Asian interests

IWP&DC spoke to **Brian Selby** of GE and **Ajay Sharma** of Entura to talk about their involvement in projects across Asia

IWP&DC: Please give details of hydropower and dam projects your company has worked on across Asia in recent years.

BRIAN SELBY: I personally joined GE's hydropower business about four months ago but the company has been active in the Asia Pacific region stretching back some 90 years. Since then, we have supported customers in every Asia Pacific country ranging from small run-of-river installations to the largest hydropower plant in the world (Three Gorges in China). One of our main Manufacturing & Engineering Centres of Excellence (COE) is based in Tianjin, China. It concentrates our best talents and skills and provides our customers in the region but also worldwide with competitive and highly-efficient solutions. Our teams in Tianjin have already delivered 60 projects and have over 10 projects currently under execution. The site hosts some of our latest advanced manufacturing and digitisation applications (e.g. digital welding, 3D measuring technologies, as well as state of the art R&D facilities such as our Hydro R&D test laboratory.

We provide a cradle-to-grave approach to our hydro technology platform, ensuring customers that their hydropower plant assets meet or exceed their performance with the highest efficiency and lowest cost possible. We constantly look for ways to improve our product designs, to increase efficiencies and lower operating costs through a combination of material selection, design improvements, manufacturing innovation and recently embedding digital monitoring and predicative "Digital Twin" capabilities.

AJAY SHARMA: Entura has worked on numerous hydropower projects in Asia. The following are just a few of the significant ones we have worked on.

- ***Chanju-I in India:*** This is a very special project for Entura as we have been involved with it since its inception. Entura was involved in the full lifecycle from concept, feasibility, tender, design, project management and commissioning. We provided technical expertise in optimising design and construction, costing, contract packaging, selecting equipment, scheduling and project management. The 36MW run-of-river hydropower project in Chamba, Himachal Pradesh, was commissioned in 2016 and is successfully operating. The project involved construction of a 16m high barrage, a 4.1 km head race tunnel, two underground desilting chambers, underground pressure tunnels, pressure shafts and a surface powerhouse.

  We are very proud to have supported the successful entry of a private sector player in India's hydropower market. Our hydropower experience and skills enabled our client to overcome challenges throughout different phases of the project including approval delays, environmental issues, stakeholder management, and disagreements with upstream developers with respect to the barrage location and height, river basin development plans and infrastructural development. Entura's continuous involvement, timely advice and support during critical situations helped the project team stay on top of these challenges, and move the project forward at all times, even enabling early commencement of construction.
- ***Nagmati dam in Nepal:*** We were the lead consultant for the feasibility and detailed design for the Nagmati Dam on the Bagmati River in Nepal as part of the Bagmati River Basin Improvement Project with funding from the Asian Development Bank. The 95m high and 550m long concrete-faced rockfill dam stores water during the monsoon period for environmental release during the dry season, improving water quality, water security and amenity for the city of Kathmandu as well as increasing resilience to potential climate change impacts (such as water-induced disasters) in the middle and lower reaches of the basin.

  Entura overcame a range of challenges to deliver a successful outcome, including the restrictions associated with the location of the site in a national park, presence of a significant downstream population, and a high seismic environment. The development of a small hydropower station provides an ongoing revenue stream to ensure that funds are generated for the operation and maintenance of the overall dam project, thus ensuring its sustainability.
- ***Laos Electric Power and Technical Standard (dam safety guidelines):*** In 2018 Entura completed and presented a set of eight dam safety guidelines, developed for the World Bank and Government of Laos to increase the safety of Laos's existing and future dams. The guidelines relate to aspects such as geology and geotechnical investigations; quality during construction and commissioning; ongoing safety surveillance; management and governance; training of personnel; and how to prepare and implement an Emergency Action Plan to deal with disasters. Entura's recommendations and standards to increase the safety of Laos's existing and future dams were fully accepted and the work was commended by the World Bank and Government of Laos. See
- ***Baleh hydropower project, Sarawak in Malaysia:*** Entura has had a successful working relationship with Sarawak Energy Berhad (SEB) over many years, supporting its capacity and capability development goals through the Entura Clean Energy and Water Institute, as well as working directly on a number of hydropower projects. We have recently been appointed to undertake the independent review of the major 1285MW Baleh hydropower project in Sarawak. Rather than engage a number of separate individuals for a panel, SEB selected Entura to undertake the independent review panel role. The project, which includes a 188m high concrete-faced rockfill dam, and a gated chute spillway, is estimated to take approximately eight years to design, construct and commission once the contracts have been awarded.
- ***Nikachhu hydropower project in Bhutan:*** This 118MW run-of-river hydropower project is being constructed on the Nikachhu River, a right bank tributary of Mangdechhu River, in the Trongsa Dzonkhag in central region of the Royal Kingdom of Bhutan. The key project components include a 38m high concrete gravity dam with gated spillways, power intake to draw a design discharge of 32.2m³/sec, feeder tunnel, underground desilting chambers, headrace tunnel, surge shaft, pressure shaft and underground powerhouse with two 59MW Pelton turbines.

