



# TG 50 D5 Turbigo P.P. Equipments Relocation

## **TG 50 D5**

# **Turbigo P.P. Equipments Relocation**

- **TG 50 D5 Design Concepts.**
- **Operating Experience.**
- **Upgrading Packages.**
- **Turbigo P.P. Equipments Relocation.**

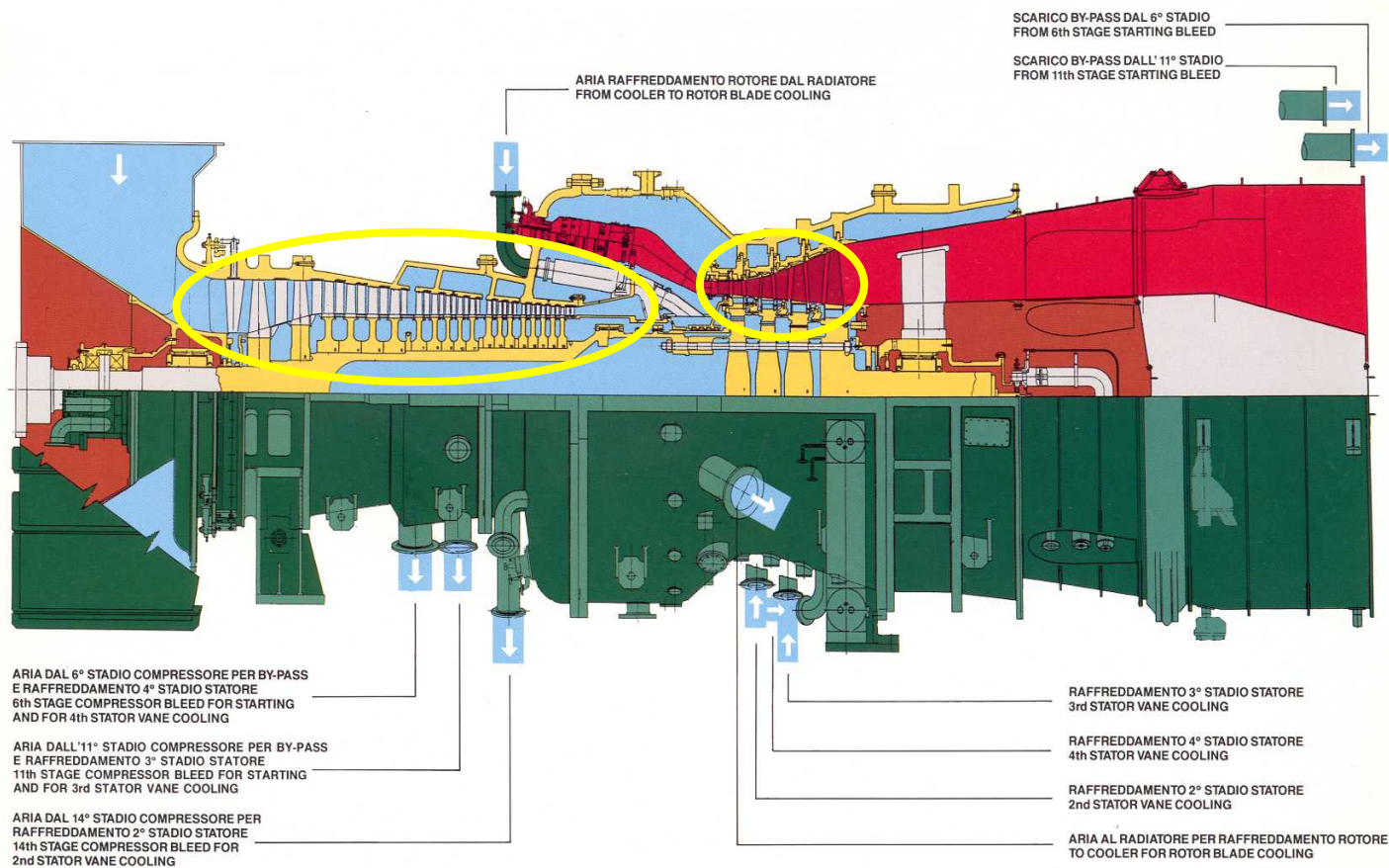
# **TG 50 D5 Design Concepts**

- **TG 50 D5 gas turbine was designed as 50 Hz version of W 501 D5.**
- **The design was based on a scale-up approach saving the commonality of turbine hot parts.**

**TG 50 D5**

# **Design Concepts**

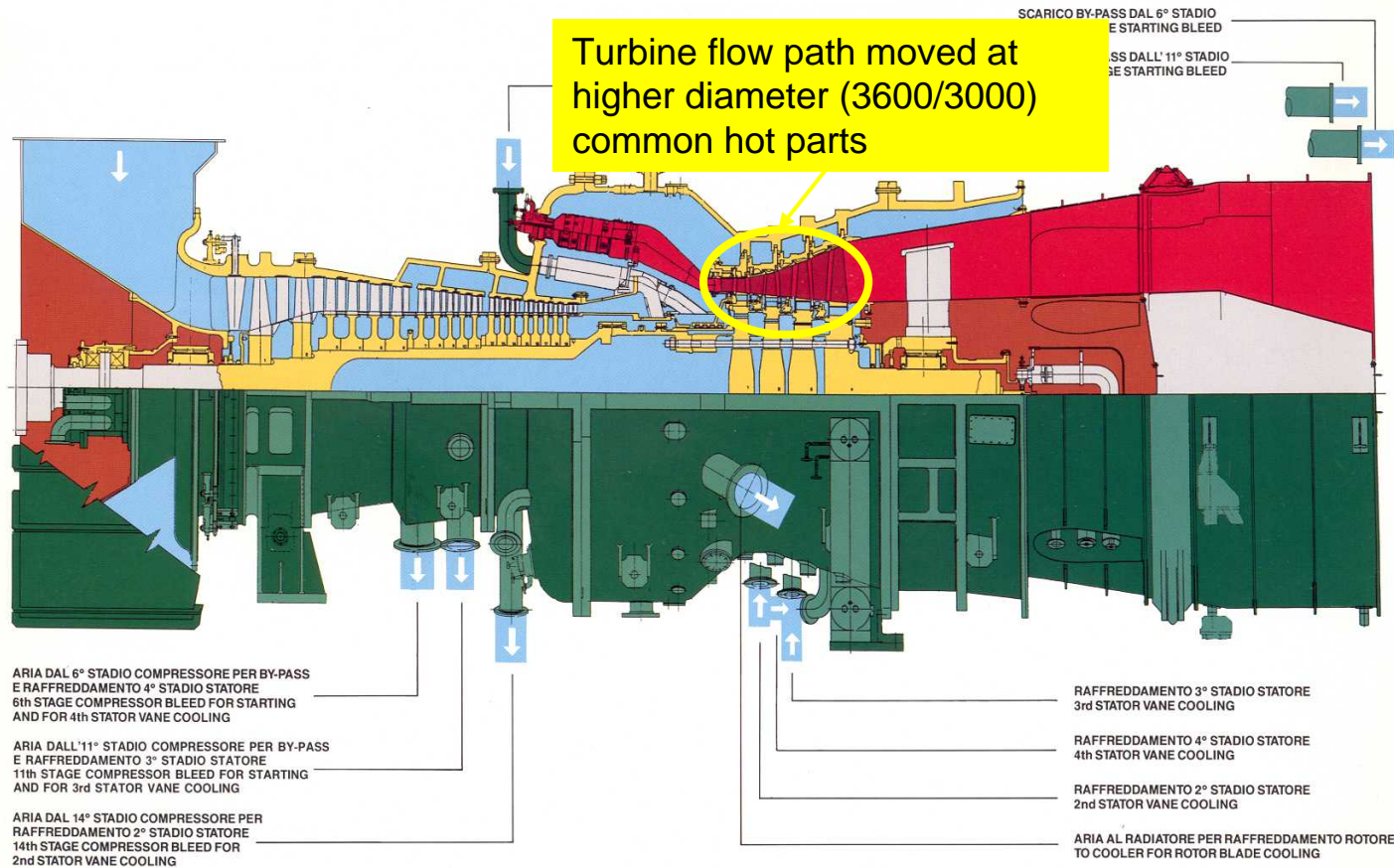
## TG 50 D5 Design Concepts



# TG 50 D5 Design Concepts

- **The W 501 D5 Turbine blade path was moved to a higher radius to compensate for lower running speed (3000 RPM instead of 3600); saving in this way the basic Blades and Vanes.**
- **The Compressor was scaled from the W 501 D5 one and adjusted in flow in order to match the Turbine**

