



*GE Power Systems*

# **Steam Turbine Designs for Coal Fired Generation**

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Steam Turbine Technology

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# Fossil Fired Programs

## Steam Turbine Designs for Coal Fired Generation

### 350 - 450 MW Rating

2 - Flow 30" or 33.5" LP Section

### 500 - 600 MW Rating

2 - Flow 40" LP Section

4 Flow 30 or 33.5" LP Section

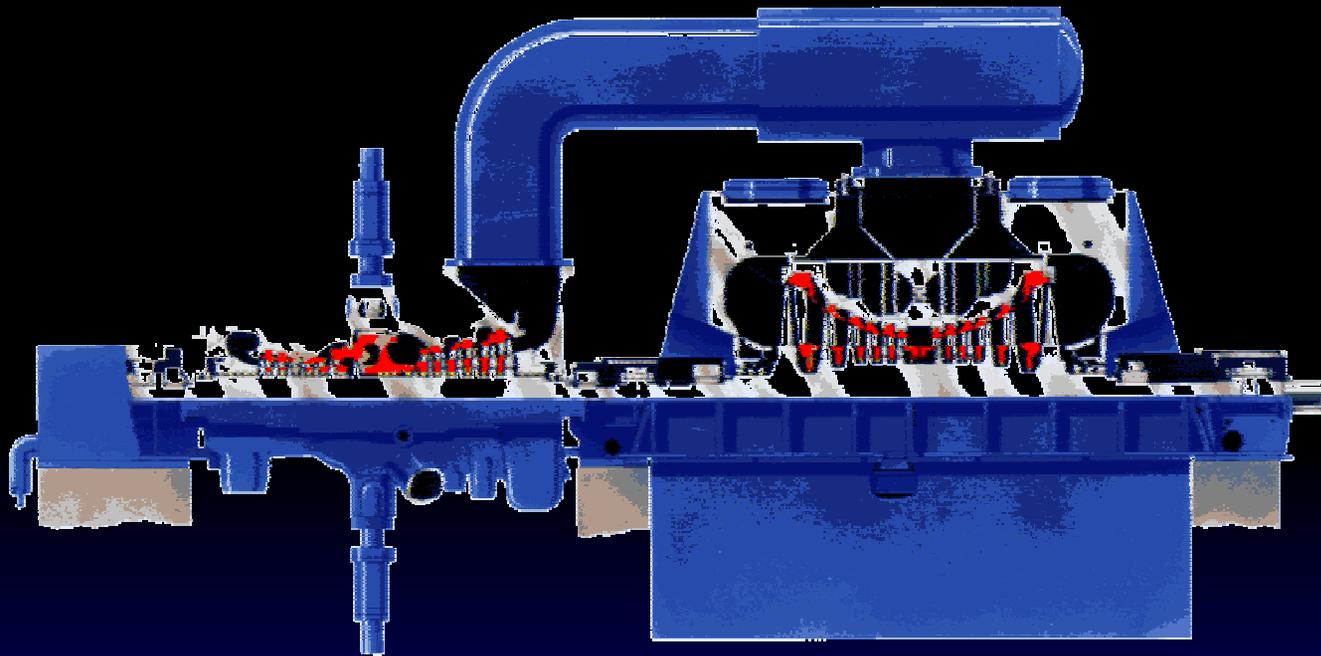
### 750 - 850 MW Rating

4 - Flow 33.5" or 40" LP Section

**Structured Product to Remove Variation**

# 300-450 MW Rating

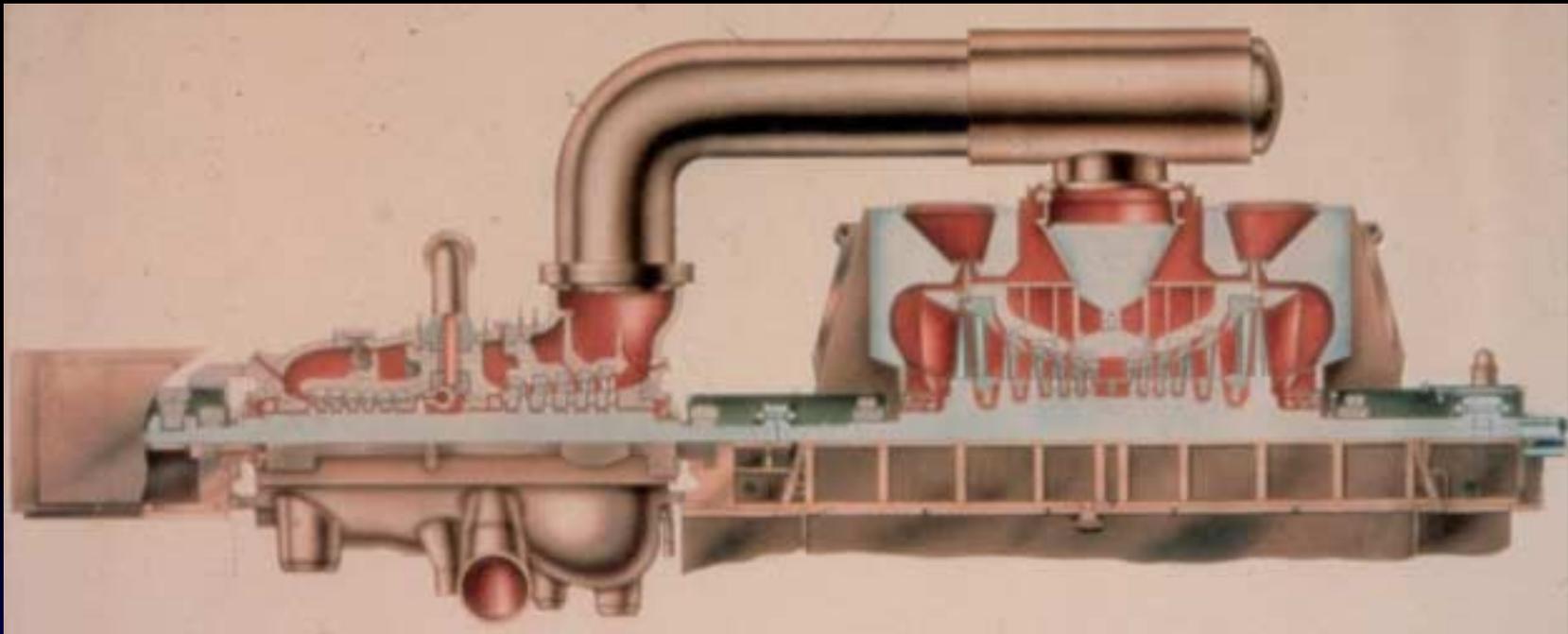
- Tandem Compound 2 Flow Reheat Steam Turbines
- Two Casing Machine, Power Ratings to 300-450 MW
- Full / Partial-Arc {2} Admission
- Initial Steam Conditions Up To 2400 Psig 1050/1050F
- Low Pressure Sections with 30" LSB, 33.5" and 40" LSB



