נתיבי הגז הטבעי לישראל
ISRAEL NATURAL GAS LINES
Infrastructure for Energy Independence

The Usage of advanced applications in Natural Gas transmission pipelines

Digitalization and Automation in the Oil and Gas Industry Challenges and Opportunities

June 18, Tel Aviv, Israel

Agenda

- Introduction to INGL transmission system
- The SCADA system
- Implementation of advance applications to address the 2020 Natural Gas transmission challenges



Israel Natural Gas Lines ("INGL")

- A government owned corporation, established in 2003 to manage the national natural gas transmission infrastructure with a license for a period of 30 years starting 2004
- INGL has 100 employees that ***plans construct*** and ***operate*** the system.
- From INGL's establishment to the present, the Israeli economy has saved on average more than $2 billion per year.

Introduction to INGL transmission System

Receiving Terminals today

- Ashdod receives gas from Noble energy -TAMAR
- Ashkelon (not active) received gas from EMG
- LNG Buoy re-gasified LNG – offshore Hadera

Receiving Terminals by 2020

- DOR to receive gas from:
  - Noble energy – Leviathan
  - Energean -Karish+Tanin

Introduction to INGL transmission System

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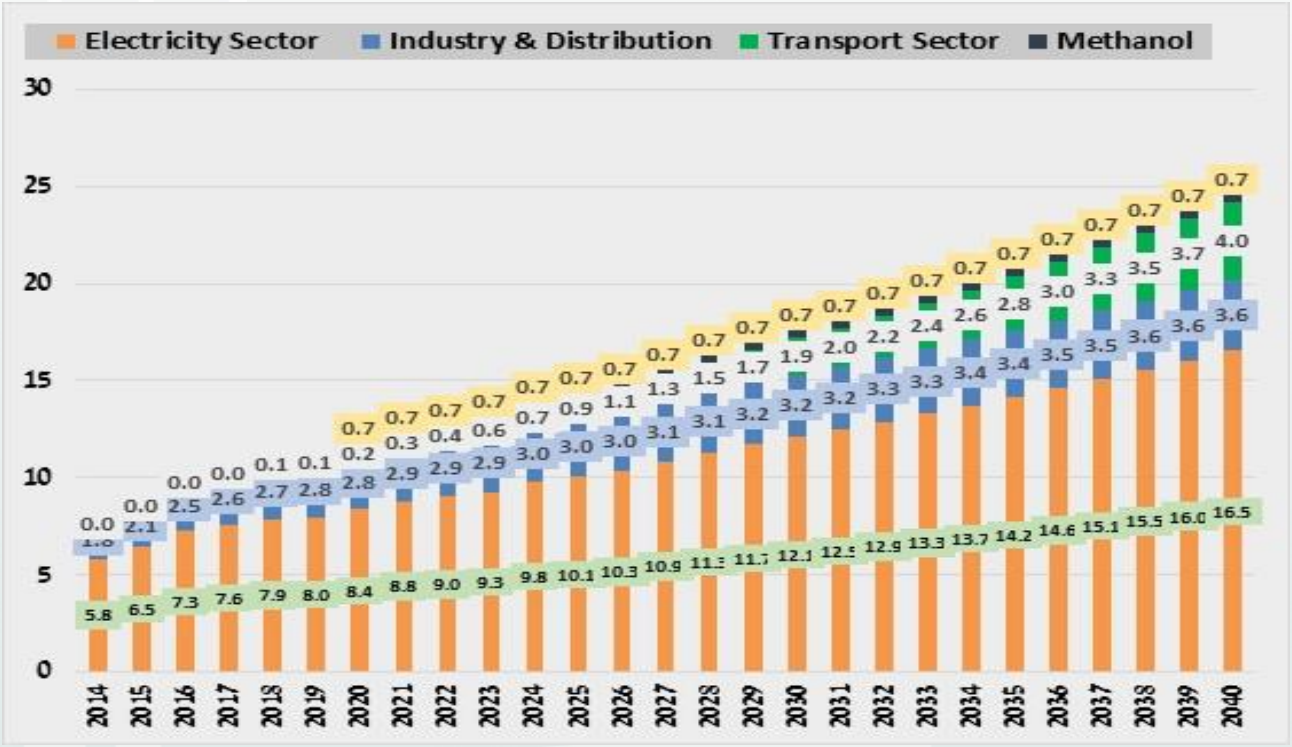
Introduction to INGL transmission System