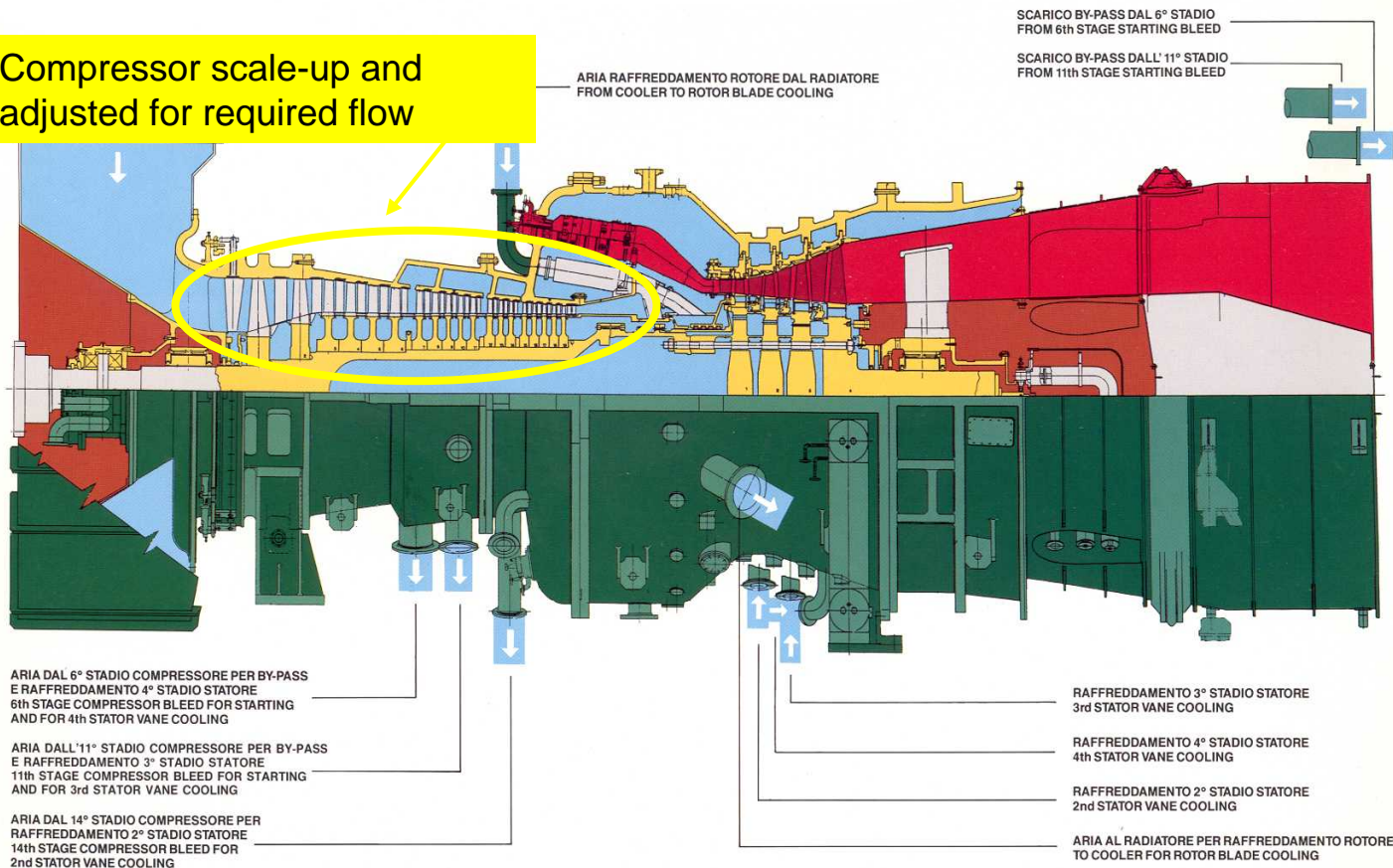
## TG 50 D5 Design Concepts-Turbine



## TG 50 D5

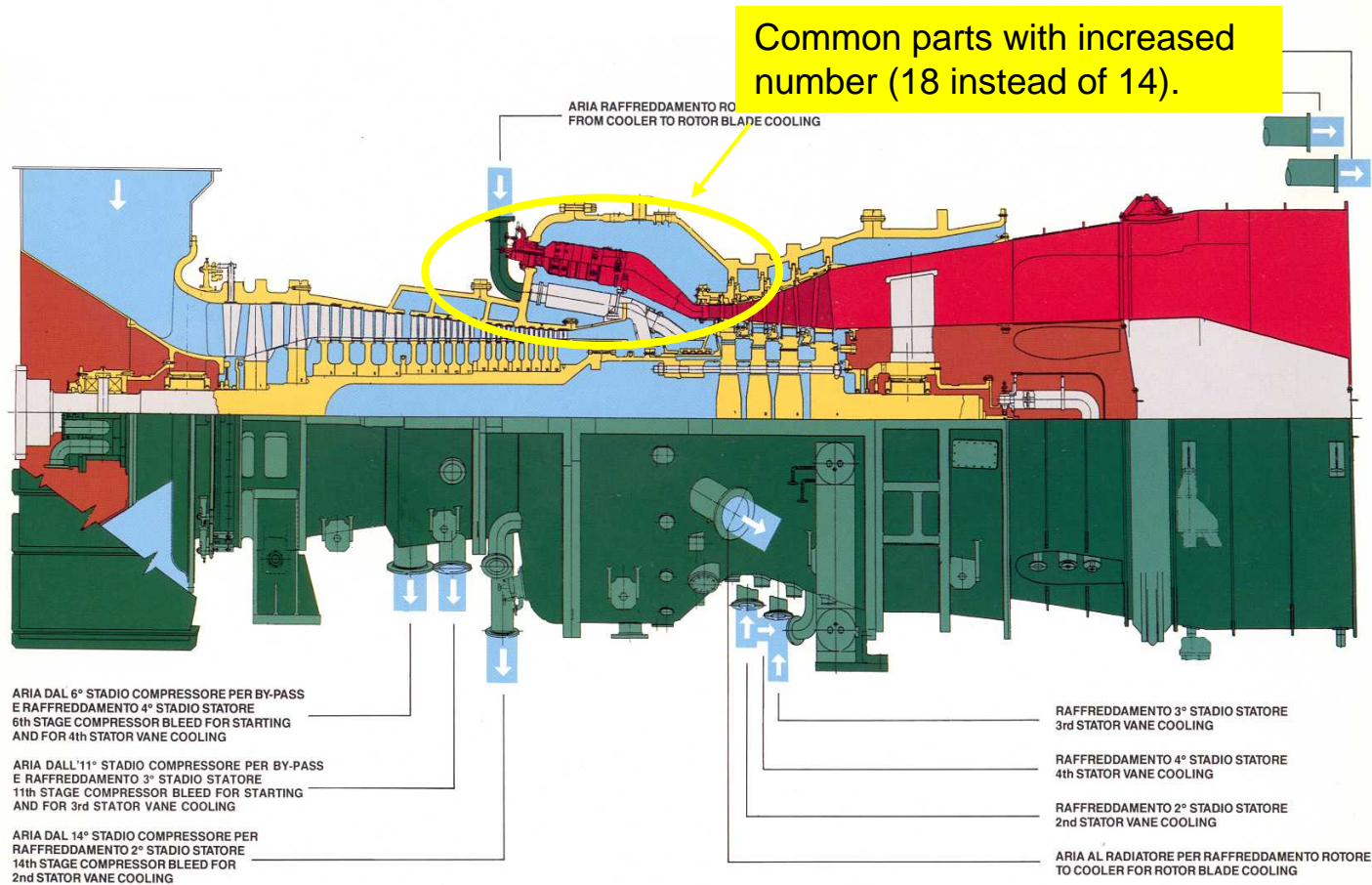
# Design Concepts-Compressor

Compressor scale-up and adjusted for required flow



## TG 50 D5

# Design Concepts-Combustion

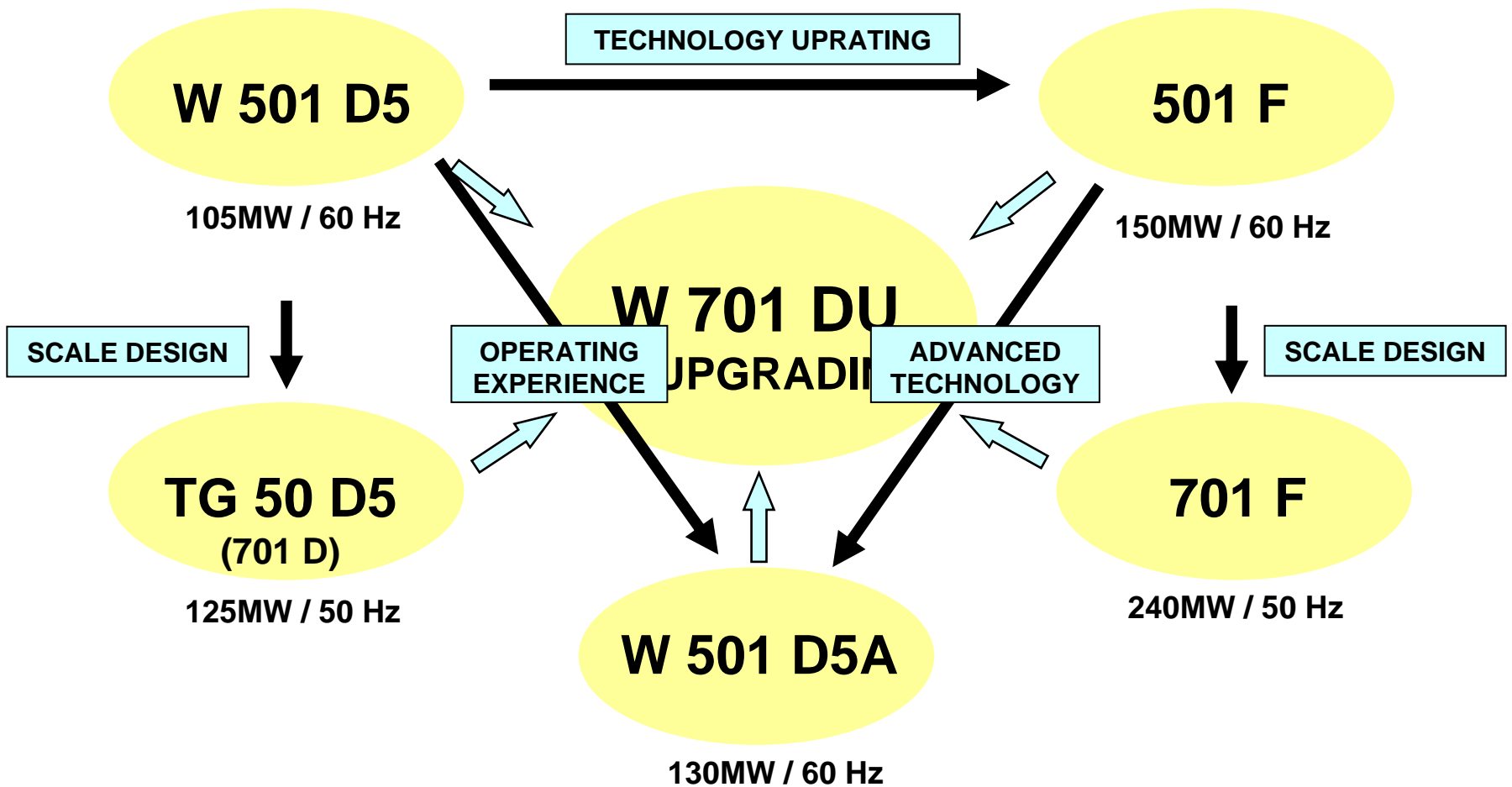


# TG 50 D5

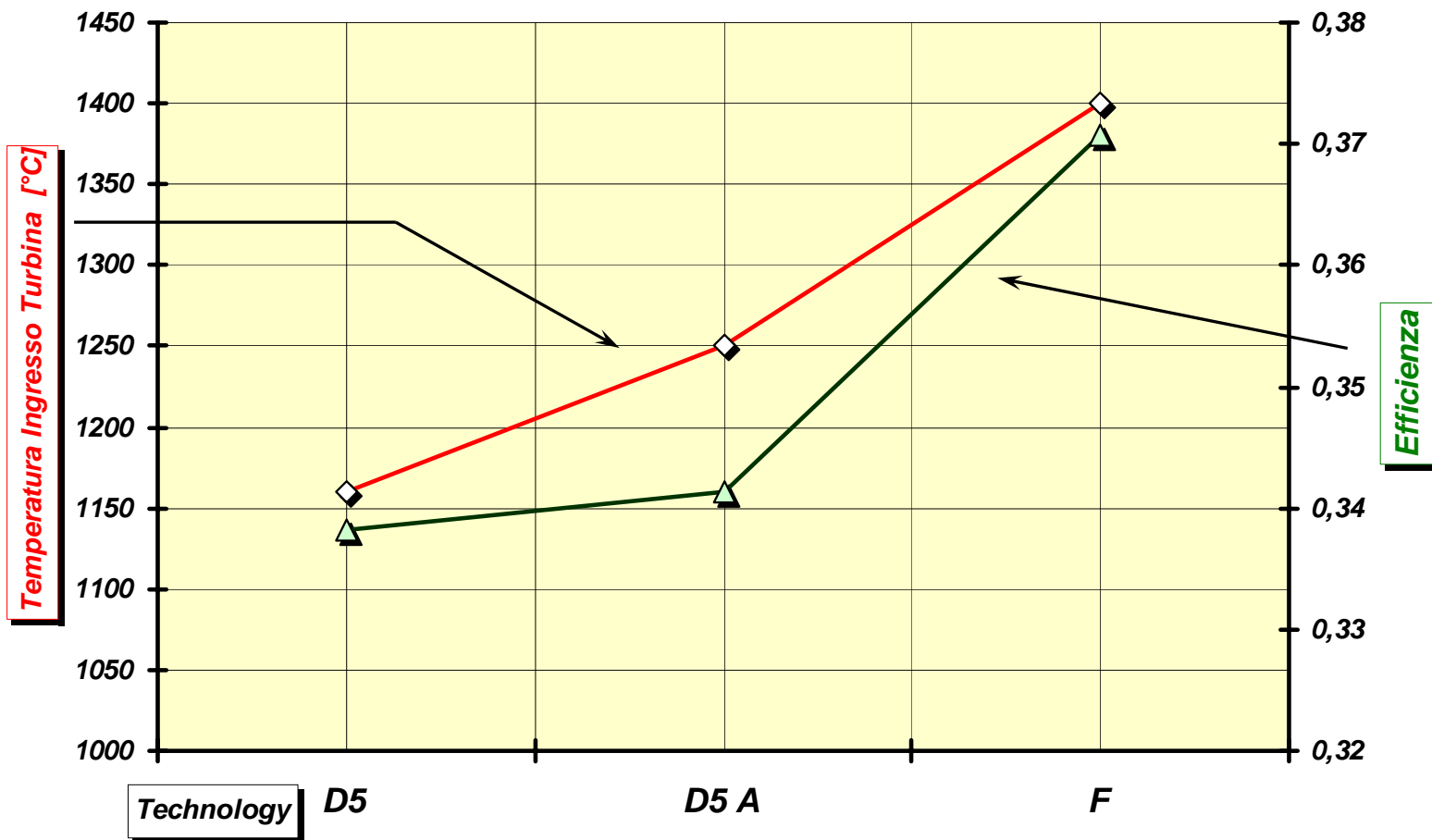
## 50 Hz/60 Hz Low of similarity design

	( Unit: ratio to the base machine )		
Item	W 501 D5 (3600 rpm)	Similarity design (3000 rpm)	TG 50 D5 (3000 rpm)
<b>PERFORMANCE</b>			
Suction flow rate	1	1.44	1.2
Pressure ratio	1	1	1
Power output	1	1.44	1.2
Efficiency	1	1	1
<b>STRENGTH</b>			
Blade stress	1	1	1/1.2
Disc stress	1	1	1
<b>VIBRATION</b>			
Natural frequency	1	1/1.2	1.2
Harmonics	1	1	1.2

