Special Report

Low Water Levels in Nurek Hydroelectric Reservoir and Spring Electricity Rationing in Tajikistan

March, 2011

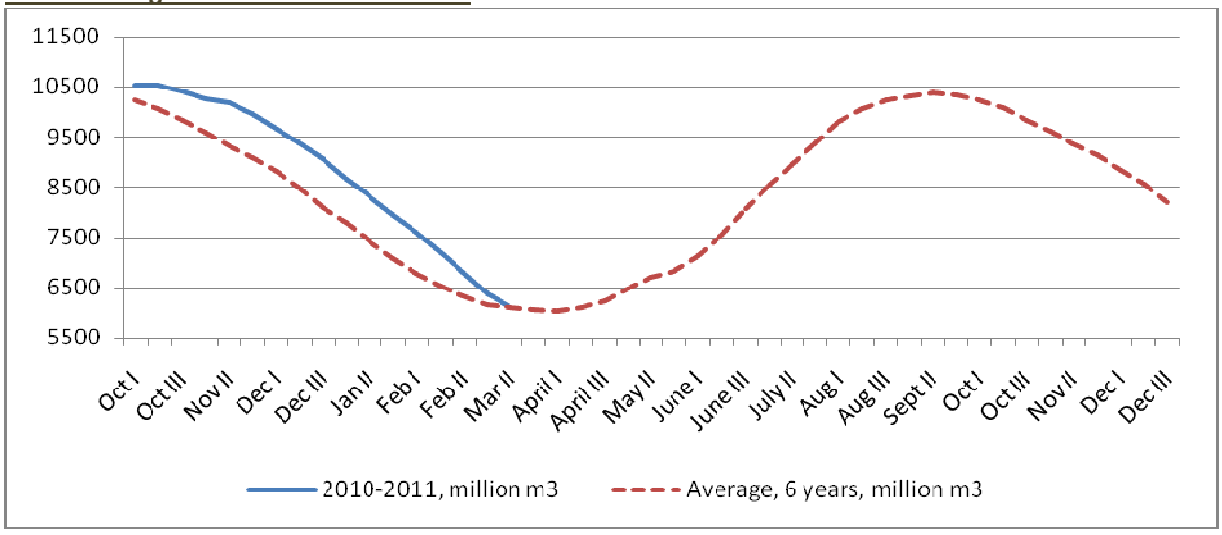
About this Report

Media reports on 24/03/2011 indicated that the level of Nurek Hydroelectric Power Station (HEPS) had reached critical levels and that the national electrical supply company *Barki Tojik* was imposing electrical rationing to conserve the supply of water in the Nurek reservoir.[1] This report reviews the background to this situation and what can be expected to happen in the next weeks.

Background

As indicated in the first chart below (***Water Storage in Nurek HEPS Reservoir***), the Nurek reservoir had been retaining water through much of the past winter at above average levels. This bodes well for ensuring that there would be adequate supplies of water to meet electricity production requirements throughout the winter with minimal load shedding.

