

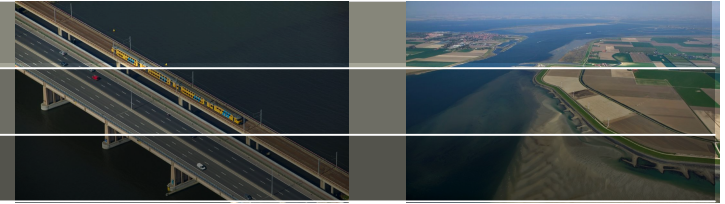


WANDA

# Wanda 4 Turbine

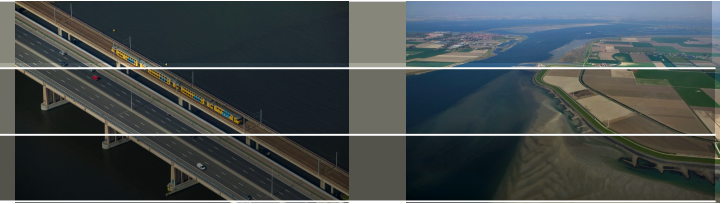
9 maart 2010

# Overzicht



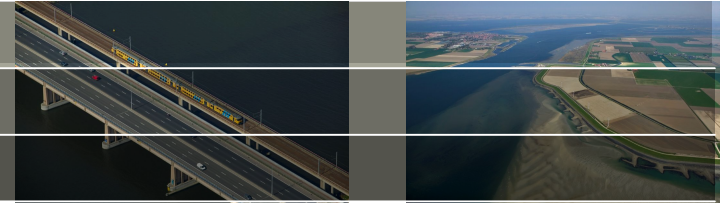
1. Introductie
2. Turbine types
3. Selectie
4. Curves
5. Samenvatting

# Introductie



- Nagenoeg alle elektriciteit wordt gegenereerd met turbines
- Vermogen = Koppel x Omwentelingssnelheid
- Gas, stoom of water

