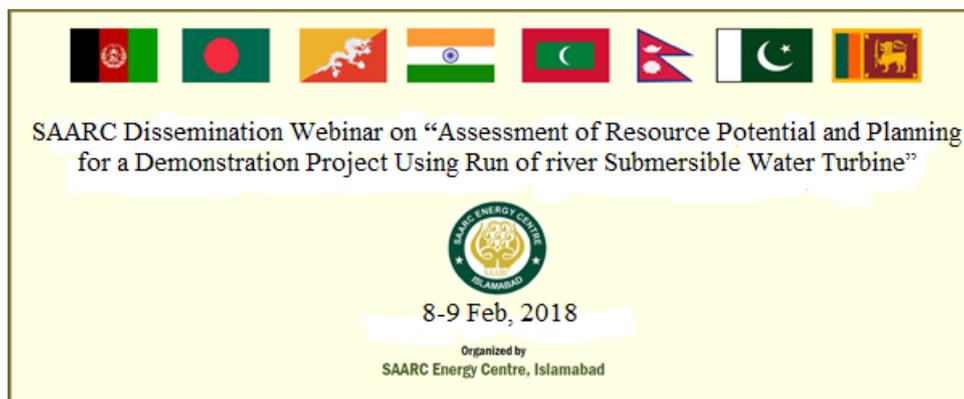


**SAARC Energy Centre,
Islamabad**

THE REPORT

**SAARC Dissemination Webinar on “Assessment of Resource Potential and Planning for a
Demonstration Project Using Run of River
Submersible Water Turbine”**



08-9 Feb, 2018

SAARC Energy Centre
697, Street 43, Sector E-11/4, NPF,
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Introduction

2. SAARC Energy Centre (SEC), Islamabad under its approved programme activity for FY 2018, successfully conducted a 2-day SAARC Dissemination Webinar on “Assessment of Resource Potential and Planning for a Demonstration Project Using Run of River Submersible Water Turbine” on 8th to 9th Feb, 2018. Webinar Agenda is available in Annexure I at Page: 10.

3. SEC, during FY 2017, had completed a comprehensive study on this subject. The study had helped to identify challenges and suggested measures/recommendations for the promotion and development of Hydro Kinetic resource potential in the SAARC Region. The aim of conducting this webinar was to disseminate the outcomes, findings and recommendations of the study report among the Member States.

Participation

4. The Webinar was attended by a total of 90 participants that included delegates from Member States, Representatives of Regional/International organizations, Academia and private sector. Participants list is available in Annexure II at Page: 14.

5. The Resource Persons from Pakistan, Italy, Germany and USA delivered detailed presentations on different aspects of Submersible Turbines and also gave short talks during knowledge sharing session of the webinar. The List of Resource Persons & SEC Team Members is available in Annexure III at Page:22.

Description

6. The webinar was conducted with an aim to disseminate the findings of the in-house research study “Assessment of Resource Potential and Planning for a Demonstration Project

Using Run of river Submersible Water Turbine”. The contents of the Webinar included detailed presentations on the Introduction of the hydrokinetic submersible turbines, various types and technologies of hydro kinetic submersible turbines, selection of site for hydrokinetic submersible turbines, assessment of resource potential of selected site, MHP best practices and productive utilization in Pakistan, application in canals using example of cooling water in thermal power plant, planning for installation of a hydrokinetic submersible turbine, commercial aspects of hydrokinetic submersible turbines, simulation studies for the installation of multiple turbines, design concepts of hydrokinetic turbines - performance in variable flows, business perspective of hydrokinetic submersible turbines in Pakistan, policy challenges in the deployment of hydrokinetic submersible turbines, knowledge sharing session, conclusions and recommendations etc.

