
WANDA
Deltares
Enabling Delta Life
Wanda 4 Turbine

Outline

1. Introduction
2. Turbine types
3. Selection
4. Curves
5. Summary

Introduction

- Almost all electricity is generated by turbines
- Power = torque x angular velocity
- Gas, steam or water

Turbine types

Reaction turbines

Torque by pressure drop

Momentum turbines

Torque by jet momentum

Francis turbine (reaction type)

Turbine and generator

Vanes closed

Vanes fully open

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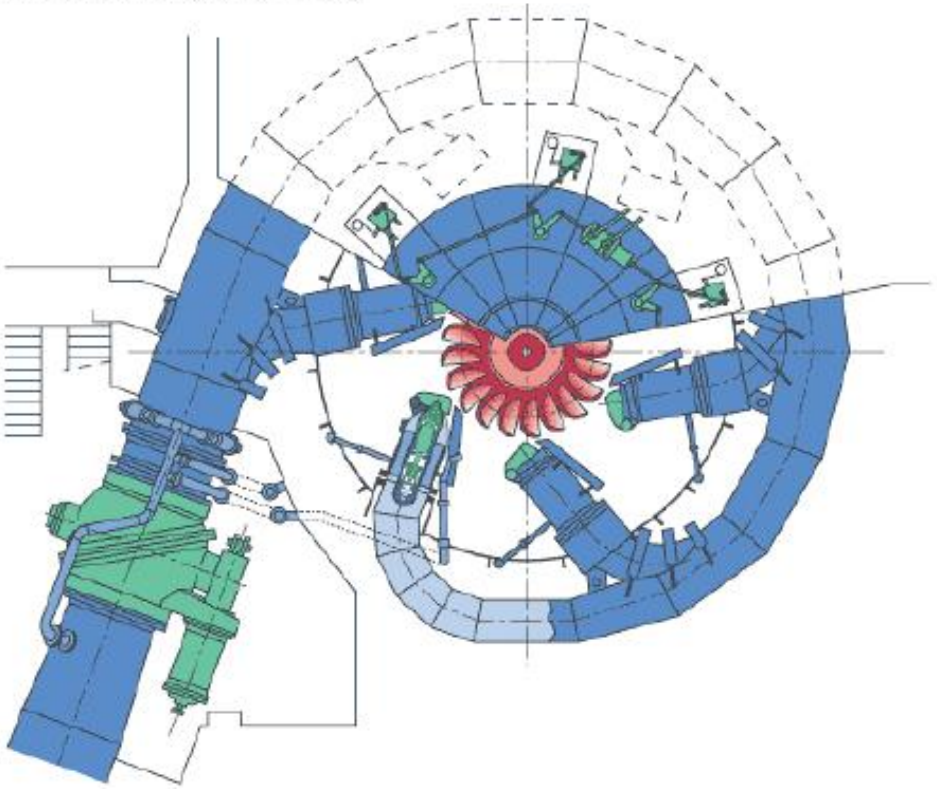
Pelton turbine (momentum type)

Runner

Installation (plan view)