Demand Forecast and Gas transmission volumes



Year	Gas transmission volumes (BCM)
2004	1.19
2005	1.64
2006	2.29
2007	2.74
2008	3.69
2009	4.19
2010	5.32
2011	4.82
2012	2.90
2013	6.86
2014	7.57
2015	8.40
2016	9.66
2017E	**10.39**

Source: Ministry of National Infrastructures, Energy & Water

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Gas Installations

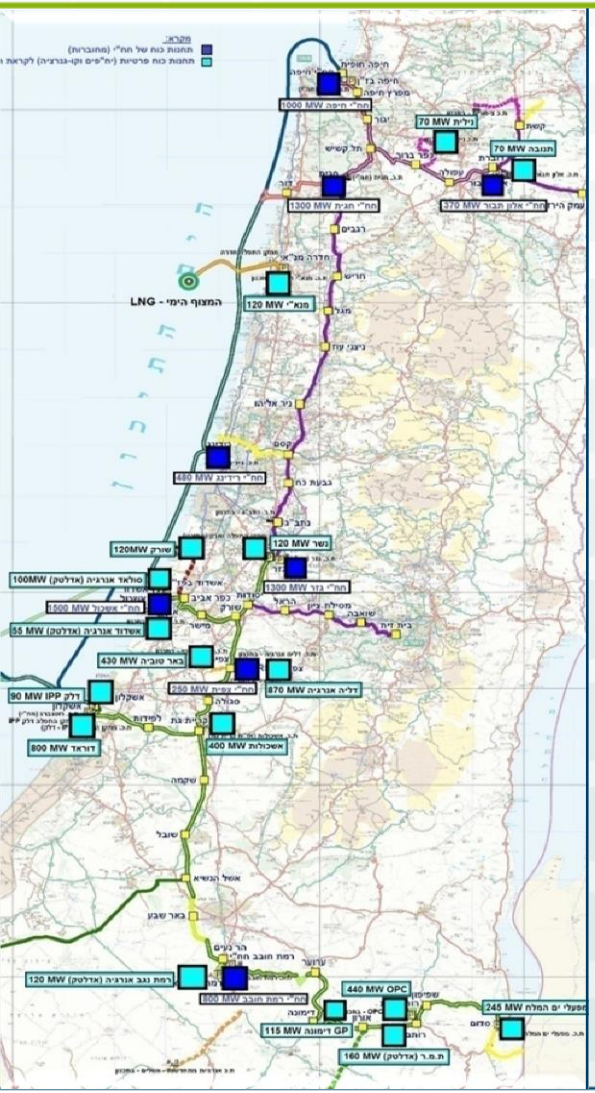
Pressure Reduction and Metering Stations

PRMS facilities to connect with customers and distribution companies

Block Valve Stations

Located at 10 kilometer intervals along the pipeline, to monitor and operate the system and to isolate sections in an emergency

Introduction to INGL transmission System



Israel Electric

Power Stations IEC - 8

7000MW

2004-2011

Nesher 120 MW 2009	**ORL Ashdod** 110 MW 2005	**Rotem OPC** 440 MW 2013
Ramat Negev 115 MW 2015	**Delek IPP** 80 MW 2007	**Dorad** 840 MW 2013
Ashdod Energy 55 MW 2015	**Sdom** 110 MW 2009	**Dalia Energy** 870 MW 2015
Sdom II 220 MW 2016	**Sorek** 105 MW 2016	

- Over 10,000 MW of natural gas power generation capacity connected
- Over 60% of power generation is based on natural gas
- 280 MW additional cogeneration to be connected in 2018