# TG 50 D5 Product Evolution



## TG 50 D5 Upgrading Background

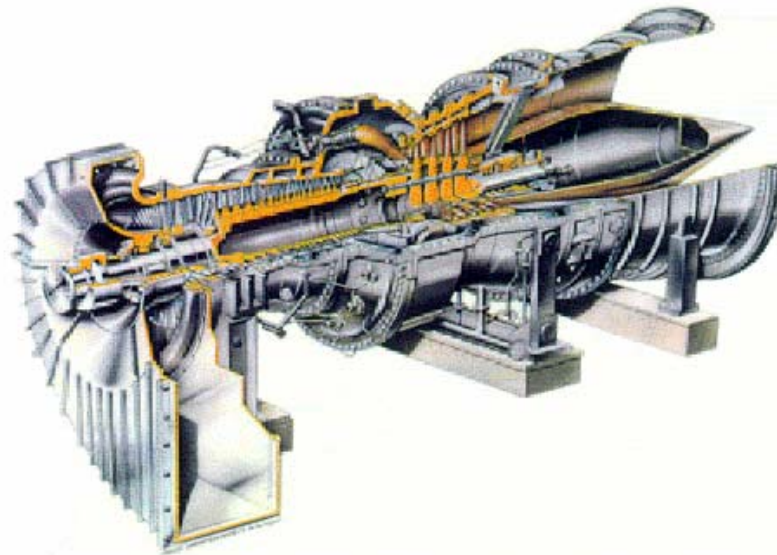


**TG 50 D5**

**Operating  
Experience**

# TG 50 D5 Upgrading Operating Experience

## TG50D5 Experience



<b>Lead Unit Operating Hours</b>	<b>&gt;</b>	<b>85,000</b>
<b>Total Operating Hours</b>	<b>&gt;</b>	<b>990,000</b>

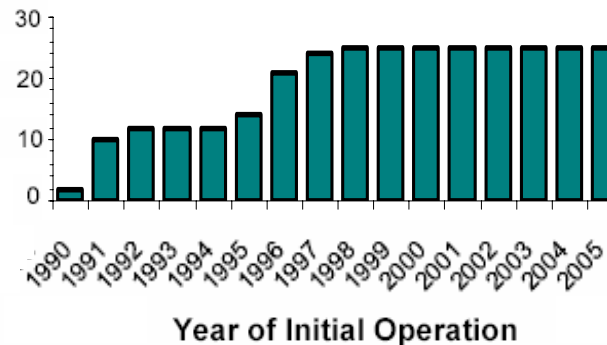
## TG 50 D5 Upgrading Operating Experience

### TG50D5 Experience



25 TG50D5 Units operating

### 25 TG50D5 Units Operating

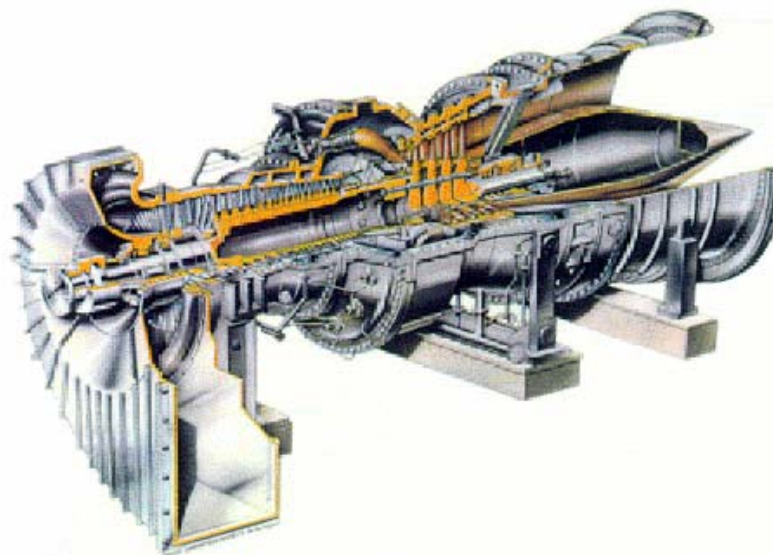


## TG 50 D5 Upgrading Operating Experience

SIEMENS  
Westinghouse

SIEMENS

### W501D5 Experience



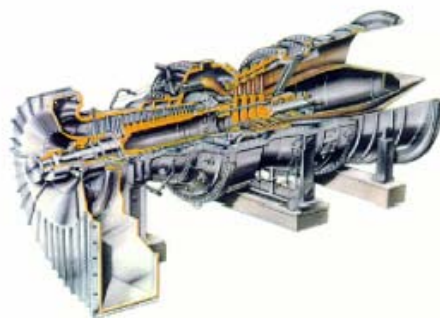
Lead Unit Operating Hours	>	158,000
Total Operating Hours	>	4,989,000

