



Italian – Norwegian Energy Dialouge  
SOLUTIONS FOR THE FUTURE

# New challenges for the turbines manufacturers

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Milan April 8th 2016

# About Rainpower

Rainpower is an experienced project organisation based on Norwegian technology.

Rainpower is specialised in Hydro Power industry.

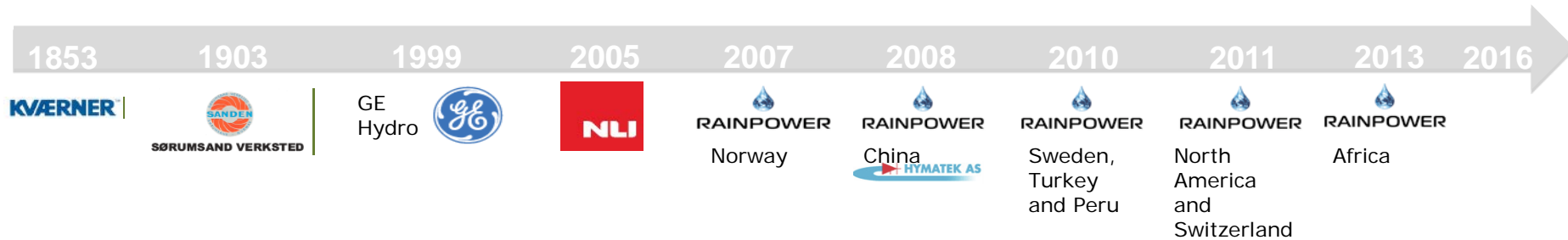
Our main area of expertise is development and productions of turbines.

Our portfolio covers new power plants, rehabilitation, upgrade as well as service and spare parts.



- Head office at Kjeller, Norway
- 100% Norwegian ownership
- Approx. 245 employees in seven countries
- Revenue in 2015: 620 MNOK

# Rainpower History – 160 years of experience



Rainpower employees experience:

- francisturbines 1 to 720 MW
- peltonturbines 2 to 315 MW
- pumpturbines 50 to 306 MW
- kaplanturbines 1 to 180 MW

# Rainpower Locations

Northern Europe	
Kjeller, Norway	Headquarter & Technological Centre
Trondheim, Norway	Turbine laboratory
Sørumsand, Norway	Fabrication & Service
Oslo, Norway	Control systems

Northern Europe	
Kristinehamn, Sweden	Sales & project office

Central Europe	
Baden, Switzerland	Sales & project office

Eastern Europe / Asia	
Istanbul, Turkey	project office

South East Asia	
Hangzhou, China	Supply & Engineering Sales & project office

Africa	
Mozambique	Project office

North America	
Vancouver	project office

South America	
Lima, Peru	project office

Presence in all relevant high and medium head turbine markets

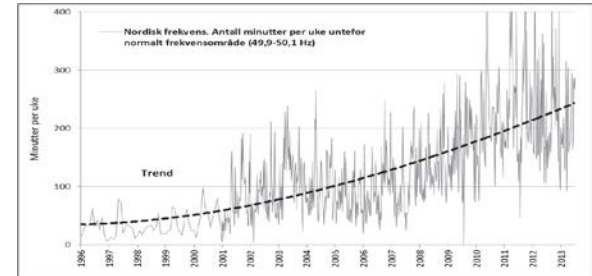
# Rainpower cooperation with Italian companies

- STE Energy
  - **Quitaracsa project**  
**2x58MW**  
(Peru) Consortium partners
  - **Misicuni project**  
**3x43MW**  
(Bolivia): sub-supplier for the turbines
- Elledi
  - Sourcing of francis runners



# New challenges for the turbine manufacturers

- Low electricity prices
- Changes in the operations of the plants
  - Unbalanced power into the grid
  - Frequency Restoration Reserve (FRR)
  - Start/ stop

