
- SP ABOVE GRADE NO FENDER
- SP UNDER GRADE NO FENDER
- SHIELDING PILE
- PERIMETER SECURITY FENCE
- SECONDARY SECURITY FENCE
- INTERNAL FENCE
- EXISTING BOUNDARY WALL
- NEW BOUNDARY WALL INCLUDING TRANSVERSE & BATTERS

**SYMBOLS**

- MO - MOORING DOCKING
- BO - BOLLARD
- LP - LOADING PLATFORM
- OR - ORIGIN
- OS - ORIGIN SUPPORT

**INDICATIVE DRAWING**

NO.	REVISION	DATE	BY	CHKD
1	ISSUED FOR TENDER	2011	SP	SP
2	ISSUED FOR TENDER	2011	SP	SP
3	ISSUED FOR TENDER	2011	SP	SP
4	ISSUED FOR TENDER	2011	SP	SP
5	ISSUED FOR TENDER	2011	SP	SP
6	ISSUED FOR TENDER	2011	SP	SP
7	ISSUED FOR TENDER	2011	SP	SP

**PROJECT**  
AQABA LNG TERMINAL

**GENERAL LAYOUT**

**COMPANY**  
NAVIGANT  
MAPSTONE  
TRACTABEL  
TROWERS & HAMLINS

**DRAWING NO.** 9X5489/ LNG\_1001 **REVISION** T4

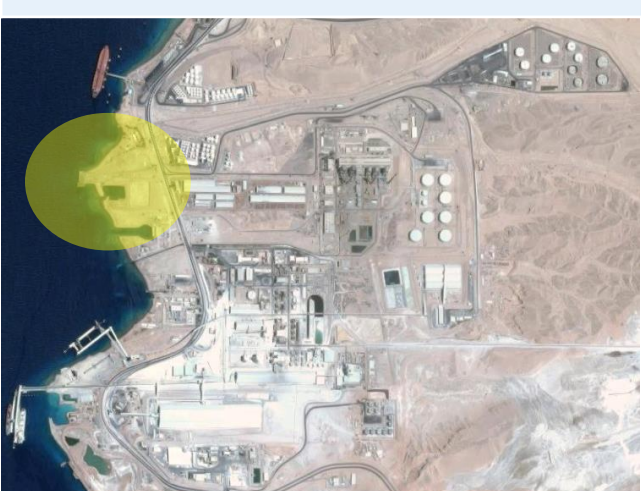
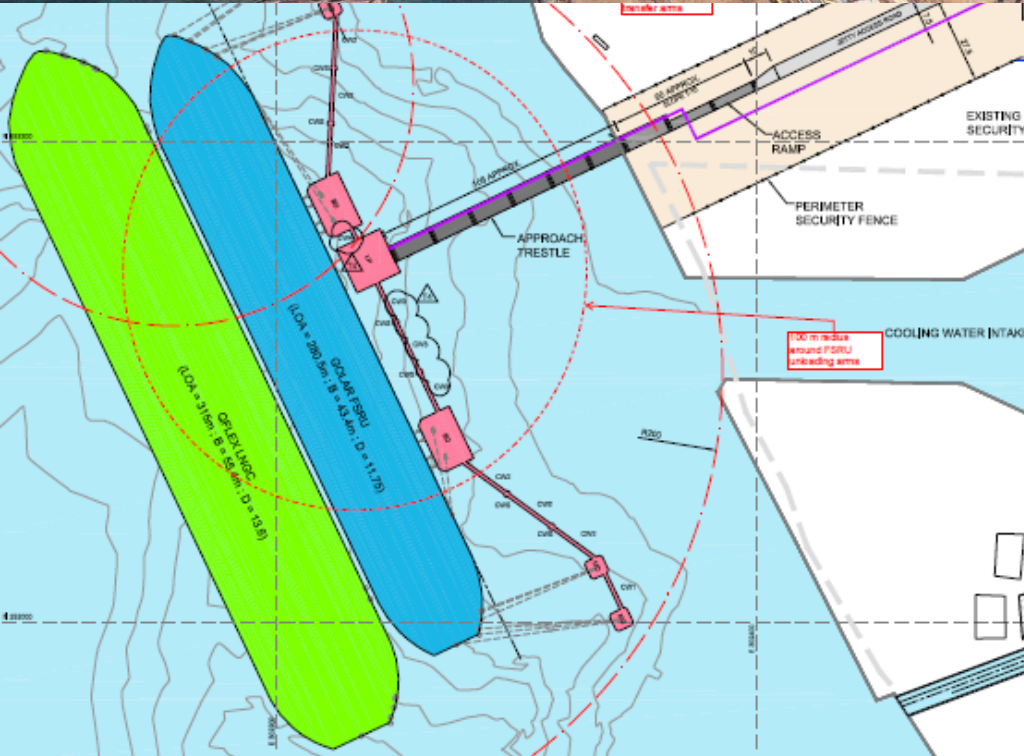
## Aqaba, Jordan FSRU

Fixed jetty, trestle-connected at South Port, Aqaba

New-build Golar Eskimo (160,000 cu m capacity); Chartered by Hashemite Kingdom of Jordan, Ministry of Energy and Mineral Resources

