



15th SYMPOSIUM ON INDUSTRIAL APPLICATIONS OF GAS TURBINES



**Industrial Gas Turbines in Canada
Past, Present and Future**

by

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Canadian Gas Turbine Scene

- Starting 1953
- 1950s Little activity, GT not competitive
- 1960s Emergence of pipeline market
- 1970s High performance units
- 1980s Expansion of cogeneration
- 1990s Start of electric power market





1953 BT

■ Electric Power

- hydro
- coal fired steam turbines

■ Transportation

- rail , steam engines
- ships , steam turbines
- air , piston engine props





1953 BT

■ Gas pipelines

- non existent
- natural gas not widely available





Gas Turbines (1953)

- Only in military aircraft
- Hercules and B52 first flights
- First civil aircraft in Canada , Viscount
- (1955)

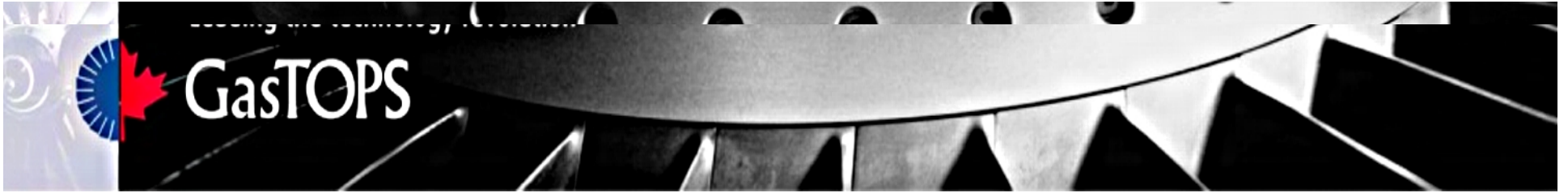




Gas Turbine Performance (1953)

- Efficiency below 20 per cent
- Low pressure ratios
- Low turbine inlet temperatures
- Need for complex cycles

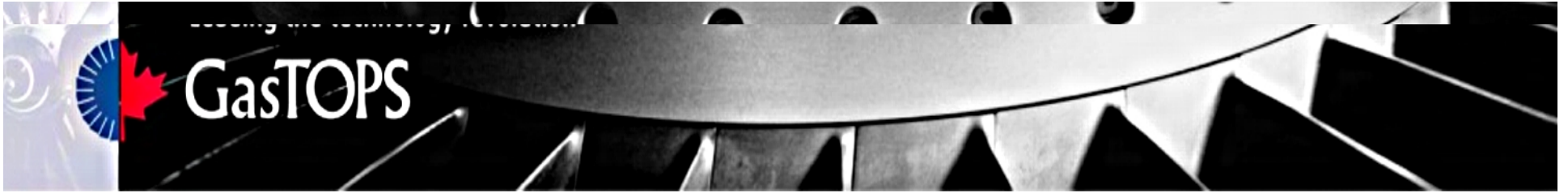




Gas Transmission

- Alberta Gas Trunk Lines
- West Coast Transmission
- TransCanada PipeLines
- Led to fall of St Laurent Government





Early Pipelines

- Mostly reciprocating engines and compressors
- Typical unit size 1 MW
- Centrifugal compressors , better suited to gas turbine drive
- Fuel dirt cheap





Pipeline Gas Turbines

■ Clark Brothers	305
■ Westinghouse	62RM
■ Westinghouse	92RM
■ Orenda	OT-2
■ Solar	Saturn





Electric Power (late 50s)

- **BC Hydro**
- **Brown-Boveri , 100 MW , 1955**
- **Edmonton Power , 18 MW , 1957**





Early 1960s

- **Industrial units- OT-2 ,W92, Saturn , W62**

- **Emergence of aero-derivatives**
 - Rolls-Royce Avon
 - Pratt and Whitney FT-4
 - Rolls-Royce Olympus





Rolls-Royce Avon

- **First unit on TCPL**
- **Rapidly became backbone of TCPL fleet**
- **Also used by AGTL (later Nova)**
- **Used for emergency/peaking generation**
 - **Ontario Hydro , Maritime Electric**
- **Still in service , max over 200,000 hrs**