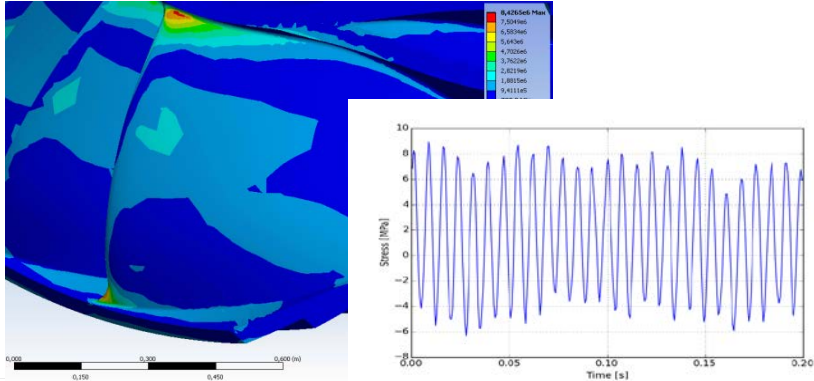


\*Lindeberg, NEF Teknisk Møte 2014



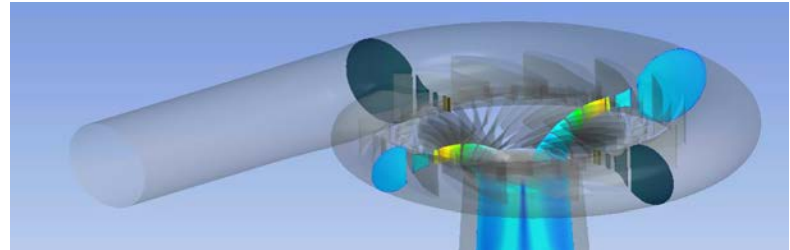
# New challenges for the turbine manufacturers

- New calculation tools
  - Dynamic stresses
  - Mechanical integrity
  - Cavitation
  - waterway
- New production methods
  - T-Blade francis runners



# High head Francis - HiFrancis

- Secure reliable operation and lifetime for high head Francis turbines operating in the future energy market.
- Common R&D effort
  - power utilities
  - Turbine manufacturers
  - Consultants
  - University
- Supported by government funds



source:; NTNU



# New Challenges also gives **great opportunities**

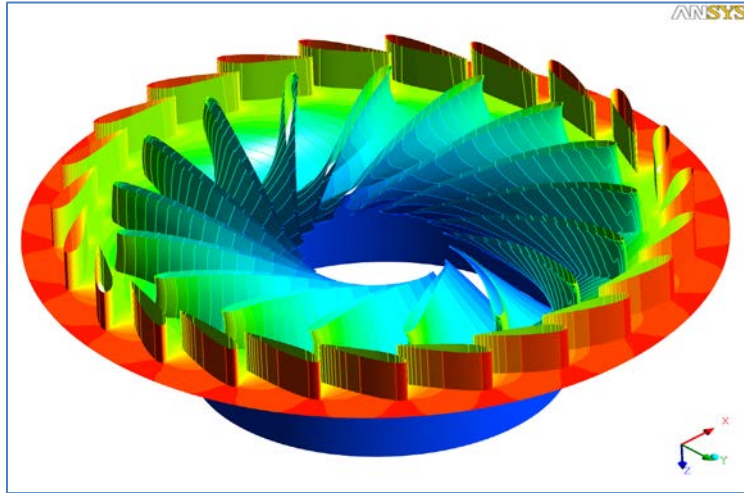
	Installed capacity MW	Amounts of plants	Average year start commercial operation	Share older than 40 years in MW	Refurbishment rate in MW	Main turbine type
Austria	12 617	579	1976	40%	4,2%	Pelton
France	24 345	957	1966	54%	1,4%	Francis
Italy	21 417	1190	1964	56%	5,1%	Pelton
Portugal	5 145	169	1972	33%	1,3%	Francis
Romania	6 604	414	1983	27%	0,02%	Kaplan
Spain	18 080	848	1962	57%	1,0%	Francis
Sweden	16 950	652	1963	60%	1,6%	Francis
Switzerland	13 918	644	1970	64%	9,9%	Pelton
Slovenia	1 155	87	1966	43%	0,7%	Kaplan
Croatia	2 108	36	1963	46%	2,3%	Francis
Albania	1 483	93	1973	24%	0,1%	Francis
Georgia	2 798	62	1962	36%	0,2%	Francis
Turkey	17 645	303	1992	5%	0,2%	Francis