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Mishor Rotem Ind.
3.2011

Ramat Hovav Ind.
3.2011

Haifa Chemicals south
3.2011

Brom
3.2011

Periclass
3.2011

Machteshim
3.2011

Rotem
3.2011

ORL Ashdod
10.2005

Dead Sea Works
9.2009

Nesher
10.2009

Agan
8.2011

Sugat
5.2014

CNG Ashdod
Construction Completed

AIPM
8.2007

Bazan
4.2011

Haifa Chemicals north
4.2011

CNG Alon Tavor
5.2014

Introduction to INGL transmission System

In operation — 9 stations

Eshel Hanasi 2013	Ramat Hovav 2013	Dimona 2013
Rotem 2015	Beit Keshet 2015	Ashkelon 2016
Nesher 2016	Ashdod 2017	Hadera 2016

Construction Completed — 4 stations

Haifa Bay	Kiryat Gat
Alon Tavor	Reading Tel Aviv

In Construction — Jerusalem (2 stations)

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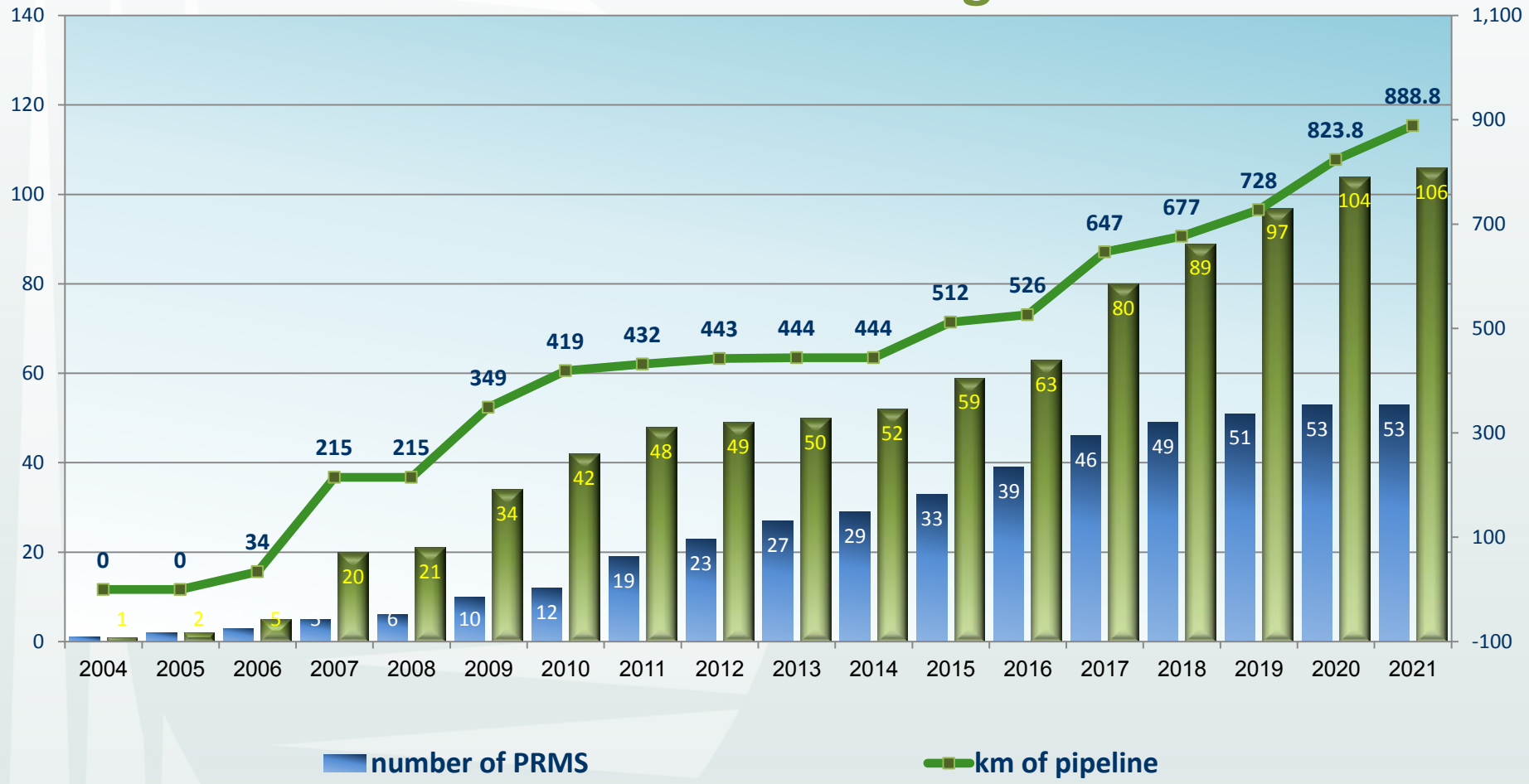
Introduction to INGL transmission System