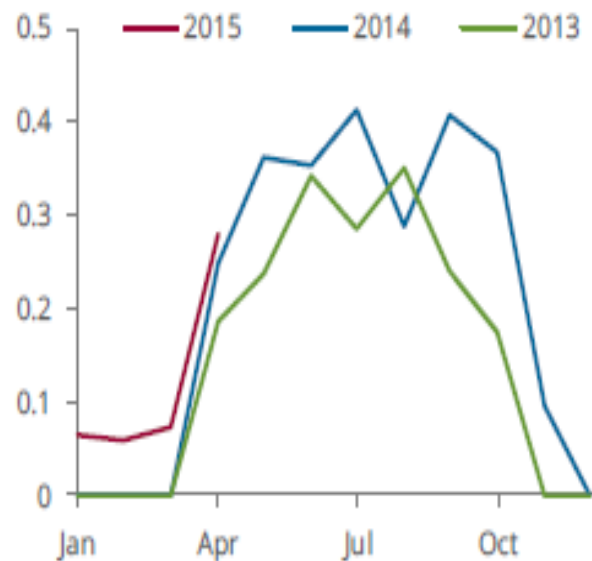
Shell: 5-year LNG supply deal

Advisors: Navigant, Mapstone, Tractabel, Trowers & Hamblins





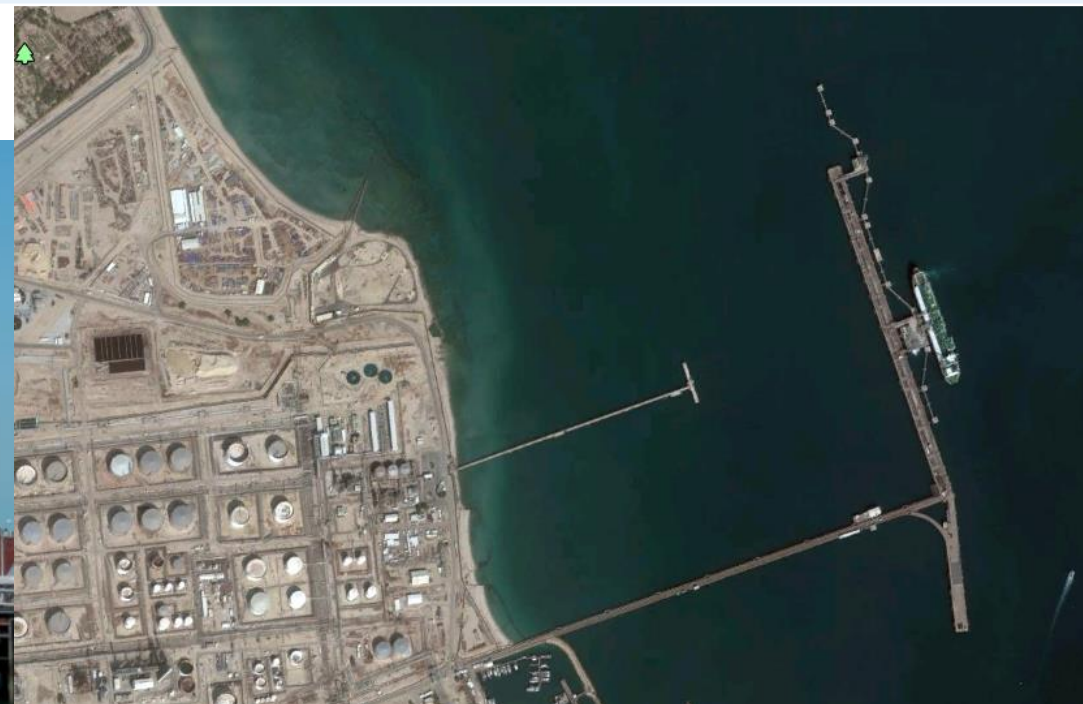
Seasonal import pattern 2013-15  
(monthly volumes in million tons LNG)



