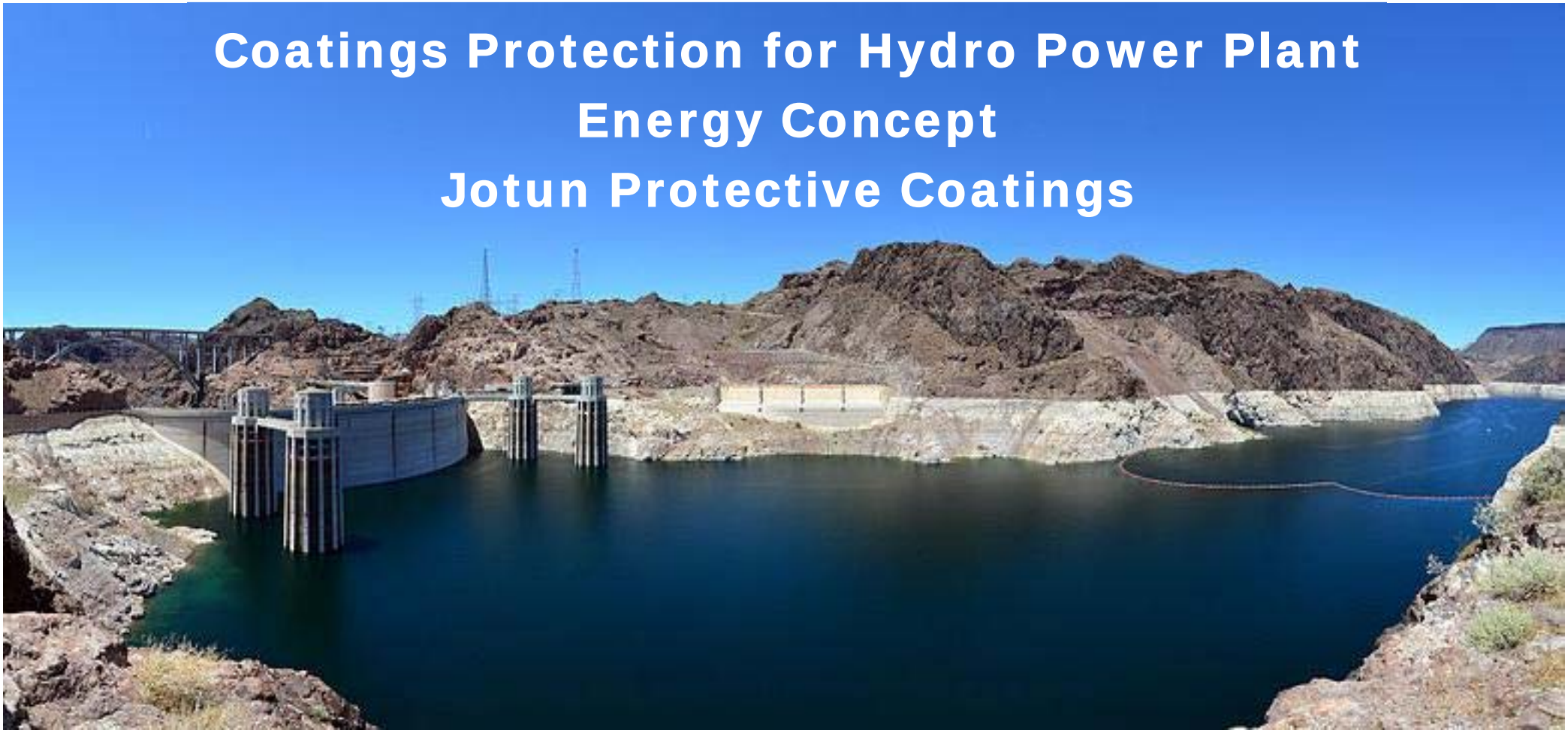
Coatings Protection for Hydro Power Plant
Energy Concept
Jotun Protective Coatings



Concept of Energy

Jotun Coatings

Power from Hydro

Coating Solutions

References

Concept of Energy

- Energy is the foundation of all life
- Energy describes the ability of a system to perform work
- Energy can neither be created, nor destroyed
- By transformation and utilization of the primary energy sources found in nature, electricity can be generated which is the foundation of modern world

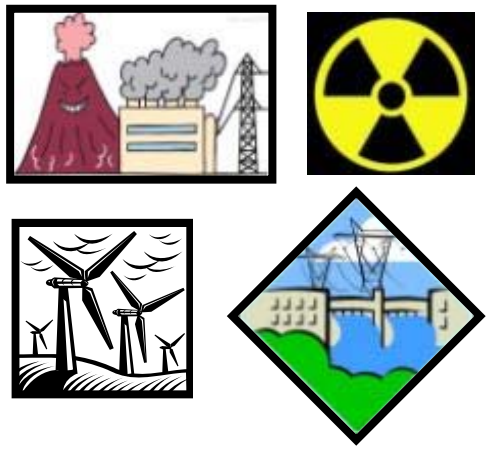
Primary Source of Energy

Energy carrier found in Nature:

- Fossil fuels such as Coal, oil and natural gas
- Nuclear fuels such as uranium
- Various forms of renewable energies, such as biomass, wind, water or solar power

Energy Concept of Protective Coatings

The Energy concept is one of four Global Protective Coatings areas of focus. The aim of the Energy Concept is to secure a market position among the top 3 in target markets.