7. The webinar started with opening remarks by Dr. Shoaib Ahmad, Acting Director, SEC, followed by three presentations which were delivered by resource persons from SEC. All the presentations were followed by a brief Q&A session. After the break, three presentations were delivered by experts from SEC, GIZ Pakistan and Smart Hydro Power Germany. On 2nd day the opening remarks were given by Mr. Ahsan Javed followed by four presentations which were delivered by resource persons from SEC, Verdant Power USA, Wind city, Italy and IST Islamabad Pakistan respectively. After the break on 2nd day, two presentations were delivered by experts from a private company and AEDB Pakistan. In the knowledge sharing session, Acting Director SEC gave answers to the questions raised by different participants of the webinar. The Programme Coordinator read out conclusions and recommendations which were gathered during the course of the webinar. Afterwards, the webinar was closed with remarks of appreciation and thanks from SAARC Energy Centre for all the participants and resource persons.

Opening Remarks

8. Dr. Shoaib Ahmad welcomed all the delegates and participants from around the globe for attending the webinar and showing keen interest. He also acknowledged the commitment and contribution of resource persons in materializing the conduct of webinar.

9. He started with brief introduction of the SEC and its annual program activities with specific emphasis on Renewable Energy (RE). He informed the participants that SEC conducts programme activities supervised by the Governing Board (GB); the GB comprises representation from all Member States of SAARC region. The programme activities of SEC includes policy based research studies, knowledge sharing events i.e., workshops, seminars, webinars, trainings, and pilot projects in all fields of Energy. He highlighted that today's

webinar was the first in current year and SEC intends to hold few more webinars on other important technical topics.

10. He further explained that the energy of flowing water has been harnessed since ages. The idea of making use of kinetic energy of water in canals and rivers is also not new. However, due to some distinct advantages and economic benefits, it is gaining fresh attention in many parts of the modern world; especially in small scale applications for provision of electricity to small households situated close to the canals and rivers.

11. He apprised the participants that the Member States in SAARC region have huge and abundant resources of hydro kinetic energy which have not been harnessed to their actual potential. He hoped that the dissemination webinar may be helpful for all the stakeholders who are working in this sector through a better understanding of key challenges faced during implementation of this technology. He remarked that this webinar is just a first step, and SEC shall in future; continue conducting such knowledge sharing events. At the end, he again thanked all the participants and resource persons for taking out time to attend the webinar.

Technical Proceedings

12. All the presentations delivered during the webinar are available at SEC's website www.saarcenergy.org. A brief information on the content of the delivered presentations is as follows:

Introduction of Hydrokinetic Submersible Turbines

13. Mr. Ihsanullah Khan Marwat, Research Fellow SEC (Energy Efficiency) gave an introduction of Hydrokinetic Submersible Turbines by differentiating them from conventional potential hydro turbines. He then presented the Theoretical global hydrokinetic potential of ocean and tidal currents as **7,800 TWh/year** and River current potential in Canada as estimated to be 15,000 MW. He also presented the two basic types of hydrokinetic turbines as axial flow and cross flow. He explained the working principal and governing equation for power output calculations. He also told the participants energy conversion efficiency and salient features of this technology.

Types & Technologies of Hydrokinetic Turbines

14. Mr. Muhammad Umar Mukhtar, Research Fellow SEC (Energy, Transport and Environment) started his presentation by broadly explaining the working principle of hydrokinetic turbine, and its similarity to a wind mill by discussing various parameters involved. In his presentation, he gave details of various types of hydrokinetic turbines, technology involved and important parameters in each case accordingly. He presented a chart showing classification of hydrokinetic turbines proposed by T. J. Hall.

Selection of site for hydrokinetic submersible turbines

15. Dr. M. Nawaz Akhtar, Programme Leader SEC (Technology Transfer) shared his knowledge with the participants of the webinar about the selection of site for hydrokinetic submersible turbines. Initially he discussed the requirement and strategy about the exploration and consideration of the potential sites. Then he presented the criteria for the selection of a site, comparison of three potential sites, result of the selection and description of the selected site regarding the research study he conducted.

Assessment of resource potential of selected site

16. Dr. M. Nawaz Akhtar started his presentation by defining three types of resource potentials as theoretical potential, technical potential and economical potential. Then he presented the calculations carried out for all of the above-mentioned 3 types of potentials.

