REPLACEMENT OF OLD CAMEL-BACK DOUBLE DISCHARGE FRANCIS UNITS through ECOBulb™ TECHNOLOGY : THE EXEMPLE OF TOMBETTA (ITALY)

Pierre DUFLON & Stefano RIZZI
Sales Managers VA TECH Hydro
France & Italy

VA TECH HYDRO

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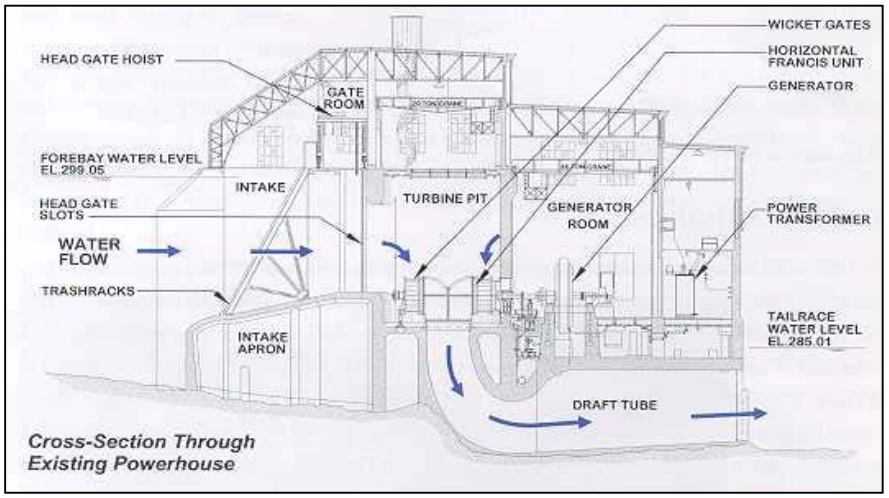

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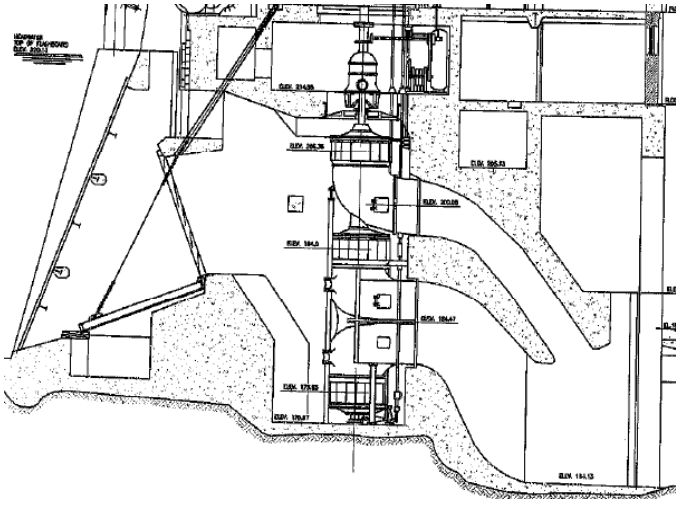

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Most of the Camel Back Double Francis units have the same technical features which are :

- Built in the early 1900's
- High setting level
- Low % of use of river flow
- Lack of reliable civil drawings
- Low Head; between 6 and 20 m
- 1 to 4 MW per unit

Concept ECOBulb™

Bulb unit : *Eco*logical & *Eco*nomical

Axial unit with direct coupled generator (no step-up gear)

Synchronous generator with permanent magnetic excitation

Ecological unit without oil lubrication loop

No external cooling system required

Silent unit and maximum Integration in the site and landscape

Reduction of the civil costs

Output range between	*500*	*and*	*5000*	*kW*
and head range between	*2*	*and*	*15*	*m*

Limits of application of the ECOBulb unit

Permanent Magnet constant excitation means :

- ×No direct regulation of the Power Factor
- ×No direct regulation of the Voltage
- ×Over Voltage proportional to the over speed

- ×No isolated operation possible

The ECOBulb unit is adapted to the integration into an existing strong and stable electrical network, in Europe, North America, …

Advantages of the ECOBulb unit

- ✓ High Turbine efficiency
- ✓ Very high Generator efficiency, at full and part load
- ✓ No step-up Gear nor lubrication system
- ✓ Very compact unit thanks to the complete integration of the Turbine and Generator

