TRACTEBEL Engineering
GDF SUEZ

Dunamenti G3 Repowering: MINIMIZING INVESTMENT COST

through conversion of a 220 MW thermal power plant into a 400 MW CCGT

PowerGen Europe, June 13th 2012

Rob Versteirt - Guillaume Lassaux

CHOOSE EXPERTS, FIND PARTNERS

CONTENT

- Project Overview & Goals
- Project Key Success Factors
- Project Achievements

Dunamenti Power Plant

2 gas turbine co-generation units

6 gas/oil fired boilers

Gas/oil fired boiler
221 MW

Project Goals:

- **Increase efficiency**
- **Keep investment cost to a minimum**

400 MW combined cycle power plant

From Pre-feasibility to Commercial Operation

Pre-feasibility	Feasibility	White Book	EPCM	Commercial Operation
- Conceptual Design - Scenario comparison - Layout possibilities	- Project basic design - **Equipment condition assessment**	- Package specifications - Budget - Planning	- Project Implementation - Packages Procurement	

CONTENT

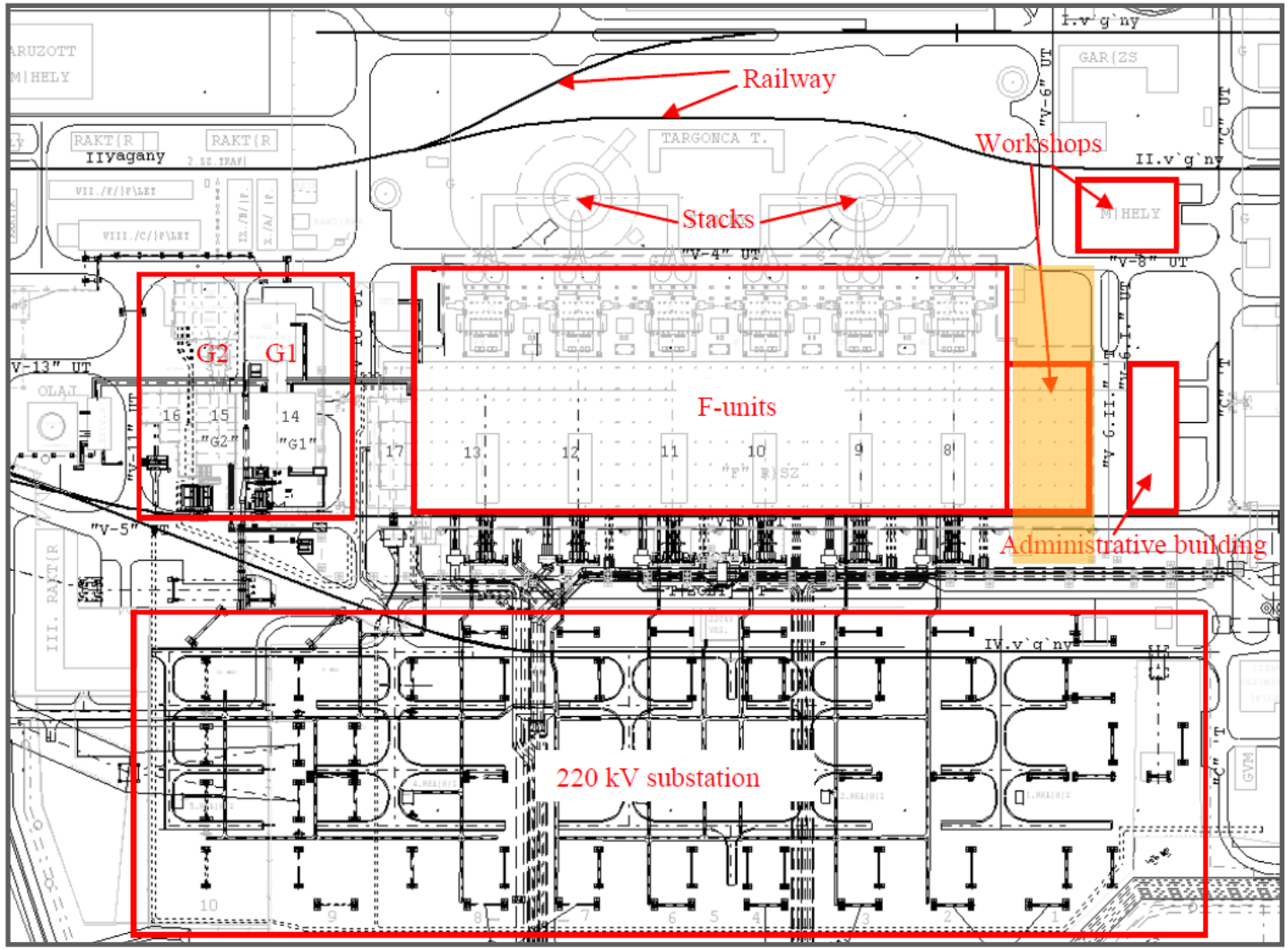
- Project Overview & Goals
- Project Key Success Factors
- Project Achievements