Forecast Growth of Network through 2021



*Including projects pending approval

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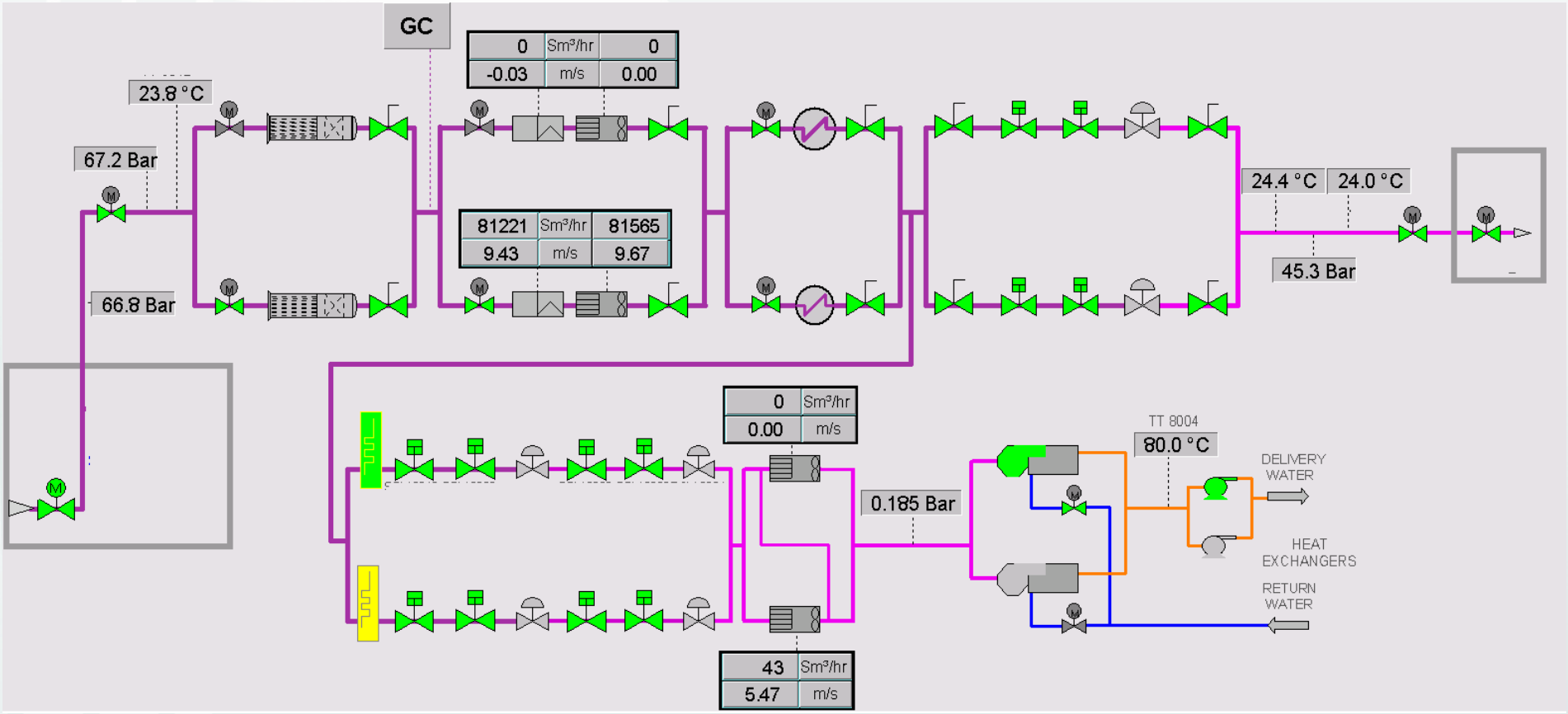
The SCADA System