## TG 50 D5 Upgrading Operating Experience

SIEMENS  
Westinghouse

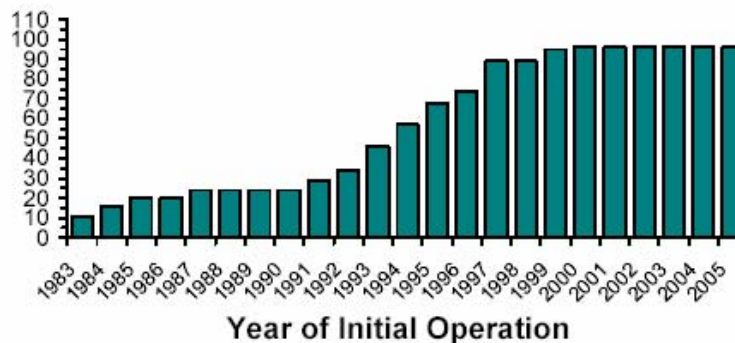
SIEMENS

### W501D5 Experience



96 Siemens Westinghouse  
W501D5 Units Operating

96 W501D5 Units Operating

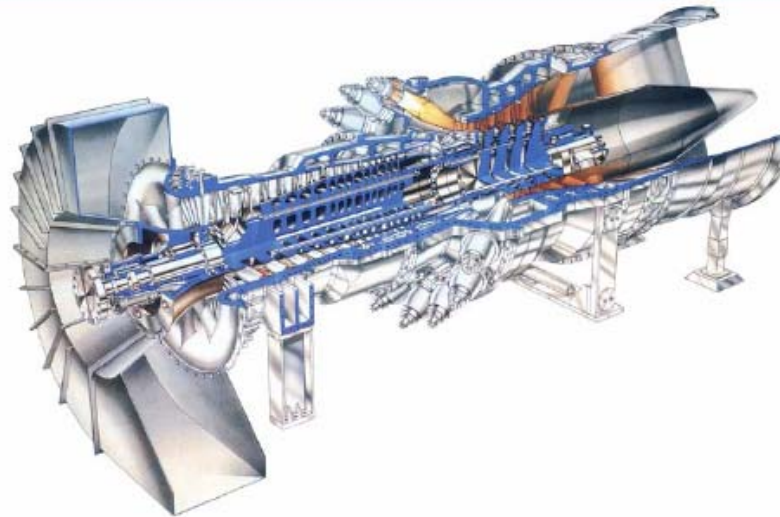


## TG 50 D5 Upgrading Operating Experience

SIEMENS  
Westinghouse

SIEMENS

### SGT6-5000F Experience



Lead Unit Operating Hours	>	94,400
Total Operating Hours	>	2,580,000

## TG 50 D5 Upgrading Operating Experience

SIEMENS  
Westinghouse

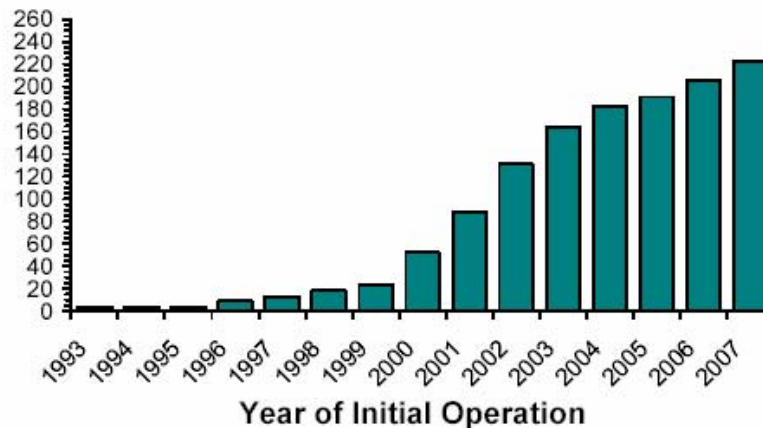
SIEMENS

### SGT6-5000F Experience



185 Siemens Westinghouse  
SGT6-5000F Units Operating

223 SGT6-5000F Total Units Operating and  
Under Contract

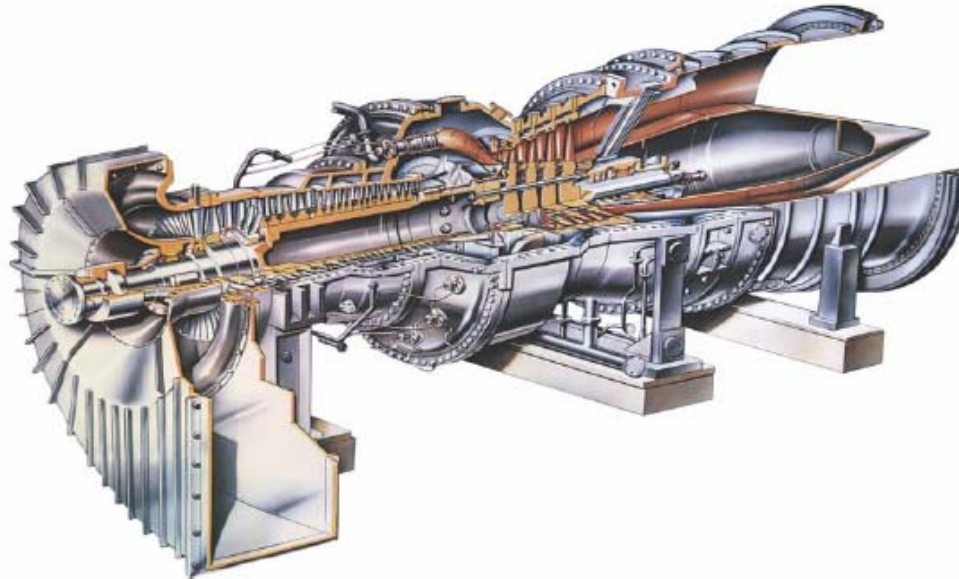


## TG 50 D5 Upgrading Operating Experience

SIEMENS  
Westinghouse

SIEMENS

### SGT6-3000E Experience



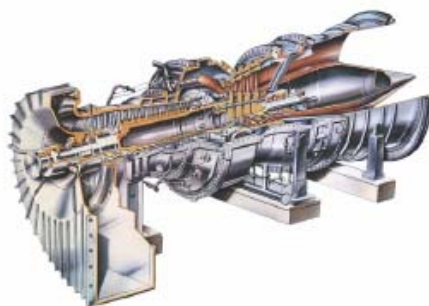
Lead Unit Operating Hours	>	64,000
Total Operating Hours	>	959,000

## TG 50 D5 Upgrading Operating Experience

**SIEMENS**  
Westinghouse

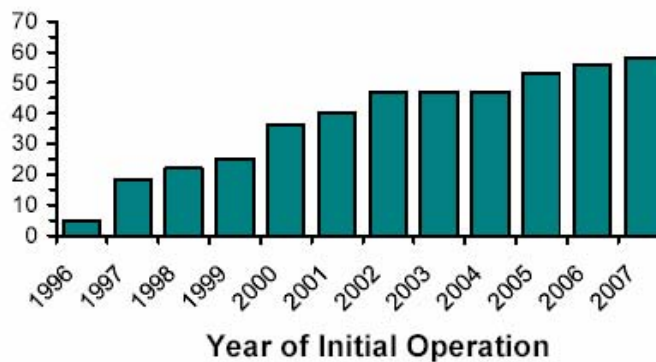
**SIEMENS**

### SGT6-3000E Experience



47 Siemens Westinghouse  
SGT6-3000E Units Operating

58 SGT6-3000E Units Operating and  
Under Contract



**TG 50 D5**

# **Upgrading Packages**

# TG 50 D5 Upgrading Background

- **“D5” technology operating experience.**

- » In Operation since 1983

- **“F” technology operating experience.**

- » In Operation since 1993

- **“D5A” (fall-out of “F” technology)**

- » In Operation since 1996

- **D5 Compressor Redesign**

- » In Operation since 1996

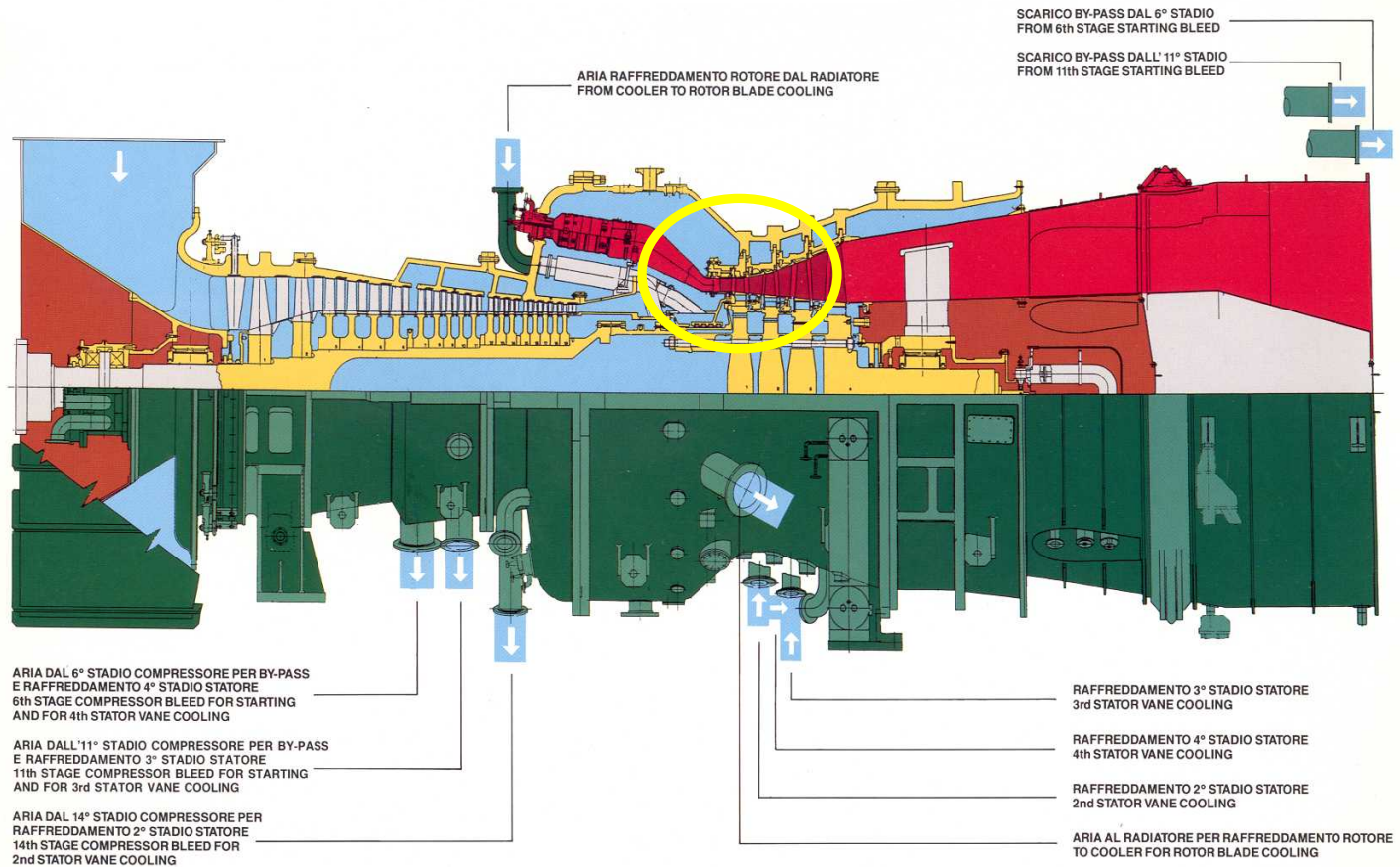
## **TG 50 D5 Upgrading Targets**

- **Increase Output and Efficiency**
  - **Increase firing temperature**
  - **Increase Compressor inlet flow**

# TG 50 D5 Upgrading

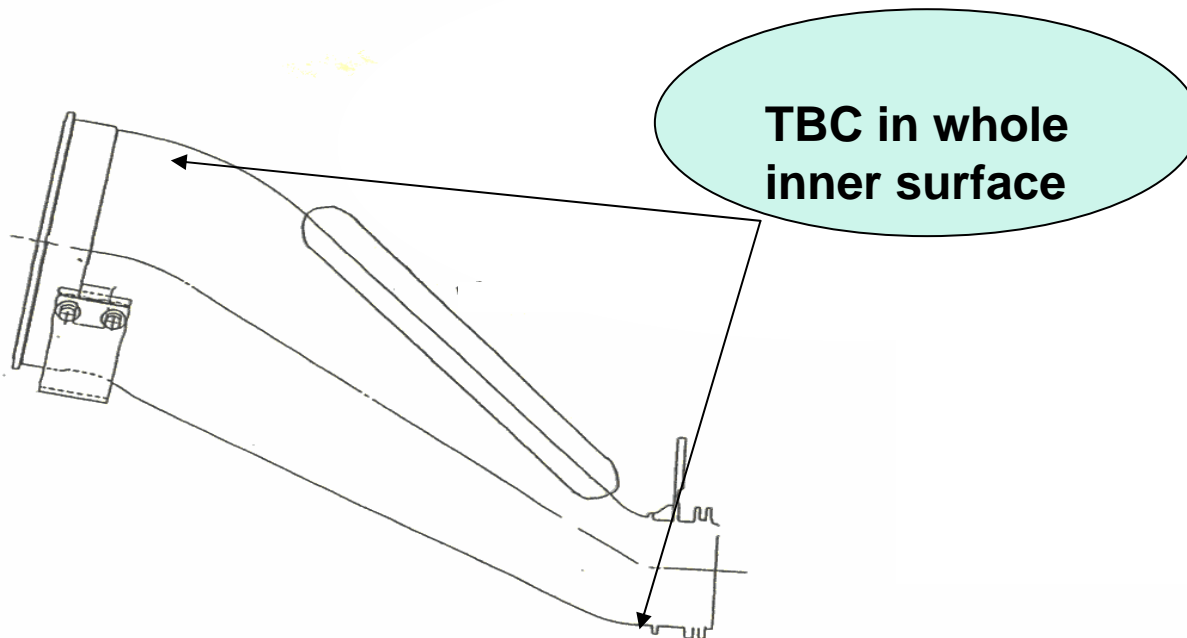
- **Hot Parts Upgrading**
  - Transition piece
  - Row 1 and Row 2 Vanes
  - Row 1, 2 and 3 Blade
- **Front Stages Compressor Upgrading**