Water Storage in Nurek HEPS Reservoir

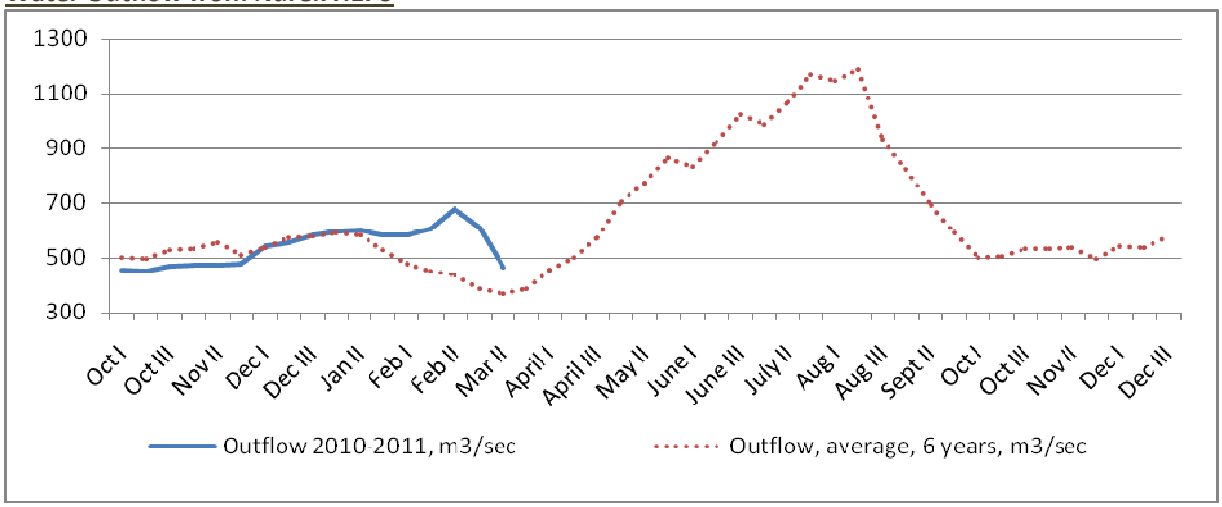


However, the releases of water from Nurek HEPS (and associated generation of electricity) rose to considerably above average from late January onward (see ***Water Outflow from Nurek HEPS***).

[1] http://news.tj/en/news/water-levels-norak-reservoir-near-critical-point;
http://news.tj/en/news/barqi-tojik-states-no-electricity-rationing-officially-introduced-dushanbe
Nurek HEPS provides approximately 57% of the electricity produced in Tajikistan. The Vakhsh River Cascade of HEPS produces over 75% of all the electricity produced in the country.

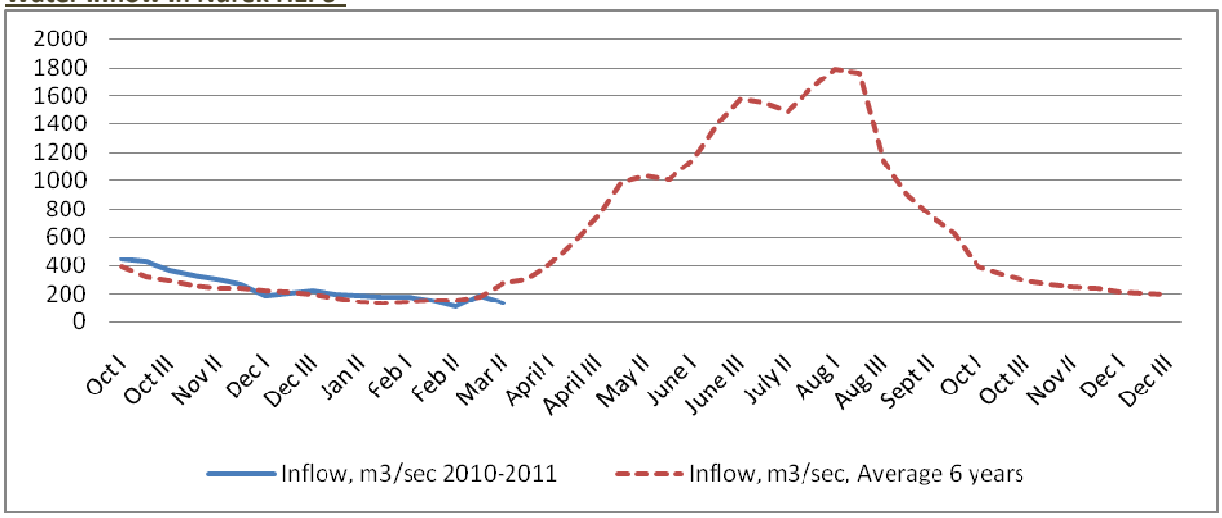
In late February *Barki Tojik* announced the lifting of normal winter restrictions on the provision of electricity supplies[2].