# Turbine types



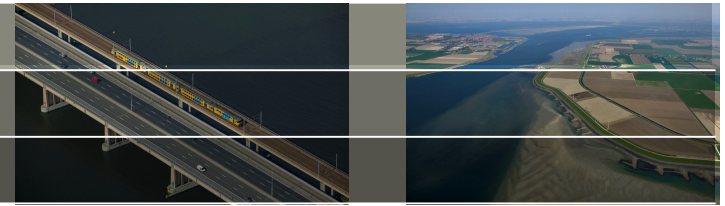
Reactieturbines

Koppel door drukval

Impulsturbines

Koppel door jet impulse

# Francis turbine (reactietype)



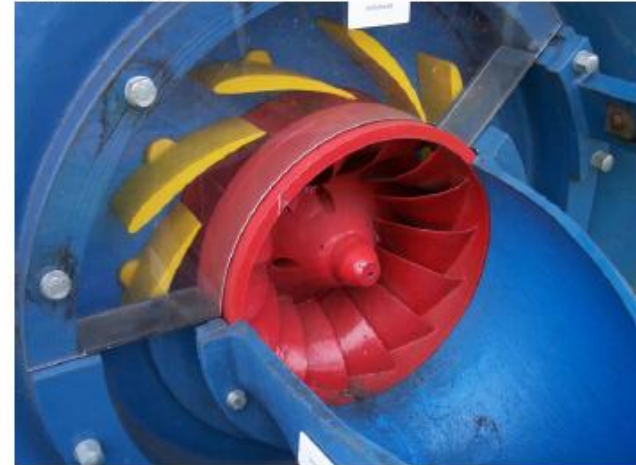
Turbine and generator