**Over 80 of these machines in operation today**

# 500-550 MW Rating

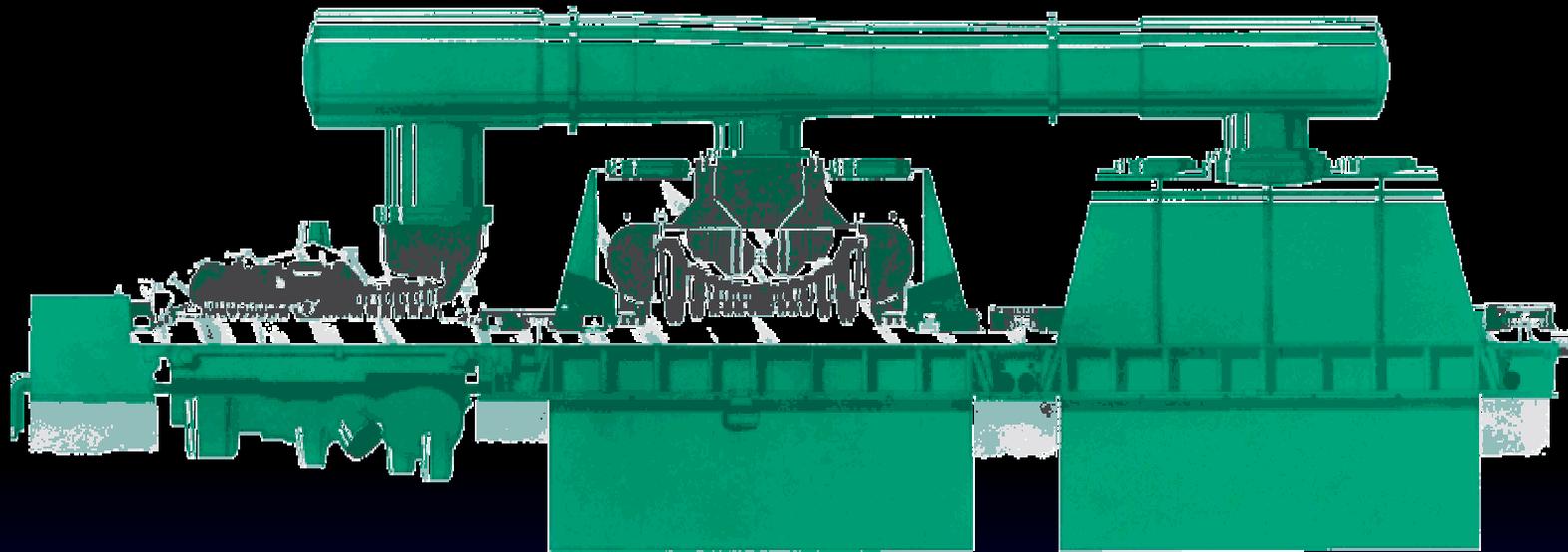
- Tandem Compound 2 Flow Reheat Steam Turbines
- Two Casing Machine, Power Ratings to 500-550 MW
- Full / Partial-Arc {2} Admission
- Initial Steam Conditions Up To 2400 Psig 1050/1050F



**Two Casing Machine Has Small Station Footprint**

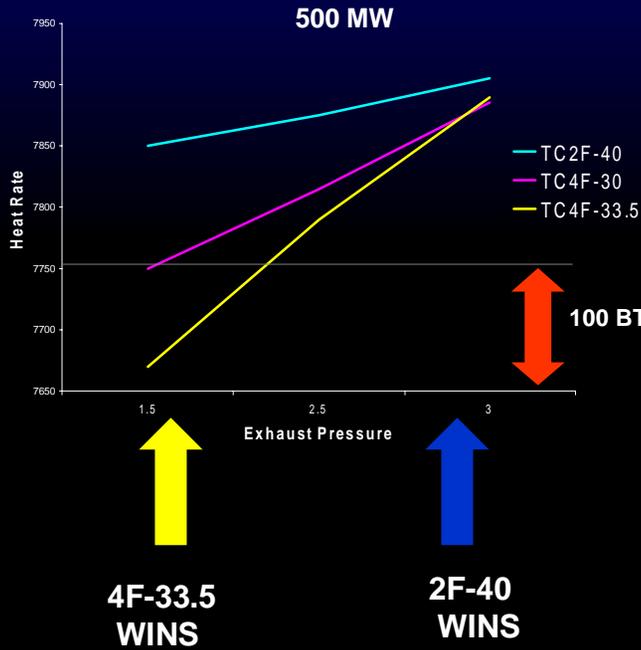
# 500-600 MW Rating

- Three Casing, 4 Flow, Output Ratings at 500-600 MW
- Full / Partial-Arc {2} Admission
- Last Stage Bucket Lengths 30", and 33.5"