17. He mentioned that the upper Jehlum canal carries a theoretical resource potential of 44.66 MW, and a technical potential of 13.37 MW but due to low water flowing velocity in the main canal, this model turbine (5 KW made by Smart Hydropower Germany) may not be feasible. However, this turbine can be installed under the Head Regulator Bridges but not on the siphons and the main canal. Hence, to harness 13.37 MW of electrical potential any other turbine which may be more efficient at low water flow velocity like 1.12 m/sec available in the main Upper Jehlum Canal can be employed.

18. He pointed out that by using the available model turbine made by Smart hydro Power Germany, under the 4 Head Regulator Bridges of this canal 0.6 MW electrical power can be harnessed with an annual profit of PKRs. 46.75 M and a payback period of 7.2 years having an EIRR =15.86 %.

MHP Best practices and Productive utilization in Pakistan

19. Mr. Asif Farid from GIZ Pakistan presented best practices and productive utilization of micro hydro power plants all over the world. He pointed out that 3000 MW of potential exists in Pakistan out of which 860 projects have been installed and 600 projects are in the pipeline. He mentioned that funding agencies for these projects include EU, WB, CDM, PPAF, ADB and PEDO etc. He also discussed different types of turbines being employed for community based projects in northern areas of Pakistan. Moreover, he presented load curves for a 200 Kw MHP community-based power plant, showing low demand in summer and high demand in winters.

Application in canals using example of cooling water in thermal power plant

20. Dr. Karl Kolmsee, CEO Smart Hydropower told the Webinar participants that their company designs, builds and commercializes hydro kinetic turbines. He presented the application of submersible hydrokinetic turbines in canals using example of cooling water

canal in thermal power plants like coal power plants. He discussed the case study of a coal power plant where 4 turbines of 5 KW capacities each, were installed in an array to produce 20 KW electrical power. The plant was grid synchronized with plant load factor above 70%. These turbines were equipped with smart power evacuation with automatic braking system eliminating operational fatigue. He also shared the key features of these turbines with the participants.

Day 2 opening remarks and agenda recap

21. Mr. Ahsan Javed started the 2nd day session with his opening remarks and introduction of the speakers with agenda recap for the 2nd day of Dissemination Seminar.

Planning for installation of a hydrokinetic submersible turbine

22. Dr. Nawaz Akhtar presented his planning for the Installation of a 5 KW Submersible Turbine on the selected site at Jaggu Water Level Crossing Head Works Upper Jehlum Canal. He shared his planning strategy with the webinar participants regarding General Planning, Planning for Procurement, Planning for Transportation of the turbine, Planning for Installation and commissioning (including standard reliability test), Planning for performance monitoring and operational life, planning for Consensus Building among Stakeholders, Planning for provision of electricity to users etc. He also shared the Gantt chart made for the above-mentioned activities and respective documents for the 72 hour reliability test run acceptance formalities with the webinar participants.

Commercial Aspects of Hydrokinetic Submersible Turbines

23. Mr. Trey Taylor from Verdant Power USA could not participate in the webinar due to odd time difference between Pakistan and USA but he shared his interview in which he briefly shared the history of development of hydrokinetic turbines in Verdant Power for a prototype 3 bladed up front nose cone turbine similar to wind turbine. They experienced the breakage of turbine blades and other issues and explained that how to space the turbines for water current regain etc. It took 6 years, starting from 2002, and they went through regulatory process to get the first commercial license for a single turbine to be installed in East River. After successful operation of this project they installed another project comprising an array of 6 turbines. He pointed out that generally these turbines are 30-40% efficient. He also told that a hydrokinetic potential of 63000 MW exists in USA.

Simulation studies for the installation of multiple turbines

24. Mr. Asim Shahzad a Faculty Member (Aero Space) from Institute of Space Technology Islamabad started his presentation by discussing challenges and risks involved in the

installation of multiple turbines in a canal. Then he presented his CAD modeling for pressure and velocity profiles in the canal. He mentioned that the simulation study, which predicted a minimum distance of 20 M between two adjacent rows, is good enough. He also discussed the variable flows of water and various cycles of speed in various flows compared to regular flows, pitch degrees for varying speeds, high pitch degrees for lower speeds of flow, inertia difference in pulsating flows, integrated pitch and inertia, variable geometry turbine concepts and efficiency of hydro kinetic turbines etc.