Source: Bloomberg, Energy Aspects

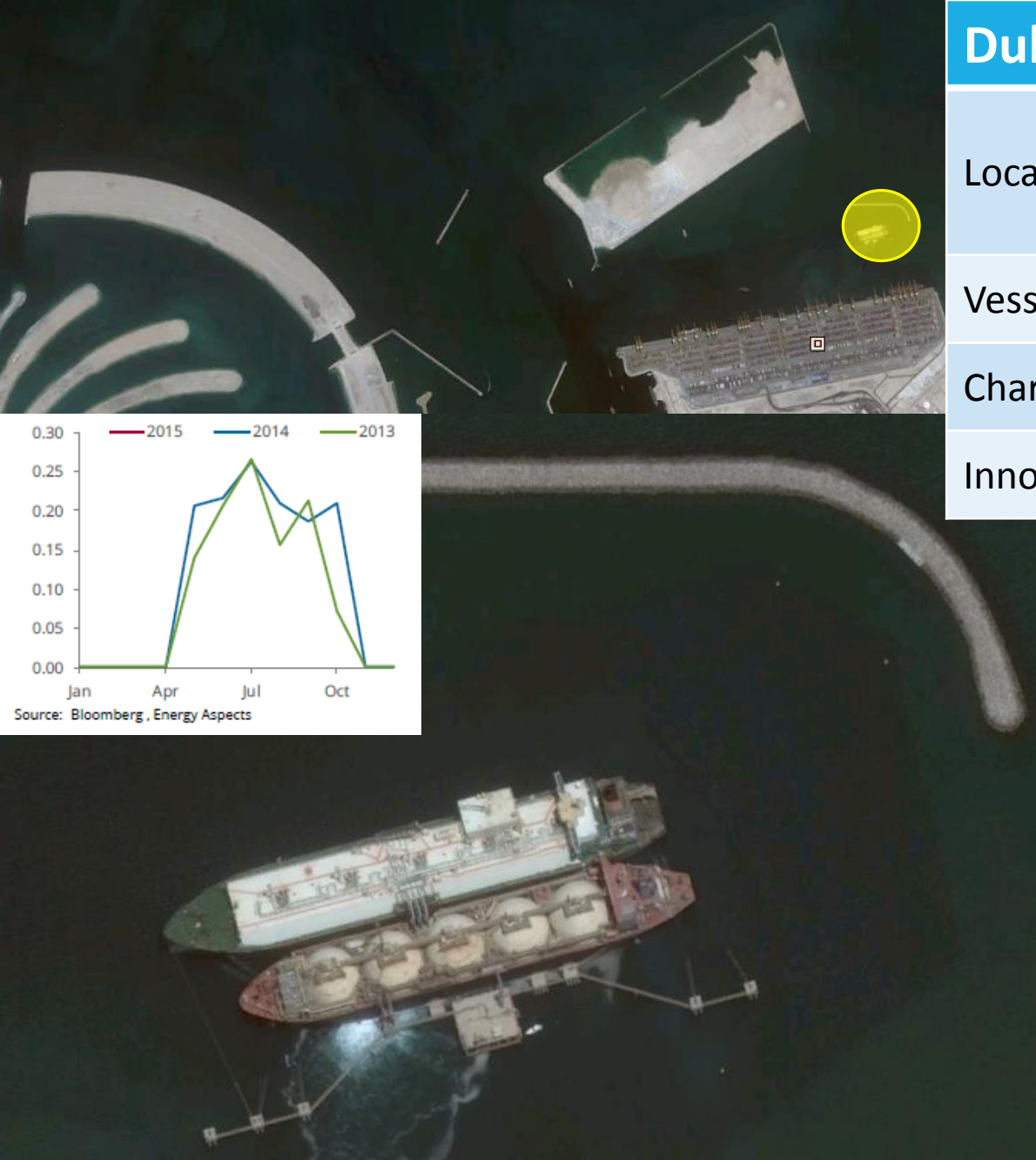
## Kuwait FSRU

Location	Mina Al Ahmadi, Kuwait	Operational 2014 (Excelerate provided an earlier FSRU from 2009-2013)
Vessel Owner/Operator		Golar "Igloo" 170,000 cu m
Chartered by		Kuwait Petroleum Corp. (KPC)
Innovation: Seasonal charter; vessel can go off-station and trade as an LNGC for about 4 months of the year.		



# Dubai

Location	Jebel Ali, Dubai, United Arab Emirates	Operational 2010
Vessel Owner/Operator	Golar "Freeze" 125,000 cu m	
Chartered by	Dubai Supply Authority (DUSUP)	
Innovation: Seasonal imports only, during cooling season.		

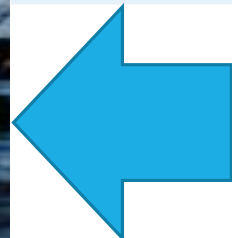




# Port Qasim (near Karachi, Pakistan)

Location	Pakistan	Operational March 2015 (in a way)
Vessel Owner/Operator		Excelerate “Exquisite” 150,900 cu m
Chartered by		Engro Corporation, Elengy

Cautionary Tale: Surprise! Port Authority orders dredging after terminal begins operations. Supplier would not deliver, so FSRU went back to Qatar for 2<sup>nd</sup> cargo.



The Exquisite in its previous job: in Brazil, before the Experience arrived



THE EXPRESS  
**TRIBUNE**  
WITH THE International New York Times

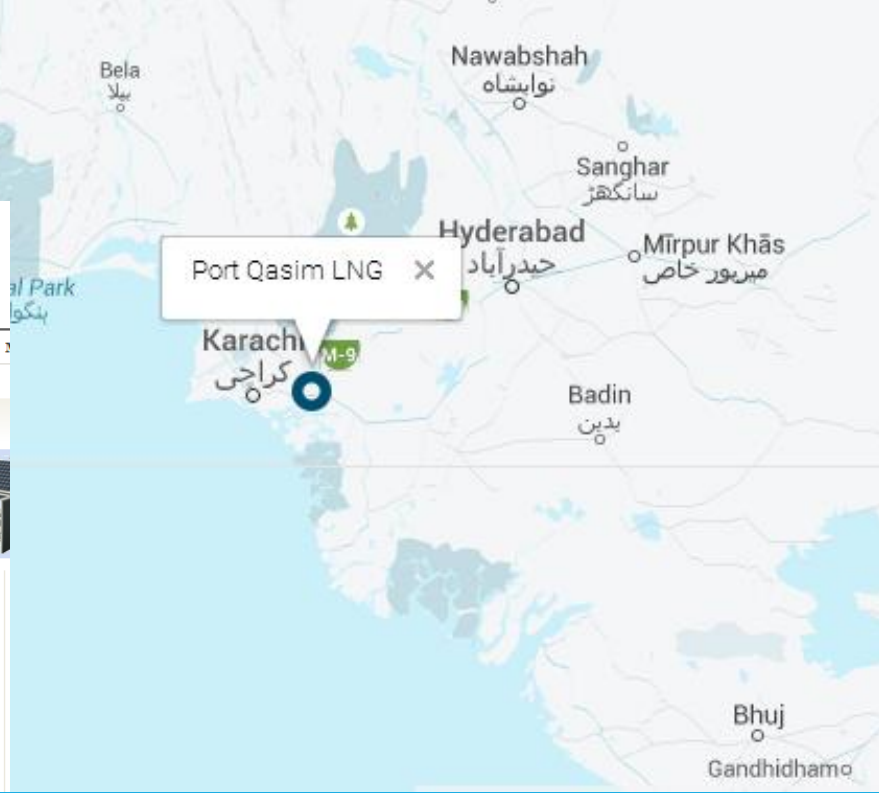
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LIVE NEWS

**Sourcing Alternative Energy Generators**  
You Need The Leading Global B2B Platform

**LNG imports: Floating storage unit violates policy, criteria, says Port Qasim Authority**

By Zafar Bhutta Published: April 23, 2015







# Lekas LNG Terminal

Location	Melaka, Malaysia	Operational 2012
Vessels Owner/Operator	MISC	
Chartered by	Petronas	

Innovation: Uses two 125,000 cu m LNG tankers as Floating Storage Units (FSUs); regas units are on the offshore jetty



Image © 2015 CNES / Astrium  
© 2015 Google



# Indonesia Lampung FSRU

Location	Sumatra	Operational July 2014
Vessel Owner/Operator	Hoegh LNG "PGN FSRU Lampung" 170,132 cu m	
Chartered for 20 yrs by	PGN	

Cautionary Tale: no deliveries since January 2015.