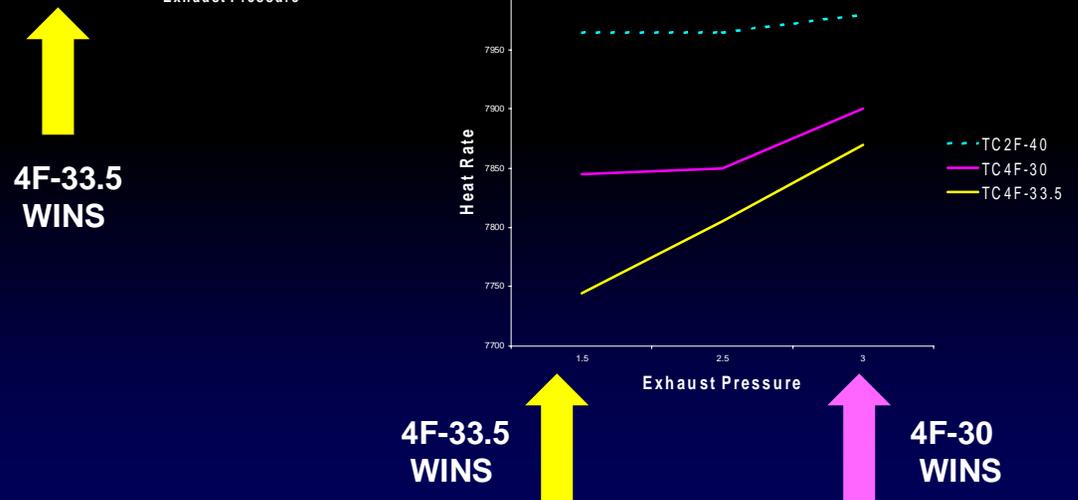
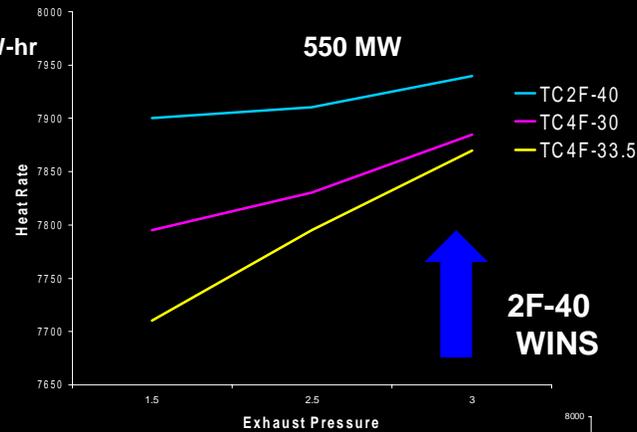


**Higher MW Rating Utilizes a Four Flow Design**

# Exhaust Pressure Impact



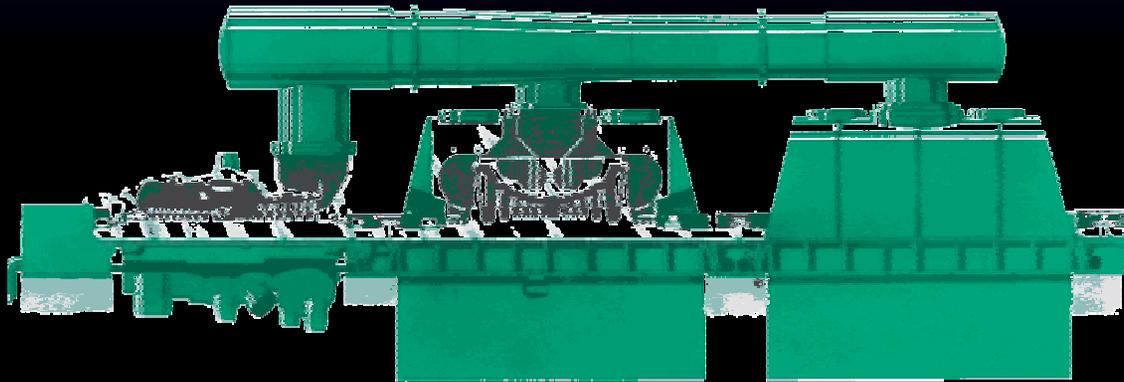
At \$40,000/BTU  
100 BTU=\$4 M



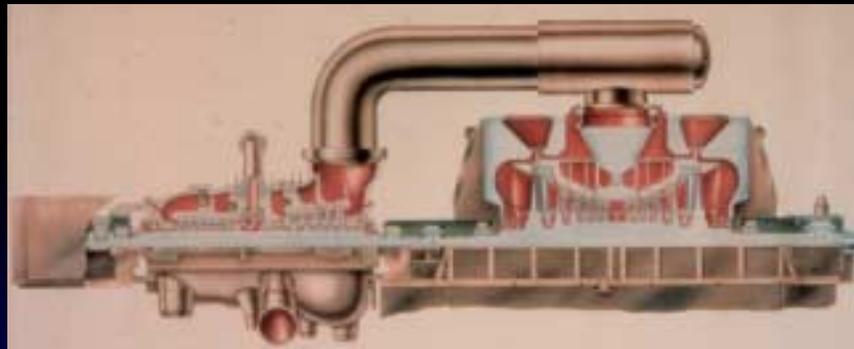
**What Are the Cooling  
Water Conditions of  
the Market Place?**