# TG 50 D5 Upgrading Hot Parts Upgrading



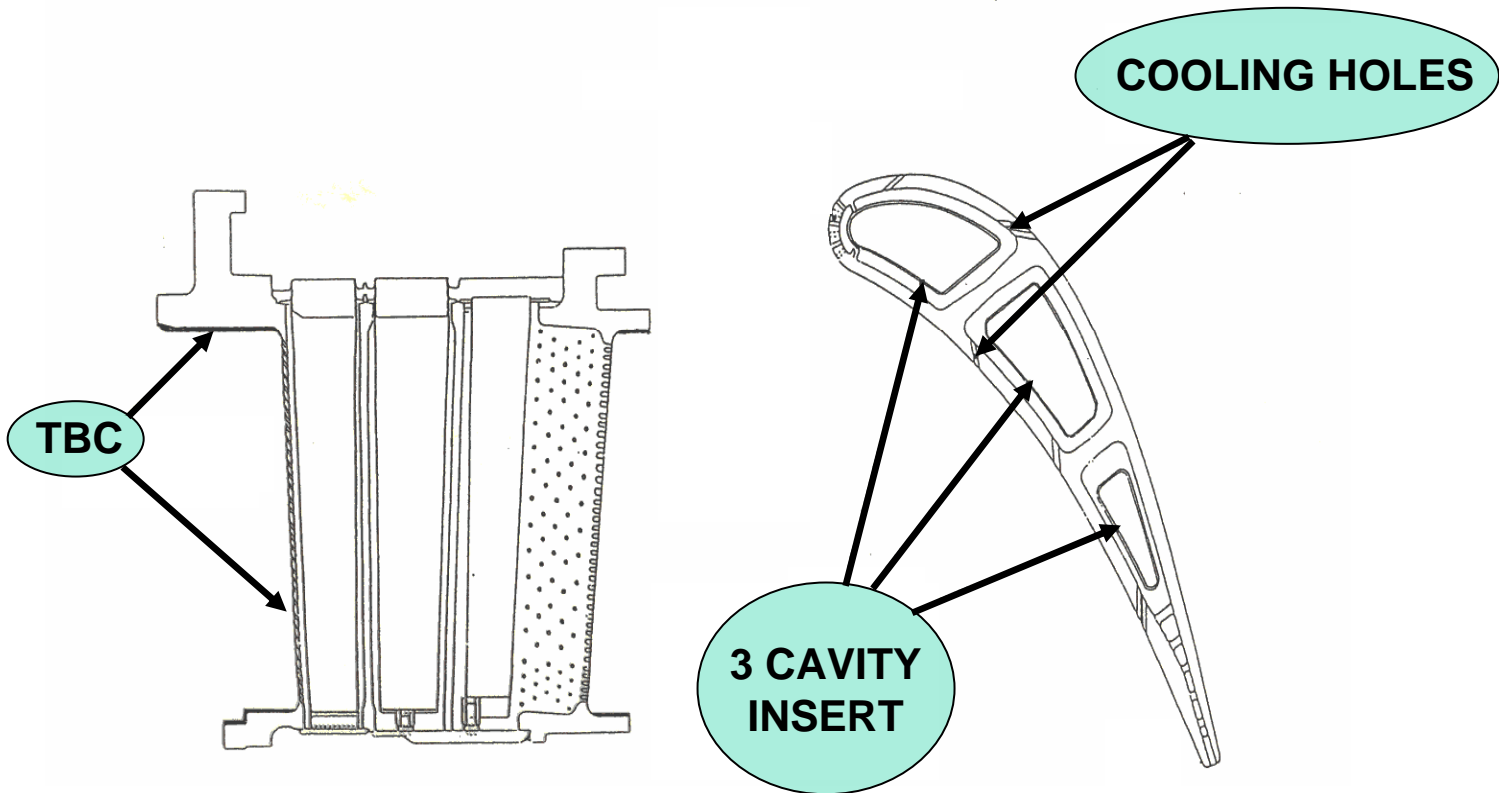
## TG 50 D5 Upgrading Transition Piece

- Higher TIT- same metal temperature.



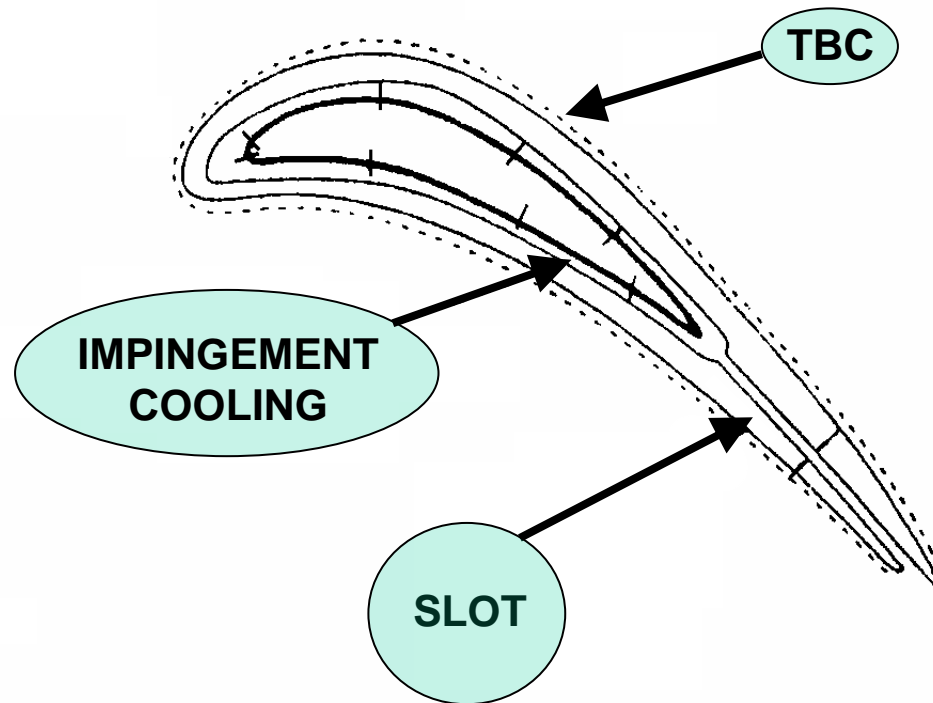
# TG 50 D5 Upgrading Row 1 Vane

- Better cooling scheme - TBC



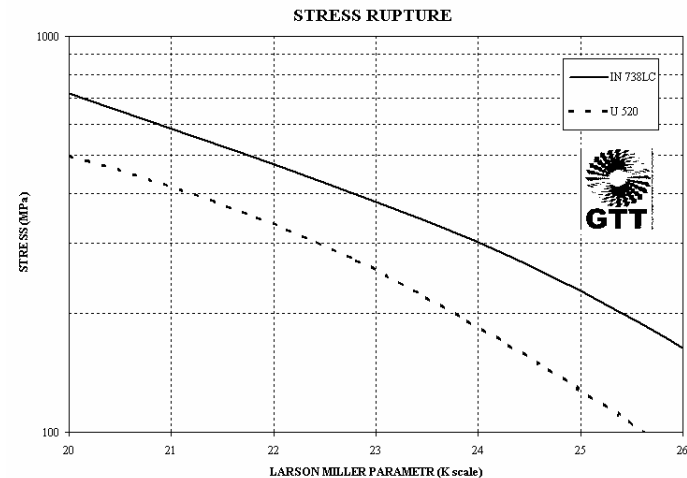
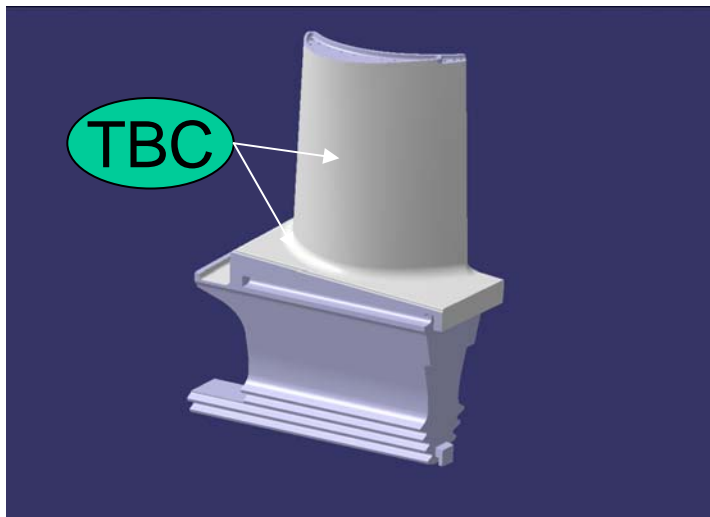
# TG 50 D5 Upgrading Row 2 Vane

- Better cooling scheme - TBC

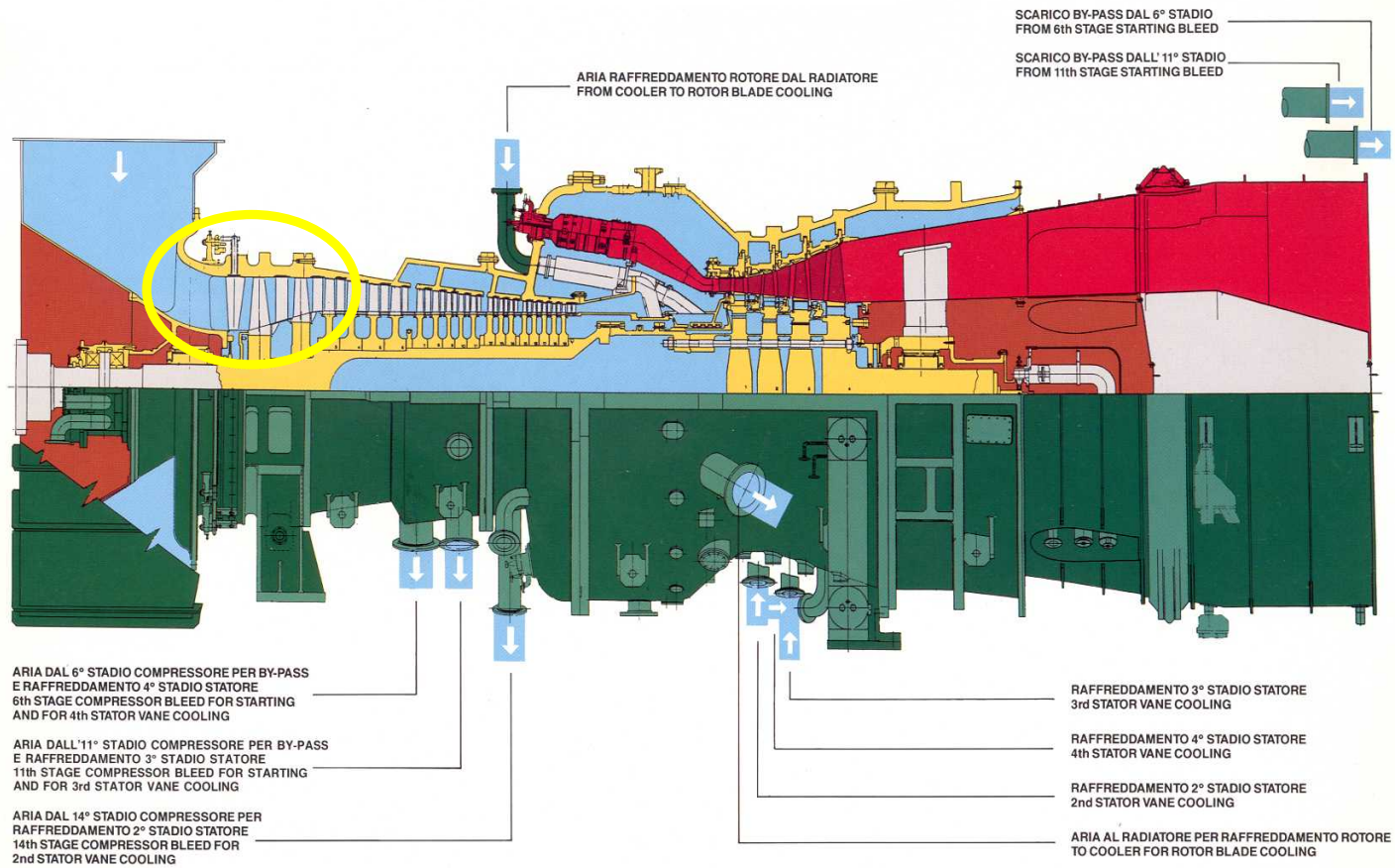


## TG 50 D5 Upgrading Row 1,2 and 3 Blade

- INCONEL 738 LC instead of U-520 on Row 1, 2 and 3 Blade
- TBC on Row 1 and 2 Blade airfoil and platform.

