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Better power system control means a more secure grid: Piloting AGC at hydro plants

Renewable energy (RE) generation in India has been on a steady rise. Ensuring the power system's reliability in the face of increased RE penetration is critical. The fluctuating nature of energy from renewables requires power balancing in real time to keep supply and demand in sync. Automatic generation control (AGC) — a major control function for adjusting the power output in response to changes in load — is an essential tool for providing secondary reserve support.

India's Central Electricity Regulatory Commission (CERC) outlined a roadmap in October 2015 for implementing reserves in a phased manner; it noted AGC implementation for secondary control as a key requirement. Subsequently, the National Load Despatch Centre (NLDC) and Power System Operation Corporation Limited (POSOCO) stated the need for AGC pilots across India's grid regions (covering all forms of generation — thermal, hydro, and RE) before regulations and procedures for a nationwide launch could be framed. The National Thermal Power Corporation Ltd (NTPC) implemented India's first AGC pilot at its Dadri thermal power plant. However, AGC enablement for hydro and renewables remained untested. USAID's Greening the Grid-Renewable Integration and Sustainable Energy (GTG-RISE) initiative addressed this gap by piloting AGC at two hydro plants in India's Southern region.

> ***"The AGC pilot at KPCL's hydro plant will showcase pathways to implement AGC and will give us critical data to inform rollout at the national level. I thank USAID for their partnership in taking forward these important pilots under its GTG-RISE initiative."***
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> **Mritunjay Kumar Narayan**
> Joint Secretary (Transmission), Ministry of Power, Govt of India

AN EVIDENCE-BASED APPROACH TO ENABLE SECONDARY RESERVES FOR HYDRO PLANTS

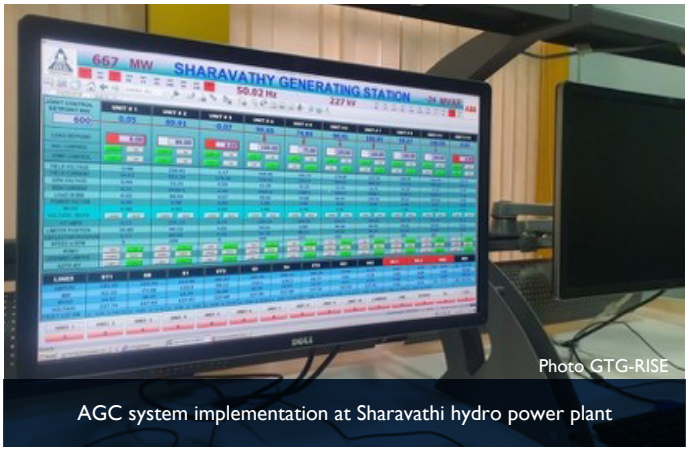
USAID through GTG-RISE has conducted a series of pilots and demonstrations to support India's Ministry of Power (MoP) in adopting innovative, evidence-based solutions to address emerging energy-sector needs. The AGC pilot at hydro plants, implemented in consultation with NLDC and POSOCO, was part of this effort.

GTG-RISE conducted a four-year (2017–2020) pilot to identify and implement the technical interventions and operational changes needed to implement secondary reserves (AGC) at hydro power plants and at the State Load Despatch Center (SLDC). The pilot was implemented at two power plants in Karnataka: Sharavathi hydro power plant (10x103.5 MW = 1,035 MW) and Varahi hydro power plant (4x115 MW = 460 MW), along with AGC enhancements at Karnataka SLDC and development of a framework for compensation to enable AGC support. The pilot was implemented in close collaboration with Karnataka Power Corporation Limited (KPCL) and Karnataka Power Transmission Corporation Limited (KPTCL). A high-profile virtual event on December 8, 2020, marked the go-live launch of AGC at the two Karnataka hydro plants. Senior officials from the MoP, USAID, POSOCO, KPCL, KPTCL, , SLDC, and system integrators attended the event.

The Greening the Grid-Renewable Integration Sustainable Energy (GTG-RISE) program, a joint initiative by USAID and India's Ministry of Power, has been testing solutions to enable large-scale RE integration in the national grid. GTG-RISE has implemented a series of prioritized innovation pilots to bolster national and regional power systems' ability to stay resilient while integrating RE. GTG-RISE is a key initiative under USAID's Asia Enhancing Growth and Development through Energy (EDGE) and is implemented by Deloitte Consulting LLP.