Vanes closed

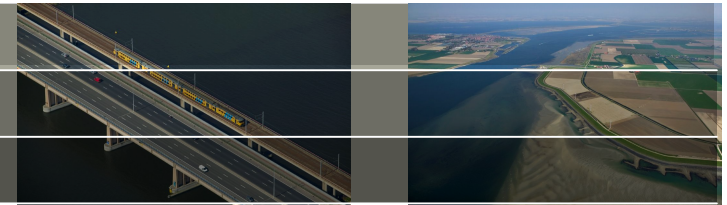


Vanes fully open





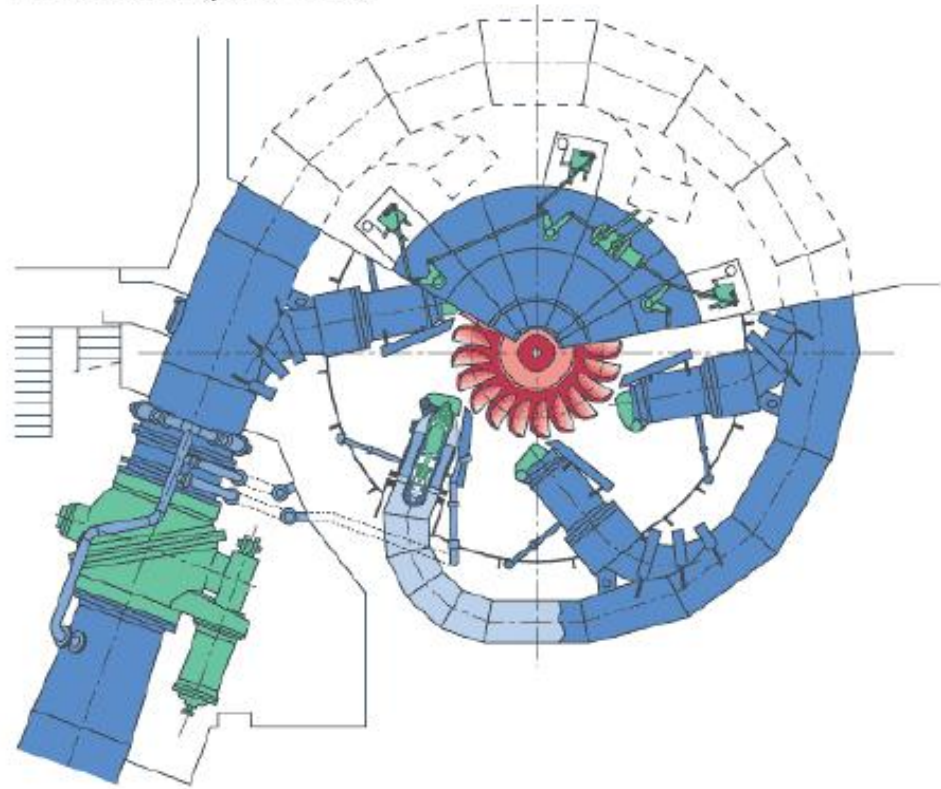
# Pelton turbine (impuls type)



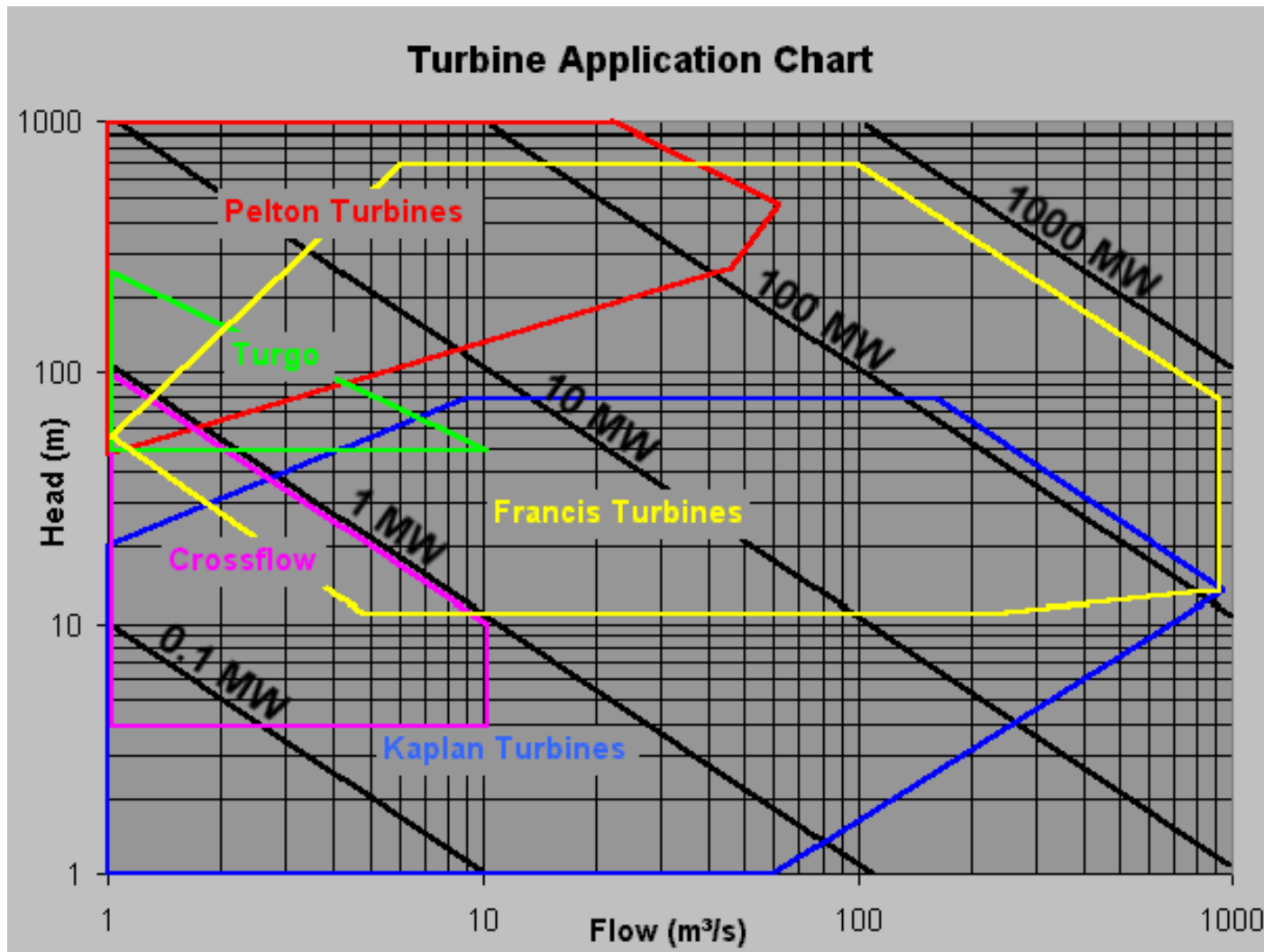
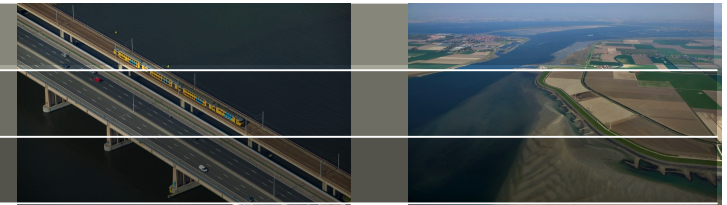
Runner