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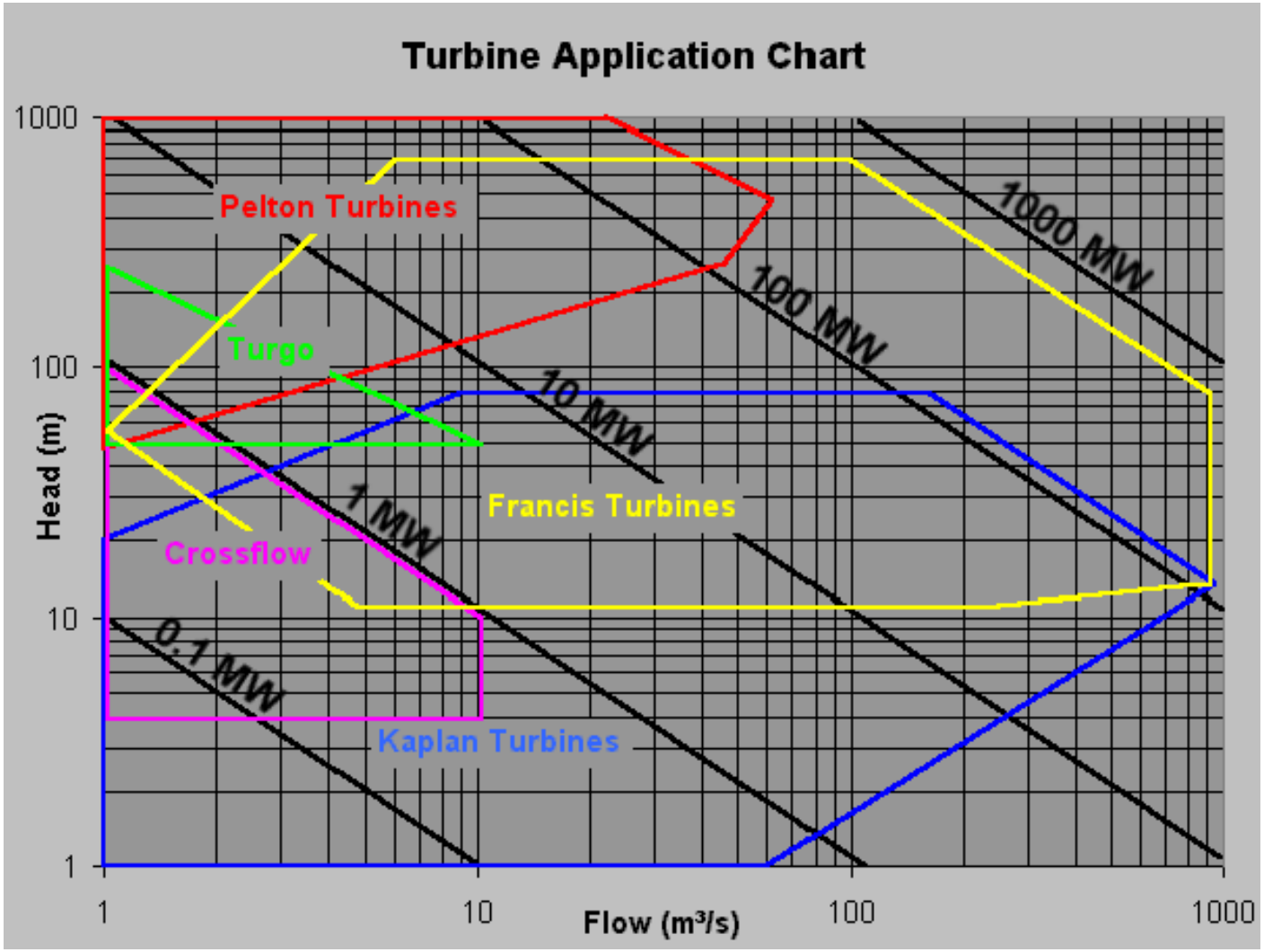
Turbine selection



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Turbine curves

Governing equations:

$$H = H_1 - H_2 \quad (1)$$

$$TN - P = I_p N \frac{dN}{dt} \quad (2)$$

Closure provided by either:

- ***Suter curves:***
  T(n,Q,θ), H(n,Q,θ)
- or ***Unit curves:***
  T(n,H,θ), Q(n,H,θ)