# Steam Turbine Technology

**500 to 600 MW Product Structure**  
**4 Flow Machine With 30", 33.5" LSB**



**2 Flow Machine With 40" LSB**



**Exhaust Pressure and Economics Will Effect the Optimum**

# 750-850 MW Rating

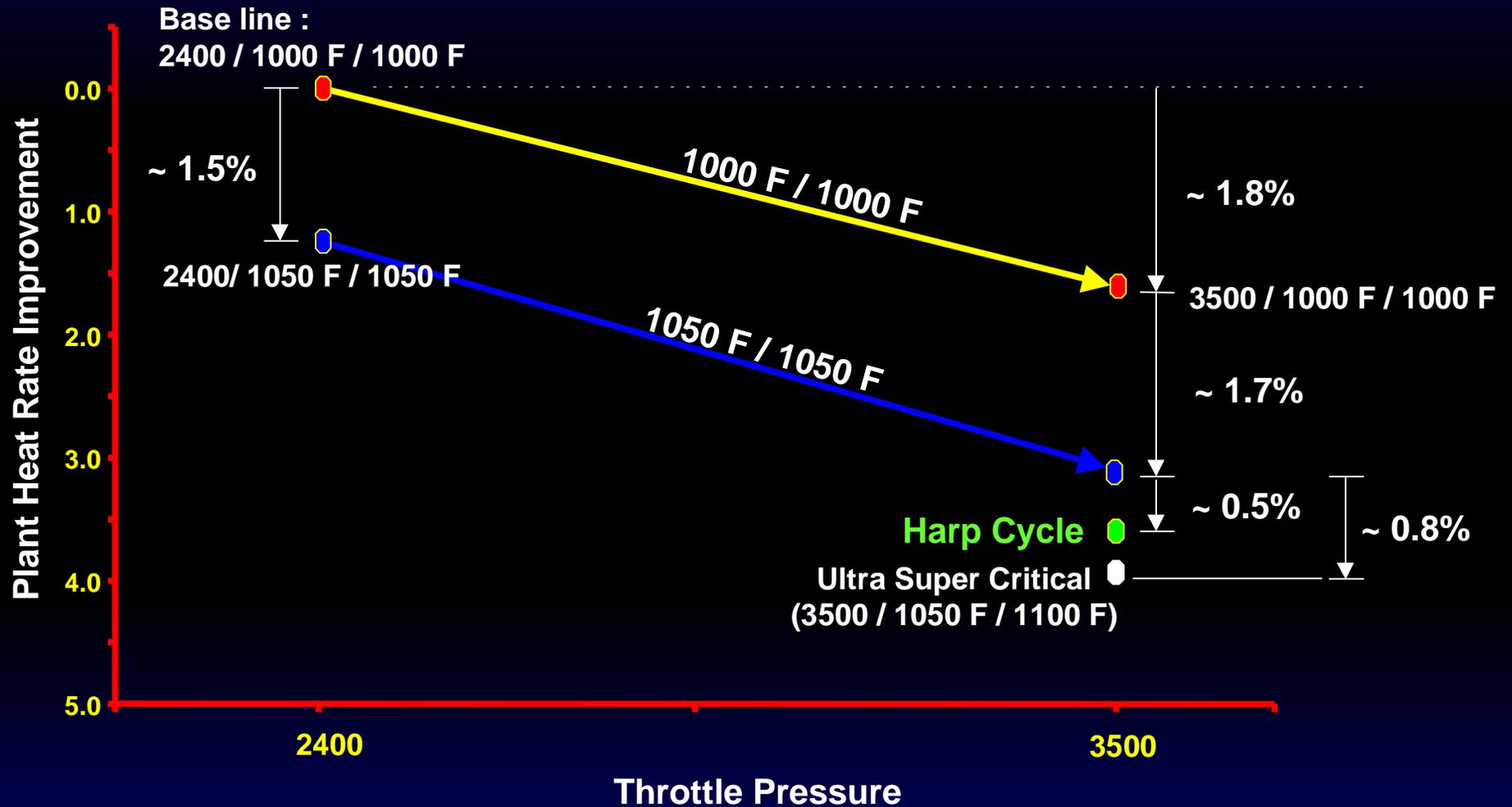
- Tandem Compound 4 Flow Reheat Steam Turbines
- Four Casing, Power Ratings to 750 - 850 MW
- Full / Partial-Arc {2} Admission
- Initial Steam Conditions up to 3500 Psig 1050/1050F
- Last Stage Bucket Length 33.5" or 40"



**Over 40 of These Units in Operation**

# Impact of Steam Conditions / Harp for Fossil Applications

## 600 MW Unit Effect



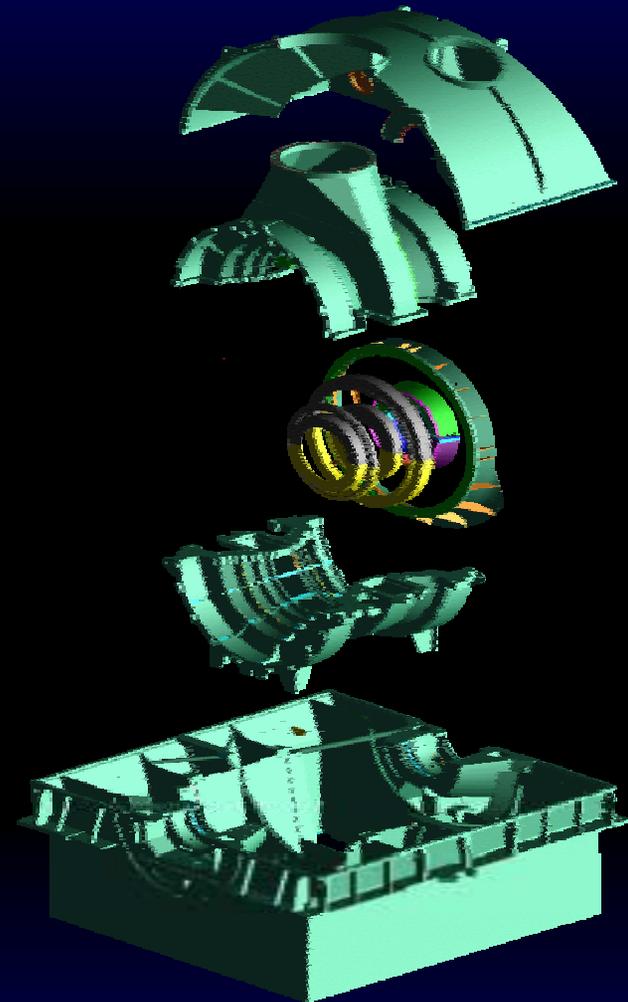
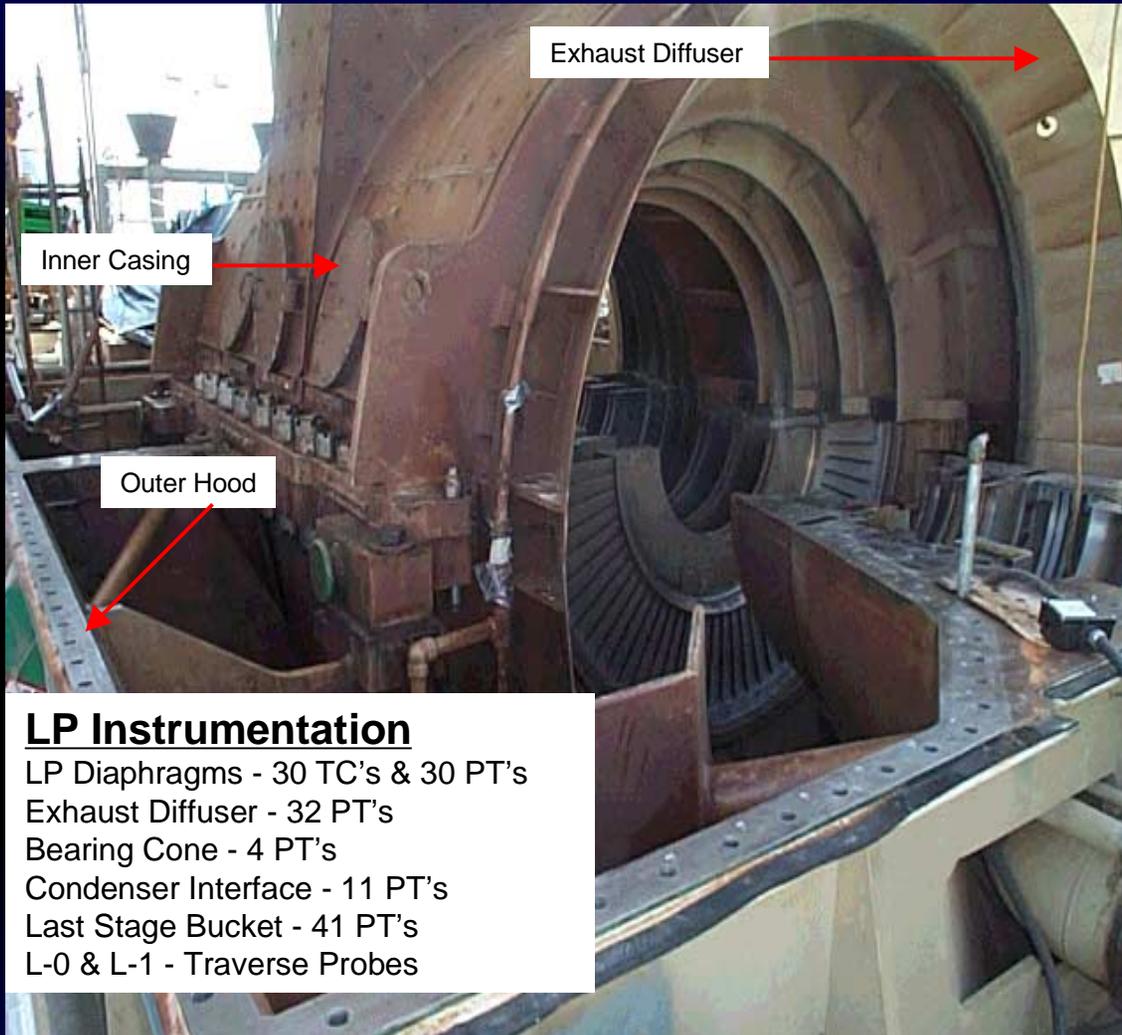
# Ultra Super Critical Steam Conditions