Water Outflow from Nurek HEPS



However, from mid-February to mid-March, the inflow of water into Nurek was below average, thus slowing the corresponding rate of fill of the reservoir (see ***Water Inflow in Nurek HEPS***). The reason for the drop in inflows is under investigation by *Barki Tojik*.

Water Inflow in Nurek HEPS[3]



The net result was that the water level (and thus the water available to generate electricity) dropped quickly and began approaching the "dead level" at Nurek reservoir. The "dead level" (857 m above sea level) is where the Nurek HEPS needs to stop outflows to avoid damage to the turbines.

[2] http://news.tj/en/news/tajikistan-ends-winter-rationing-electricity
[3] Data from http://www.cawater-info.net/analysis/water/nurek_e.htm#

Reaching the "dead level" could result in Nurek HEPS stopping all electricity generation. But, in reality, reaching the "dead level" means that generation would be limited to what flows of water were coming into the reservoir since the reservoir would have no water in storage for generation. This is referred to as "run-of-the-river" mode. A similar situation developed in 2008.

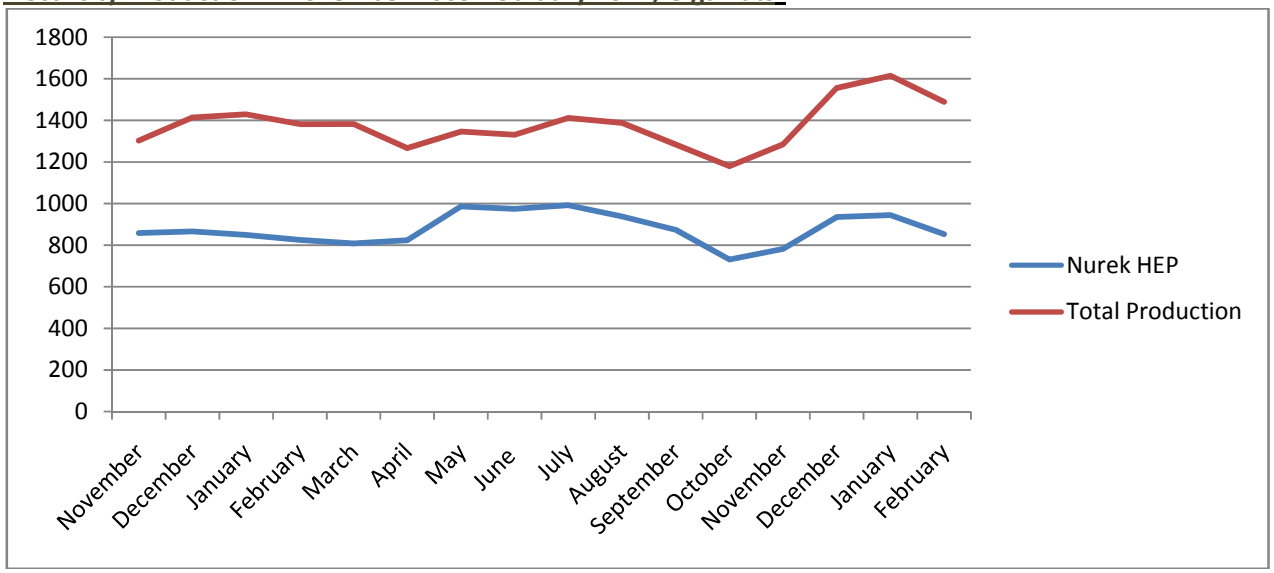
Because other dams in the Vakhsh River Cascade have water in storage and Nurek HEPS could operate in a run-of-the-river mode, coming close to the "dead level" would not cut off all electrical production. But it would (as we are seeing) significantly reduce electricity generation to conserve water in the Nurek HEPS reservoir.