- 20 year agreement signed Jan 2012 with Perusahaan Gas Negara (PGN)
- Newbuild FSRU located offshore South Sumatra with Tower Yoke mooring and off/onshore pipeline to the off-take station
- 240 mmscf/d send out capacity
- Propane IFV with open loop
- 20 year operation with no dry-docking
- FSRU with limited propulsion (10kn)



## West Java FSRU

Location

Jakarta

Operational in 2012

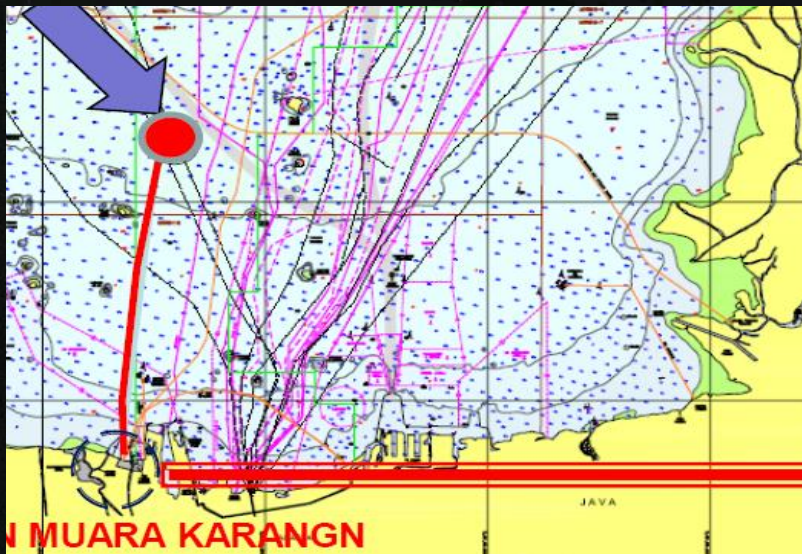
Vessel Owner/Operator

Golar "Nusantara Regas Satu"  
125,000 cu m

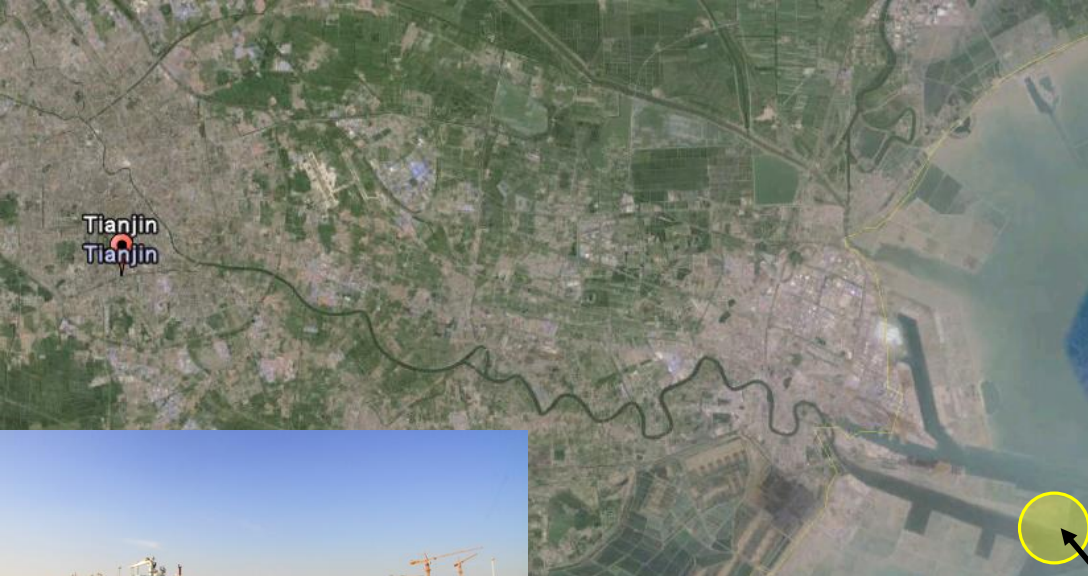
Chartered for 11 yrs by

PT Nusantara Regas (Pertamina,  
PGN joint venture)

Innovation: Conversion of LNG Carrier built in 1997



# Tianjin FSRU, Northeast China



Location	Tianjin, China	Operational 2013
Vessel Owner/Operator	Hoegh "Cape Ann" (LTC with GDF Suez) 145,130 cu m	
Chartered by	CNOOC (5 years, from GDF Suez)	