CONTENT

- Project Overview & Goals
- Project Key Success Factors
- Project Achievements

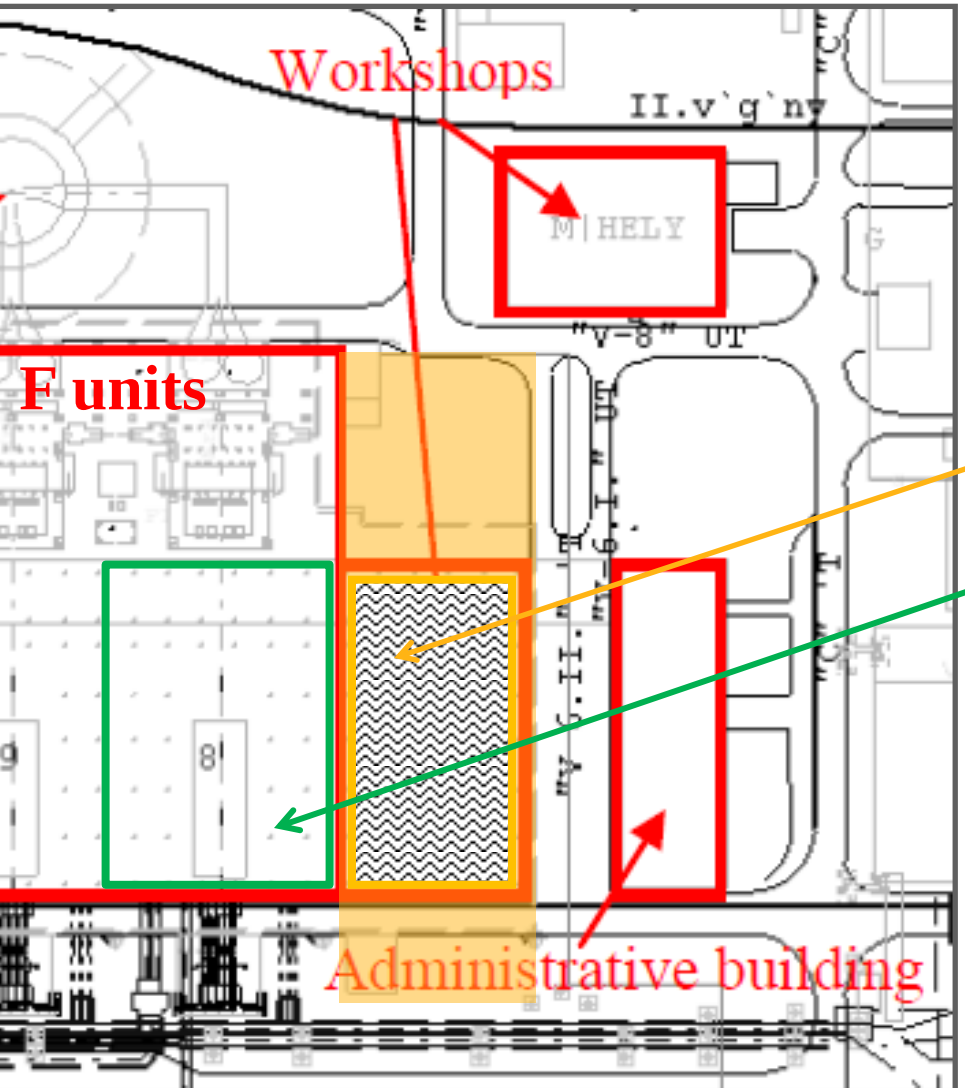
- Tailored Project Layout
- Optimised Balance of Re-use of Equipment vs. Cycle Efficiency
- Adapted Project Procurement & Implementation