- **INGL SCADA combines field devices, communications infrastructure and software integrated into a 3 level control system that provides safe and reliable operation of remote facilities.**
- **INGL SCADA is an important key for highly Safe, operational and profitable operation.**

The SCADA System

Level 1 – Site Control



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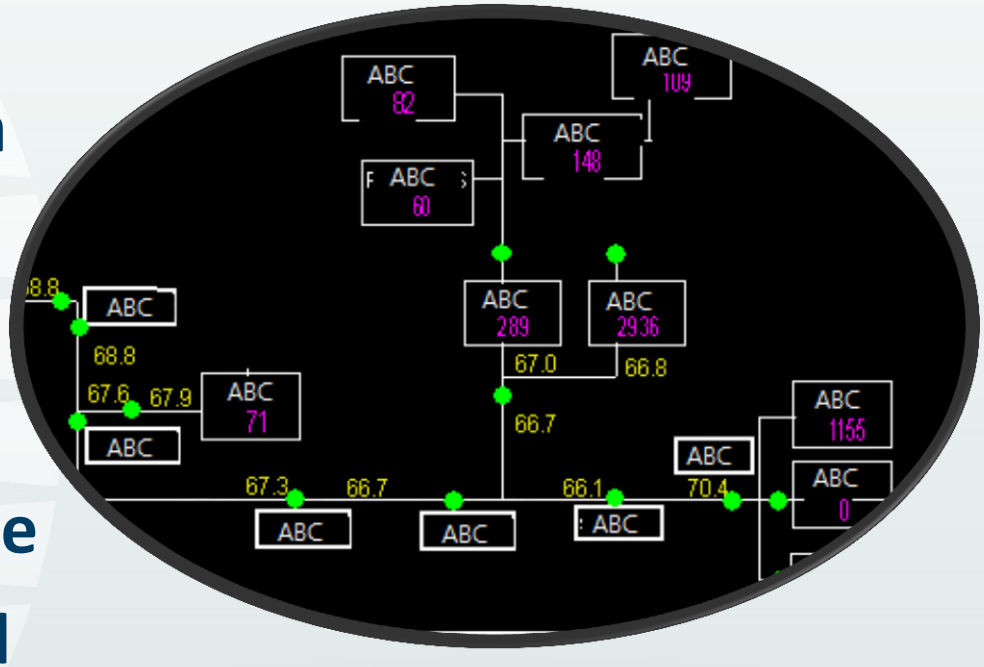
The SCADA System

Level 2 – Centralized Control

- Control the network remotely. Monitor, gather, and process real-time data
- Interact with devices such as sensors, valves, pumps and motors
- Record events into a log file
- Interact with suppliers and customers



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The SCADA System

Level 3 – Operation Control

- **Connected to the SCADA are applications at the top of the pyramid among them advanced control and optimization applications as well as business applications**

Implementation of Advanced Applications

Control system side

- Top priority is reliability and availability
- Trend: using general hardware and OS
- companies are in the hands of vendors

IT side

- Traditional security tools may not work for control systems
- IT people do not know control systems
- Enterprise networks are being connected to control systems

Implementation of Advanced Applications

Line Pack – Calculates the gas inventory in the pipeline. The line pack application requires that the user input the pipeline segment data (length and diameter). The application acquires real-time pressure measurements (and temperature and gas composition) from the SCADA system. The calculated information on line pack is returned to the SCADA system for display to the gas controllers.

Leak Detection The actual pressure and system flow readings from the SCADA are compared with the modeled pressure Discrepancies and flow readings. could indicate a leak.

Gas Scheduling –This application takes the gas plan from the nominations system and compares it to the real-time flow values to help the controller meet the receipt or delivery requirements.