We have identified four main sub-concepts based on the source of energy:

- Thermal (Coal-fired, Oil, Gas)
- Nuclear
- Wind
- Hydro

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Global presence

- Jotun is one of the world's leading manufacturers of paints and coatings
- Total sales of NOK 14 742 million in 2011
- 39 factories located on all continents
- 74 companies in 43 countries
- 8 514 employees
- Head office in Sandefjord, Norway

Technical Service - Team No.1

- Our Global Technical Team No. 1 consists of more than 750 full-time, specially trained, coating advisors. The majority of these are certified to FROSIO or NACE Certification standard.

- This ensures that technical specifications, local legislation, and standards specified by the authorities, are followed and that all coating related work is carried out as specified and to your complete satisfaction.

Expertise in coatings technology

- Our coatings are designed to meet EN ISO 12944, NORSOK M-501 as well as forthcoming VOC standards and regulations, and et al
- Jotun's central resource for research and development is in Sandefjord, Norway supported by regional laboratories in China, Dubai, Korea, Malaysia and the US
- This large group of scientists also works together with research and development personnel at Jotun factories throughout the world
- They combine the strengths of state-of-the-art technology and innovative thinking with practical knowledge and experience

Experiences

- Jotun has more than 80 years history in the paint industry, with extensive successful experiences within the energy market
- In more than 1,800 power installations worldwide, structures totalling some 65,000,000 square metres in area are currently being protected by Jotun's protective coatings
- These coatings include a wide range of specialized coatings for the protection of thermal (coal, oil and gas), hydro, wind and nuclear power plants

Special tools and services

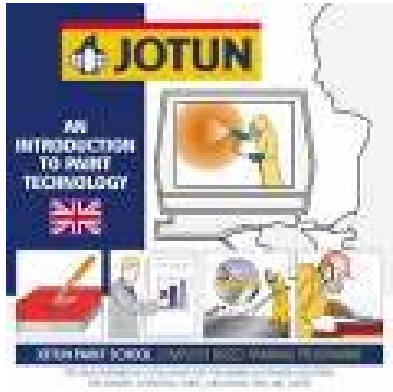
- **JAMP**

  Jotun Asset Management Programme is an effective tool, designed by Jotun for energy installations, to help minimize the maintenance costs during the expected lifetime of the plant and prevent unplanned, costly shutdowns by recommending when painting is required.

Special tools and services

- **Education and training**

  The Jotun Energy Paint School has proved enormously successful and offers both theoretical and practical training with customers participating in various types of courses. We can also offer seminars and individually designed courses, in co-operation with you and selected external lecturers, as well as self-study courses on CD-ROM.



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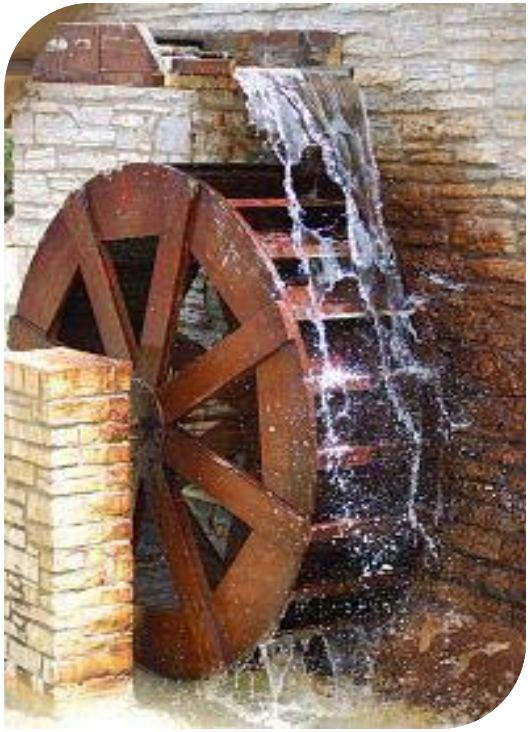
We are DEDICATED to the Hydro Industry!

- Whole solutions – Steel & Concrete
- Advanced products – commitments to constant innovations
- Dedicated teams - of specialists deliver the required competence and service around the globe

Hydro Power History

- We have used running water as an energy source for thousands of years, mainly to grind corn.
- The first house in the world to be lit by hydro power was Cragside House, in Northumberland, England, in 1878.
- Nowadays, hydro power is the most widely used form of renewable Energy.
- The name comes from "hydro", the Greek word for water.



Hydro Power Today

Worldwide, Hydro Power Plants had an installed capacity of 1,010 GW in 2010.

Approximately 16% of the world's electricity is renewable. Hydro accounts for 21% of renewable sources and 3.4% of total energy sources.