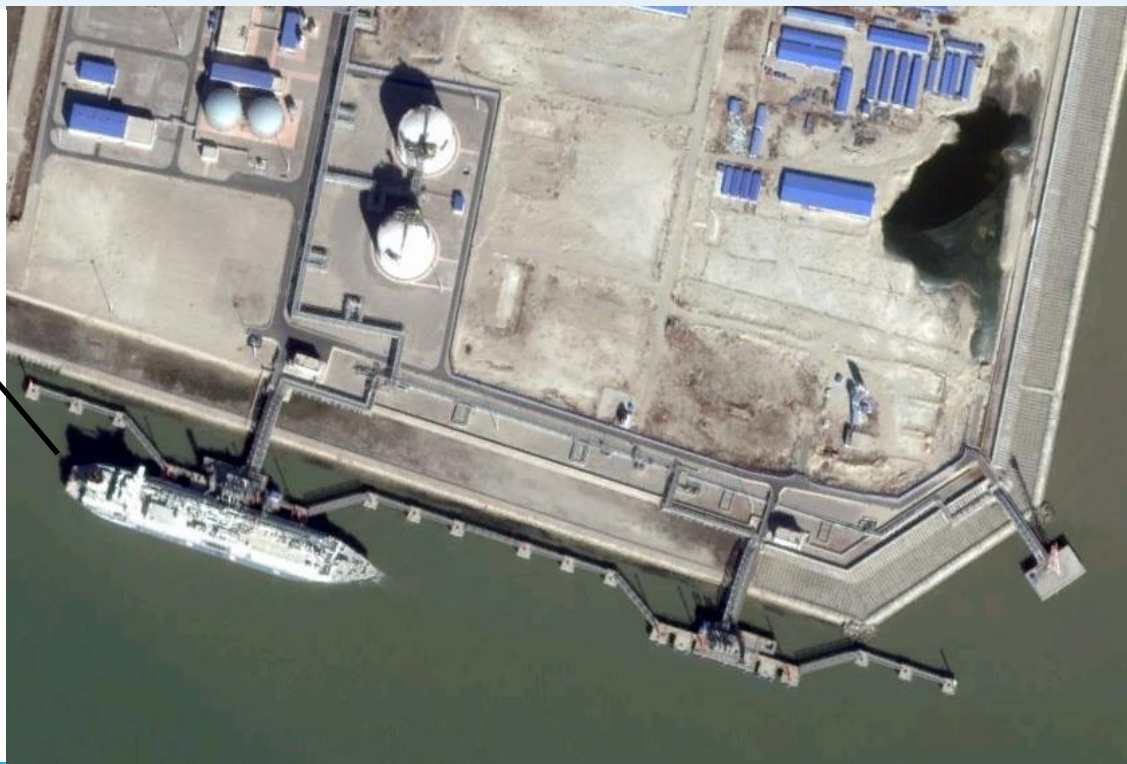
Innovation: Integrated with 2x30,000 cu m onshore tanks, terminal offers full break-bulk service.



CNOOC

GDF SUEZ

H  
HÖEGH LNG





# Bahia Blanca (left) and GNL Escobar (below)

Location	Argentina	Operational 2008 and 2011
Vessels Owner/Operator		Excelerate Energy “Express” and “Exemplar” each 150,900 cu m
Chartered by		YPF

Innovation: Escobar’s location up a river means that only partially laden LNG vessels, or smaller vessels, can deliver to it





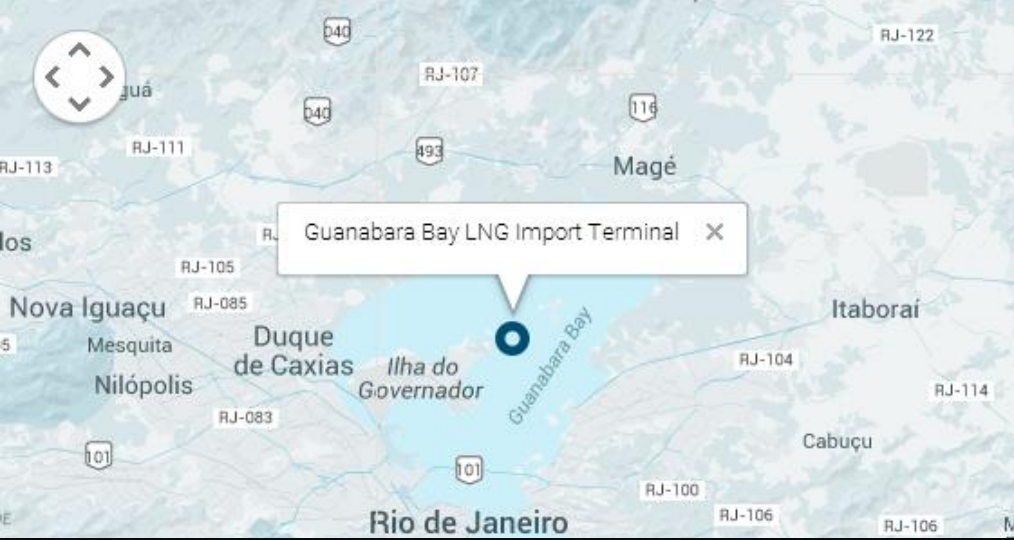
## GNL del Plata (near Montevideo, Uruguay)

Location	Uruguay	Operational in 2015 or 2016
Vessel Owner/Operator	Mitsui (MOL)	
Chartered by	Gas Sayago	