Look-ahead simulation forecast the pressure based on the gas usage and nomination

Survivability analysis forecast the gas system survival parameters when supply is been disturbed or stopped

Implementation of Advanced Applications

What-if analysis – predicts the outcome of events by using the hydraulic data and the real time information

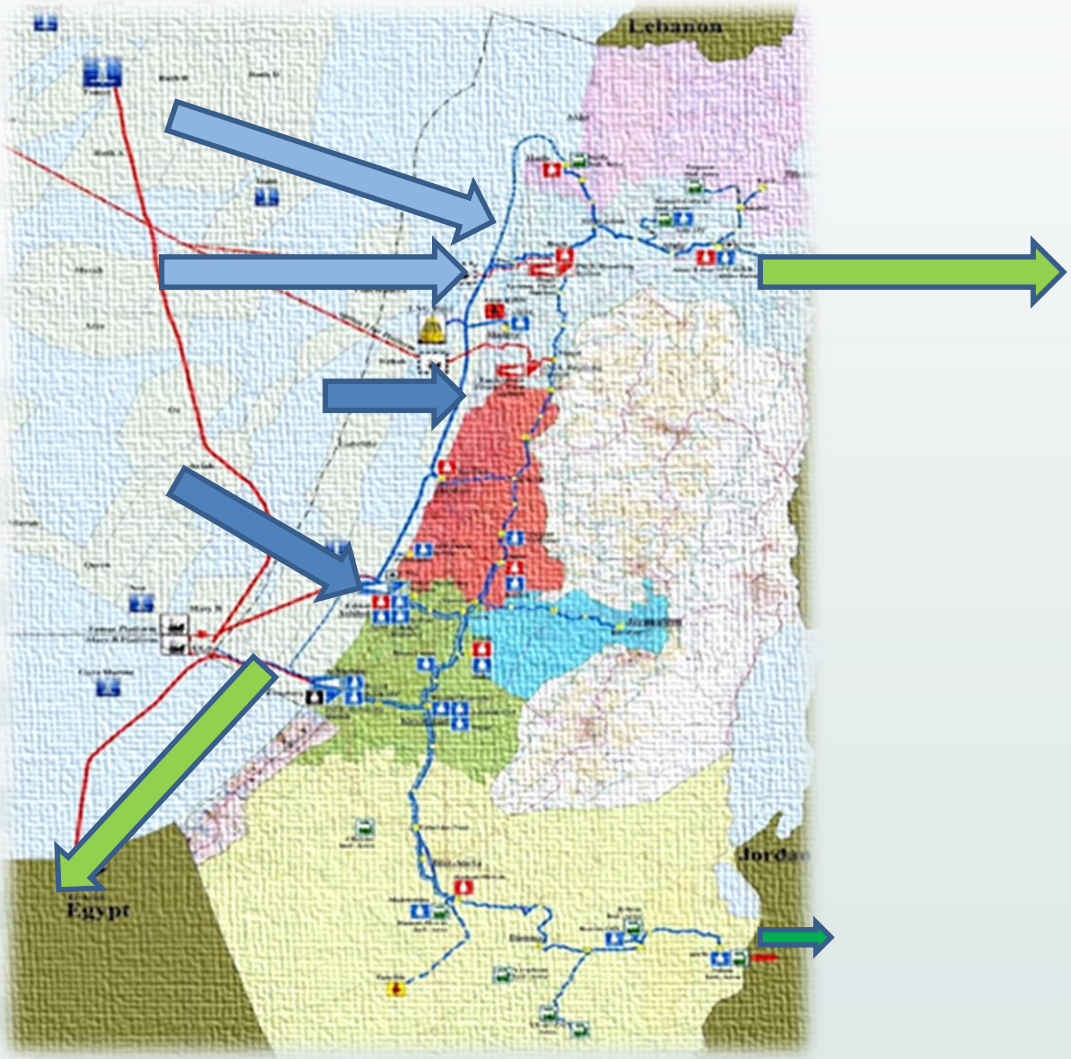
SCADA data validation – verify the data validity according to predesigned rules

Training and simulators - an offline copy of the SCADA system is connected to a model that simulates the pipeline. An instructor, through a training console, introduces an upset in the model which propagates through to the SCADA system. The trainee operates the SCADA console as if he was operating the pipeline.

Implementation of Advanced Applications

2020 Challenges

- More than one gas supplier
- New Export markets
- Managing pipeline operation



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