- 1050 MW
- 250 Bar/600/610C  
(3626 Psia/1112/1130F)
- 4 Flow 48" LSB
- Cross-Compound
- COD 7/00
- Steam Turbine 48.7%  
Thermal Efficiency

**World's Most Powerful Ultra Super Critical Steam Turbine**

# Exhaust Hood Performance Validation



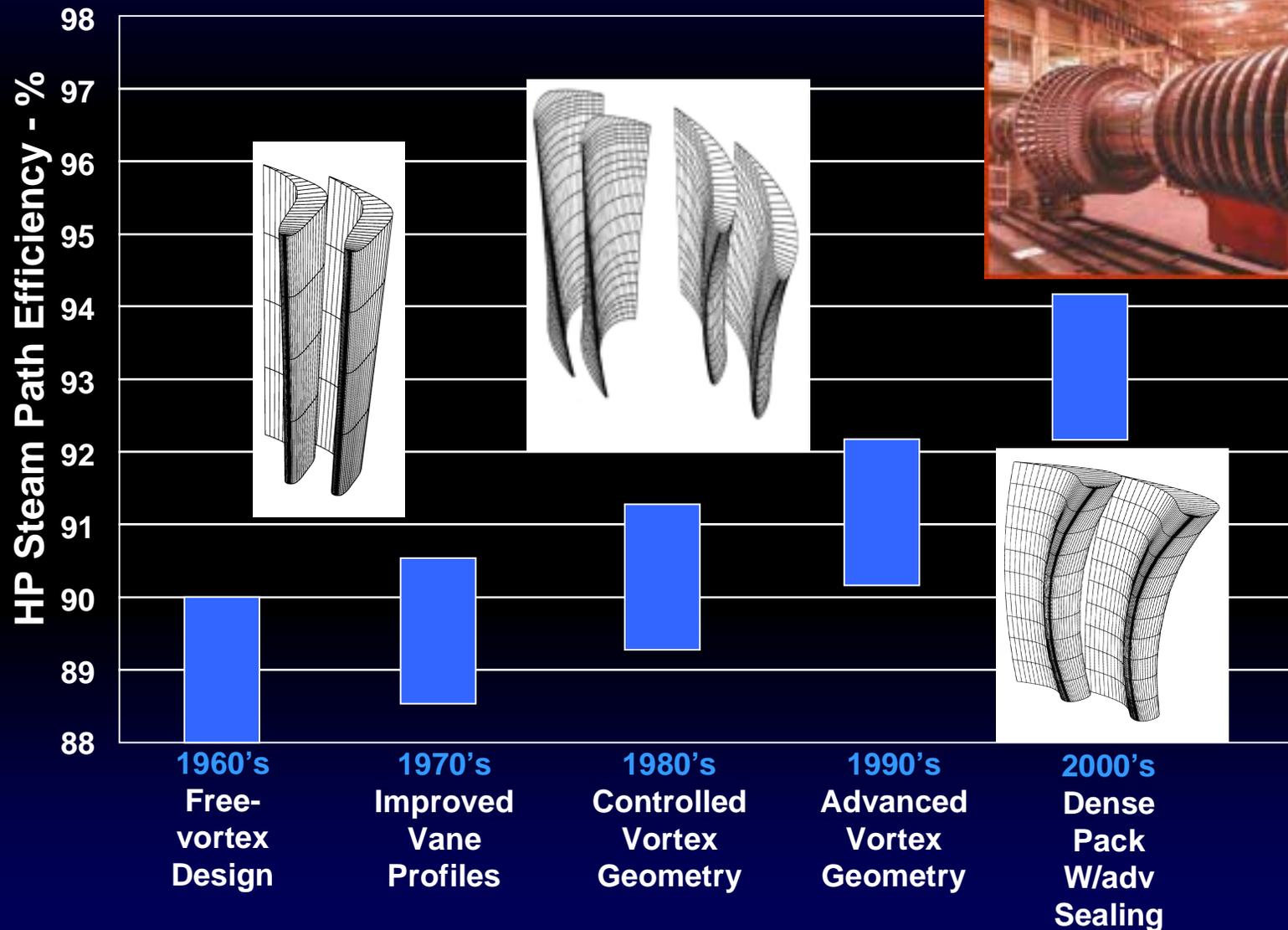
## **LP Instrumentation**

LP Diaphragms - 30 TC's & 30 PT's  
Exhaust Diffuser - 32 PT's  
Bearing Cone - 4 PT's  
Condenser Interface - 11 PT's  
Last Stage Bucket - 41 PT's  
L-0 & L-1 - Traverse Probes