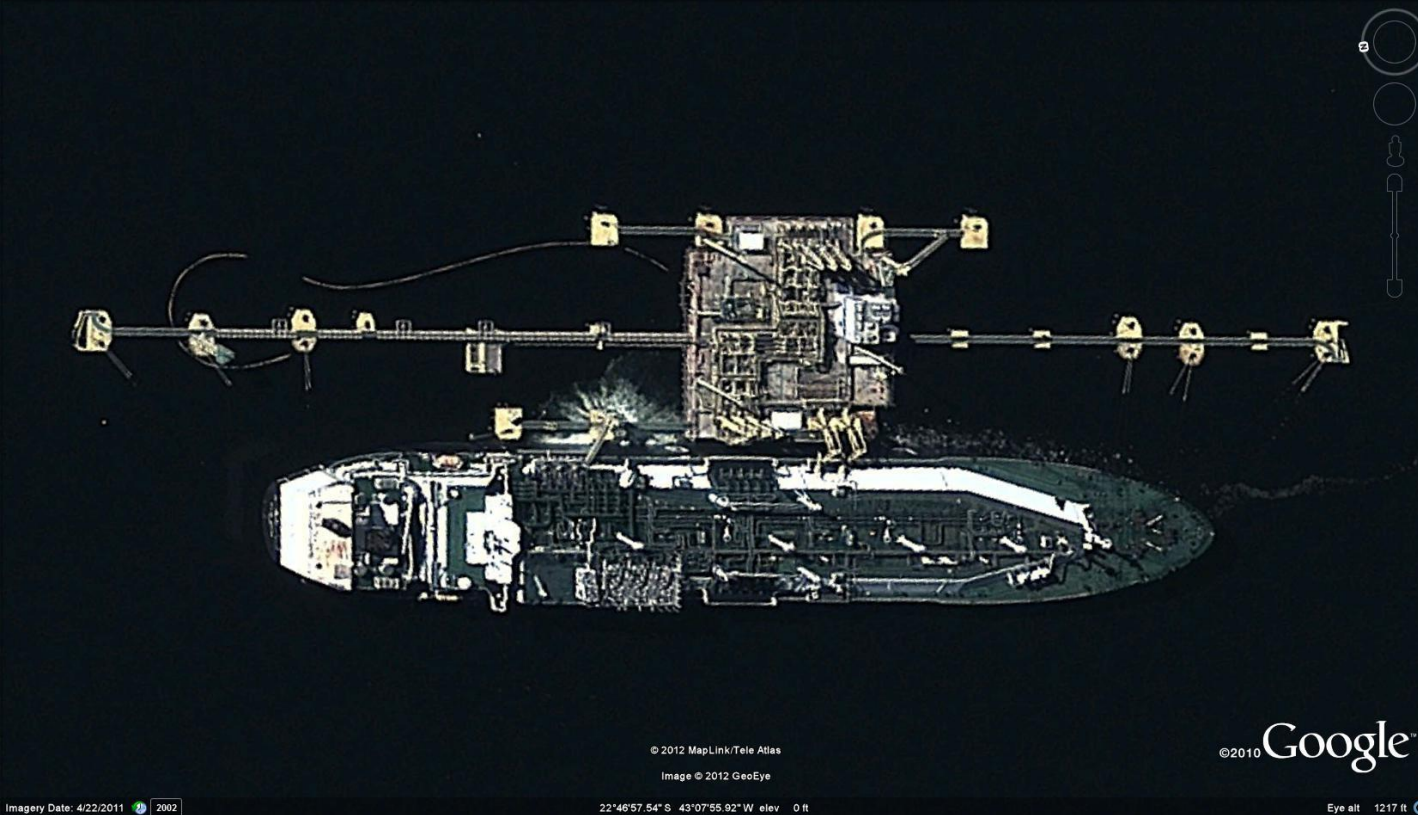
Innovation: First use of Q-Max size vessel as FSRU (263,000 cu m)  
Cautionary tale: \$600-million for offshore jetty and breakwater



# Guanabara Bay, Brazil (that's Rio!)



Location	Rio de Janeiro	Operational May 2014
Vessel Owner/Operator		Excelerate Energy “Experience”
Chartered for 15 yrs by		Petrobras
Innovation: largest FSRU (173,400 cu m, 700-mmcf/d send-out capacity); terminal started in 2012 with a smaller vessel since re-located to Recife		



Ricardo Stuckert/PR

# Bahia Regasification Terminal (TRBA), Brazil



Location	Baía de Todos os Santos, Salvador	Operational January 2014
Vessel Owner/Operator		Golar "Winter" 138,000 cu m
Chartered until 2024 by		Petrobras

Innovation: Previously, the Golar Winter was the vessel used for the Guanabara Bay FSRU, and has now been re-located to Bahia