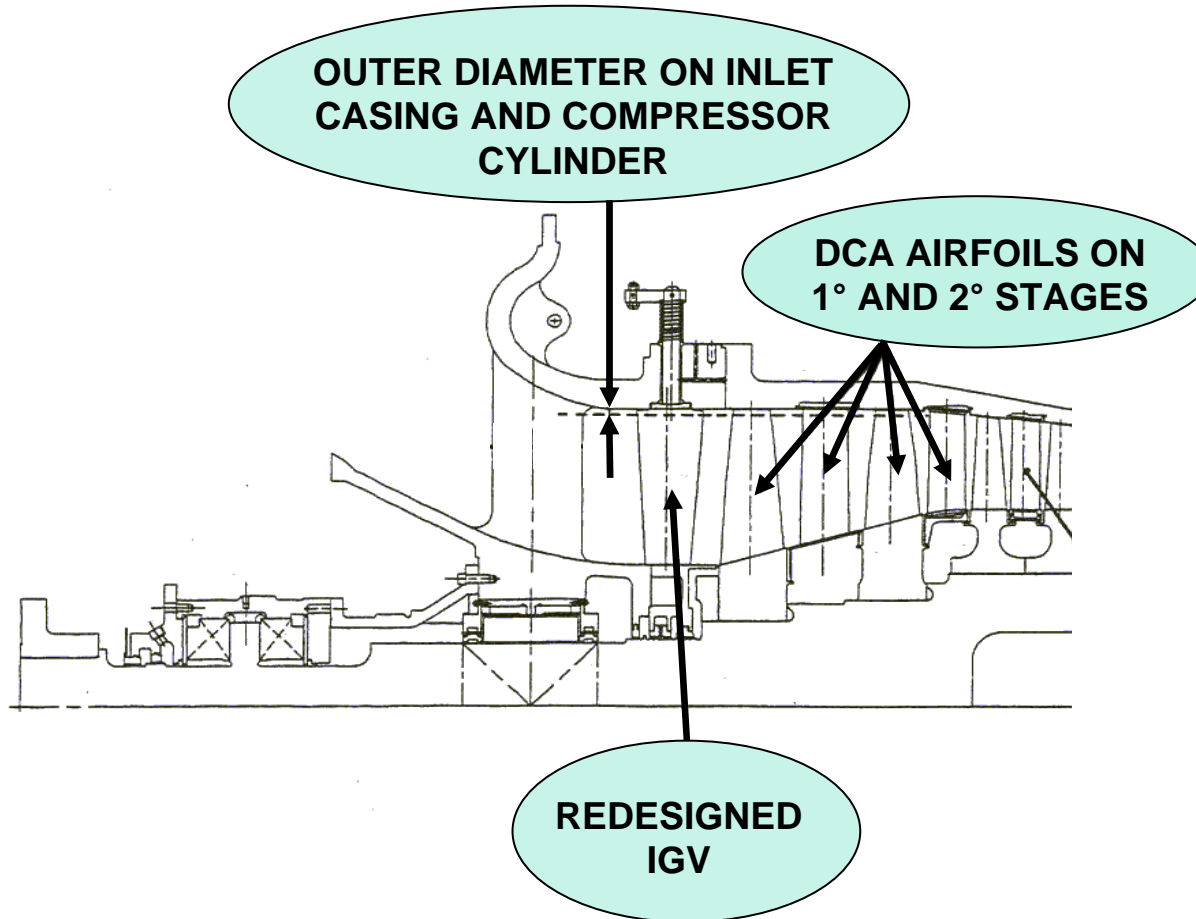


## TG 50 D5 Upgrading Compressor Upgrading

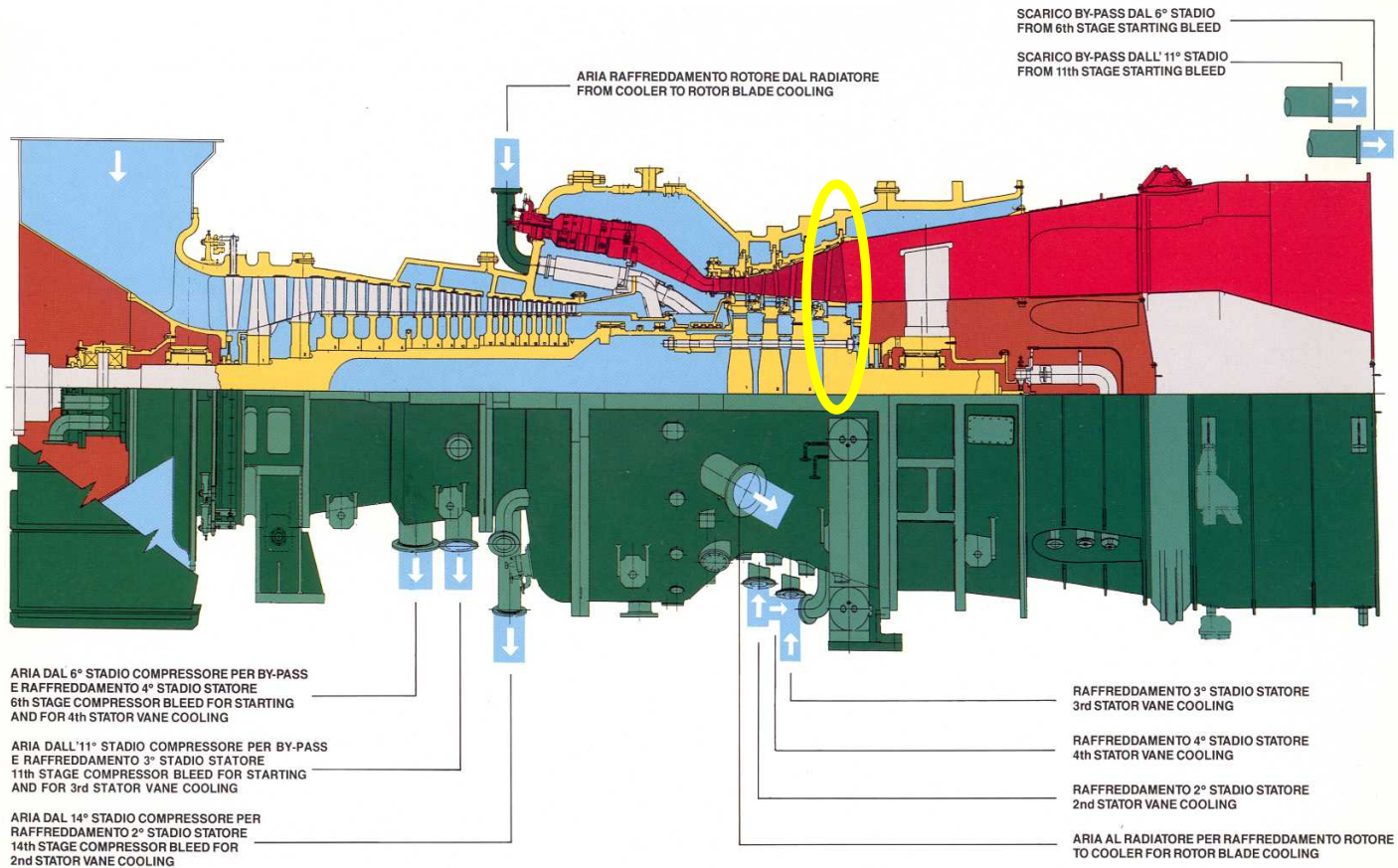


# TG 50 D5 Upgrading Compressor Upgrading

## ● Front stages Upgrading



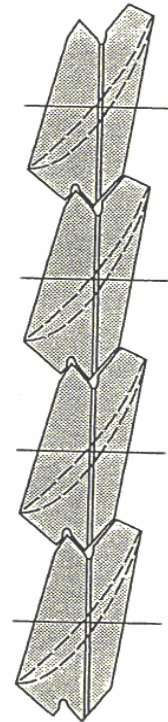
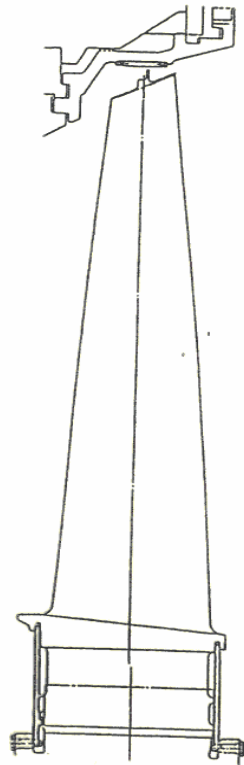
## TG 50 D5 Upgrading Row 4 Blade D5A Type



