



ADVANTAGE ON YOUR SIDE

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www.flovel.net

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Welcome to the next level, welcome to flow.

Dear partners and friends of FLOVEL Energy Private Limited, dear customers!

We are very happy to introduce you to the first issue of our magazine "flow". For more than 45 years, we have been investing all our strength and knowledge into an industry, whose challenges are worth staying on the ball for decades to come. During this period, we have been able to survive in a highly competitive market and develop solutions for our customers, which are not only satisfying but also sustainably successful. And we have developed strengths, of which we are convinced, that they will help us to get our customers moving faster and further. Our passion is to be as close as possible to our customers over the entire duration of a project, to be a perfect solution-provider and point of contact for all aspects of hydropower business and hydropower projects. A property that our competitors can only partly meet. In order to further expand these strengths, we have decided to step-up our communication with the customers and, among other things, brought this new customer magazine to life for you. Twice a year, we would like to report on a wide range of topics, introduce our new projects and provide a look behind the scenes of our company.

We will use this magazine to present FLOVEL in a transparent and informative way in order to bring the advantage on your side.

Maharaj Kar Chairman & Managing Director

CUSTOMER MEET 2018 BY FLOVEL

FLOVEL Energy Private Limited, India hosted the Customer Meet 2018 at Kathmandu, Nepal in Hotel Radisson on 20th September 2018. Invitees were many prominent personalities of Nepal hydropower sector and were a wonderful blend



of promoters, major bankers providing finances to hydro projects and hydropower consultants involved in the development of hydropower projects in the country. The Customer Meet 2018 was focused to showcase that the strength of FLOVEL is in its ability to offer comprehensive Electro-Mechanical solutions on turnkey basis for the development of hydropower projects.

new HYDROS

Right at the beginning of this first issue, we would like to give you a short overview of new projects, events and interesting facts about the hydropower market and FLOVEL. We hope that these newsflashes are an interesting and entertaining start to our new customer magazine.



Vietnam-challenge mastered

We are proud to present a new project in Vietnam. Xoong Con HPP

A new project in Vietnam is born. The extensive activities for this project were an exciting challenge. FLOVEL was responsible for a wide scope of work. The project is successfully commissioned and synchronized to the Vietnam Electricity (EVN) grid in December, 2018.

Features

- » Unit Capacity: 8.5 MW + 15% COL
- » No. of Units: Two (2) Nos.
- » Type of Turbine: Horizontal Francis
- » Rated net head: 129.35 m
- » Speed: 600 rpm

Scope of work

From designing, manufacturing, supplying and delivering to the Port, Supervision of Erection, Testing & Commissioning of complete Electro-Mechanical Equipment which includes Hydro Turbine, Generator, MIV, Oil Pressure Unit, Transformers to all Electrical & Electrical BOP items and 110 KV Switchyard.



First commissioned Project in Nepal is running successfully to the satisfaction of our customer.

Customer Name:

Super Mai Hydro Power Ltd., Kathmandu, Nepal Date of Commissioning: October 2018

Completion Period: 12.5 months from Contract Commencement date Location of Project site: llam District, Ilam Municipality of Nepal

Salient Features of Project:

Unit Capacity: 3.9 MW + 10% COL No. of Units: Two (2) Nos. Rated net head: 123.93 m

Type of Turbine: Horizontal Francis Speed: 750 rpm

Scope of work:

Designing, Manufacturing, Supplying

and Delivering to the Site, Supervision of Erection, Testing & Commissioning of complete Electro-Mechanical Equipment which includes Hydro Turbine, Generator, MIV, Oil Pressure Unit, Transformers, All Electrical & Electrical BOP items and 132 KV Switchyard.

Achievement:

Project was completed as per Contract schedule i.e in 12.5 months, which was remarkable feat achieved in Nepal by FLOVEL. This was appreciated by our esteemed Customer as well as other Developers in Nepal. With commissioning of this Project, FLOVEL sets a strong foothold in Hydropower Sector in Nepal.