Types of Hydro Power

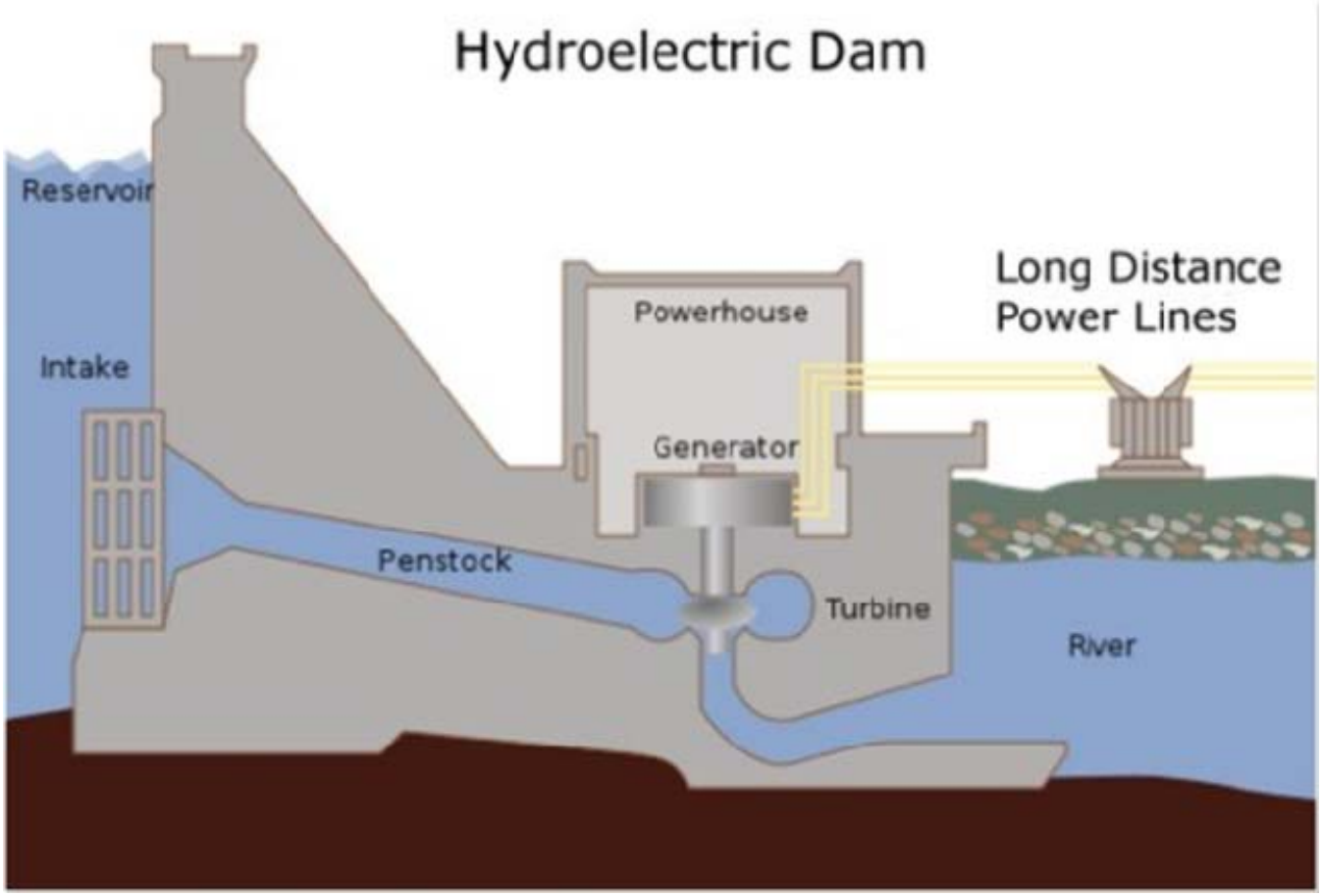
- **Diversion**
  A diversion, sometimes called run-of-river facility diverts a portion of a river through a canal or penstock. It may not require the use of a dam.

- **Impoundment**
  An impoundment facility, typically a large hydropower system, uses a dam to store river water in a reservoir. The water may be released either to meet changing electricity needs or to maintain a constant reservoir level.