  Entura's role, which began in 2015, includes project due diligence; advice to the lender on all technical matters to protect the lender's interest; intermittent quarterly project reviews during the construction period to assess the progress of construction including costs, schedule and lender's risk; and assistance in commissioning.

Left: **Brian Selby is the Association of Southeast Asian Nations (ASEAN) Region Sales Executive for GE's Hydro Solutions**

Right: **Ajay Sharma is Entura's Director for International Business**

Did you experience any specific successes or obstacles which had to be overcome?

BRIAN SELBY: Hydropower projects are complex, multi-year construction developments that require detailed planning and execution to ensure all impacts to the surrounding environment, people and even government energy policy are recognised and appropriately addressed. GE Renewable Energy uses its years of development and execution experience to support our project customers to understand and resolve these issues in a fair and balanced manner ensuring each project meets our customers objectives.

Do you have more projects in the pipeline for the future?

BRIAN SELBY: The hydropower industry in the Asia Pacific remains very strong with customers focused on three areas – hydropower storage (for grid firming and fast power outcomes); small, distributed run-of-river hydropower plants; and modernisation of existing plants (asset life extension, higher efficiencies, etc.)

AJAY SHARMA: The international market is very important for our business, and we look forward to continuing our involvement in hydropower and integrated renewables projects throughout South Asia and Southeast Asia. These regions will also continue to need capability development to support future energy generation and successful operation of existing assets, and the Entura Clean Energy and Water Institute will continue to offer flexible, relevant services to help meet these needs.

As more nations turn to pumped hydro energy storage projects to firm and support weather-dependent renewables such as wind and solar developments, we expect that there will be future opportunities to share the insights and skills that we are developing in Tasmania through our involvement in the 'Battery of the Nation' initiative, and the work we are involved in with the Kidston pumped hydro energy storage plus solar project in Queensland.

Are there still plenty of opportunities for hydropower development across Asia?

BRIAN SELBY: The most exciting development for hydropower is the inclusion of hydropower storage as part of the answer to the rapid adoption of renewable energy into the region's energy generation mix. Intermittent renewable energy – wind, solar – does impact grid performance and reliability and hydropower storage helps reduce this impact by providing – on a large scale when required – renewable, extremely cost effective, highly efficient and reactive firming power.

China has for example planned to add 60GW of hydro storage by 2020 in the 13th Five Year Plan. It already has highly efficient assets such as the Hohhot power plant, designed to complement wind farm production while providing the grid with power for peak demand, supplemental power for periods of reduced production, and energy storage for emergency power standby and frequency regulation. GE Renewable Energy designed the pump turbines and motor generators of Hohhot.

AJAY SHARMA: All over Asia, it is recognised that electricity is a vital tool to improve quality of life and alleviate poverty for growing populations as well as to build developing economies. Nations across Asia are also setting more ambitious clean energy targets in line with global movements. So that means there's a growing need for renewable energy, whether in the form of hydropower or wind or solar or in combinations of renewables and storage.

Wherever wind and solar are booming (such as in India), hydropower still has a huge role in providing the necessary storage to firm weather-dependent renewables and support grids as they integrate increasing levels of intermittent renewable technologies. Pumped storage hydropower may be particularly useful in this context.

This is a global shift in the way hydropower has been viewed. Whereas hydropower was traditionally viewed as a stand-alone, established renewable technology providing both baseload and peaking capacity, now we're seeing a much greater sense of integration with other renewable technologies as part of broader 'clean energy' systems.

Another worldwide trend is the ongoing shift towards development of small to medium hydropower systems in areas where many of the larger opportunities have already been exploited. For example, in China, many of the large hydropower schemes (10,000MW, plus) have already been identified or developed, so new hydro developments are more likely to fall within the small to medium range, with the added advantage of shorter construction and implementation times.

With favourable topography and water resources, large populations, high growth in energy demand and gaps in existing infrastructure (e.g. transmission lines, substations) and generation capacity, we see significant potential for further hydropower development in South Asia and Southeast Asia. For example, estimates suggest that less than a third of India's potential for hydropower has been developed to date, and there's still plenty of opportunity, particularly in the rugged north and north-west of the country – and that presents an opportunity for organisations seeking to embrace renewable developments as part of their commitment to sustainable social and industrial development, quality of life, and a clean energy future.

In your experience, are there specific factors, such as politics, financing, climate and culture, which can hinder such development in this region?

BRIAN SELBY: All of these issues are important and must be appropriately considered when planning and implementing a hydropower plant. Active engagement with all stakeholders is key to any project success and this is especially true for a hydropower plant which has an expected asset generation life longer than 50 years.