Design concepts of Hydrokinetic turbines - Performance in variable flows

25. Mr. Tommaso Morbiato presented explanations for the various design concepts including adopted from design concepts for wind turbines by discussing the effect of different parameters on the performance of variable flows for the hydrokinetic turbines. He discussed different issues of such turbines installed in river flows like energy balance of the system, design speed decrease, tangential stress perturbation at shores and embankment durability etc.

Business Perspective of hydrokinetic submersible turbines in Pakistan

26. Mr. Malik Nadeem Awan, a private entrepreneur presented his talk on Business Perspective of hydrokinetic submersible turbines in Pakistan. He started his presentation with the discussion on energy situation by mentioning required energy share by house hold, industrial, agriculture, commercial, government and street lights sectors etc. Then he discussed the available energy sources in Pakistan and measures to meet the shortfall. He also mentioned that the potential small hydropower projects in India are capable of generating 15000 MW out of which 611 projects are operational producing 2045 MW while 225 projects are under construction which may produce 669 MW.

27. Lastly, he discussed the 5 KW Submersible turbine made by Smart Hydropower Germany, its utilization potential and important parameters. He also suggested possible workable projects in Ghazi Brotha canal.

Policy Challenges in the deployment of hydrokinetic submersible turbines

28. Mr. Irfan Yousaf from Alternative Energy Development Board presented Policy Challenges in the deployment of hydrokinetic submersible turbines. He mentioned that small hydro power potential of 3268 MW exists in Pakistan. He also disclosed that in 2006, in consultation with provincial governments Pakistan Renewable Energy Policy was announced. Accordingly all hydro power plants up to 50 MW come under this policy. Moreover, he shared the tariff incentives and power purchase made mandatory for the distribution companies.

Knowledge sharing session

29. The participants of the webinar provided their feedback on the quality and content of the event. Generally, they pointed it out as a very useful and timely intervention by SEC.

Conclusions and Recommendations

30. Mr. Ahsan Javed, Research Fellow (RE) read out the recommendations which were gathered during the course of the webinar and from the outcome of the previously conducted study report. They are as follows:

31. Recommendations from Participants

Following recommendations were given by the participants;

- I. A comparison of available types of hydro kinetic turbines for different aspects like, efficiency, required velocity of water flow, ease of installation and price/KW etc. is highly required for adopting this technology which requires appropriate funding and GIZ Pakistan may be requested to fund this project accordingly.
- II. Relevant Government institutes should include this technology in their list of RETs.
- III. Further investigation on deployment of this technology to be carried out.
- IV. Relevant Government Institutes should make arrangements for assessment of resource potential in respective member states.
- V. Relevant Government institutes may start awareness campaign for the introduction of this technology in their respective countries.
- VI. Because of relatively low cost and durability of hydrokinetic turbines, SAARC Member States having hydrokinetic potential may adopt the technology to supply the needed electricity to small communities and villages.

Closing of Webinar

32. Mr. Ahsan Javed, Research Fellow (RE) informed all the participants that the presentations will be available on SAARC Energy Centre's website (www.saarcenergy.org). He requested the participants to submit suggestions and comments to SEC for any further improvement, plus they may suggest and submit any topics of their interest to SEC for arranging future webinars. He closed the webinar with a thank you note to everyone for attending the Webinar.