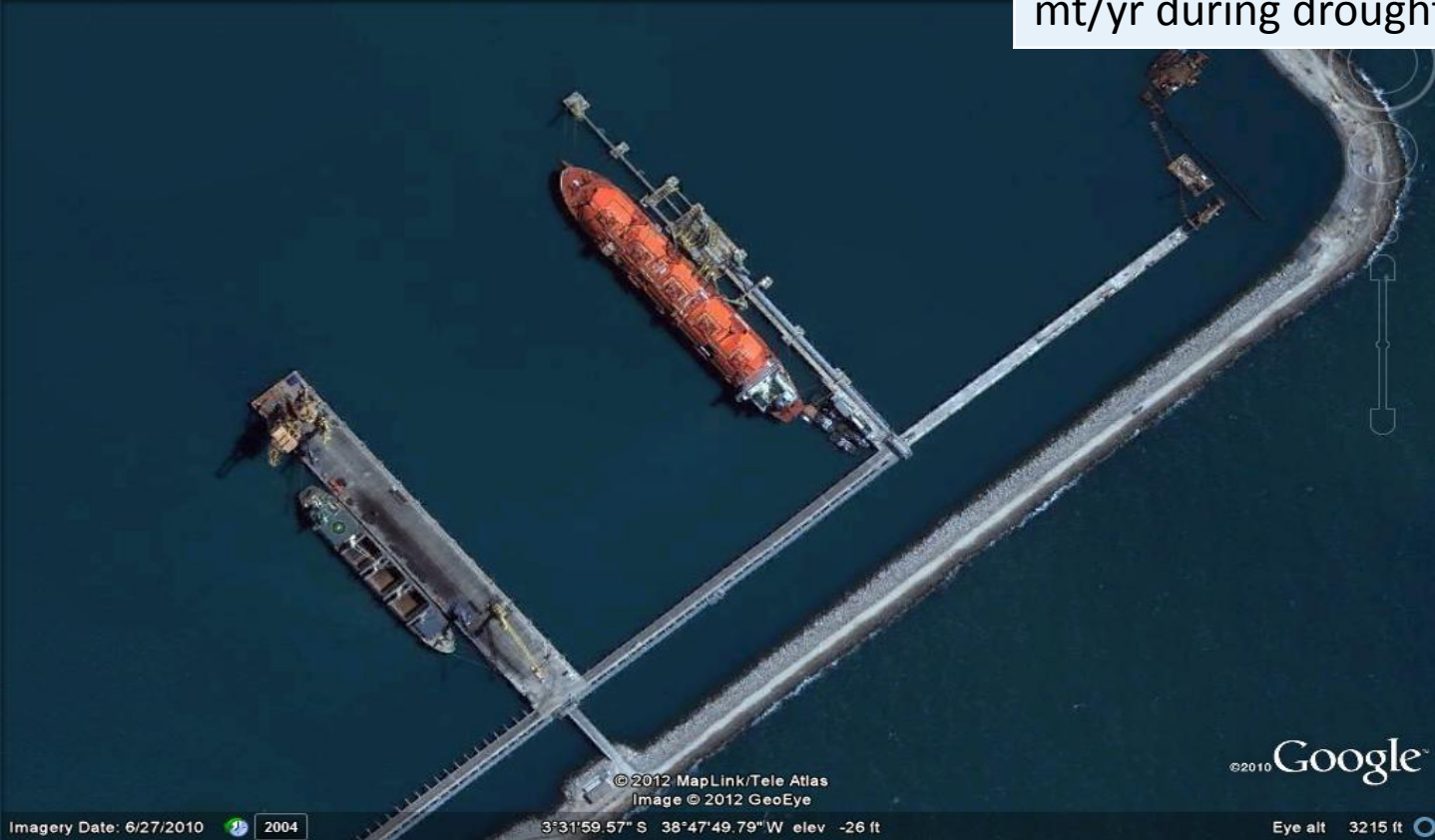




# Pecem, Ceara State, Northeast Brazil

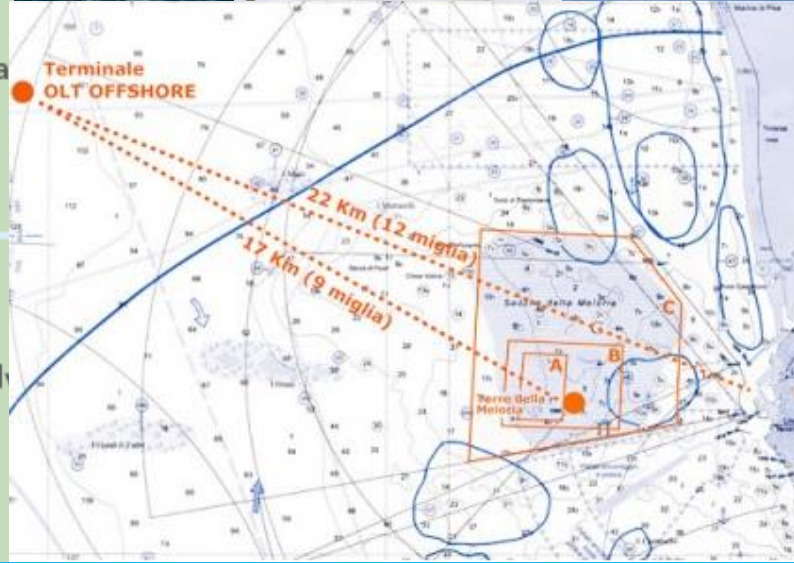
Location	Pecem	Operational 2009
Vessel Owner/Operator	Golar "Spirit" 129,000 cu m	
Chartered by	Petrobras	

Lesson: This facility has proven its "options" value by ramping up to 1.2-mt/yr during droughts, making up for reduced hydro power.



# OLT (Offshore LNG Toscana)

Location	Offshore Livorno, Italy	Operational 2013
Vessel Owner/Operator		OLT Group (Golar, E.ON) 137,500 cu m
Chartered by		ECOS (Exmar, Fratelli Cosulich)
Cautionary Tale: €900-million capex!		