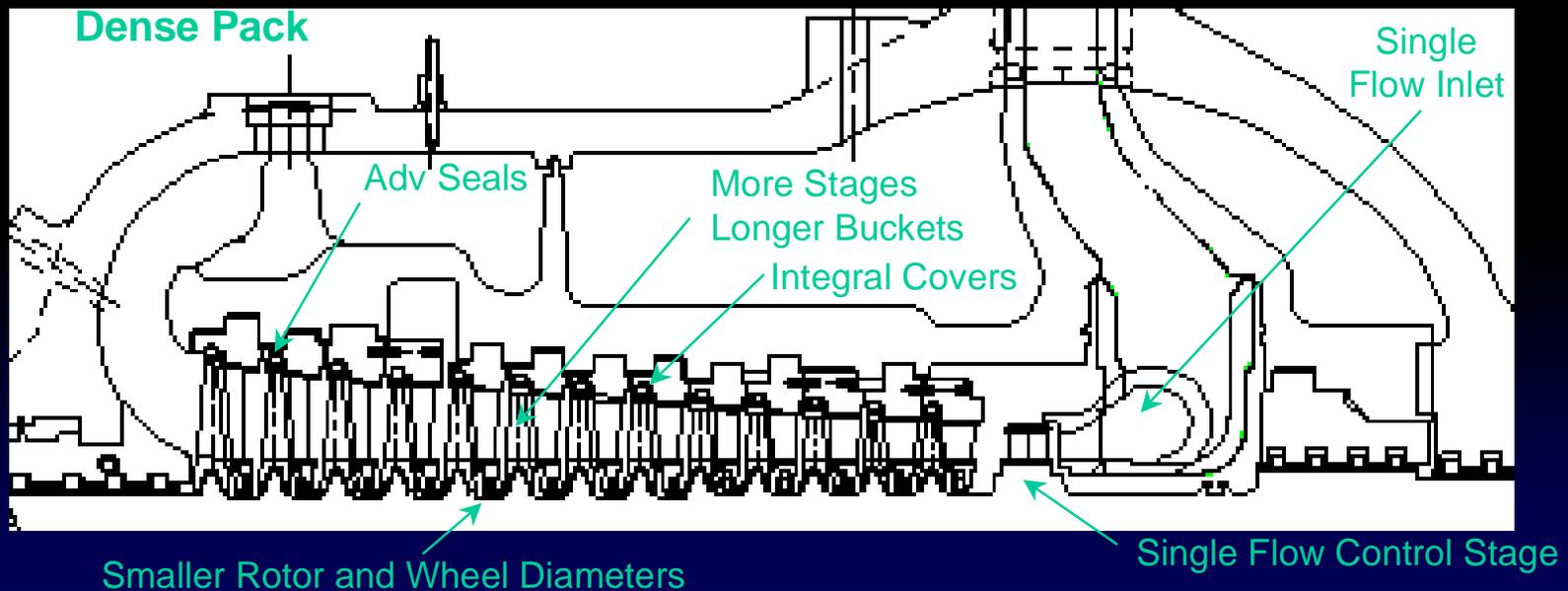
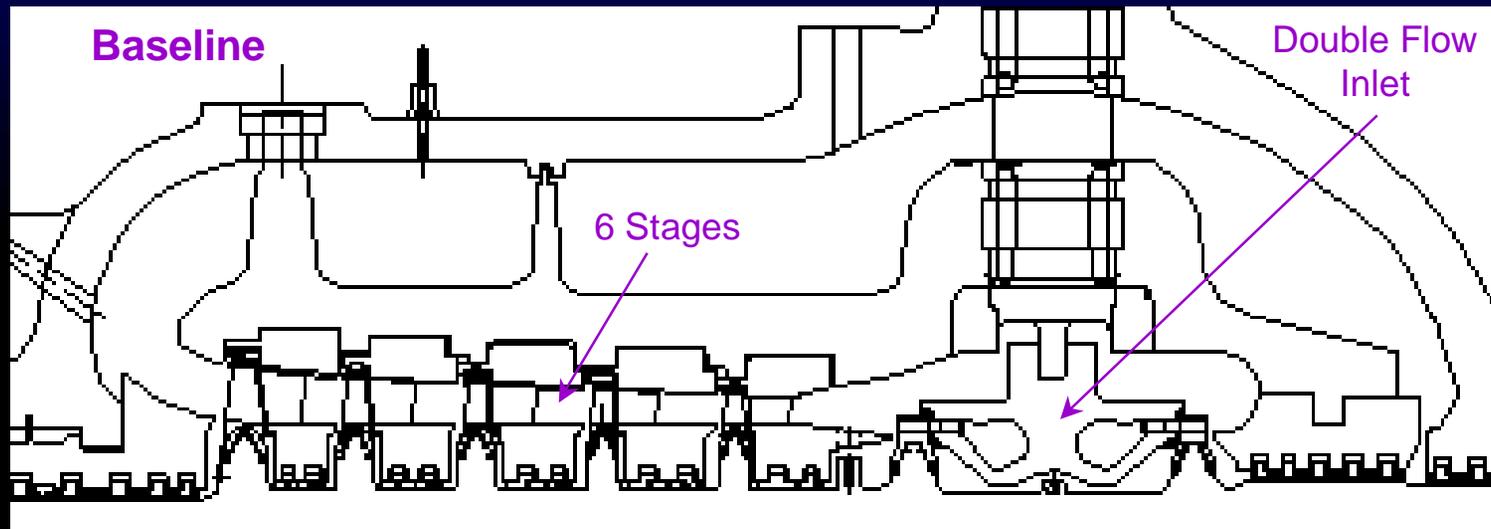
**181 Precision Instruments Being Used to Characterize Steam Turbine Thermodynamic and Mechanical Performance**