Project Location – Original Layout



Customize Layout for Defined Location

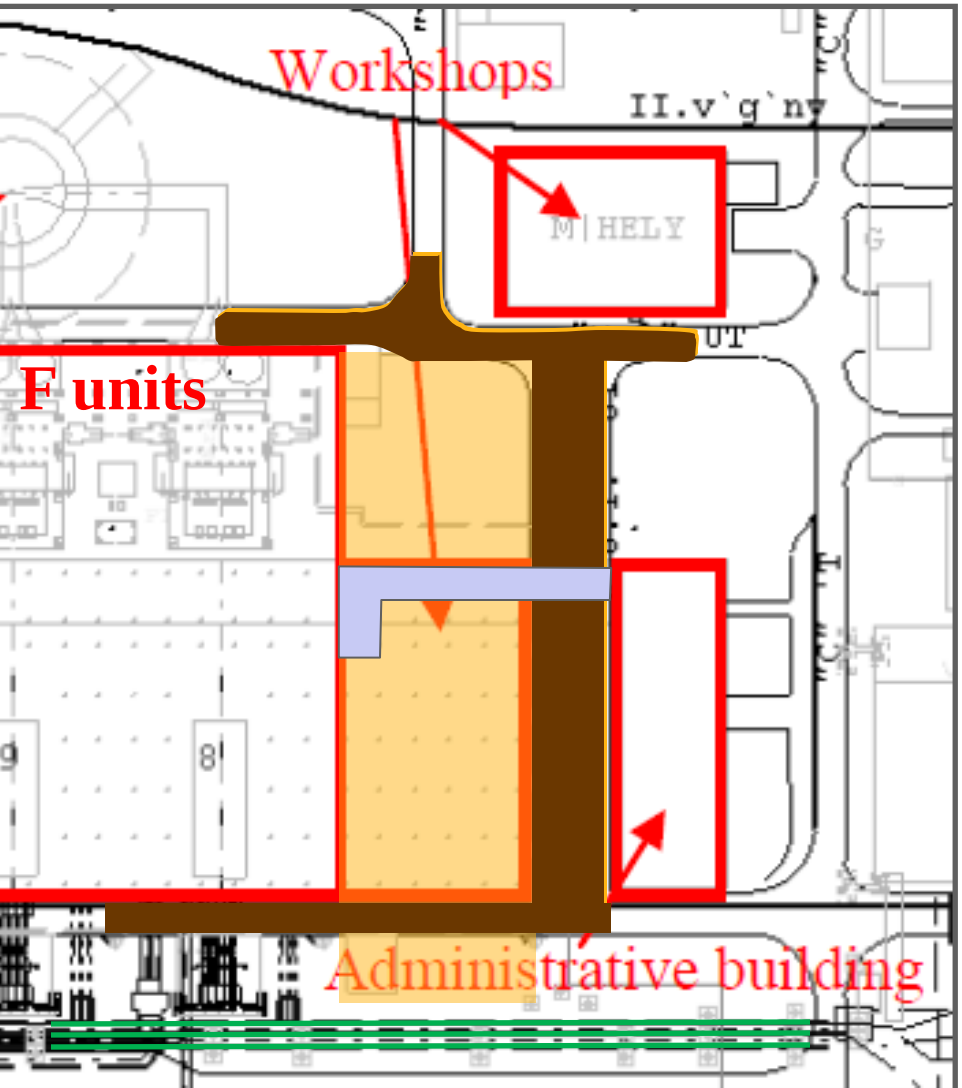
Minimize Demolition