AJAY SHARMA: Hydropower developments in Asia, like all power developments anywhere in the world, involve challenges: land acquisition, resettlement, environmental issues, rehabilitation, geology, technical challenges in dam and scheme design and construction, financing, approvals and so on. These challenges can be considerable, but can also be overcome with the right expertise on hand.

- ***Training and capacity building:*** We've learned that viable opportunities, enthusiasm, government incentives and subsidies and policy certainty are important factors in the success of new renewable developments, but another critical factor is reliable expertise, which may be less available to proponents of hydropower projects if they are new to the hydropower sector. This presents an opportunity for international consultants particularly in the area of training and capacity building. Leading utilities around the world are increasingly recognising the need to invest in the development of their people as well as their systems and processes to help ensure implementation of sound business strategy. Building local capacity and skills for

Above: **Chanju-I hydropower station in India – Entura has been involved since its inception**

Above: **Nagmati Dam in Kathmandu – Entura overcame a range of challenges to deliver a successful outcome**

j operation and maintenance of power and water assets over the longer term is a critical component of ensuring the long-term success and sustainability of new developments and the safe management of older assets. Through the Entura institute we've been delivering training across Asia for the last ten years, including extensive hydropower and dam safety training programs in India, Bhutan, Bangladesh, Malaysia, Laos, Cambodia and more. The Entura Clean Energy and Waterlinstitute collaborates with the Asian Institute of Technology in Bangkok and Universiti Tenaga Nasional in Kuala Lumpur.

- ***Sustainable, basin-wide development planning:*** Another challenge we've noted in Asia, though this is not unique to the region, is the need for comprehensive and systematic basin-wide approaches to development. Project-by-project approaches rarely fully consider power-system-wide implications of new projects on generation capacity or water quality, the potential cumulative effect or increase in severity of social or environmental impacts, or long-term planning concerns at the basin level such as climate change and changed hydrological patterns. River-basin-wide planning, instituted and supported at the national level, can optimise economic, engineering, environmental and social outcomes. In India, we've carried out basin-wide optimisation studies in Uttarkhand, Himachal Pradesh and Meghalaya. Entura has also supported the sustainable development of the Mekong region through sustainability assessment and participation in regional forums.
- ***Dam safety, flood management and emergency planning:*** The need for ongoing attention to dam safety, flood management and emergency planning are by no means unique to Asia; however, the 2018 failure of the Xepian Xe Namnoy dam in Laos and floods experienced in Kerala, India have focused attention on strengthening dam safety, flood management and emergency planning in these nations. We are actively participating in dam safety initiatives for the Central Water Commission in India, and we were involved in drafting a set of new dam safety guidelines for Laos in 2018. These related to aspects such as geology and geotechnical investigations; quality during construction and commissioning; ongoing safety surveillance; management and governance; training of personnel; and how to prepare and implement an Emergency Action Plan to deal with disasters.

IWP&DC: Have you learned any lessons from hydro development in other areas of the world which can be applied in Asia?

BRIAN SELBY: Hydropower is an equal and complementary partner in the renewable generation space. It provides long term, affordable power either from a large generation plant or more frequently as a distributed, smaller output operation. It is a technology platform that blends easily into a comprehensive energy generation portfolio mix and hosts incremental generation opportunities – floating solar for example – that is cost effective and responsive to the needs of a region.

Incorporating digital into the running of hydropower plants is creating new opportunities for higher efficiencies and lower operating costs for customers. Harnessing the power of the data created every second by a hydropower plant – detecting, analysing and predicting – provides huge opportunities for even better performance and outcomes for our customers.

AJAY SHARMA: Our extensive asset-owner expertise in hydropower development, operation and maintenance, gained through our long-term involvement with Tasmania's hydropower system, forms the foundation of the expertise and insight we bring to our international consulting work. We've identified six key considerations for successful hydropower development – and these principles are just as relevant wherever the development occurs.

1. What is the resource, and how might it change? It is essential to properly investigate the long-term history and variability of an area's water resource, and to factor in the potential for changing climate impacts.
2. How stable is the proposed location? Thorough, specialised investigation of the proposed site's topology, geology and seismic risk is crucial, and can greatly impact cost, financing and viability.
3. How much power do you need now and will that change in future? It is important to consider industrial demand, as well as the rate of population increase and the increasing demand for power due to changing technology and lifestyle expectations.
4. Can you get the power to where it is needed? A key consideration for a successful hydropower development is the ability to deliver the power to where it is needed through existing, upgraded or new transmission and distribution infrastructure.
5. What social and environmental impacts are possible? From the earliest thoughts and discussions about a new hydropower development, it is critical to consider the project's stakeholders, community and environment.
6. Can you obtain finance? No hydropower project will succeed without available, secure project financing, and lenders around the world are increasingly cautious and will require evidence of best-practice and sustainability to release project funds. Using a framework such as the Hydropower Sustainability Assessment Protocol offers investors greater confidence that their investment is safe and that risks have been fully considered. ●