The choice of materials for turbines
Kaplan turbine

- Spiral Casing
- Stay Vanes
- Guide Vanes
- Runner
- Draft Tube Cone
Dajiang Power Plant, China
Power: 129 MW
Head: 18.6 m
Flow Rate: 825 m³/s
Kaplan turbines

Spiral casing

Materials:

- Structural steel
  - Carbon steel
  - HSMA (High Strength Micro Alloy)
  - Heat treatment steel
- Concrete (for low head turbines)
Kaplan turbines
Stay ring and stay vanes

Materials:

- Structural steel
  - Carbon steel
  - HSMA (High Strength Micro Alloy)

- Example:
  - S355- -  (DIN)
  - St52- -  (EN)
Kaplan turbines

Guide vanes

Materials:

- Structural steel
  - Stainless steel
  - Carbon steel
  - HSMA (High Strength Micro Alloy)
  - Heat treatment steel

- Examples
  - 16Cr 5Ni
  - 13Cr 4Ni
  - 13Cr 1Ni
  - S355- (DIN)
Kaplan turbines

Runner

Materials:

– Blades:
  • Structural steel
    – Stainless steel
      » 16Cr 5Ni
      » 13Cr 4Ni
      » 13Cr 1Ni
  – Hub
    • Structural steel
      – Carbon steel
      – HSMA (High Strength Micro Alloy)
      – Heat treatment steel
      – Stainless steel

Dajiang Power Plant, China
Kaplan turbines

Draft tube cone

**Materials:**
- Structural steel
  - Stainless steel
  - Carbon steel
  - HSMA (High Strength Micro Alloy)
  - Heat treatment steel
- Example:
  - 16 5
  - S355- - (DIN)
  - St52- - (EN)
Kaplan turbines
Draft tube, downstream the cone

- **Materials:**
  - Structural steel
    - Carbon steel
    - HSMA (High Strength Micro Alloy)
    - Heat treatment steel
  - Concrete
Kaplan turbines
Turbine shaft

• Materials:
  – Structural steel
    • HSMA (High Strength Micro Alloy)
    • Heat treatment steel
  – Example:
    • S355- - (DIN)
    • St52- - (EN)
Francis turbine
Spiral casing, stay ring and stay vanes

Materials:

- Structural steel
  - Carbon steel
  - HSMA (High Strength Micro Alloy)
  - Heat treatment steel

- Example:
  - S355- - (DIN)
  - St52- - (EN)
Weight of the spiral casing

![Graph showing weight of spiral casing over years with specific materials and their corresponding stress values]
Francis turbines

Covers

• Materials:
  – Structural steel
    • HSMA (High Strength Micro Alloy)
    • Heat treatment steel
  – Example:
    • S355-  (DIN)
    • St52-  (EN)
Francis turbines

Draft tube cone

Materials:

– Structural steel
  • Carbon steel
  • HSMA (High Strength Micro Alloy)
  • Heat treatment steel

– Example:
  • S355- - (DIN)
  • St52- - (EN)

Ulvik Power Plant in Norway
Francis turbines
Draft tube

Materials:

- Structural steel
  - Carbon steel
  - HSMA (High Strength Micro Alloy)
  - Heat treatment steel

La Grande 3
Power Plant in Canada

Sauchella-Huebra Power Plant in Spain
Francis turbines
Draft tube, outer part

Materials:

- Structural steel
  - Carbon steel
  - HSMA (High Strength Micro Alloy)
  - Heat treatment steel

- Concrete

Ulvik Power Plant in Norway
La Grande 3 Power Plant in Canada
Francis turbines

Guide vanes

Materials:

– Structural steel
  • Stainless steel
    – 13Cr 4Ni
    – 16Cr 5Ni
Francis turbines

Runner

Materials:

- Structural steel
  - Stainless steel
    - 13Cr 1Ni
    - 13Cr 4Ni
    - 16Cr 5Ni
    - 18Cr 8Ni

Milling of the runner for the Sauchella-Huebra Power Plant in Spain
Francis turbines

Labyrinth seals

Materials:

- Stainless steel on the rotating seal
  - 13Cr 4Ni
  - 16Cr 5Ni
- Nickel aluminium bronze on the stationary seal
  - JM7
Francis turbines

Turbine shaft

- Materials:
  - Structural steel
    - HSMA (High Strength Micro Alloy)
    - Heat treatment steel
  - Example:
    - S355- (DIN)
    - St52- (EN)
Pelton turbine
Manifold

• Materials:
  – Structural steel
    • HSMA (High Strength Micro Alloy)
    • Heat treatment steel
  – Example:
    • S355- -  (DIN)
    • St52- -  (EN)

*Q = 28.5 m³/s
*H = 1130 m
*P = 288 MW

Jostedal Power Plant, Norway
Pelton turbine
Nozzle

• Materials
  – Parts that are exposed for water
    • Stainless steel
      – 13Cr 4Ni
      – 16Cr 5Ni
  – Other parts
    • HSMA (High Strength Micro Alloy)
    • Heat treatment steel
Pelton turbine

Deflector

• Materials:
  – Structural steel
    • Carbon steel
    • HSMA (High Strength Micro Alloy)
  – Heat treatment steel

Jostedal Power Plant, Norway
Pelton turbine

Runner

- Materials:
  - Stainless steel
    - 13Cr 4Ni
Pelton turbines

Turbine shaft

Materials:

- Structural steel
  - HSMA (High Strength Micro Alloy)
  - Heat treatment steel

Example:

- S355- - (DIN)
- St52- - (EN)
Pelton turbine
Housing

- **Materials:**
  - Structural steel
    - Carbon steel
    - HSMA (High Strength Micro Alloy)
    - Heat treatment steel