Only workshop to be demolished

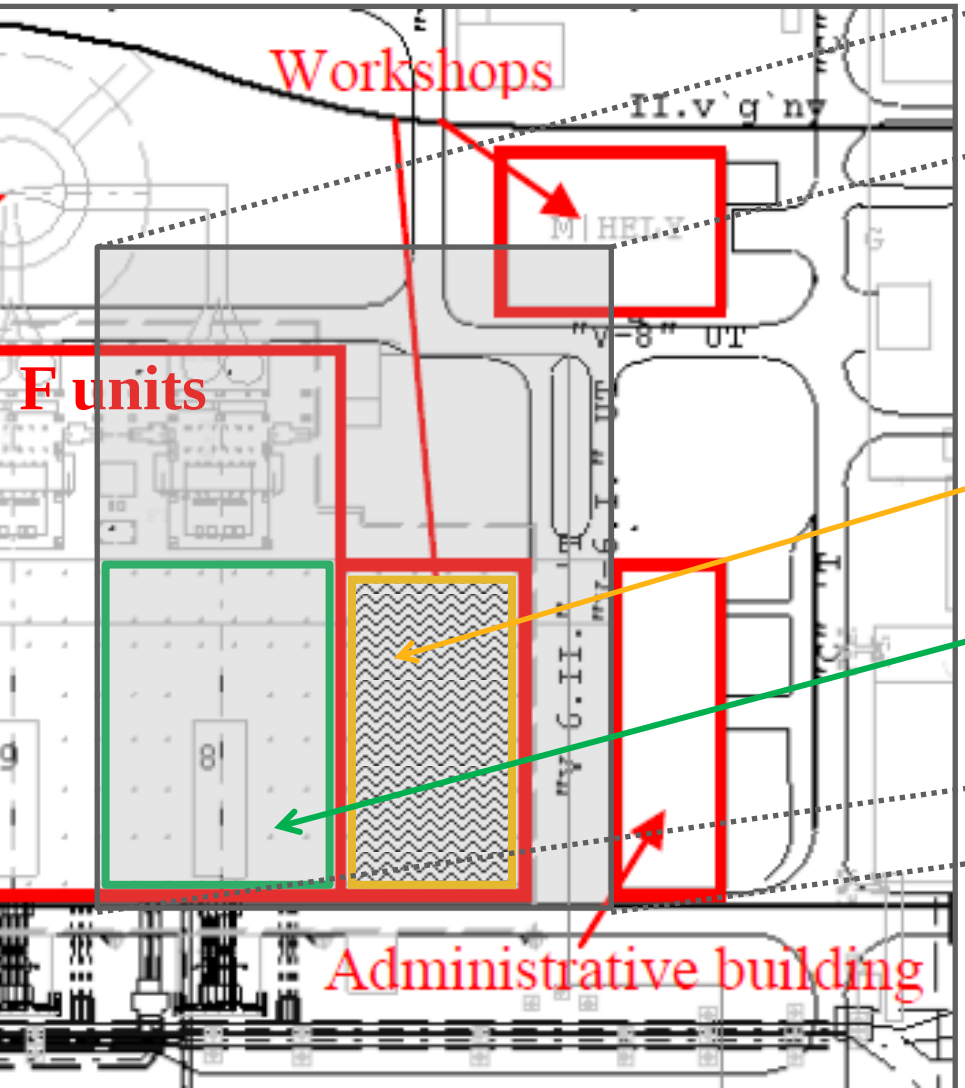
Re-used steam turbine & electrical buildings

