LJUBISAV KRSMANOVIĆ, PH.D., PROF. EMERITUS FACULTY OF MECHANICAL ENGINEERING UNIVERSITY OF BELGRADE

Stanislav Pejović,

In the year 2003, along with the International Conference on CSHS in Belgrade, Department of Hydraulic Energy of the Faculty of Mechanical Engineer, University of Belgrade, is celebrating and honouring the 80th birthday of Professor Emeritus Dr. Ljubisav Krsmanović. This is a fitting moment as well to celebrate the 45 years long career of Professor Krsmanović.

Ljubisav Krsmanović was born in what is now Bosnia and Herzegovina (Johovica, Bihac, on January 17, 1923), where he lived until the end of the Second World War. Following the war, Prof. Krsmanović started his university education at the University of Belgrade and graduated at the Faculty of Mechanical Engineering in 1954. After a brief industrial career, he started his academic career in 1958 at the Faculty of Mechanical Engineer (Appendix 1), where he worked until his retirement in 1988.

In 1958 Prof. Ljubisav Krsmanović joined Prof. Nikola Obradović's group, which was designing a mini turbine for remote mountain villages of former Yugoslavia. His work focused in particular to the efficiency of the mini turbine, and to measure the flow field of air and water through its runner. This lead to his Ph.D. thesis defence in 1965, titled "Flow in Francis Runner at Runaway Speed". Following years Prof. Krsmanović dedicated to work on subjects related to energy generation, testing, maintenance, and optimization of hydroelectric and pumping stations as well as engineering education. Furthermore, he designed pumps, fans and ventilators. Prof. Krsmanović work was also rooted in promoting, understanding and solving problems related to rotating machines (turbo-machines), energy generators, transient analyses, and design of machines and systems.

As a mentor and professor, Dr. Ljubisav Krsmanović transferred his knowledge and experience to many generations of young engineers, leading five of them to the title of Doctor of Philosophy (Appendix 2). He wrote either as an author or co-author five books, as well as three textbooks with solved numerical problems for Mechanical Engineering students. Beside that, Prof. Ljubisav Krsmanović published fifty-one technical articles and scientific manuscripts, and consulted on forty-four projects.

Active is industrial work of Krsmanović and can be summarized as a consultant on design, construction site and model testing of large number of pumps, pump storage units, and hydro-power plants. He was also participating in simulation of several systems such as Iron Gate I (See Appendix 1. Hydroelectric Plants and Machines in Former Yugoslavia).

Along with his active research and industrial contributions to Yugoslav Hydro-industry, Dr. Krsmanović served on many administrative functions. In early nineties, he was the Vice Dean of the Faculty of Mechanical Engineering. He was also the Chair of the Faculty Counsel, the Chair of Hydraulic Energy Department, as well as the Director of Department of the Faculty of Mechanical Engineering at the University of Belgrade. In the same time he was an adjunct professor at an impressive number of other institutions including at the University of Ljubljana (Slovenia), University of Rijeka (Croatia), University of Skopje (Macedonia), University of Sarajevo (Bosnia and Herzegovina), University of Podgorica (Monte Negro), University of Banja Luka (Bosnia and Herzegovina), University of Split (Croatia) and in Serbia at the Universities of Niš and Novi Sad.

For his invaluable contribution to the research and high education in former Yugoslavia, Prof. Ljubisav Krsmanović was awarded by the Faculty of Mechanical Engineering in Belgrade, Niš and Skopje, Hydroelectric Plant "Bočac," " Perućica," and "Zvornik," as well as the Hydro-technical Institute "Jaroslav Černi." Furthermore, he was honoured with the "Red Medal for Work" by Yugoslavia. As a member of the Council of the Yugoslav Association for Theoretical and Applied Mechanics, a member of IAHR (International Association for Hydraulic Research) and German Association for Theoretical and Applied Mathematics, Professor Krsmanović was also determined to constantly improve transfer of knowledge to the professional associations.

More personally, Professor Krsmanović was an Assistant Professor and the youngest colleague when I joined the group. His knowledge, skills and patience helped me finish my Ph.D. thesis, by always responding promptly and thoughtfully to all of my questions. Beside all help on many aspects of my research and teaching, Ljubisav (Ljuba) also provided me with friendship and many pleasant moments to remember.

It is an inspiration to look over and to see the many things gifted and talented researcher can contribute to. It is a privilege and honour to be a friend and colleague of Professor Ljubisav Krsmanović.