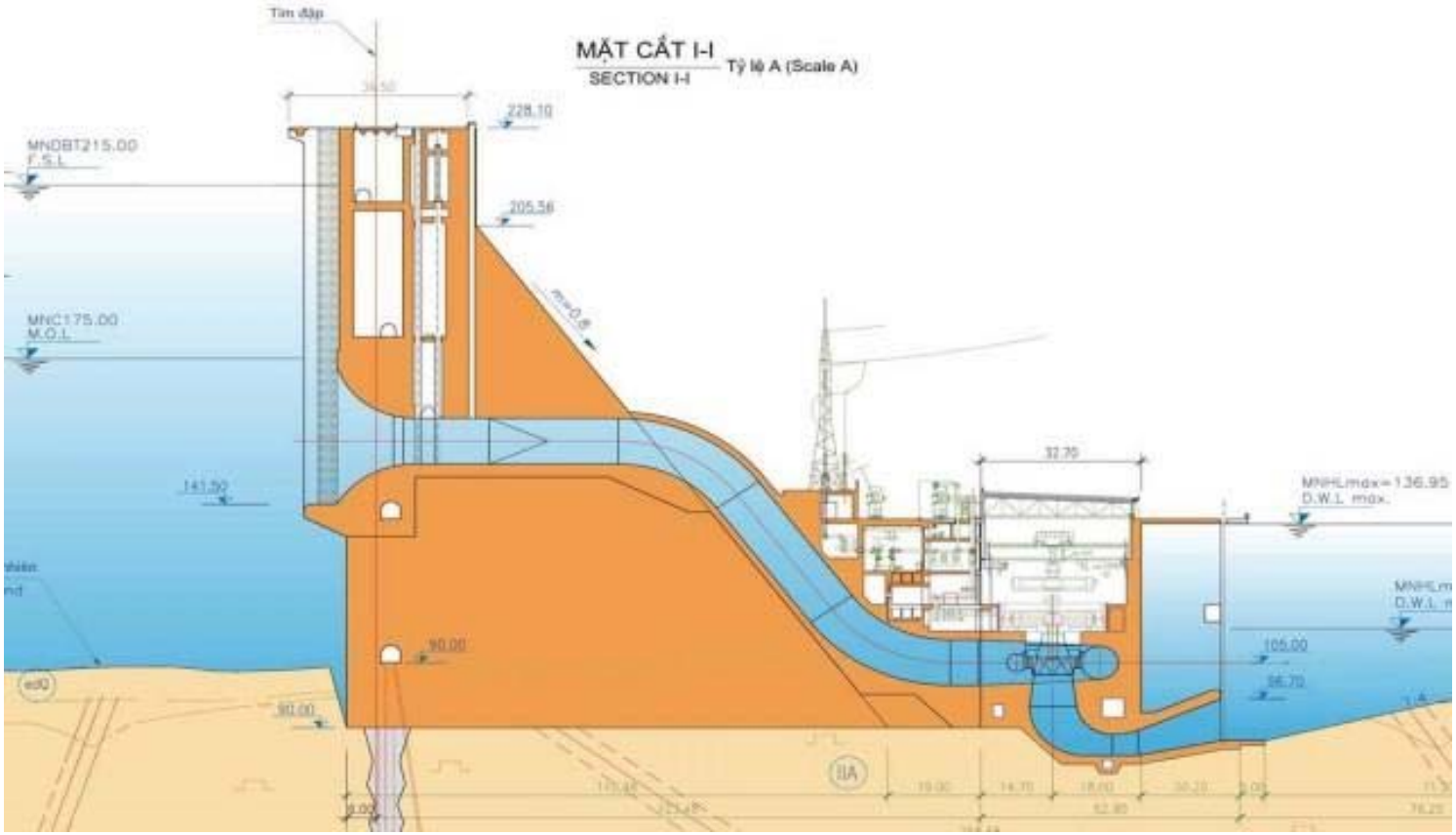
- **Pumped Storage**
  When the demand for electricity is low, a pumped storage facility stores energy by pumping water from a lower reservoir to an upper reservoir. During periods of high electrical demand, the water is released back to the lower reservoir to generate electricity.