Customize Layout for Defined Location
Constraint: Infrastructure to be preserved



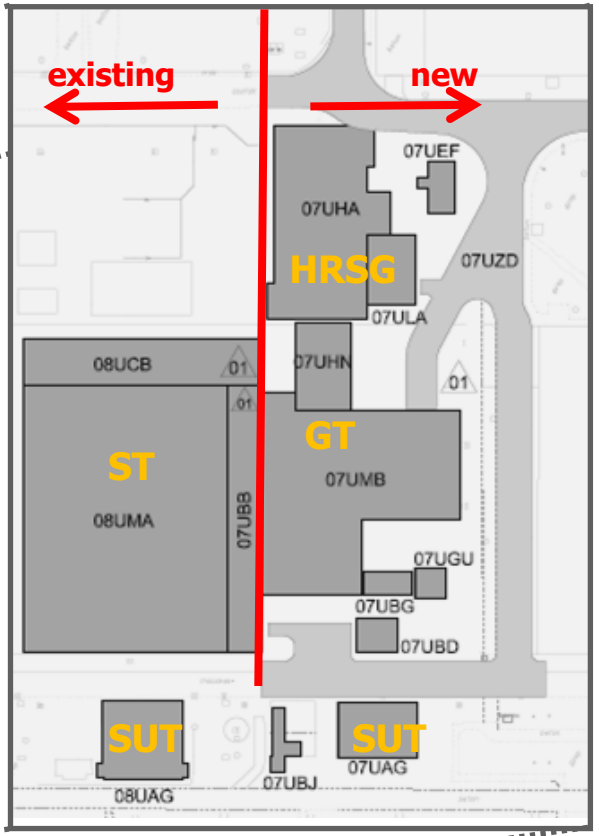
- Layout of existing roads on the site of the power plant
- Main cable gallery crossing the selected area and supplying power to power plant auxiliaries
- Steam pipe rack to the south of the chosen project location

Tailored Project Layout



Demolished workshop

Re-used steam turbine & electrical buildings



CONTENT

- Project Overview & Goals
- Project Key Success Factors
- Project Achievements

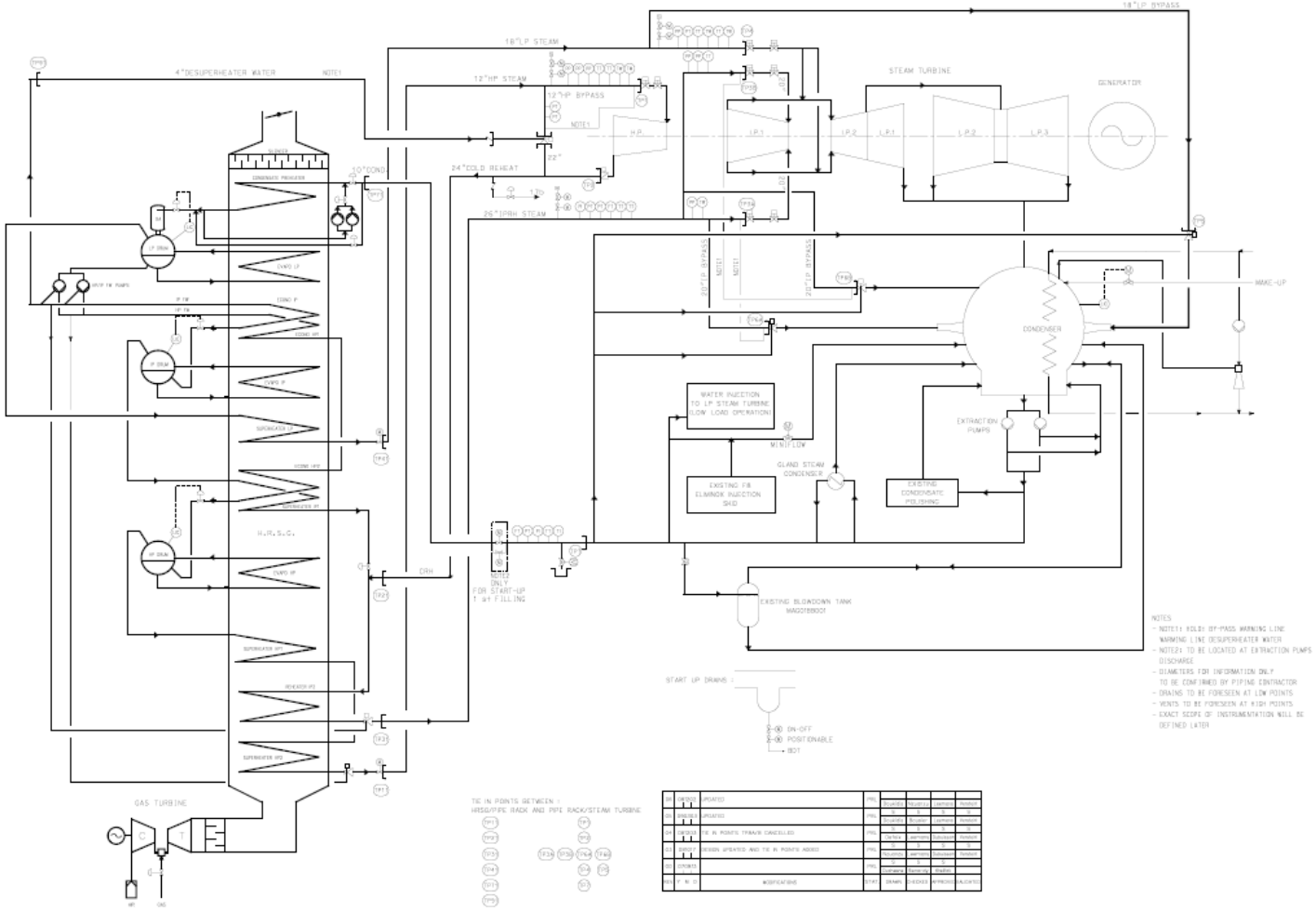
- Tailored Project Layout
- Optimised Balance of Re-use of Equipment vs. Cycle Efficiency
- Adapted Project Procurement & Implementation