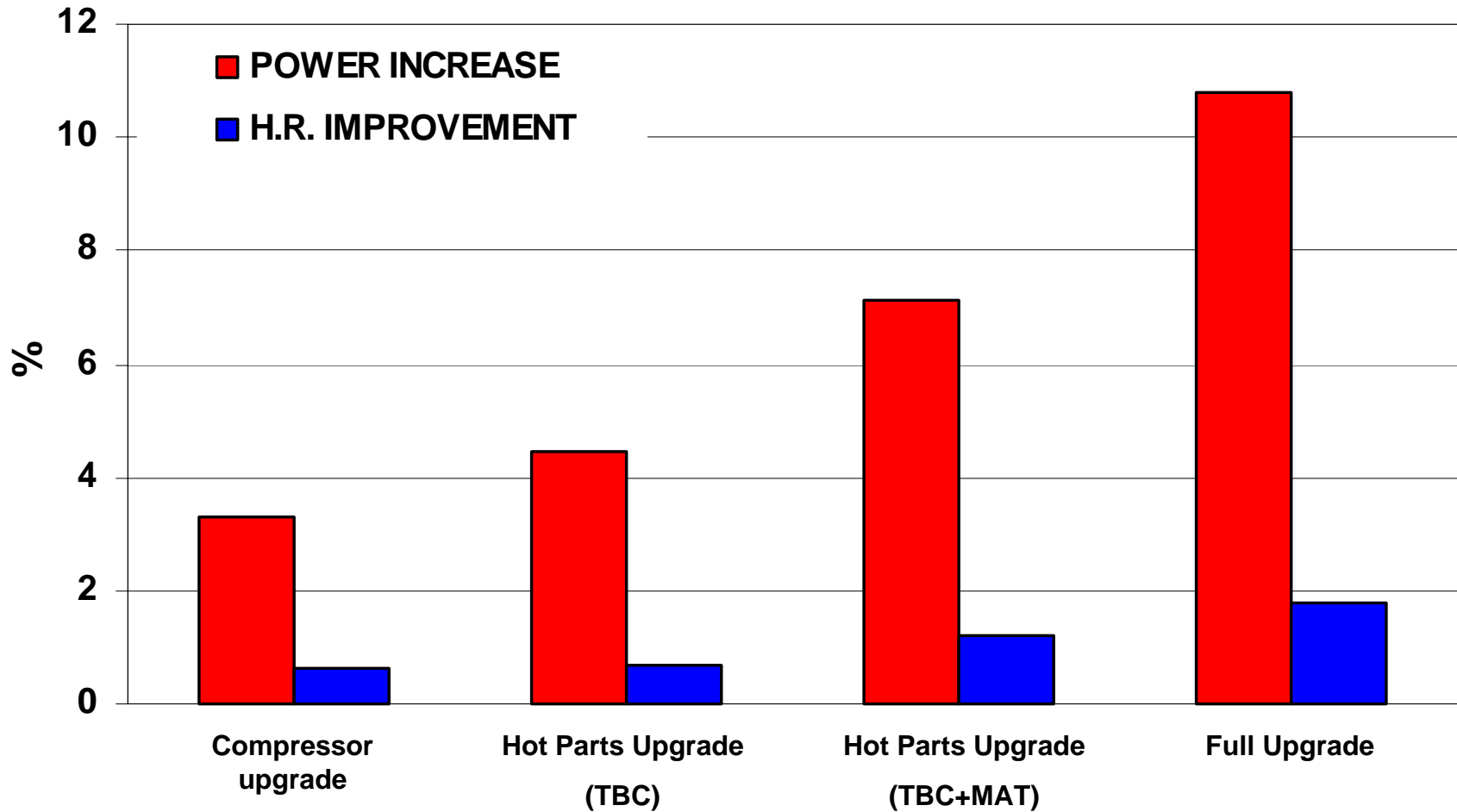
# TG 50 D5 Upgrading Row 4 Blade D5A Type

## ● Tip shrouded Row 4 Blade

- Improved dynamics
- Increased number of blades



# TG 50 D5 Upgrading GT Upgrading Effects



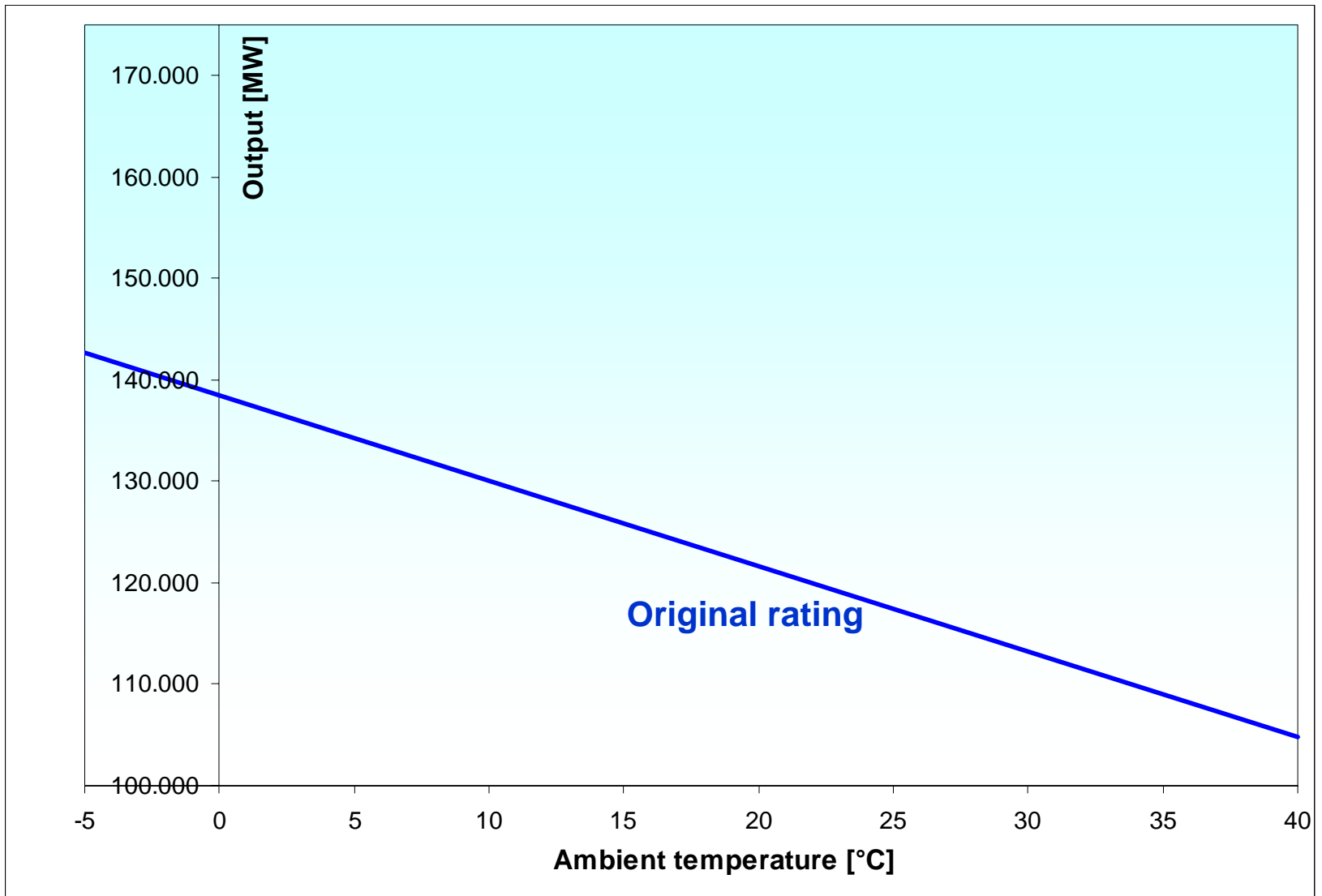
**TG 50 D5**

**Turbigo P.P.  
Equipments  
Relocation**

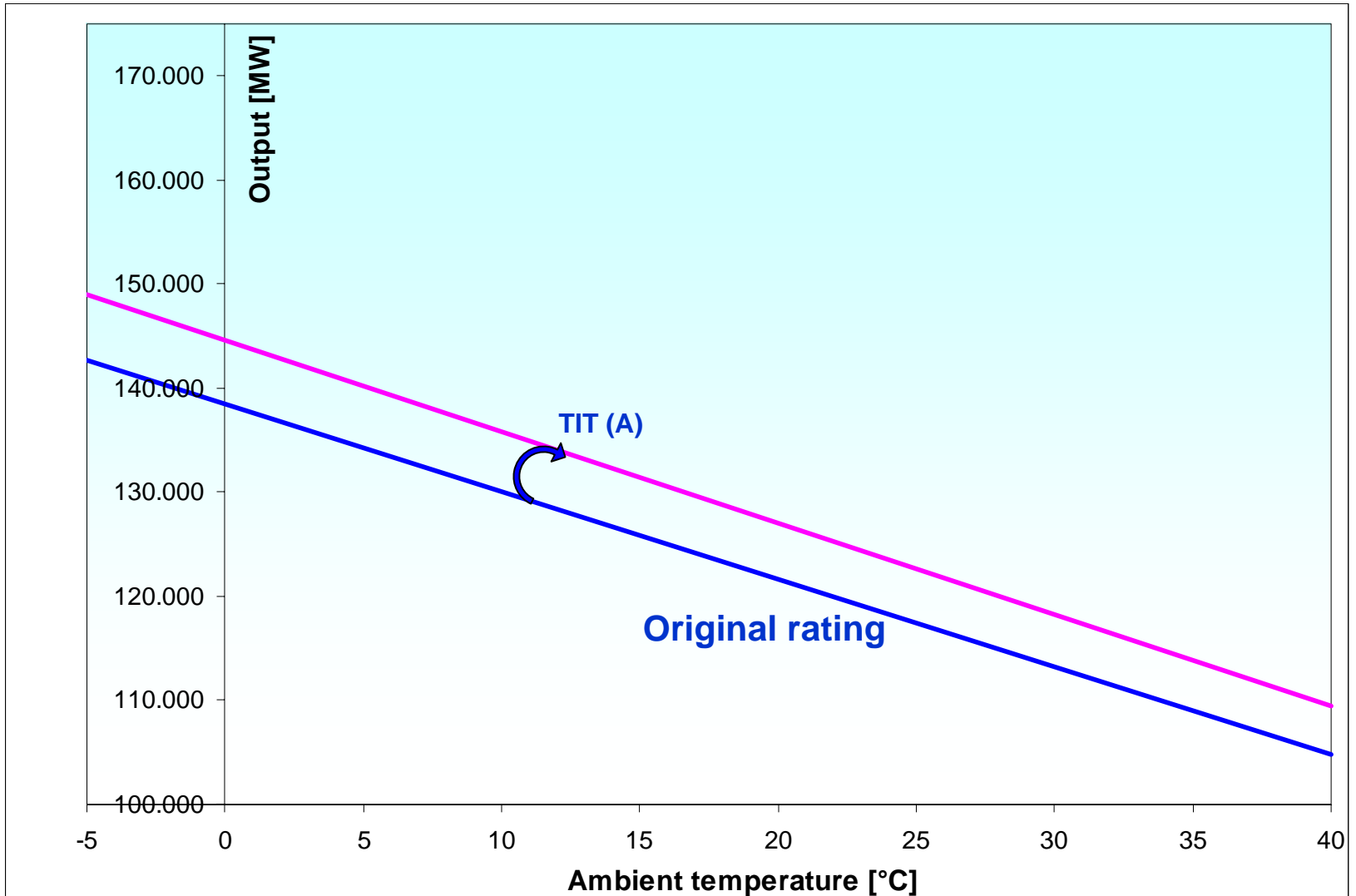
## **TG 50 D5 Upgrading**

- **GT upgrading benefits can be just partially allowable because of existing Electrical Equipments rating**
  - **Electrical Generator**
  - **Step up Transformer**
  - **Air to water cooler**