The ECOBulb unit is the result of putting together the competences of VA TECH Hydro and ELIN for a Compact Hydro development

Units in operation

Aubas, Lot, France:

Transformation of one asynchron unit into one runner regulated ECOBulb : 330 kW - 214 Rpm, unit in continuous operation since October 2002 without troubles . Extensive electrical tests performed on this unit

Paullo, Milano, Italy:
Two ECOBulb units, runner regulated : 1020 kW - 150 Rpm, units in operation since August 2004, next project started with 1 ECOBulb DR

Sonoco, Ontario, Canada:
Two ECOBulb units runner regulated : 4000 kW - 144 Rpm, in operation since september 2005

Tombetta, Verona, Italy:
Four Vertical ECOBulb units double regulated : 1400 kW - 214 Rpm, in operation since end of 2005

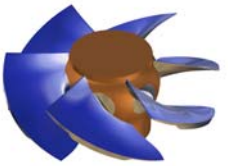
Orders in progress
Genivolta 2 (Italy) and Belgiardino (Italy) : Two ECOBulbs double regulated

Santa Teresa & Villanova (Italy) : Four ECOBulbs identical to Paullo

Refurbishment goals are multiple :

- Built in the early 1900's
- High setting level
- Low % of use of river flow
- Lack of reliable civil drawings
- Low Head; between 6 and 20 m
- 1 to 4 MW per unit

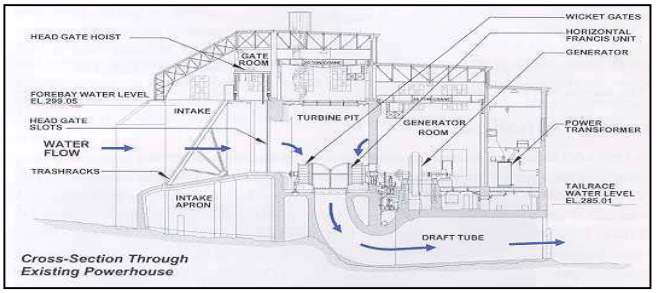
- Fit for the 21st century
- Avoid cavitation
- Increase % of use of river flow
- Not weaken the existing civil structure
- Low Head; cannot be changed drastically !
- Increase unit output
- Optimize client investment

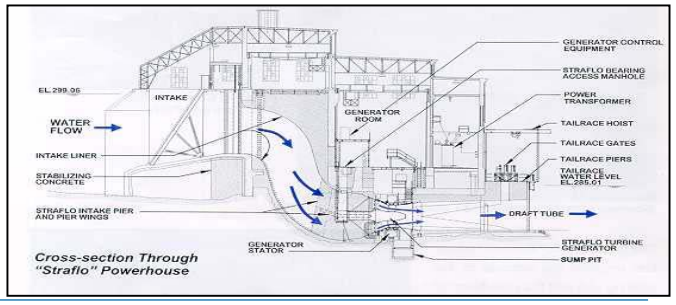


Refurbishment options :

- Camel-Back replacement : Cheap solution, no benefits
- Open Flume Single Francis : Low benefits, cavitation limits
- Axial propeller : Lack of flexibility, generator price
- Vertical Kaplan : Civil impact
- Vertical axial : Discharge limited by elbow draft tube
- Pit : Step-up gear is a must due to pit size
- Inverted Pit : Step-up gear and head losses due to the pit
- Straflo™ : For large units, fixed blades
- Bulb : For large units, size of the bulb
- ECOBulb™ : No PF nor voltage regulation