Hydro Power Plant Outlook

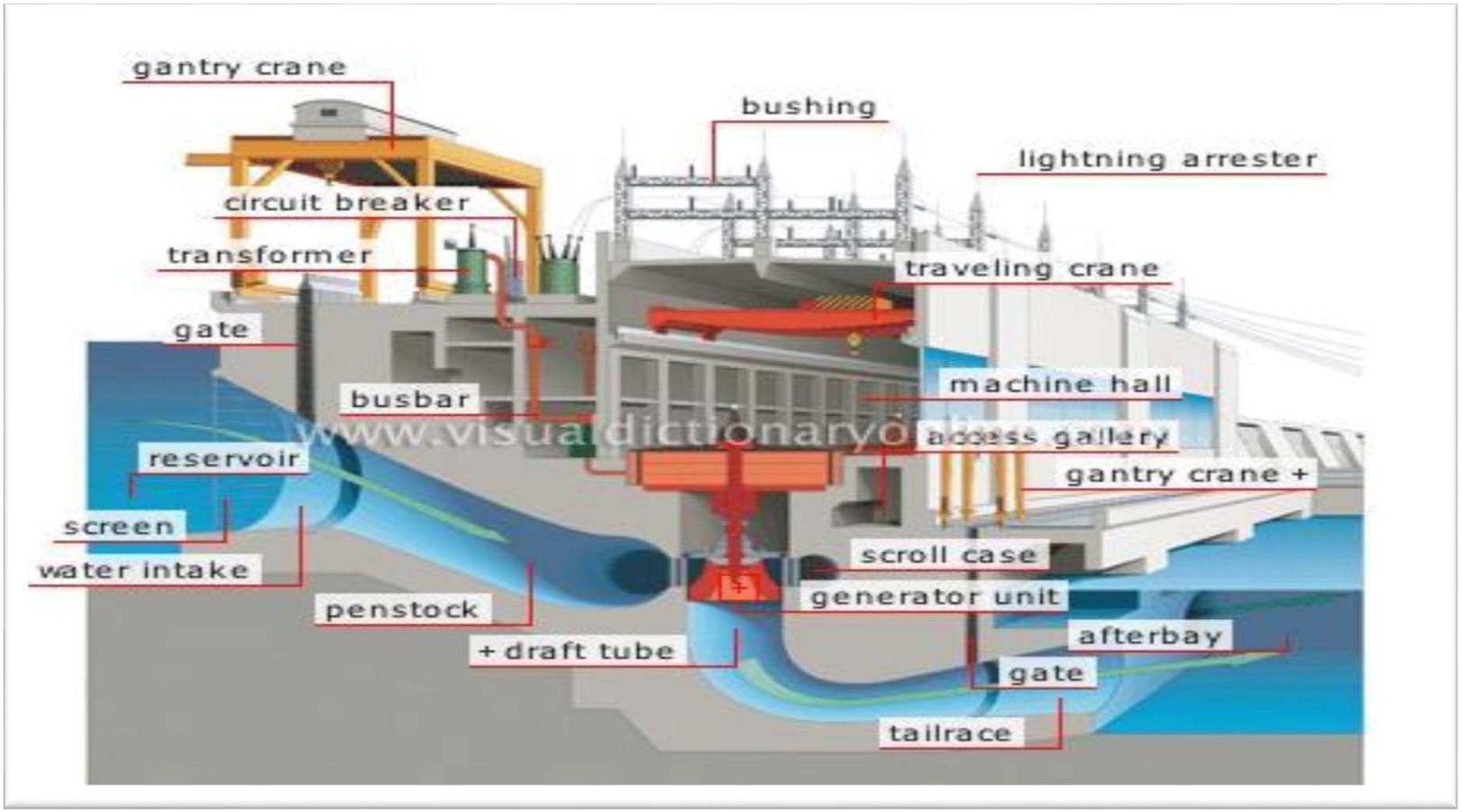
Basic principle of Hydro Power Plant

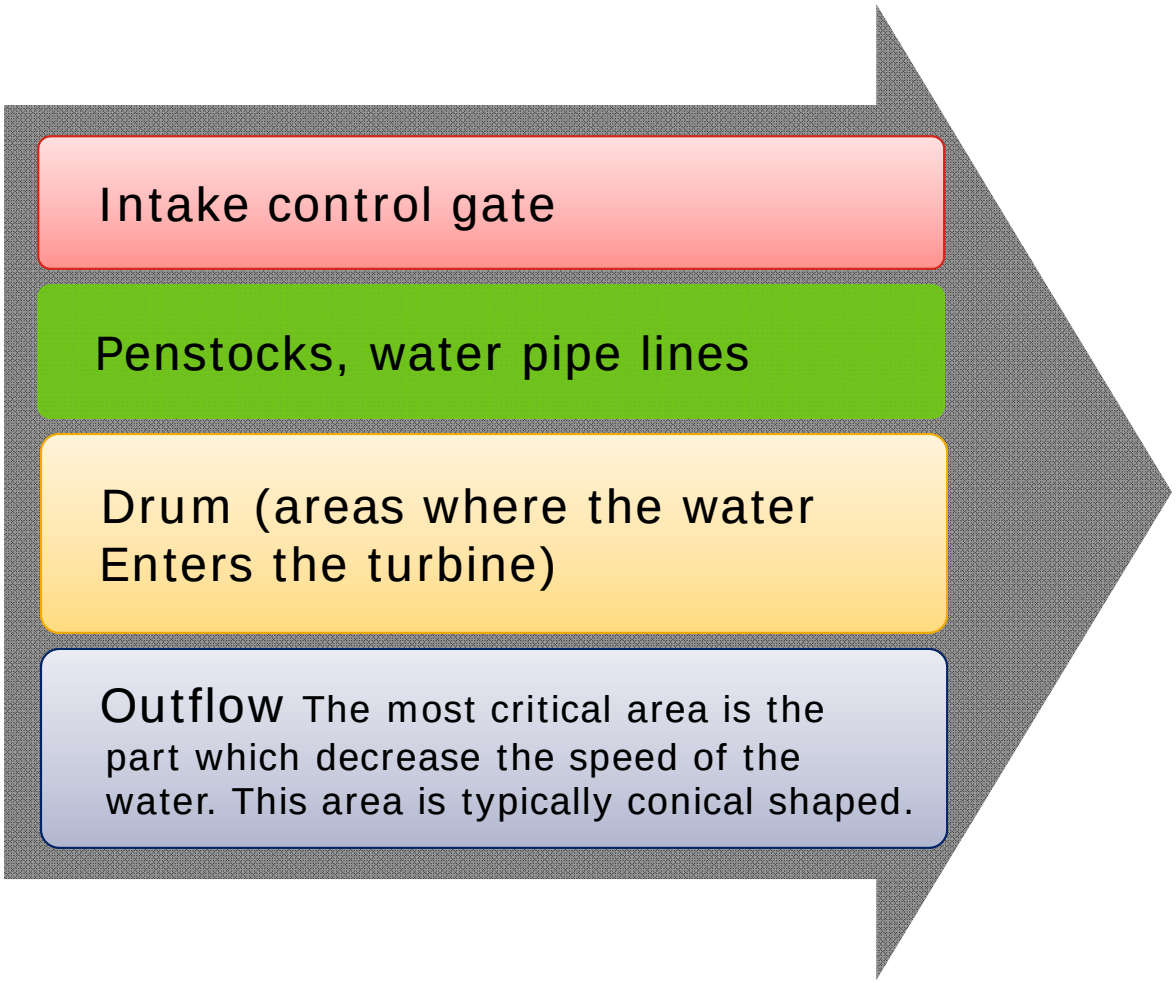


Design of a typical Hydro-electricity Plant



How Hydro Power Plant Works?