Optimised Balance of Re-use of Equipment vs. Cycle Efficiency

- Heat and mass balance comparisons during pre-feasibility phase:
  - Gas turbine: F-class (275-285 MW)
  - Steam turbine: existing or new
  - With existing ST: 2 or 3 pressure levels HRSG
- Use of existing steam turbine in the combined cycle :
  - HP module: oversized ➔ lower efficiency
  - LP module: expected flow rate matched initial design flow rate
  - Existing HP module offered limited residual lifetime

➔ Optimization: replacement of HP turbine with re-use of IP and LP module

Final Process Flow Diagram

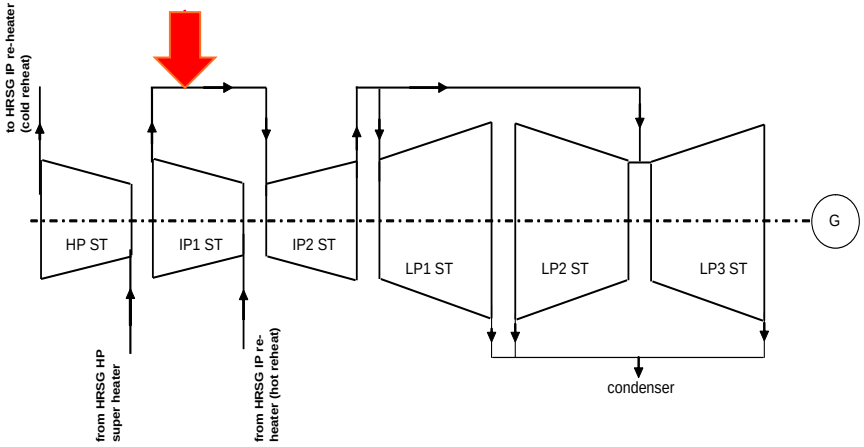


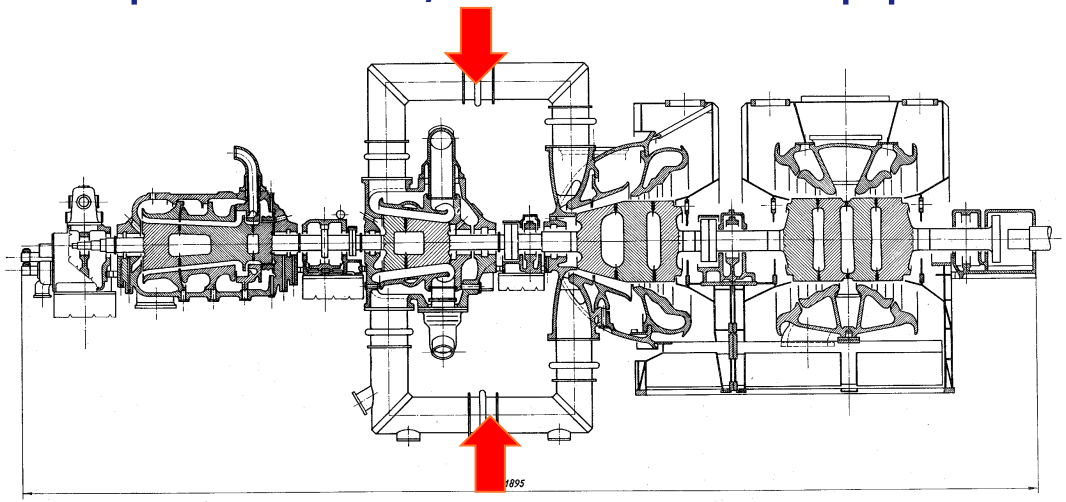
Re-used ST with new HP part: **Lower efficiency (0.4%)** than new ST but **lower investment cost**

3 pressure level HRSG versus 2 pressure level: **+0.6% efficiency**

Implementation of ST Modifications

- All extractions closed
- Additional LP steam injection point in IP1/IP2 cross-over pipes





- Modern steam turbine controller
  - Adapted to new operation modes
  - Thermal stress computer (HP and IP modules)

Re-use of Existing Equipment and Common Power Plant Systems

- Partial refurbishment of the steam turbine allowed extensive re-use of the old F-unit equipment
  - ST auxiliary equipment (lube oil, jacking oil, gland steam, vacuum ejector systems)
  - Condenser: new stainless steel tubes
  - ST generator: rewinding
  - Main cooling water system: unchanged

➢ Re-use of the steam turbine offered additional cost cut-down: "Leverage effect"

CONTENT

- Project Overview & Goals
- Project Key Success Factors
- Project Achievements

- Tailored Project Layout
- Optimised Balance of Re-use of Equipment vs. Cycle Efficiency
- Adapted Project Procurement & Implementation

Procurement Adapted to Tailored Design