TENAGA EXPO & FORUM EXHIBITION 2018, A FRUITFULL PARTICIPATION IN KUALA LUMPUR, MALAYSIA

Tenaga Expo and Forum 2018 was organized by UBM in Kuala Lumpur, Malaysia to promote Power generation, distribution, transmission and engineering industries in Malaysia and Southeast Asia. The exhibition aimed at providing opportunities to various enterprises to increase international exchanges and cooperation in spreading business. FLOVEL represented Hydropower Sector in the exhibition under the umbrella of Indian Chamber of Commerce (ICC). FLOVEL's motive behind participation was to get acquainted with the Malaysian hydropower sector and to engage with prospective customers in the region. During the exhibition, many visitors visited FLOVEL's stall and their impression was that FLOVEL, India possesses capability and technology as good as any European company. Also Dr. Varun Jeph, who is Commercial Representative (High Commission of India) in Malaysia visited FLOVEL's stall and expressed his keenness in getting to know more about FLOVEL. All in all the participation in Tenaga Expo & Forum Exhibition was very fruitful and marked the beginning of FLOVEL's extended efforts in Malaysia.



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FLOVEL has a new logo and a new website. Both elements are part of the new Corporate Design, which was developed by the Austrian agency Faschingbauer & Schaar. All elements of the corporate design are part of a strategy with which the brand FLOVEL is to be strengthened worldwide and can act competitively on the international hydropower market.

ADVANTAGE on your side

THE BRAND RELAUNCH IS AN IMPORTANT STEP OF OUR STRATEGY TO ENTER NEW MARKETS AND TO ESTABLISH FLOVEL AS THE GO-TO-BRAND FOR CUSTOMERS. IT WAS VERY IMPORTANT TO MAINTAIN CONTINUITY WITH OUR EXISTING BRAND INSTEAD OF DEVELOPING A COMPLETELY NEW BRAND-DESIGN. WE HAVE BUILT



STRONG FOUNDATIONS IN OUR JOURNEY SO FAR, IDEA IS TO STEP-UP AND BUILD FORWARD.

Gautam Kar, Executive Director, FLOVEL Energy Private Limited





Every company decides at some point to change its visual appearance to move with the times and meet the requirements of a highly competitive market. Further, the digital age has set new trends in design. The use on digital channels must be concise and simple.

The look of the existing logo has not been completely changed. The clear order to the agency was to keep the "old" lettering in its essence but to make it more modern and reflect closeness. The result is a lettering, which is more compact, independent,

The evolution from the old logo to the new one. The red dots mark those places where changes were made in the letters.







closed and concise. The uniform shape of the letters is now easier to read and gives the logo a better image character. The agency calls it "finetuning". The color blue has been preserved, but a new symbol, which is strongly reminiscent of turbine blades by the three elements, has replaced the old green frame. The design is deliberately kept flat. No embellishments, no 3D looks – simple and flat shapes are dominating – these can be captured better on small mobile screens. This is similar to the way operating systems iOS and Android are designed.

A new slogan now expresses FLOVEL's promise to its customers. The slogan shows in combination with the logo, a much focused and differentiated brand.

The colors in the logo are the company colors now and clearly defined in a manual for its purpose. They will be found again on the new website, in the new corporate brochure, in product brochures and in all other communication channels. Furthermore, they'll also be used in the new FLOVEL office. Gautam Kar, Executive Director, **FLOVEL Energy Private Limited**

"EMPLOYEES SPEND 9-10 HOURS AT WORK EVERYDAY. THEY NEED TO FEEL IT BUILDS MOTIVATION AND IMPROVES PRODUCTIVITY. AN OFFICE IS A REFLECTION OF YOUR WORKING STYLE AND CULTURE.

W OFFICE new opportunities

An interview with Gautam Kar, Executive Director, FLOVEL Energy Private Limited, and Rahul Bhatt, Managing Director and Chief Architect, Cherry Hill Interiors Limited.

A new office for so many people is not a project from today to tomorrow. What were the motives for you to start such a project?

Gautam Kar: Since its inception in 1971 FLOVEL has grown organically with the additions of new markets and projects. Today we have close to 300 employees and are serving 12+ countries worldwide. A fully-functional Corporate Office with modern amenities is a business requirement. Technology plays a big role today in conducting business and offices need to be able to support it. Employee expectations from workplace have also evolved. A new office enables us to build it as per FLOVEL's current and future requirements.

The new office expresses a new mentality. What were the first thoughts when you first met FLOVEL and were informed about its field of business-activity?

Rahul Bhatt: I was delighted. Typically, Indian companies, specially in manufacturing segment, view Corporate Office expenditure as an overhead. Their approach is cost driven and functional, which is at odds with an architect's view of a building. But at FLOVEL, they viewed the Corporate Office as part of their business strategy and nat was exciting.