Positions need to pay attention related to Painting

Challenge in **Corrosion Protection** of hydro power station -

The Risk of Osmotic Blistering

- If it is salts or other contaminations on the surface before coating it is a risk of paint defect osmotic blistering
- For fresh water exposure as in hydropower plant it is an increased risk due to no or little salt in the water
- The risk increases by increasing cleanliness of the water
- It is important to be aware of the increased risk of osmotic blistering when deciding the coating system

Penstock

Introduction	Penstocks are normally equipped with a gate system and a surge tank. Flow is regulated by turbine operation and is nil when turbines are not in service. Maintenance requirements may include hot water wash, manual cleaning, antifouling coatings, and desiccation.
Environment	C4, C5, Im 1, Im 2
Dimensions	Varied, depending on the design and the height difference of the Dam.
Paint Area	Interior: 28,000 m^2 Exterior: 28,000 m^2
Paint Potential	Interior: 14,000 L Exterior: 17,000 L

Gates

Introduction	It is adjustable gates used to control water flow in a hydro power plant. It is designed to set spillway crest heights in dams, to adjust flow rates in sluices and canals, or to stop water flow entirely as part of a levee or storm surge system.
Environment	C4, Im 1, Im 2
Dimensions	Varied, depending on the type of the gate.
Paint Area	Varied
Paint Potential	Gates are consistently suffering water immersion and sunshine. It is one of the most important areas that can be corroded easily.

Dam

Introduction	It is a barrier that impounds water or underground streams. It has a section called spillway which is designed to pass water from the upstream side of a dam.
Environment	C4, IM 1
Dimensions	Varied, depending on the design
Paint Area	Varied
Paint Potential	Dam, which is made of concrete, is generally not painted. But areas that are suffering abrasion impacts from the water can be easily corroded and should be protected by anti-abrasion paints.

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Coating Specifications – Steel substrates

- Position: Penstock internal
- Environment: IM 1,2
- Durability: ISO 12944 – 1 High (>15 years)
- Test Report: Available upon request

Coating	**Dry film thickness**	**Paint type**
Shopprimer	15-25 µm	**Muki Z 2001** low zinc ethyl silicate
Primer 1st coat	300 µm	**Marathon** Epoxy Glass Flakes
Primer 2nd coat	200 µm	**Marathon** Epoxy Glass Flakes

Coating Specifications – Steel substrates

- Position: Penstock, Hoist Structures external
- Environment: IM 3
- Durability: ISO 12944 – 1 High (>15 years)
- Test Report: Available upon request

Coating	**Dry film thickness**	**Paint type**
Shopprimer	15-25 µm	**Muki Z 2001** low zinc ethyl silicate
Primer	100 µm X 2	**Penguard Express** Fast Cure Epoxy
Topcoat	60 µm	**Hardtop XP** Polyurethane

Coating Specifications – Steel substrates

- Position: Gates external
- Environment: IM 1
- Durability: ISO 12944 – 1 High (>15 years)
- Test Report: Available upon request

Coating	**Dry film thickness**	**Paint type**
Shopprimer	15-25 µm	**Muki Z 2001** low zinc ethyl silicate
Primer 1st coat	250 µm	**Jotamastic 90** Epoxy mastic
Primer 2nd coat	250 µm	**Jotamastic 90** Epoxy mastic

Coating Specifications – Concrete substrates

- Position: Dam external (Concrete)
- Environment: IM 1
- Durability: ISO 12944 – 1 High (>15 years)
- Test Report: Available upon request

Coating	**Dry film thickness**	**Paint type**
Tie Coat	50 µm	**Penguard Clear Sealer** Epoxy Sealer
Primer 1st coat	300 µm	**Marathon** Epoxy Glass Flakes
Primer 2nd coat	200 µm	**Marathon** Epoxy Glass Flakes

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References

Project name: Zaramagskaya Hydro-power Plant-1
Country: Russia
Year: 2010-2011
Owner:
Contractor: Rus HYDRO
Position: The equipment

Coating system:

Coating	DFT ISO 12944-5	Paint type
Primer	2*120 µm	**Primastic Universal**
Midcoat	100 µm	**Primastic Universal**
Topcoat	2*50 µm	**Hardtop AS**

Project name: Ambuklao Hydroelectric Plant Dam
Country: Philippine
Year: 2008-2011
Owner: SNAP (SN and Aboitiz Power)
Contractor: McConnell Dowell
Position: Penstock and Floor

Penstock (internal)

Coating	DFT ISO 12944-5	Paint type
Primer	75 µm	Resist 86
Midcoat	250 µm	Jotamastic 87 GF