Pratt and Whitney FT-4

- Mostly for electrical power
 - Nova Scotia Power
 - Quebec Hydro

- Also naval propulsion , DDH 280





Rolls-Royce Olympus

■ Electric Power

- Quebec Hydro
- Ontario Hydro
- BC Hydro
- Newfoundland and Labrador

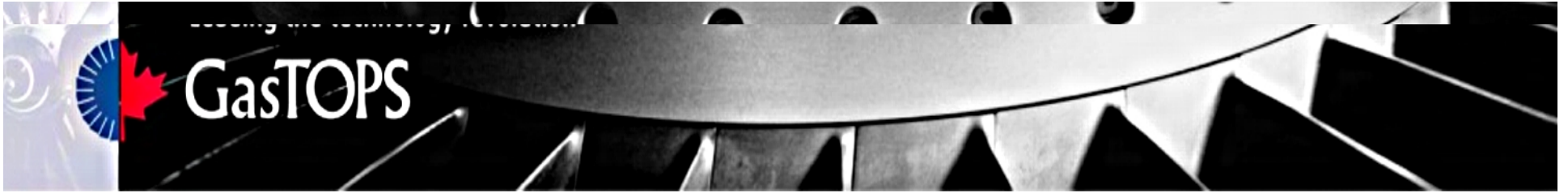




Solar Turbines

■ Saturn	1 MW
■ Centaur	2 MW
■ Taurus	5 MW
■ Mars	10 MW
■ Titan	15 MW





Pipeline Applications

- Base load operation
- Very long running hours
- Demonstrated long life of gas turbines
- Opened up markets for other applications



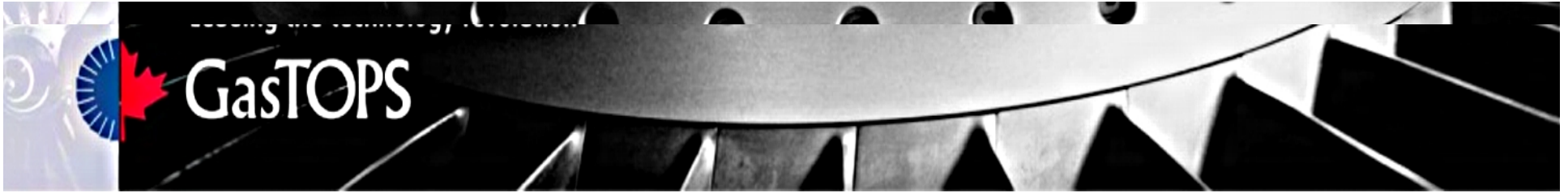


Nuclear Power Plants

- Provide much of Ontario's base load
- All have GTs for emergency backup

- Pickering OT-3
- Bruce Avon
- Darlington Olympus and Solar Mars





Cogeneration 1

- First application in Canada
- Pinetree Line (radar warning system)
- Orenda OT-5
 - heating in winter
 - absorption chilling in summer
- About 20 units installed 1961
- Ran for about 20 years till Pinetree closed





Cogeneration 2

- First large scale application , 1970s
- Dow , Sarnia
 - First GE Frame 7
 - Added BB machine
 - Still operating





2nd Generation Aero Derivatives

- **RB 211 (TCPL , Burstall , 1974)**
- **LM 2500 (Nova , Clearwater)**
- **LM 1600 (Nova , Knight)**

- **Pushed efficiency levels to 35-37 %**





3rd Generation Aero Derivatives

- **LM 6000 (TransAlta , Ottawa)**
- **RR Trent (Whitby)**
- **Both cogeneration applications**





Smaller Cogen Systems

- **Solar Taurus** **York University**
 - **Allison 501** **Heinz**
 - **Alstom Tornado** **University of Toronto**
 - **Alstom Typhoon** **NRC , Ottawa**
-
- **Applications where electrical and heat loads can be balanced**





Large Cogen Systems

- W501 Cardinal , Ontario
Joffre , Alberta
- GE Fr7 Fort MacMurray
Fort Saskatchewan
- GT24 Campbell River , BC
- GT11 Sarnia

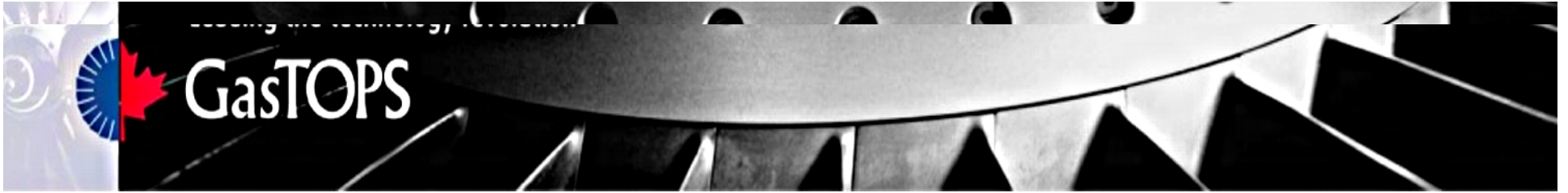




Thermal Power Stations 1

- Aging coal plant
- Could use combined cycle, gas , 58 %
- 200MW GT can give 600 MW block (2+1)
- Considerable flexibility in size
- Rapid construction , simple cycle first





Thermal Power Stations 2

- IGCC plant where coal is plentiful
- Can burn coal cleanly , about 40 % effy
- Size limit may be a problem
- 2 x 430 MW plant in UK to be built on a coalfield





Distributed Systems

- Microturbines are low efficiency
- Niche markets, e.g. flare gas disposal
- Proposed for condominiums , malls etc
- Capstone , Ingersoll Rand prime players





Conclusions

- Domination of pipeline market
- Base load stations in future
- Expect to see IGCC as gas supply dwindles

- See you in 2053