The new working world also mean significant investments for the company. Are these even worthwhile?

Gautam Kar: Human capital is vital for our business. Employees spend 9-10 hours at work everyday. They need to feel good about it. It builds motivation and improves productivity. An office is a reflection of your working style and culture. It assures visiting clients of the company's capabilities and intent. Besides, technology and connectivity have become key to modern day working style. An office has to be able to support it. It should have spaces for the varying work-related requirement of both the individuals as well as the organisation.

What were the difficulties in planning the new office?

Rahul Bhatt: The key challenge is to integrate the feel and the functionality in a seamless manner. There are basic requirements –



Water gives power and dynamic to the new office. For example, it as be an optical design element and the rooms have been named after rivers.







technology, seating, facilities etc. - to be taken care of. But it should not compromise the idea of office as an extension of the brand. As an architect we need a design that syncs the two.

FLOVEL is in a relaunch phase, which concerns the general company appearance. Also the logo and the website were redesigned. How is this reflected in the new office?

Gautam Kar: Our new logo and the tagline ("Advantage on your side") reflects who we are and what we offer to our customers. We have carried the same theme to our office with its design reflecting our personality and vision. It has an open, flexible space that makes one immediately feel part of it. It is technology enabled and is equipped with all the modern facilities. It has a futuristic, comforting feel.

An important part in the office architecture is light and acoustics. How did you solve that?

Rahul Bhatt: These are intrinsic parts of design. Walls and materials are chosen keeping the ambience required. Keeping in mind FLOVEL's open and collaborative business approach, we designed the office to reflect the same.

Prt = 1 + $(\Delta Z * L * a)$ $(a_1 * L_1 + a_2 * L_2 + a_3 * L_3 + a_4 * L_4 + a_5 * L_5$

The mighty **Kullu Valley** (Himachal Pradesh, INDIA) stretches for 80 km from the deep and narrow Larji Canyon near Mandi to the 3,980 meters high Rothang Pass.

SARBARI II: A PRACTICAL EXAMPLE Transient analysis of hydropower stations with long penstocks

This article aims at analyzing the transient condition in water conductor system of hydro-power installation with long penstocks. For this practical example of SARBARI II is taken. Sarbari II is owned by DSL Hydrowatt Private Limited and situated in lush green valleys of Kullu (Himachal Pradesh, INDIA). This power house is at the downstream of Sarbari I. The discharge of Sarbari I is fed to Sarbari II through a pressurized tunnel and penstock of length approximating 3,851 meters.



SARBARI I – SARBARI II

length approximating 3,851 m

PARAMETERS

The SARBARI II SHPP is equipped with two (2) units of two (2) jet horizontal Pelton machines running at synchronous speed of 375 rpm, operating under rated head of 189.65 m. Each unit can generate output of 2,700 kW + 25% continuous overload and are capable to give maximum continuous output of 3,575 kW with discharge of 2,275 m³/s. The power house is situated at an elevation of 1,423.00 m above mean sea level with maximum temperature of (+) 30° C and minimum temperature of (-) 5° C.

Penstock parameters

SECTION no	LENGTH (m)	DIAMETER (m)	THICKNESS (mm)	DISCHARGE (m³/s)
I	3,500	1.6	6	4.55
II	50	1.25	8	4.55
	50	1.25	10	4.55
IV	135.8	1.25	16	4.55
V	116	1.25	20	4.55
VI	20	1.0	20	2,275

Plant parameters

Number of units:	2	
Type of turbines:	Horizontal Pelton 2 Jets	
Maximum Head:	191.65 m	
Rated Head:	189.65 m	
Minimum Head:	187.65 m	
Rated generator output:	2,700 kW	
Synchronous speed:	375 rpm	
Pressure rise:	25 %	





The discharge of Sarbari I is fed to Sarbari II through a pressurized tunnel and penstock of length approximating 3,851 meters

METHODOLOGY

The following turbine operations produce transient state conditions in the water conductor system of hydroelectric power plant: » Unit starting.

» Load rejection.

Following methods were used to carry out transient analysis: » Arithmetic integration method using Joukowsky's philosophy: it is based on the principle of Newton's second law which states that Force = Rate of change of momentum. Arithmetical integration method consists of numerically integrating the pressures developed by the successive instantaneous steps during the complete needle closure time. Thus, the total time from the beginning of the closure and total pressure developed up to that time is obtained at the end of each step.