Stanislav Pejovic, Ph.D., P.Eng.
1412 – 300 Webb Drive
Mississauga, Ontario
Canada, L5B 3W3
Tel/Fax: xx1-905-896-1253
E-mail: pejovics@asme.org
Website: http://fon.fon.bg.ac.yu/~cane

Appendix 1: Hydroelectric Plants and Machines in Former Yugoslavia

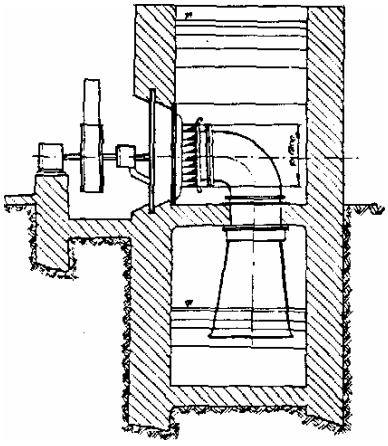
The construction of the first turbines in the countries of former Yugoslavia was designed to support the work of iron smelters. It was manufactured at Dvor, near Žeženberk (Slovenia) and was considered to be the oldest turbine developed in former Yugoslavia, made by Samassa family in the 18th centuries. After the First World War, companies in Livarne and Skofja Loka were producing Francis and Pelton turbines. At that time, the development of Kaplan turbines began in Belgrade as well by the Machine and Foundry Works - Pejić, Stefanović & Co. in Hiš.

In the eastern parts of Yugoslavia engineering progressed somewhat more slowly, but the first turbines constructed by local engineers were very successful and the Military Engineering Institute in Kragujevac, Serbia produced its first turbine in 1865 for the flow of 22 - 24 1/sec, at head of 27 m and speed of 229.3 rpm[1].

The first Kaplan turbine in Yugoslavia was constructed in 1929 at the former Institute of Technology in Belgrade and tested by Prof. Nikola Obradović, later professor at the Faculty of Mechanical Engineering in Belgrade and Krsmanović's Ph.D. mentor.

After the Second World War and nationalization of industry, the hydraulic machine production continued in the state company "Jastrebac," Nis and in August 1946, following a decision of the Ministry o Industry and Mining " Tito's Co. Litostroj" was founded in Ljubljana (September 1, 1947). In next year Federal Institute of Turbomachines, today "Turboinstitut", was founded as the part of "Litostroj". At the same time, Federal Institute of Energy "Jaroslav Cerni" for hydraulic civil engineering tests and commissioning of power plants, and Federal Electrical Engineering Institute "Nikola Tesla", Beograd were established to carry out in collaboration with the Faculties of engineering in Yugoslavia site tests and commissioning of electric plants. From 1950 to 1970 small turbines were designed, examined and constructed at the Department of the Hydraulic Machines of the Faculty of Mechanical Engineering in Belgrade. This unit was built in mini hydroelectric plants in Yugoslavia and Indonesia (Fig. 1) and it was the part of Prof. Krsmanović's Ph.D. thesis.

Figure 1. Small turbines constructed in Yugoslavia after the Second World War was the part of Prof. Krsmanović's Ph.D. thesis.



Small generators coupled with diesel motor were producing the first electrical light for illumination the small areas, first in Belgrade, 1880 and then in other towns. After 1929 an outstanding increase in electric energy production was achieved. The ideas of establishing an electro-system was presented at the Conference of the Electric Company Union of the

[1] It is interesting to note that, at the World Industry Exhibition in Paris, organized on the hundredth anniversary of the French Revolution, held from May 24 to November 24, 1889 the Serbian stand was held by the Military Engineering Institute from Kragujevac, triumphed five silver and one bronze medals. After having visited the stand, the Swiss industrial businessman Sulzer said: "This witty and precisely designed construction shows that there, far away, in Turkey, the culture is beginning to wake up".