Floor Coating

Coating	DFT ISO 12944-5	Paint type
Primer 1st coat	150 µm	Jotafloor SF Primer
Primer 2nd coat Primer 3rd coat	800 µm, light traffic; 2000 µm, heavy traffic	Jotafloor SL Universal

Project name: EVN Dakmi 4 HPP 120MW
Country: Vietnam
Year: 2010
Owner:
Contractor: LILAMA IDICO
Position: Penstock and Underwater

Penstock

Coating	DFT ISO 12944-5	Paint type
Primer 1st coat	50 µm	Barrier 77
Primer 2nd coat	2*400 µm	Marathon

Underwater

Coating	DFT ISO 12944-5	Paint type
Primer	50 µm	Barrier 77
Midcoat	3*125 µm	Jotamastic 80

Project name: Son La Hydro-power Plant (2400MW)
Country: Vietnam
Year: 2007-2011
Owner:
Contractor:
Position: Pipeline, Penstock

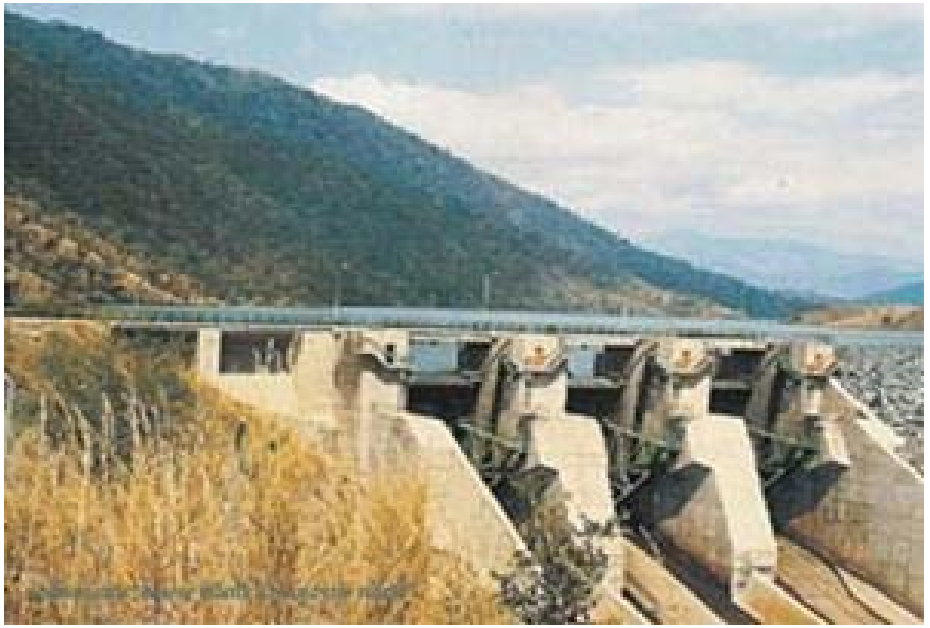
Under water level areas

Coating	DFT ISO 12944-5	Paint type
Primer 1st coat	30 µm	**Barrier 77**
Primer 2nd coat	450 µm	**Marathon XHB**

Above water level areas

Coating	DFT ISO 12944-5	Paint type
Primer	180 µm	**Penguard Express ZP**
Topcoat	80 µm	**Hardtop XP**

Project name: Kidatu Hydro Power Plant (4 X 50 MW)
Country: Tanzania
Year: 2001
Owner:
Contractor:
Position: Sluice gate



Project name: Usta Hydro-electric Power Plant (Oslo Energi)

Country: Norway

Year: 2000

Owner:

Contractor:

Position: Penstock, Turbine

Project name: Mosvatn Hydro Power Plant (Statkraft)
Country: Norway
Year: 2000
Owner:
Contractor:
Position: Sluice gate

Project name: Eikredammen Hydro - electric Power Plant (Oslo Energi)

Country: Norway

Year: 1994

Owner:

Contractor:

Position: Concrete Baffle Wall

Project name:	Stolsdammen Hydro-electric Power Plant (Oslo Energi)
Country:	Norway
Year:	1994
Owner:	
Contractor:	
Position:	Concrete Baffle Wall

Project name: Askara Hydro-electric Power Plant
(Sogn Og Fjordane Energiverk)
Country: Norway
Year: 1993
Owner:
Contractor:
Position: Penstock and Turbine

Project : Wimalasurendra Power Station.

Country : Sri Lanka

Paint System :

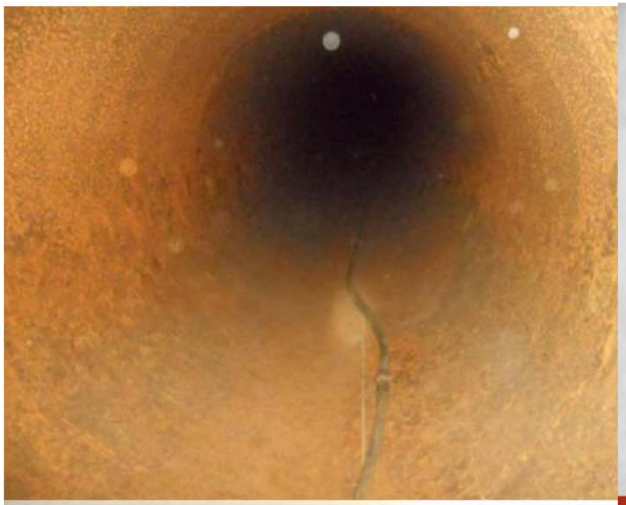
Barrier 80 - 50 Mic

Jotacote Universal – 125 Mic

Jotacote Universal – 125 Mic

Jotacote Universal – 125 Mic

Year Of Application : April 2016



Project : Canyon Hydro Power Station.