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Pumpturbine: Suter

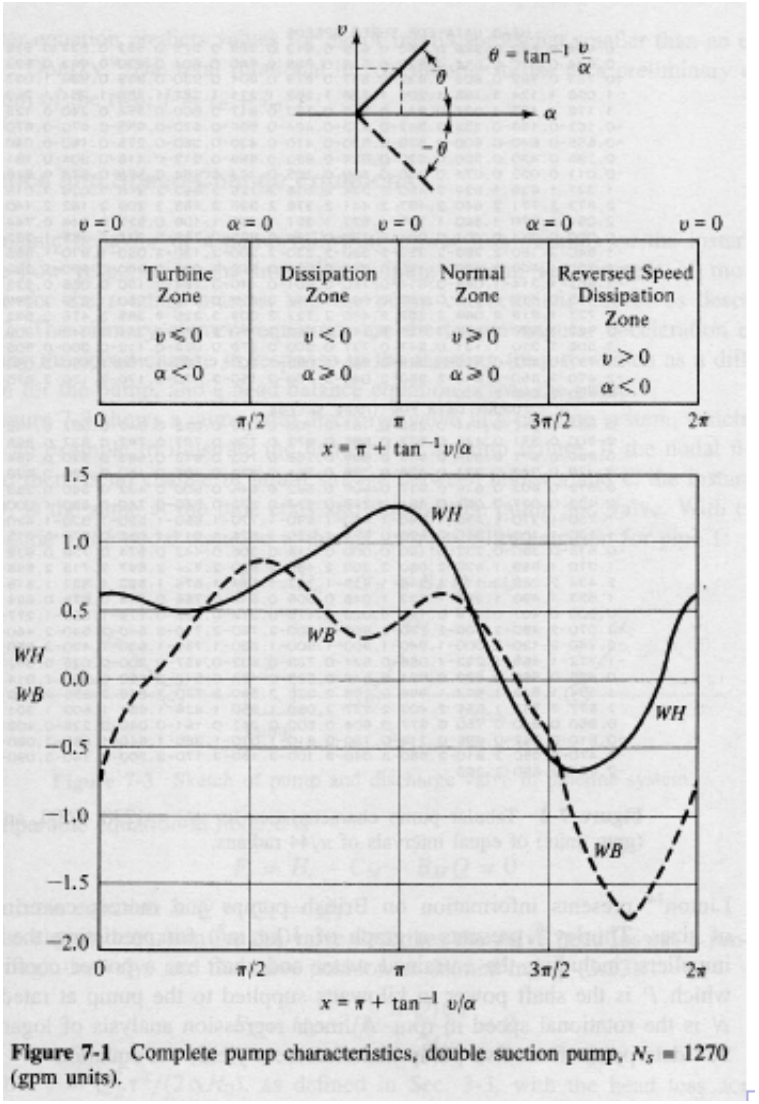

Figure 7-1 Complete pump characteristics, double suction pump, $N_s = 1270$ (gpm units).

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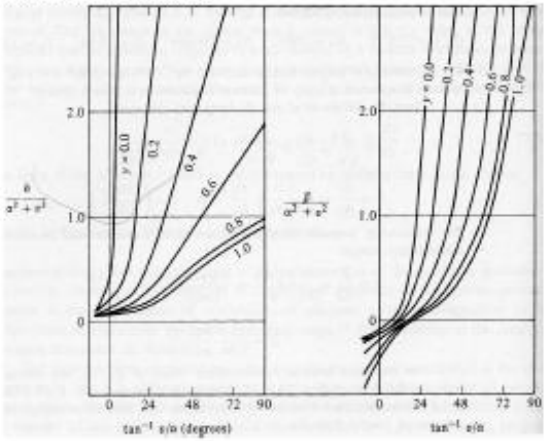
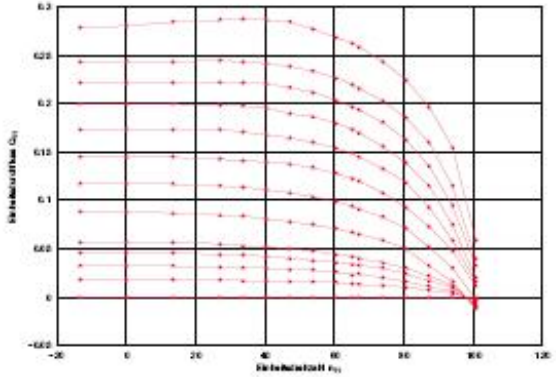
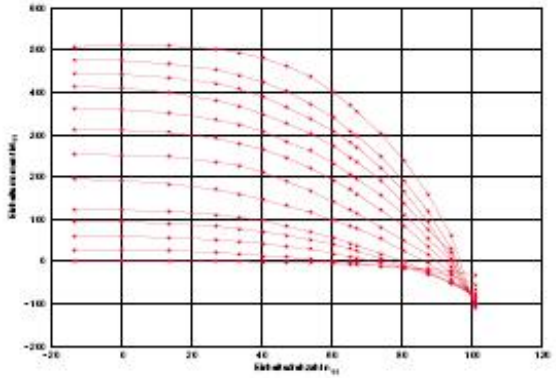
Different curve types

Suter curves:

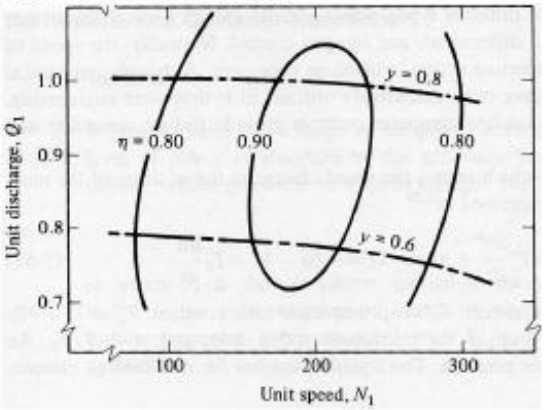


Unit curves:





Turbine hill curves:



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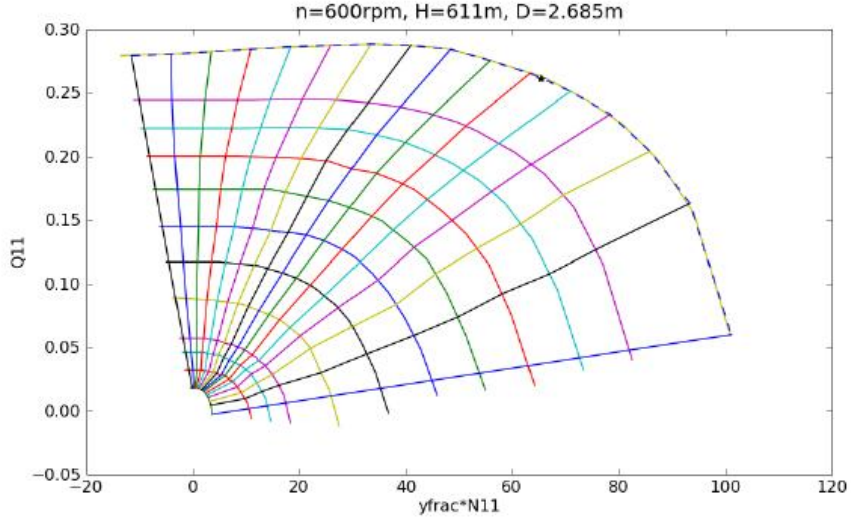
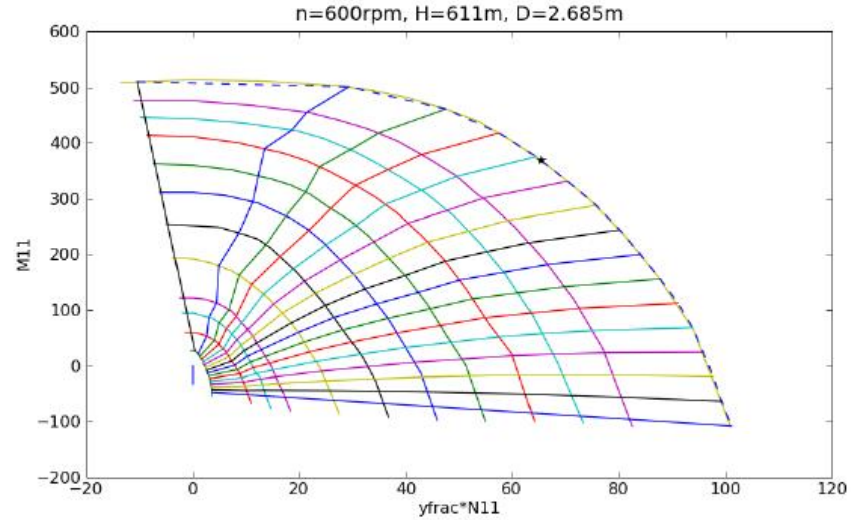

n=600rpm, H=611m, D=2.685m
Q11
yfrac*N11
0.30
0.25
0.20
0.15
0.10
0.05
0.00
−0.05
−20
0
20
40
60
80
100
120


n=600rpm, H=611m, D=2.685m
M11
yfrac*N11
600
500
400
300
200
100
0
−100
−200
−20
0
20
40
60
80
100
120

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Summary

- Impulse and reaction turbines
- Selection (Q,H,P)
- ***Suter curves:***
  T(n,Q,θ), H(n,Q,θ)
- or ***Unit curves:***
  T(n,H,θ), Q(n,H,θ)