The Impact

The immediate impact of the reduced inflows to Nurek HEPS has led to dramatic load shedding (i.e., an intentional reduction in the number of consumers who are supplied electricity) across the country. *Barki Tojik* is prioritizing available electrical supplies for strategic requirements such as hospitals and social facilities .

As indicated in the chart below, electrical production in Tajikistan dropped 8% from January to February after rising 38% from October 2010 to January 2011. The increase in electrical generation is reported to be associated with bringing on-line the full production capacity of the Sangtuda -1 HEPS as well as outflows from Nurek HEPS (which generate electricity and feed hydropower plants down river).

Electricity Production – November 2009-February 2011, Gigawats[4]



Asia Plus reported that Tajikistan exported[5] over 36 million kWh of electricity with a value of US$ 700,000 in January and February 2011, and imported 18 million kWh of electrical power

[4] Data from *Barki Tojik*.
[5] Exports are reported to be largely to Afghanistan.

with a value of US$ 847,400 during the same period.[6] These quantities are relatively small in comparison to overall production and demand in Tajikistan.

The actual scale and impact of the current load shedding will depend on:

- The weather-related demand for heating, where cooler temperatures would increase the demand for electricity and thus increase the need for load shedding, with the reverse true for warmer temperatures and *Barki Tojik* able to supply more customers, and,
- *Barki Tojik*'s ability to generate electricity, which will also depend on weather conditions, with warmer temperatures likely leading to increased electrical supplies (see below).

Because of these variables it is not possible to accurately predict the impact of the current load shedding on industrial production and other electricity-reliant economic activities.

How did this happen?

The immediate cause of the electrical crisis was the combination of reduced inflows to Nurek HEPS and reduced reserves of water in the reservoir to buffer the drop in inflows. This concurrence of events is unfortunate given *Barki Tojik* earlier success in maintaining good reserves of water for the early part of the winter. As for the actual cause of the reduced inflow, no conclusive cause has been established and investigations are continuing.

What happens next?

Barki Tojik will need to continue to conserve water, limit electrical production and implement load shedding until inflows to the Vakhsh River Cascade increase. Historically, this increase takes place between mid-March and mid-April, as the snow accumulated over the winter begins to melt. This melting is contingent on average or warmer than average temperatures and rainfall (rainfall triggers increased rates of snow melt). A colder and dryer than average spring will delay the onset of the spring melt and replenishment of Nurek HEP.

Thus, how long reduced flows into Nurek HEPS, and reduced electrical supplies and load shedding will continue depends on when the warmer and often wetter weather of spring arrives in Tajikistan. The advent of spring for Nurek HEPS and the Cascade is easily monitored through monitoring the rate in water inflow to the reservoir.

In fact, the rate of inflow was 200 m^3/second at the point when *Barki Tojik* decided to reduce outflows and implement radical load shedding. On 28 March inflow was reported at 400 m^3/second. Under current conditions it is expected that inflows exceeding 600 m^3/second will mean that load shedding will no longer be needed and electrical supplies will return to normal.

[6] http://news.tj/en/news/tajikistan-exports-36-mln-kwh-electricity-jan-feb-2011)

Lessons

Although the exact reason why *Barki Tojik* decided to increase electrical production at a time when demand for electricity is normally very high and water reserves the lowest is not known, it is clear that such decisions should be made with a good understanding of short and medium term weather forecasts as well as analysis of historical weather data.

This historical analysis would need to identify the normal on-set of the spring melting as well as the frequency and conditions precedent for both below average and above average inflows. The resulting information can be used in more accurately anticipating when to increase outflows from Nurek HEPS, and also when to hold back water to avoid unanticipated (and unnecessary) disruptions of electrical supplies in Tajikistan.

Risk Monitoring & Warning System (RMWS)
Address: 37/1 Bokhtar Street, VEFA Business Center, 7th Floor, 702
Dushanbe, Tajikistan
Tel: (+992 47) 441 07 37*Tel/Fax: (992 47) 441 07 38
E-mail:earlywarning.tj@undp.org