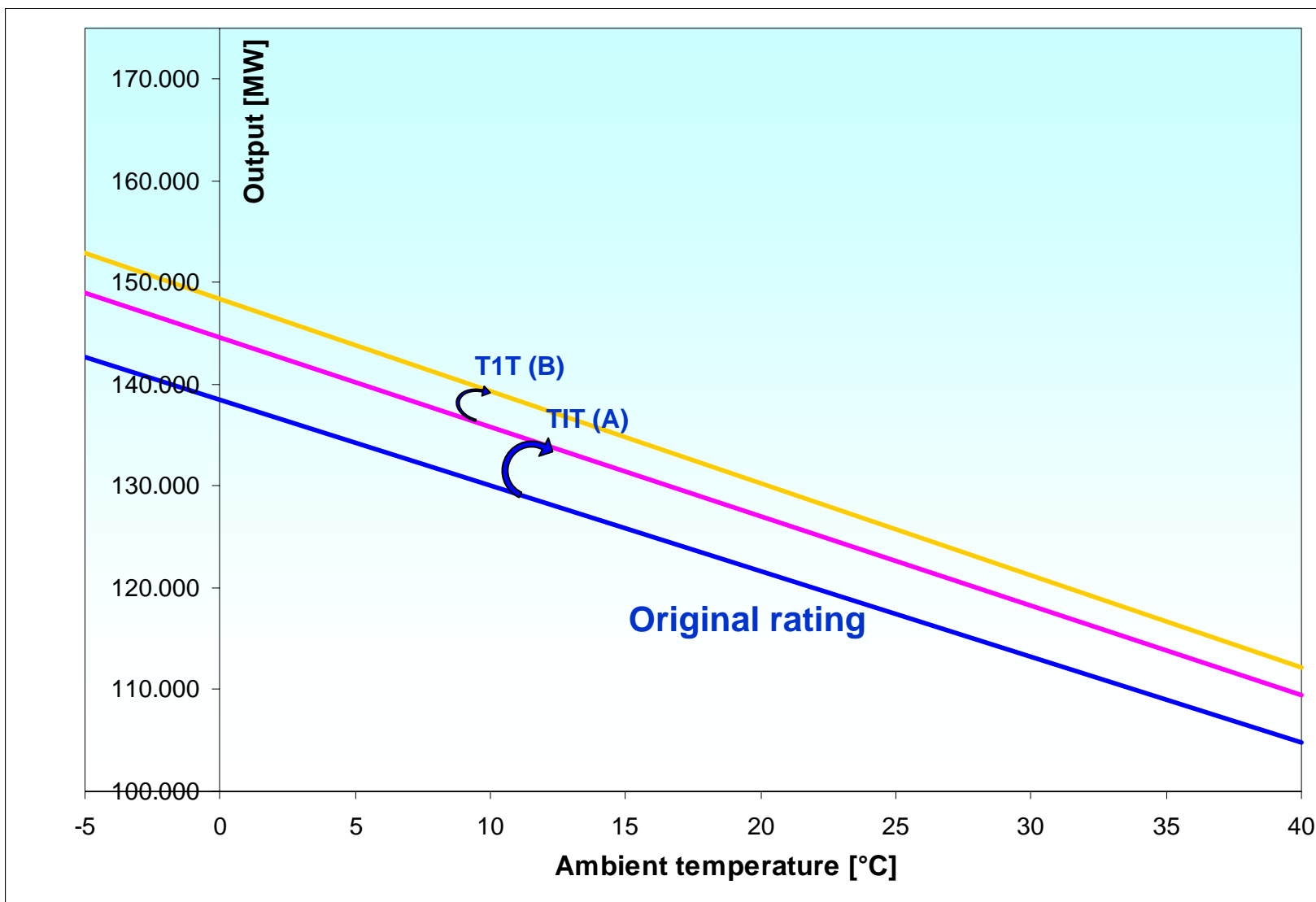
# TG 50 D5 Upgrading



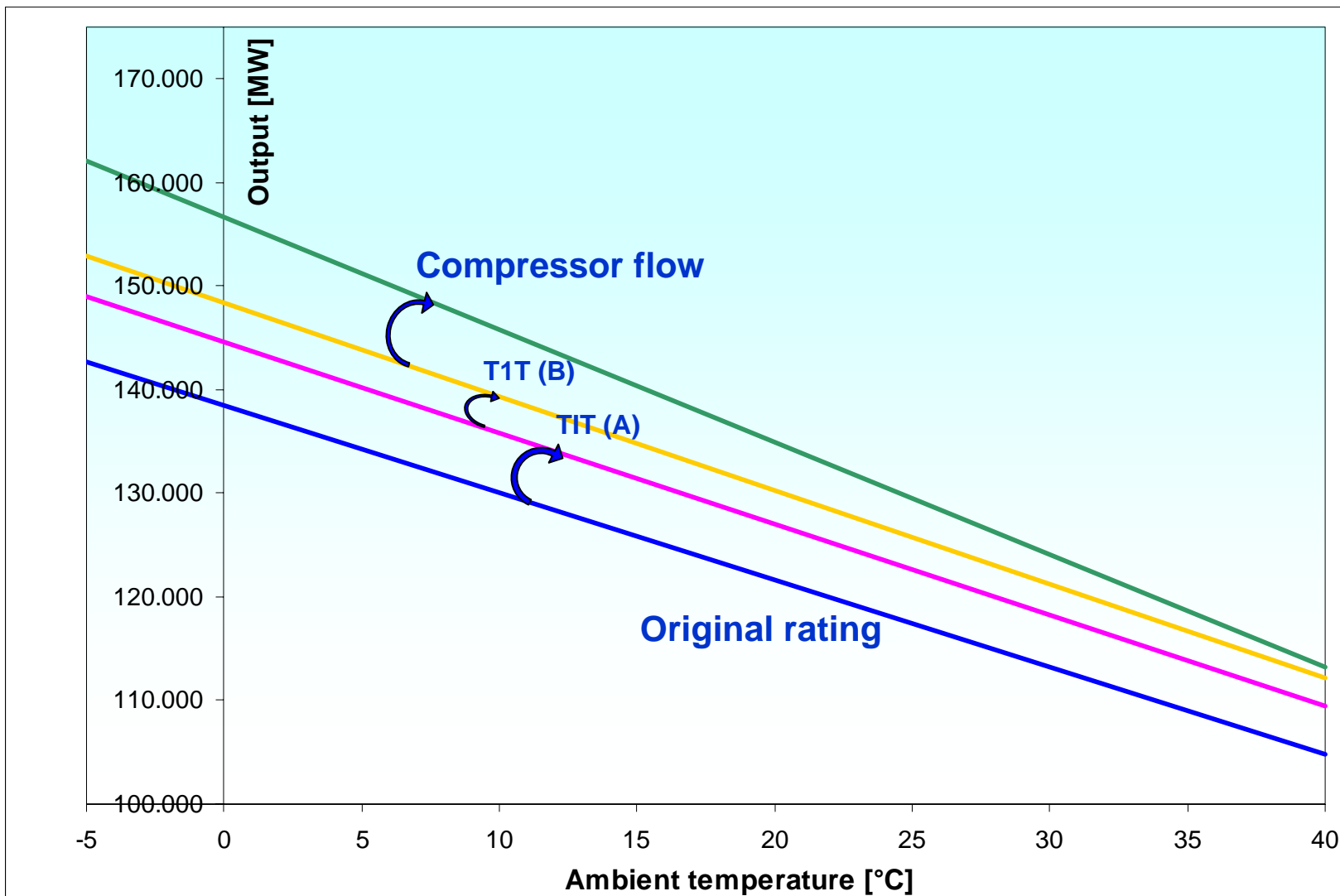
# TG 50 D5 Upgrading Hot parts Upgrading effect



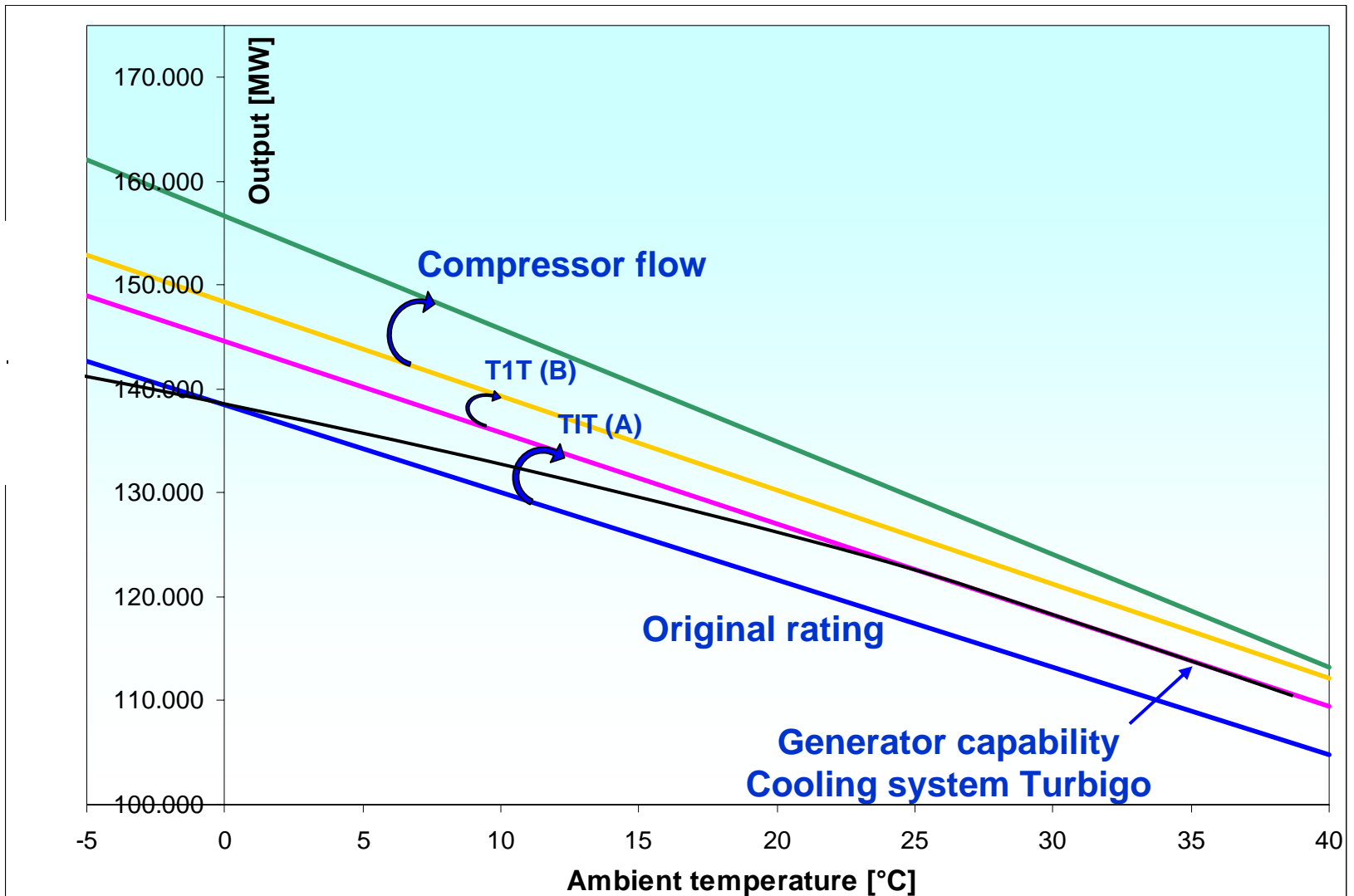
## TG 50 D5 Upgrading Hot parts Upgrading effect



# TG 50 D5 Upgrading Compressor Upgrading effect



## TG 50 D5 Upgrading Generator Capability – Cooling Turbigo



# TG 50 D5 Upgrading Row 4 Blade Power Limitation