# Evolution of Steam Path Design

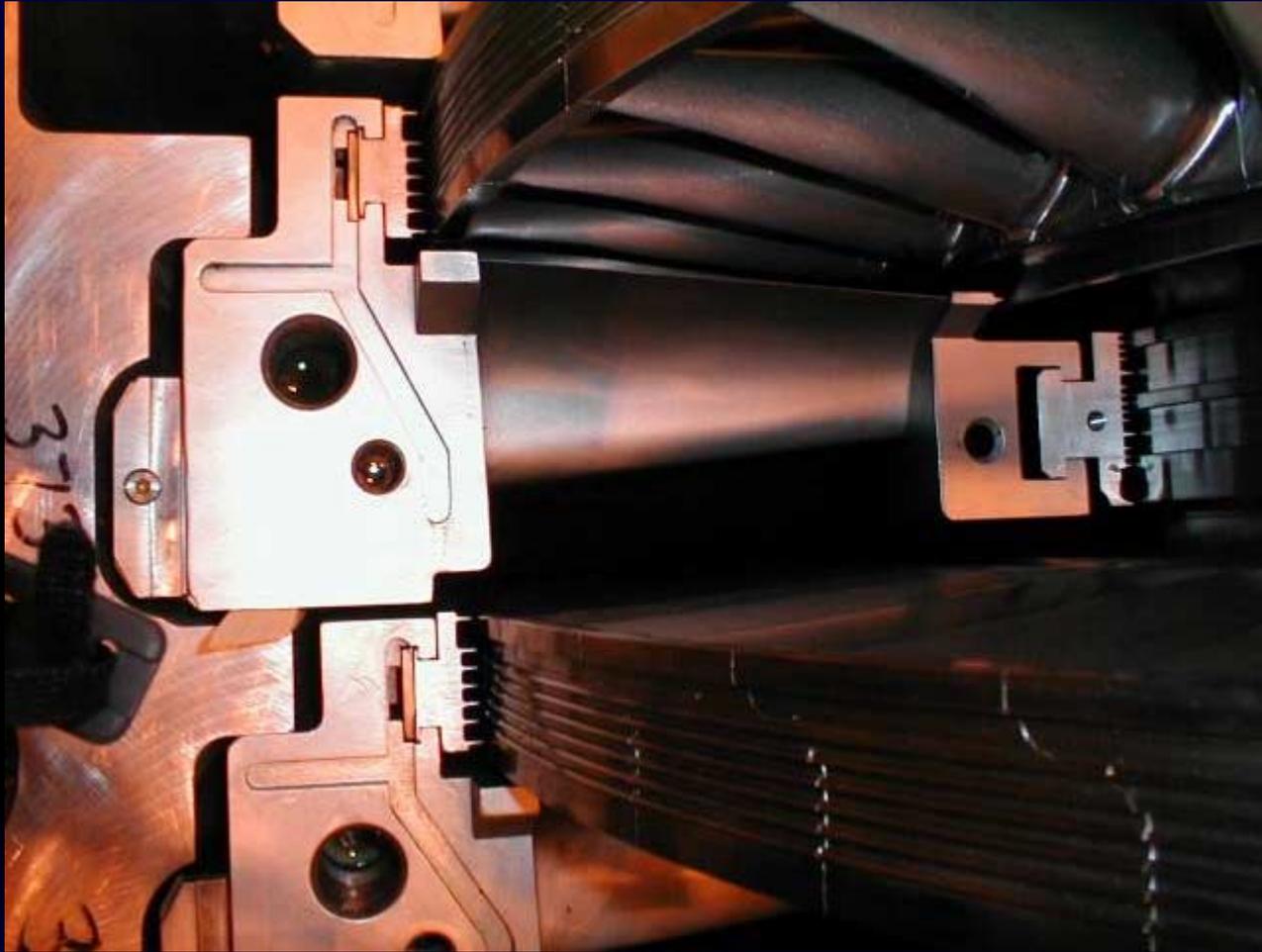
## Typical HP Steam Path Efficiency of Single Stages