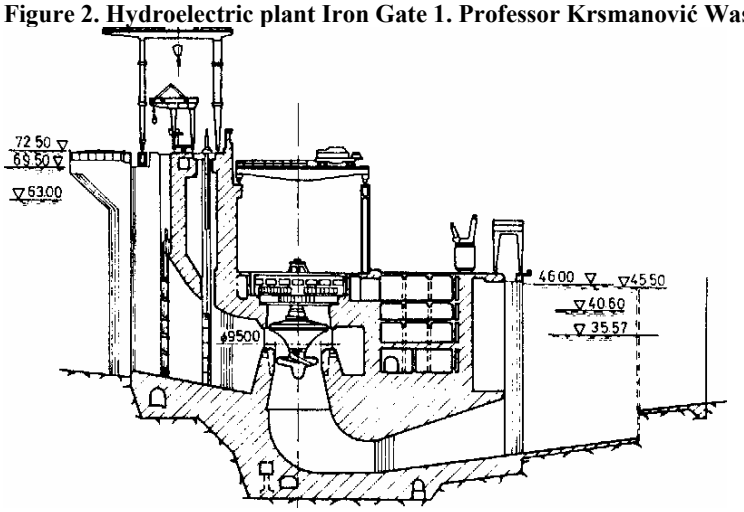
Kingdom of Yugoslavia held in 1934, and standards for an electric grid was issued in 1937, but the system was not established at that time.

After the end of the World War II, the fast growth of industry required more electrical energy. In the period from 1945 - 1955, coal fired power plants were built, whereas from 1955, hydroelectric ones were constructed as well. The total output of Yugoslav generators was increased 41 times, which corresponds to an average increase of 9% per year. At the same time the consumption was increased 101,7 times, or 11% per year. At the end of 1989 the total power of Yugoslav electric plants was 21489 MW, where 8385 MW or 39% was hydro, and 13104 MW or 61% from coal fired electric plants.

Yugoslav electrical industry built large number of the hydroelectric plants, such as:

- Hydroelectric plant "Iron Gate I" ("Djerdap I:" 12 Kaplan units, 6 on the Yugoslav, and 6 on the Romanian side of Danube, head of 27.6 m, power 194 MW, speed 71.5 rpm, flow 600 m^3/sec, runner diameter 9.5m, manufacturer LMZ, Leningrad, Russia, see Fig. 2.)

Figure 2. Hydroelectric plant Iron Gate 1. Professor Krsmanović Was Involved in Its Construction

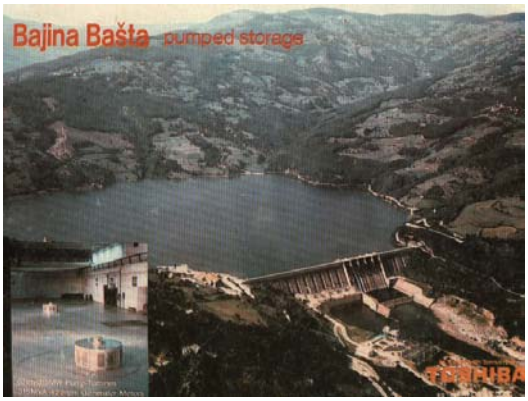


- Reversible Pumped-Storage Hydroelectric Plant "Bajina Bašta" (2 units: turbine operation 315 MW, head 600m, speed 428 rpm; pumping head 531 to 621 m, discharge 39 to 51 m^3/s, power 310 MW, manufacturer Toshiba, Tokyo, Japan, see Fig. 3).

-Other companies, which delivered component to Yugoslav Power Industry were: Andritz, ČKD, Charmille, Ganz-Mavag, Hydroart, KSB, Kvarner Eureka (Nohab, KMW), Litostroj, LMZ, Neyrpic, Sulzer-Escher Wyss, Toshiba, Vest Alpine, Voith.

This briefly describes the history of the hydro-energetic industry in Yugoslavia when Professor Krsmanović joined the profession. He, along with his students, was involved in the construction of the most of Hydroelectric Plants that still operate in the Balkan Region. He also participated in the production of hydraulic machines and ventilators in the former Yugoslavia.

Figure 3. Pumped-Storage Hydroelectric Plant "Bajina Bašta," Professor Krsmanović Was Involved in Its Construction



Appendix 2: List of Graduate Students

1. Prof. Dušan Obradović
   Ph.D. thesis: "Method of Singularity and Calculation of Blade Cascades"
   Graduated 1970

2. Metodije Mirčevski
   M.Sc. thesis: "Subsonic Flow through Compressors Cascades of Blade by the Method of Conform Mapping"
   Graduated 1974

3. Predrag Popovski
   M.Sc. thesis: "Calculation of Flow Velocity Along the Blade by the Method of Conform Mapping"
   Graduated 1974
   Ph.D. thesis: "Flow Calculation Along the Blade of Turbomachines in the Layer of Constant Thickness"
   Graduated 1976
   Currently Professor at the University of Skopje (Macedonia).

4. Dragica Milenković
   M.Sc. and Ph.D. thesis: "Unstable Flow in Turbomachines Followed up by Vortex Separation"
   Graduated 1988
   Currently Professor at the University of Niš (Serbia).