…





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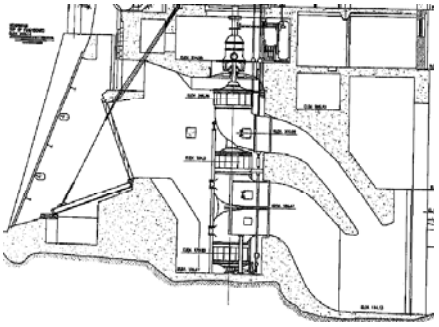
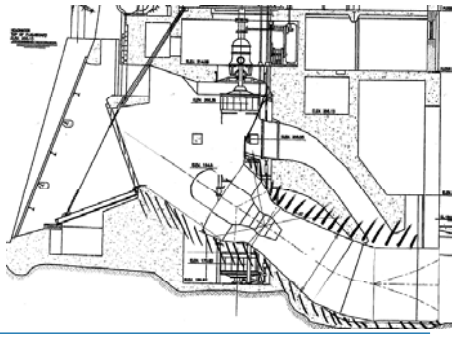
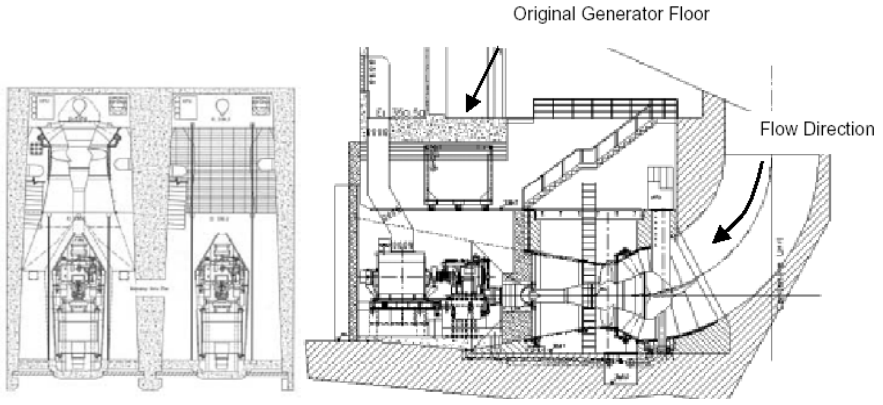


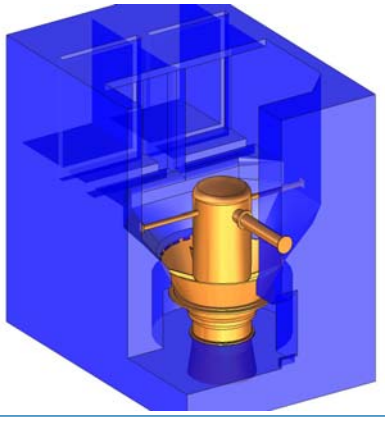




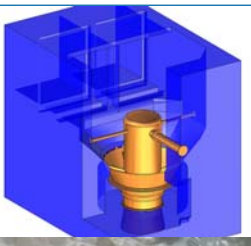
Tombetta

Net head : **10.5** **m**
Discharge : **4 x 15** **m^3/s**

Tombetta



Net head :	10.5	m
Discharge per unit :	15	m^3/s
Mech. output :	1400	kW
Electrical output :	1450	kVA
Power Factor 100% :	0.95	Cap.
Runner diameter :	1770	mm
6 blades,		
Double regulated		
Eta Turbine max.P :	92.0	%
Eta Generator max.P :	97.2	%
Eta Total max. :	89.4	%
	at 14 m^3/s	



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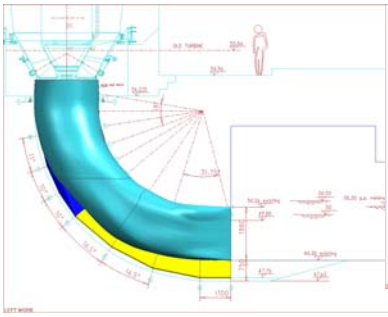

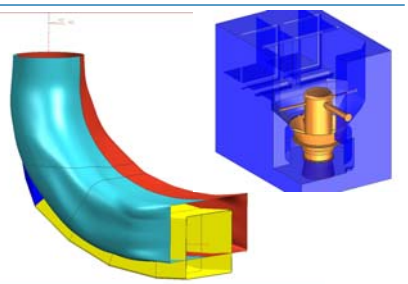

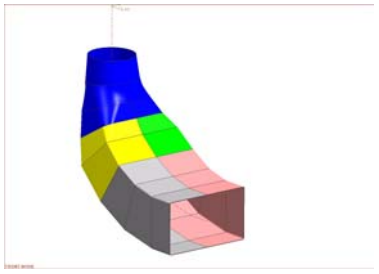

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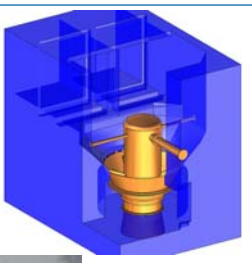

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Thank you for your attention