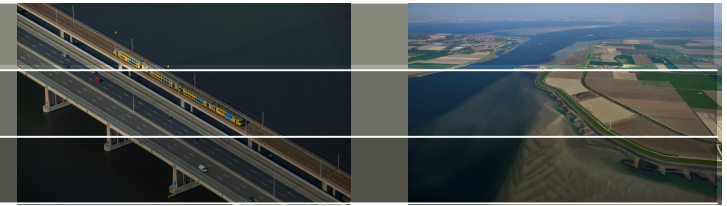
Installation (plan view)



# Turbine selectie



# 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:**

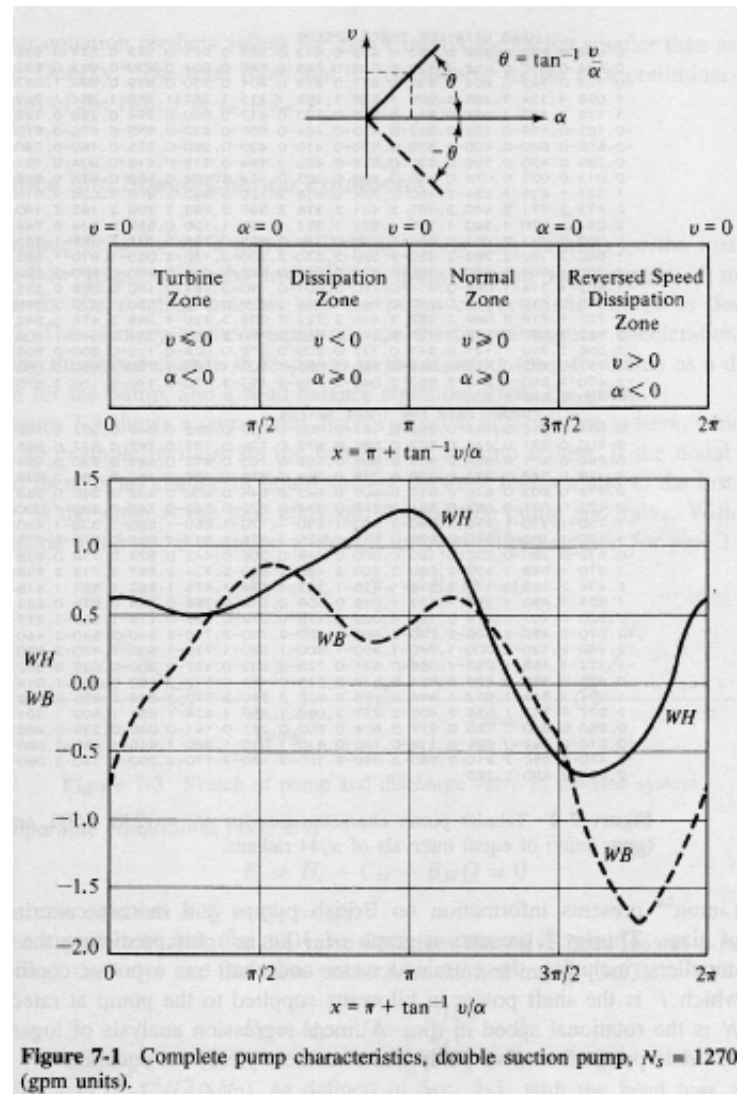
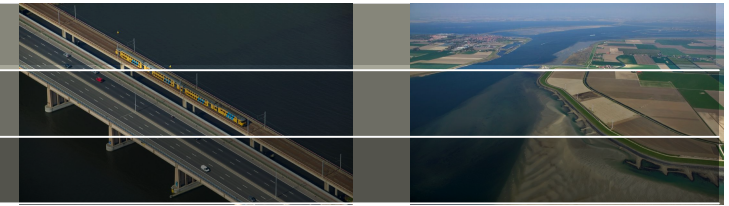
$$T(n, Q, \theta), H(n, Q, \theta)$$