**Study to Assess Resource Potential and Planning for a Demonstration Project
Using Hydrokinetic Submersible Turbine**

Time	Activity	Speaker	Emails
DAY 1 (1000-1400 hrs)			
1000-1005 hrs	Introduction of webinar team and panel of experts	Mr. Ahsan Javed, SEC	ahsan@saarcenergy.org
1005-1015 hrs	Opening remarks	Dr. Shoaib Ahmad, SEC	ddcoord@saarcenergy.org
1015-1030 hrs	Introduction of the hydrokinetic submersible turbines	Mr. Ihsan Ullah, SEC	rfee@saarcenergy.org
1030-1035 hrs	Q&A		
1035-1055 hrs	Various types and technologies of hydrokinetic submersible turbines	Mr. M. Umar Mukhtar, SEC	rfete@saarcenergy.org
1055-1100 hrs	Q&A		
1100-1120 hrs	Selection of site for hydrokinetic submersible turbines	Dr. M. Nawaz Akhtar, SEC	pltt@saarcenergy.org
1120-1125 hrs	Q&A		
1125-1200 hrs	Break		
1200-1235 hrs	Assessment of resource potential of selected site	Dr. M. Nawaz Akhtar, SEC	pltt@saarcenergy.org
1235-1240 hrs	Q&A		
1240-1300 hrs	MHP Best practices and Productive utilization in Pakistan	Asif Farid, GIZ	asif.farid@giz.de
1300-1305 hrs	Q&A		

**Study to Assess Resource Potential and Planning for a Demonstration Project
Using Hydrokinetic Submersible Turbine**

Time	Activity	Speaker	Emails
DAY 1 (1000-1400 hrs)			
1305-1335 hrs	Application in canals using example of cooling water in thermal power plant	Dr. Karl Kolmsee, Smart Hydro	karl.kolmsee@smart-hydro.de
1335-1345 hrs	Q&A		
1345-1355 hrs	Day 1 closing remarks	Mr. Ahsan Javed, SEC	ahsan@saarcenergy.org
DAY 2 (0900-1300 hrs)			
0900-0910 hrs	Day 2 opening remarks and agenda recap	Mr. Ahsan Javed, SEC	ahsan@saarcenergy.org
0910-0945 hrs	Planning for installation of a hydrokinetic submersible turbine	Dr. M. Nawaz Akhtar, SEC	pltt@saarcenergy.org
0945-0950 hrs	Q&A		
0950-1000 hrs	Commercial aspects of hydrokinetic submersible turbines	Mr. Trey Taylor, Verdant USA	ttaylor@verdantpower.com
1000-1035 hrs	Simulation studies for the installation of multiple turbines	Mr. Asim Shahzad, IST (TBC)	tariqasim@yahoo.com
1035-1040 hrs	Q&A		
1040-1100 hrs	Design concepts of Hydrokinetic turbines - Performance in variable flows	Tommaso Morbiato, Windcity	tmorbiato@windcity.it
1100-1105 hrs	Q&A		
1105-1130 hrs	BREAK		

**Study to Assess Resource Potential and Planning for a Demonstration Project
Using Hydrokinetic Submersible Turbine**

Time	Activity	Speaker	Emails
DAY 2 (1000-1400 hrs)			
1130-1150 hrs	Business Perspective of hydrokinetic submersible turbines in Pakistan	Mr. Malik Nadeem Awan (TBC)	alawangtc@gmail.com
1150-1155 hrs	Q&A		
1155-1220 hrs	Policy Challenges in the deployment of hydrokinetic submersible turbines	Mr. Irfan Yusuf, AEDB	irfan.yousuf@yahoo.com
1220-1225 hrs	Q&A		
1225-1245 hrs	Knowledge sharing session		
1245-1300 hrs	Conclusions, Recommendations and Closing of webinar	Mr. Ahsan Javed, SEC	ahsan@saarcenergy.org

Information for the participants:

- All times mentioned in agenda are according to Pakistan Standard Time (PKT). The participants from other Member States may attend Webinar by following their own national time. The time conversion for all Member States is given below for reference:

Country	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Sri Lanka
Local time	(PKT-00:30)	(PKT+01:00)	(PKT+01:00)	(PKT+00:30)	PKT	(PKT+00:45)	(PKT+00:30)

2. The participants can ask questions to presenters by typing questions or clicking to the raised hand option into the Attendees pane of the main window of GotoWebinar software. You may send in your questions at any time during the presentations; we will collect these and address them during the Q&A session at the end of each presentation.
3. All participants can also submit comments/views and/or observations on the draft study report to SAARC Energy Centre through email to Mr. Ahsan Javed, Research Fellow (RE) (ahsan@saarcenergy.org) before 28th Feb, 2018.

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