- Executed in the framework of an EPCM multi-contract approach (Engineering, Procurement, Construction Management)
  - Scope of the contractual packages was defined in function of the market and project requirements
  - Flexibility for further project optimization and savings
- Main suppliers:
  - Gas turbine: ANSALDO ENERGIA V94.3 A4
  - Heat recovery steam generator: CMI
  - Steam turbine: Alstom Hungary
  - Electrical works: Fabricom
  - Civil works: Strabag

Implementation Project Timelines

Implementation Project Timelines

April 2009

Civil Works

Implementation Project Timelines

April 2009 — Civil Works

September 2009 — HRSG erection

Implementation Project Timelines

April 2009 — Civil Works

September 2009 — HRSG erection

April 2010 — Gas Turbine Arrival

Implementation Project Timelines

April 2009	September 2009	April 2010	December 2010	June 24th, 2011
Civil Works	HRSG erection	Gas Turbine Arrival	1st Firing	Performance Test

CONTENT

- Project Overview & Goals
- Project Key Success Factors
- Project Achievements

Gas/oil fired boiler
221 MW

Project Goals:

- **Increase efficiency**
- **Keep investment cost to a minimum**

400 MW combined cycle power plant

Key Success Factors:

- Tailored Project Layout
- Optimised Balance of Re-use of Equipment vs. Cycle Efficiency
- Adapted Project Procurement & Implementation

Gas/oil fired boiler
221 MW

Project Goals:

- **Increase efficiency**
- **Keep investment cost to a minimum**

400 MW combined cycle power plant

Dunamenti G3 unit now in operation: Actual performances better than guaranteed

Investment cost maintained at a low level through an optimized integration in the plant

A repowering offers a significant cost advantage in comparison with a Greenfield solution

Questions?