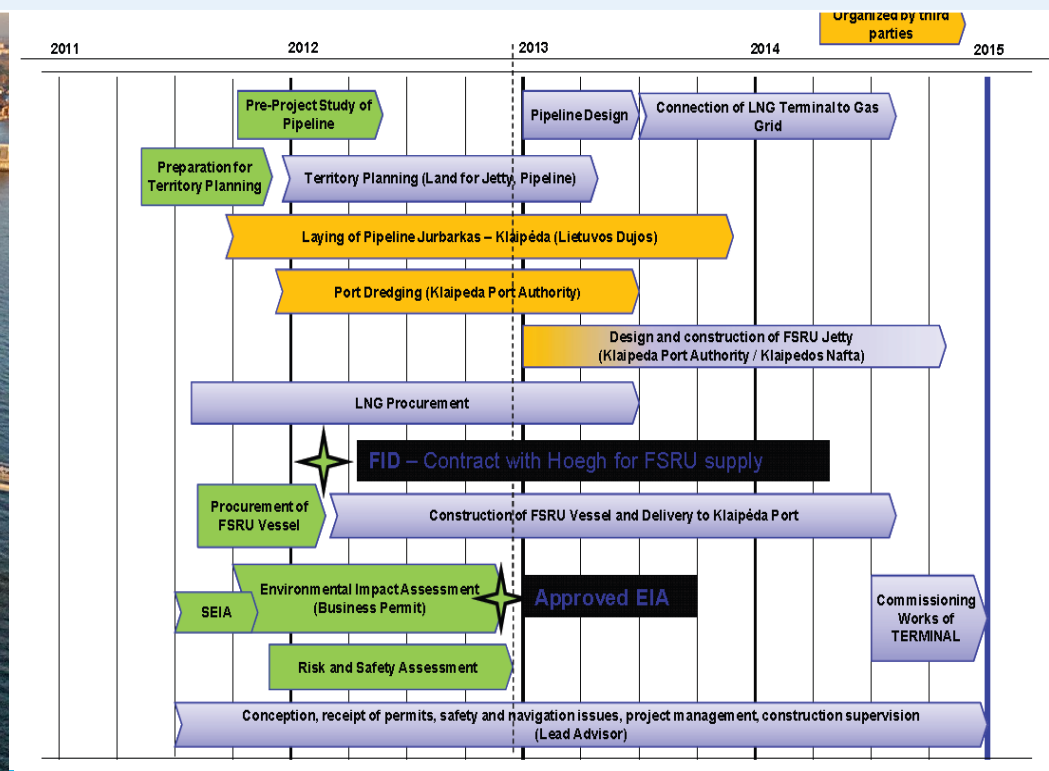




# Lithuania FSRU

Location	Klaipėda, Lithuania
Vessel Owner/Operator	Hoegh LNG "Independence" 170,132 cu m
Chartered for 10 yrs by	Klaipėdas Nafta

Lessons learned: terminal has operated since November 2014 and Gazprom has cut prices by 20% since then to maintain market share



# How countries have first entered the LNG market – the technical solution for imports

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## Onshore (7)

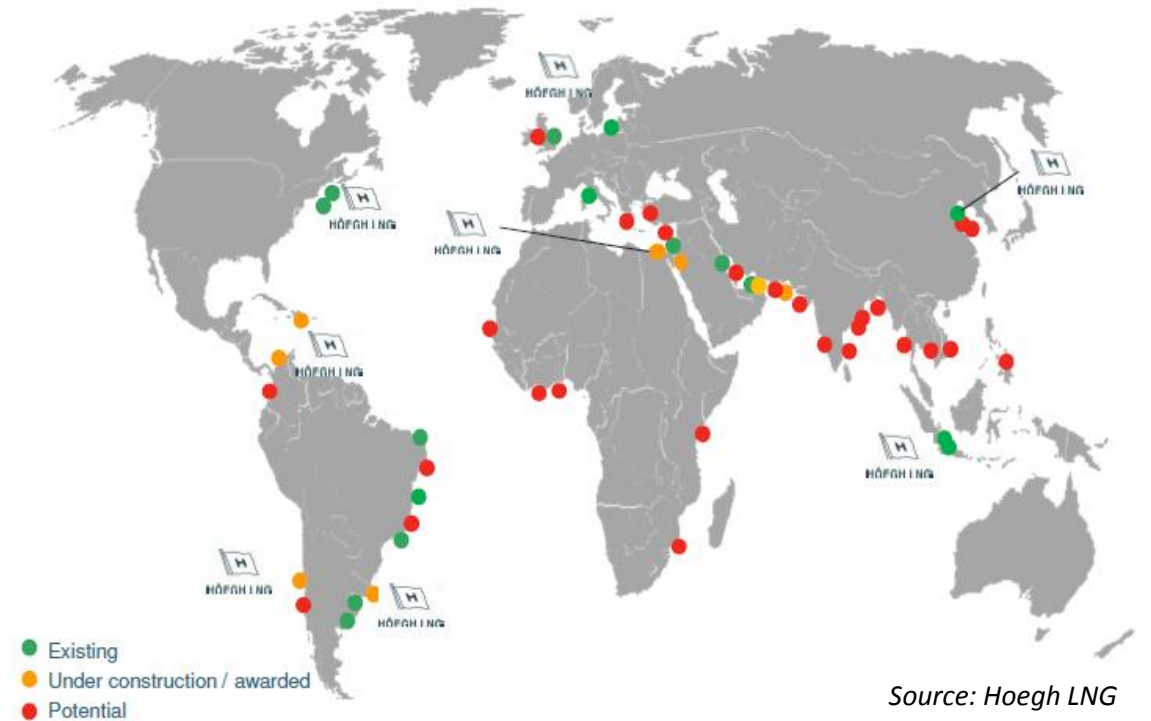
China  
Mexico  
Chile  
Thailand  
Singapore  
Poland  
Philippines (2016?)

## FSRU/FSU (13)

Kuwait	Dubai
Indonesia	Malaysia
Egypt	Jordan
Pakistan	Argentina
Brazil	Israel
Lithuania	Colombia (2016)
Uruguay (2016)	

# .... and coming soon:

- Colombia (Cartagena) – Hoegh
- Chile – Hoegh
- Kaliningrad, Russia – Gazprom (???)
- Chittagong area, Bangladesh – Excelerate
- Puerto Rico (Aguirre) – Excelerate
- Plus India, more China, more Brazil, Tunisia, Morocco, Cote d'Ivoire . . .
- And Myanmar?



# Competitors in the FSRU Space

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