- or **Unit curves:**

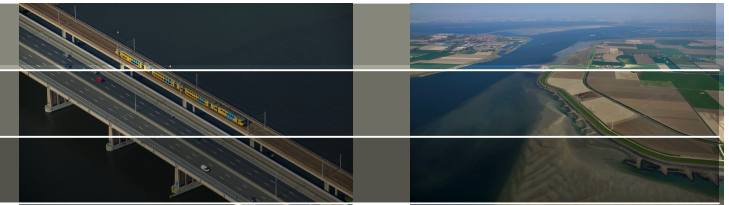
$$T(n, H, \theta), Q(n, H, \theta)$$



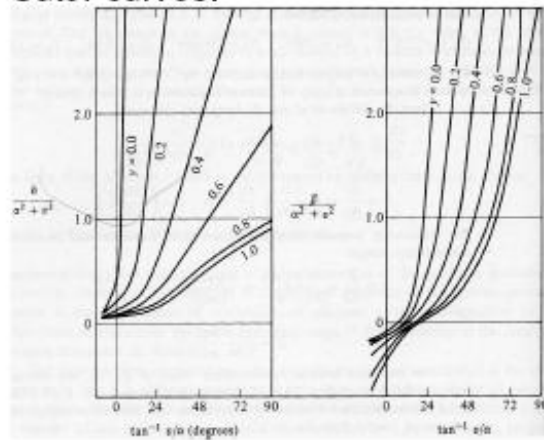
# Pumpturbine: Suter



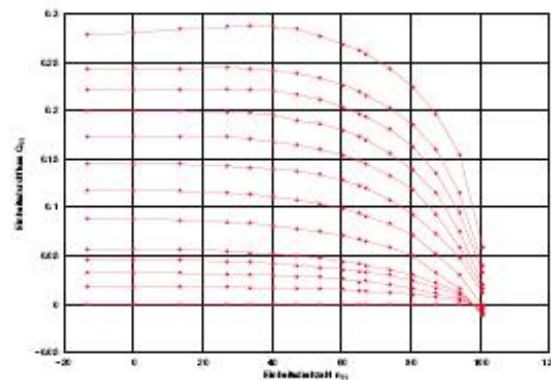
# Verschillende typen curves



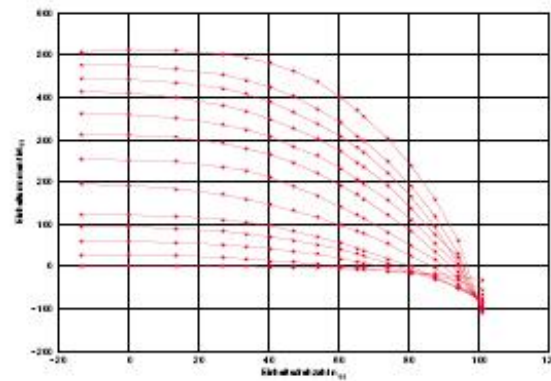
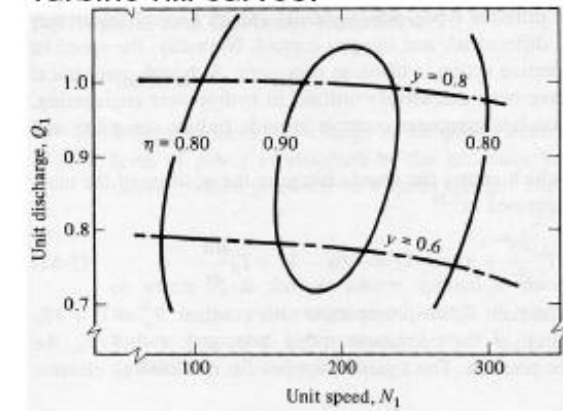
Suter curves:

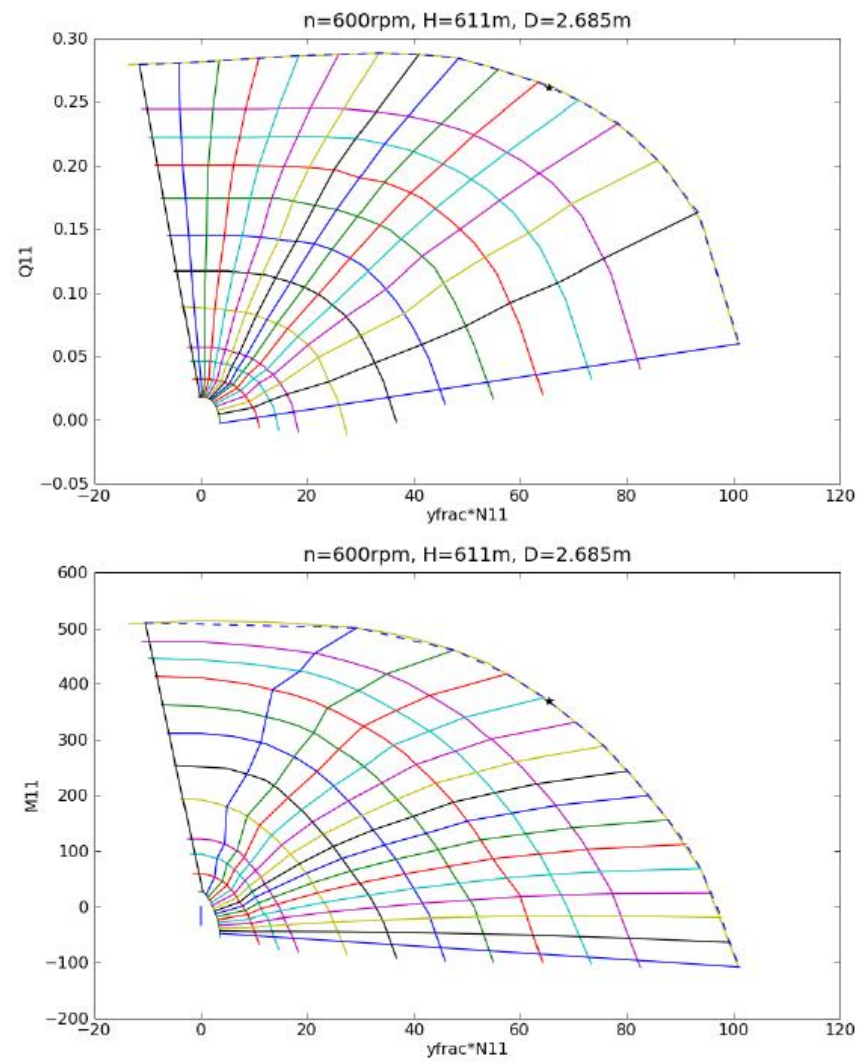


Unit curves:

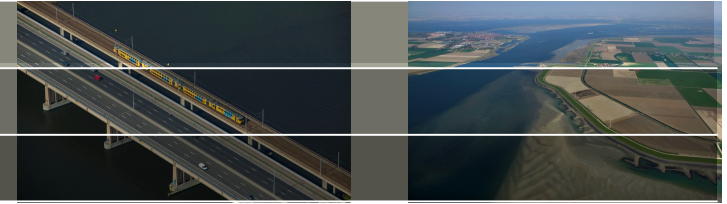


Turbine hill curves:





# Samenvatting



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