The AGC pilot is a dream come true for all system operators. Integration of renewables is going to become more complex, and Karnataka is leading from the front by demonstrating the use of AGC in its hydro power plant. I congratulate everyone associated with this pilot.

K.V.S. Baba
Chairman and MD, POSOCO



AGC system implementation at Sharavathi hydro power plant

Detailed technical feasibility studies were carried out at the two pilot sites to assess units' preparedness, including the hardware and software interventions needed for AGC enablement and their cost implications. The hardware and software interventions were carried out, followed by test runs, capacity building, and technical outcomes. Data from the pilot's test runs was analyzed to arrive at comprehensive recommendations about AGC's technical benefits for grid operation and the compensation mechanism for participating hydro units.

IMPROVING GRID MANAGEMENT THROUGH AGC

After the AGC implementation, the system was tested for hydro units' responses for AGC signals sent from the Karnataka SLDC in nearly real time. The units with AGC increased their generation when the Karnataka state grid needed to import power and decreased generation when the state was exporting power. The AGC module at the SLDC was able to generate AGC signals in response to tie-line power flows and frequency response.

AGC response from the hydro units successfully compensated for variable RE up to 100 MW from Sharavathi and up to 36 MW from Varahi, demonstrating how secondary reserves enabled through AGC facilitate smooth grid operation in the face of RE variation. The secondary reserves from AGC also helped the system operator to minimize the deviation settlement mechanism (DSM) charges linked with frequency. The reduction in DSM charges will help to avoid penalties to be paid to central pool and minimises cost to distribution companies. The saving on DSM charges can passed to reduction in tariff for consumers.

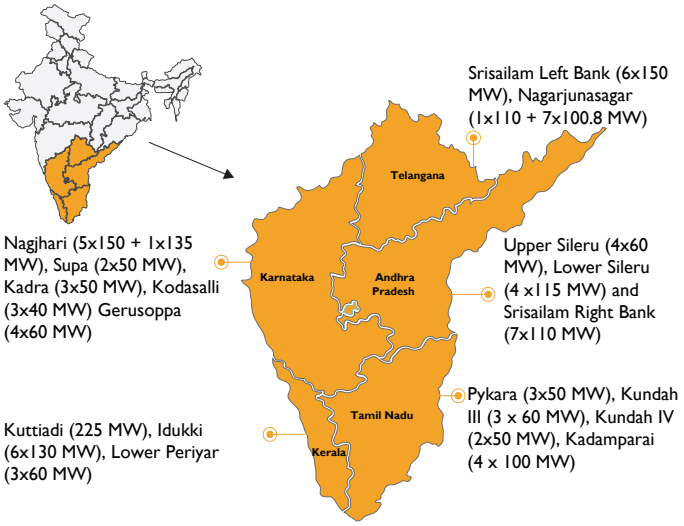
The pilot also built the capacity of key plant personnel for AGC operations; more than 100 engineers were trained through operator trainings and knowledge dissemination workshops.

BOLSTERING CONFIDENCE AHEAD OF A NATIONAL ROLLOUT

The AGC pilot has generated evidence to inform the development and implementation of a long-term ancillary services roadmap for the county and boost integration of renewables. Its comprehensive set of recommendations can be the building blocks for a nationwide rollout of AGC at hydro power plants. Besides supporting KPCL to enable AGC, the pilot's results and recommendations have been well received by POSOCO and the State Electricity Regulatory Commission (SERC). The Southern Regional Power Committee (SRPC) has recommended that all hydro units in the Southern region follow the GTG-RISE pilot for similar implementations at all hydro units in the region.

GTG-RISE had also conducted a techno-economic analysis of the incremental costs accrued due to an AGC-enabled fast response by hydro units. The analysis would support regulatory framework guidelines for a compensation mechanism for secondary reserves (AGC). To this end, a report on technical outcomes and regulatory framework guidelines has been submitted to state and central regulators to help build their understanding of AGC's technical benefits and compensation for secondary reserves.

AGC can be enabled at most hydro units in India by defining the proper compensation for AGC participation under the secondary reserve markets. The potential is big: India's hydro generation stands at around 46,000 MW. Southern India represents a huge opportunity, with a number of hydro units where AGC can be implemented, including Andhra Pradesh, Telangana, Karnataka, Kerala and Tamil Nadu.



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