Source: Intpow

***Average age of equipment: 45 years***

# Turbine Upgrading – Main Objectives

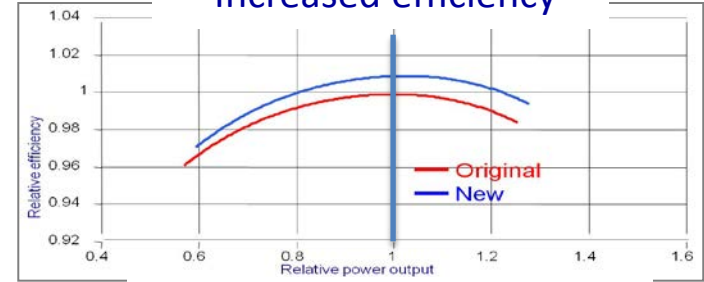
Turbine design optimization  
... to fit new performance requirements



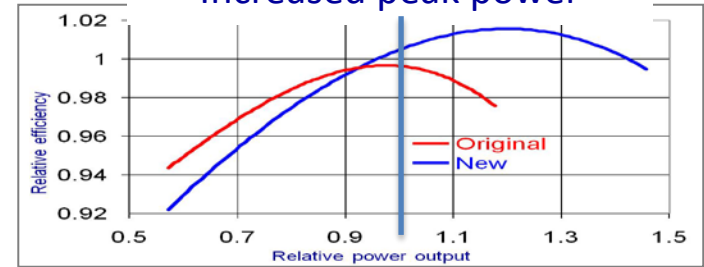
... by using new technology



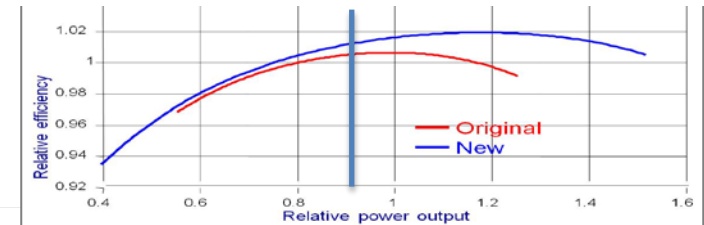
### Increased efficiency



### Increased peak power

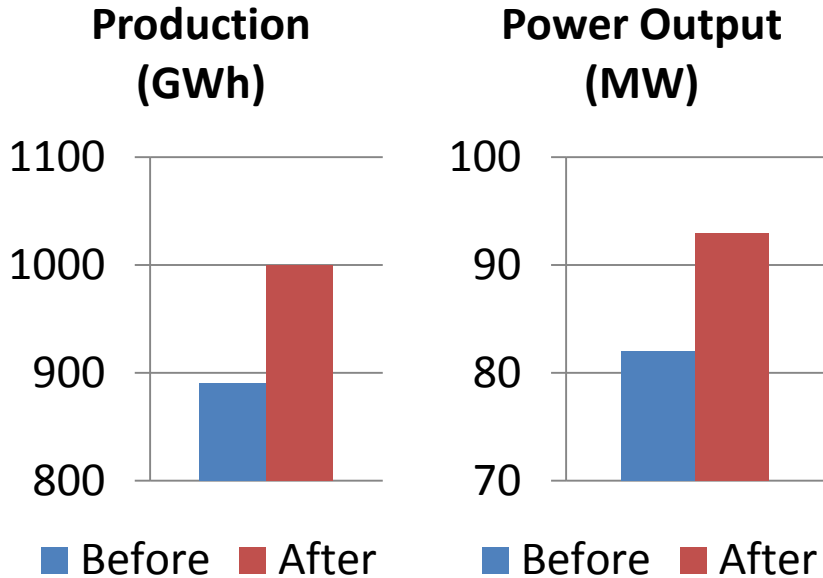


### Increased efficiency and power



**RAINPOWER**

# Upgrade Case – Røldal Power Plant



+12,2%

+13,4%

*... equivalent to 10 small hydro plants or 20 wind mills...*



# Thank you

[www.rainpower.no](http://www.rainpower.no)