» Allievis method: Allievis method for the solution of maximum or minimum water hammer pressures, when the velocity is decreased from zero or is increased from zero to a certain value

The above-mentioned methods were used for determining:

- » Needle closing and opening times.
- » Main inlet valve opening and closing times.
- » Penstock protection valve closing and opening time.

SR. no	R.D.	DIA OF PEN- STOCK (mm)	THICKNESS provided (mm)	LENGTH (m)
1	0 to 49.97	1,250	8	49.97
2	49.97 to 91.92	1,250	10	41.95
3	91.92 to 227.71	1,250	16	135.79
4	227.71 to 343.65	1,250	20	115.94
	Total Length			343.65

EQUATIONS AND CALCULATIONS

The total length of penstock is 3851.8 m (neglecting the length of unit penstock as it is very small in comparison to the total length of penstock and hence will not affect the final result).

» Wave propagation speed:

$$\alpha = \frac{\sqrt{\frac{K}{\rho}}}{\sqrt{1 + \frac{K * D * (5 - 4 * \mu)}{4 * t * E}}}$$

» Average water hammer wave velocity:

$$a = \frac{\begin{pmatrix} a_1 * L_1 + a_2 * L_2 \\ + a_3 * L_3 + a_4 * L_4 \\ + a_5 * L_5 \end{pmatrix}}{I}$$

» The wave velocity calculated in the various sections of the penstock is tabulated as follows:

Wave velocity

a ₁	752.2 m/s
a2	898.2 m/s
a3	957.7 m/s
a4	1074.6 m/s
a ₅	1124.2 m/s
avg	779.3 m/s

- » Parameter ΣLC_{max} based on Li and Di: $\Sigma LC_{max} = 9,224.34$ m/s
- » Maximum flow velocity is calculated which in case of SARBARI II is 2.39 m/s.
- » Allievis constant: A_c = 0.3685
- » Allowable reduction in flow velocity during water hammer: ∆C = 0.4775 m/s
- » Pressure rise at outlet end of tunnel:

$$P_{rt} = 1 + \frac{(\Delta Z * L * a)}{\begin{pmatrix} a_1 * L_1 + a_2 * L_2 \\ + a_3 * L_3 + a_4 * L_4 \\ + a_5 * L_5 \end{pmatrix}}$$

 $P_{rt} = 1.1754$

- » Increase in pressure at the outlet end of tunnel: $\Delta P = 33.26$ m
- » Water hammer reflection time $T_{wr} = 9.88$ s. This is also known as critical time of closure.
- » Allowable reduction in flow during water hammer: $\Delta Q = 0.90 \text{ m}^3/\text{s}.$
- » Water time inertia constant $T_w = 4.95$ s.

$$T_{c} = \frac{2 * K * T_{w}}{\Delta Z}$$
$$T_{c} = 74.25 \approx 75.0 \text{ s}$$

However, some of the parameters varies calculation criteria may vary depending on different project parameters.



RESULTS AND CONCLUSIONS

After the detailed transient analysis for the SARBARI II SHPP, the following results were derived:

- » Needle Opening and Closing Time: The setting of the closing speed of needle is of importance in order to avoid excessive pressure rise during shut down. The needle closing and opening time is set to 75 sec. which is much higher than the critical time of closure of needle/ Main inlet valve.
- » Main Inlet Valve Opening and Closing Time: The main inlet valve opening and closing time is set higher than the needle closing time of 75 s. The main inlet valve opening and closing time is set to 90 s.
- » Penstock Protection valve opening and closing time: The penstock protection valve opening and closing time is set to 110 s which is higher than the critical time of closure and selected needle closing time.
- » The actual pressure rise measured at site during field testing conducted by AHEC Roorkee is 11% which is less than the permissible pressure rise of 25%.

"OUR MISSION IN DESIGN & ENGINEERING PERFORMING SPECIALIZED ANALYSIS LIKE TRANSIENT FOR SURGE CONTROL IS TO PROTECT THE IMPORTANT INFRASTRUCTURE OF OUR CUSTOMERS."

Luciano Devinar, Chief Technology Officer – D&E, **FLOVEL Energy Private Limited**



Small hydropower has no CO₂ emissions, which would be produced from other energy sources.

which would be produced from other energy sources. This is an important contribution to the climate protection. Water is the oldest regenerative energy source and ensures climate stabilsation.

We FLOVEL that.

FLOVEL Energy Private Limited

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