5. Božidar Bogdanović
   M.Sc. thesis: "Calculation of Velocity Distribution Along the Blades in Axial Cascade by Mapping on the Layer"
   Currently Professor at the University of Niš (Serbia)

6. Tomislav Zlatonovski
   M.Sc. thesis: "Analysis of Non-viscous 2D flow through a Radial Blade Cascade by the Method of Singularity"

Currently Professor at the University of Bitola (Macedonia)

7. Vitomir Djordjević
   M.Sc. thesis (1974) and Ph.D. thesis: "Cavitation Erosion of Composite Materials"
   Graduated 1978
   Currently Professor Emeritus at the University of Belgrade (Serbia)

8. Krsto Stevanović
   Thesis: "Cavitations Damages in Pelton Turbines"
   Graduated 1983

9. Svetislav Stojković
   Ph.D. thesis: "Characteristics of Turbo Transformers"
   Graduated 1973
   Currently professor at the University of Kragujevac (Serbia)

Appendix 3. List of books published by Professor Ljubisav Krsmanovic

- ***Books:***

1. Krsmanović Lj., Gajić A., *Turbomašine - Teorijske Osnove (Theory of turbo-machines),* Mašinski Fakultet, Beograd, ISBN 86-7083-208-9, 1992.

2. Gajić A., Krsmanović Lj., *Matematička analiza i postupci eksperimentalnih istraživanja (Mathematical Analysis and Experimental Analyses) ,* ISBN 86-7083-242-9, Mašinski Fakultet, Beograd, 1994.

3. Krsmanović Lj., Gajić A., *Turbomašine - Pumpe (Turbomachines - Pumps),* Mašinski Fakultet, Beograd, ISBN 86-7083-271-2, ID: 45507852,CIP-Nar: Bibl. Srbije, 62-135 (075.8), 1996.

4. Krsmanović Lj., Gajić A., *Turbomašine - Hidrodinamički prenosnici snage (Turbomachines - Turbo Transformers),* Universitet u Beogradu, Beograd, ISBN 86-810119-79-1, CIP-Nar. Bibl. Srbije, 621.817.032 (075.8), 1998.

5. Krsmanović Lj., Gajić A., *Turbomašine - Ventilatori (Turbomachines - Ventilators),* Mašinski Fakultet, Beograd, ISBN 86-7083-383-2, CIP-Nar. Bibl. Srbije, 621.63(075.8), 2000.

- ***Textbooks for Students and Technical Research and Development Projects***

6. Pejović S., Krsmanović Lj., Gajić A., *Povratni hidraulički udar i havarija agregata HE Zvornik (Reverse Waterhammer and ″Zvornik″ Hydroelectric Plant Accident),* Mašinski fakultet, Beograd, 1978.

7. Pejović S., Krsmanović Lj., *Problemi regulisanja hidroenergetskih agregata, predavanja prof. G.I. Krivčenka na Mašinskom Fakultetu i Titovim Zavodima "Litostroj," Ljubljana (Governing of Hydropower Plant Units: Lectures of Prof. Dr. G. I. Krivcenko at the Faculty of Mechanical Engineering and Tito's Co. "Litostroj", Ljubljana),* Mašinski Fakultet, Belgrade, 1978.

8. Gajić A., Pejović S., Krsmanović Lj., Obradović D., *Analiza nestacionarnih pojava -hidrauličkiog udara i vibracija u hidropostrojenjima (Hydraulic Transient Analysis - Waterhammer and hydraulic Vibrations in Hydroelectric Plants)*, Mašinski fakultet, Beograd, 1982.

9. Pejović S., Krsmanović Lj., Gajić A., *Merenje i analiza vibracija hidropostrojenja Measurement and Analysis of Hydraulic Plants' Vibrations),* Mašinski fakultet, Beograd, 1984.

10. Krsmanović Lj., Pejović S., Gajić A., Djonin K., Hercegovac E., Jovanović Lj., Predić Z., *Ispitivanje mašinske opreme u toku eksploatacije u cilju povećanja pogonske spremnosti postrojenja (Analysis of Mechanical Equipment in Operation to Increase Reliability of Plants),* Mašinski fakultet, Beograd, 1985.

11. Gajić A., Pejović S., Krsmanović Lj., *Turbomašine - ilustrovani i ispitni zadaci (Turbomachines - Solved Examples and Exams Questions),* Mašinski Fakultet, Beograd, 1993.