# Potential Dense Pack Design Features

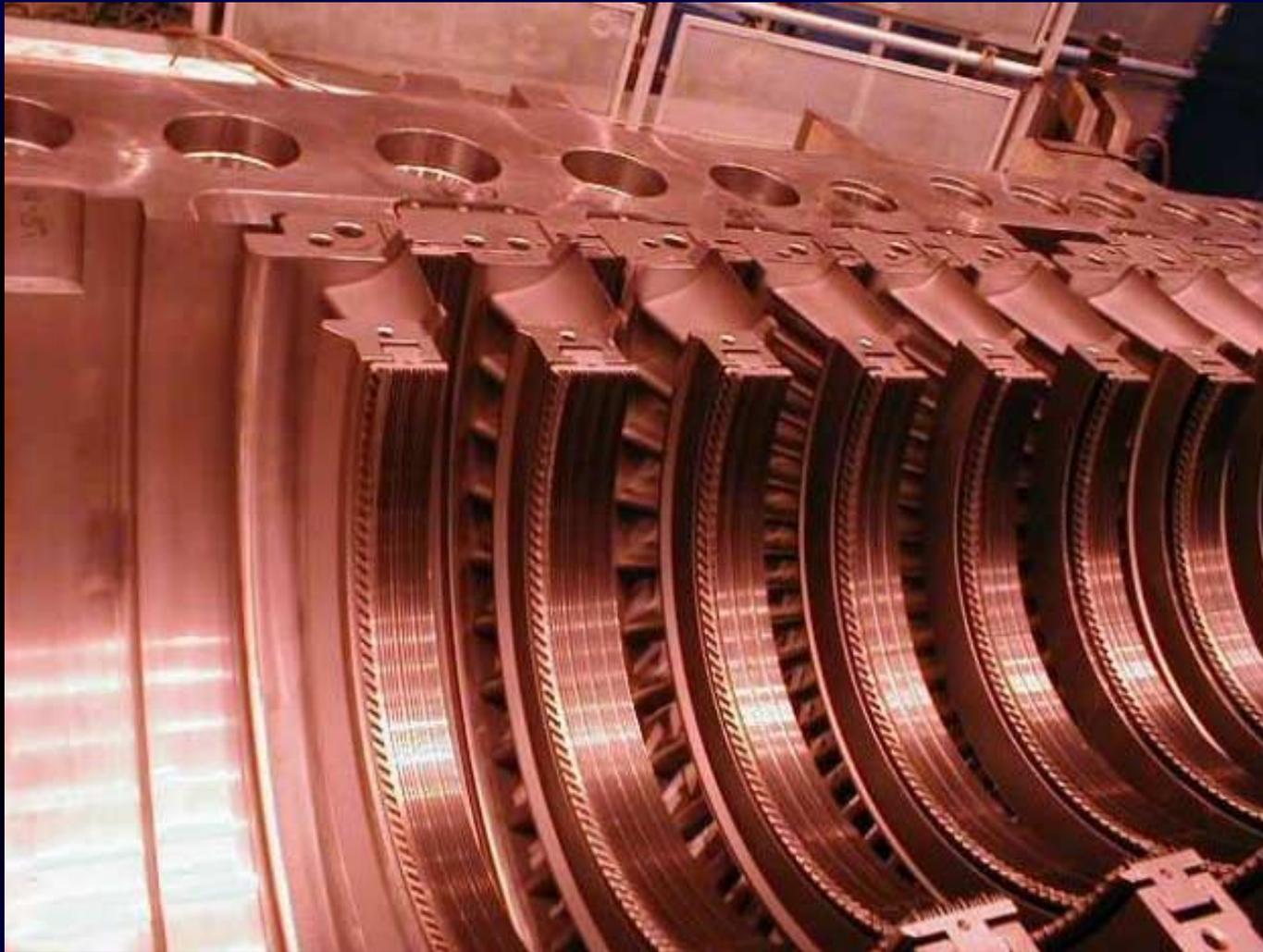


# Dense Pack Diaphragm



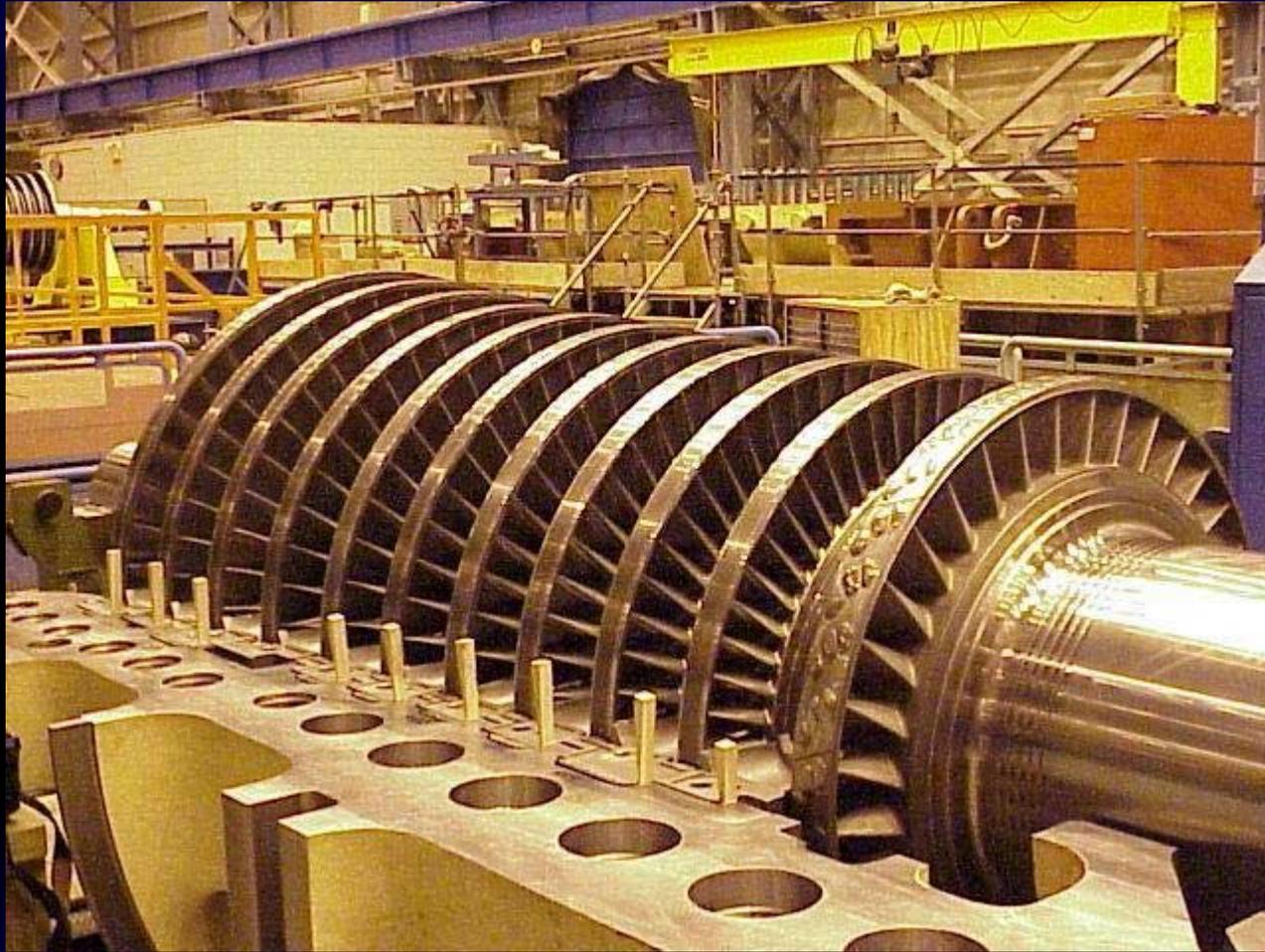
**Dense Pack Diaphragms with Advanced Seals**

# Dense Pack HP Section



**Dense Pack Diaphragms in the Lower Shell**

# Dense Pack Hp Section



**800 MW HP Dense Pack on the Half Shell**

# Summary

## 350 - 450 MW Rating

- 2 Flow 30 or 33.5" LSB

## 500 - 600 MW Rating

- 2 Flow or 4 Flow
- Various LSB's to Optimize

## 750 - 850 MW Rating

- 4 Flow 33.5 or 40" LSB



**Proven Designs with Improved Technology**