Country : Sri Lanka

Paint System :

Jotamastic 80 Alum – 80 Mic
Jotacote Universal – 125 Mic
Jotacote Universal – 125 Mic

Year Of Application : April 2014

Project : Laxapana Power Station - Hydro

Catwalk Structure

Country : Srilanka

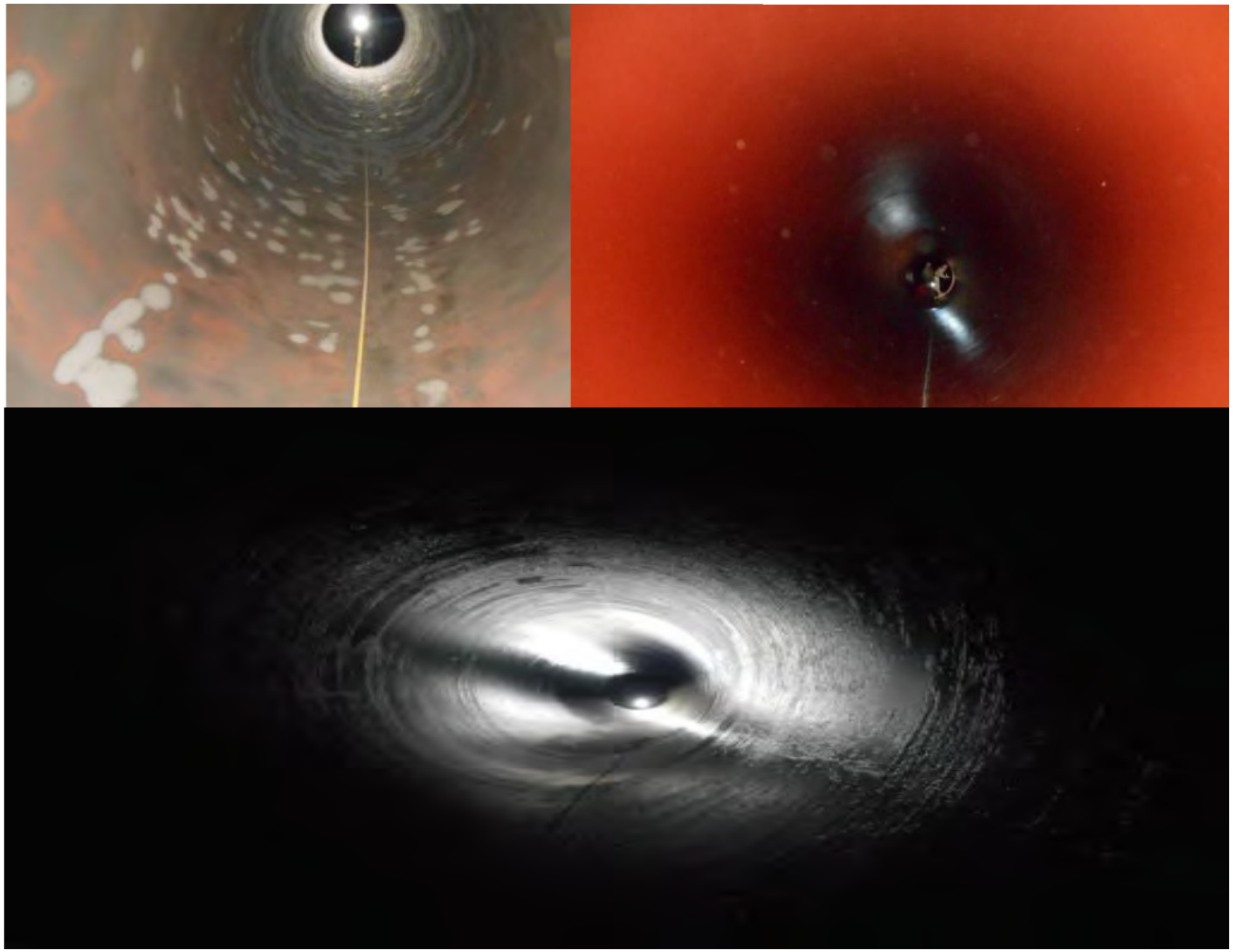
Paint System :

Jotamastic 80 - 80 Mic

Jotacote Universal – 175 Mic

Jotacote Universal – 175 Mic

Year Of Application : March 2014



Project : Bajoli Holi Hydro Power 3X60MW (GMR)

Structure : Penstock

Country : India

Paint System :
Penguard Pro GF – 255 Mic
Penguard Pro GF – 255 Mic

Year Of Application :
Nov 2017 till date

Jotun Protects Property

Thank You!

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