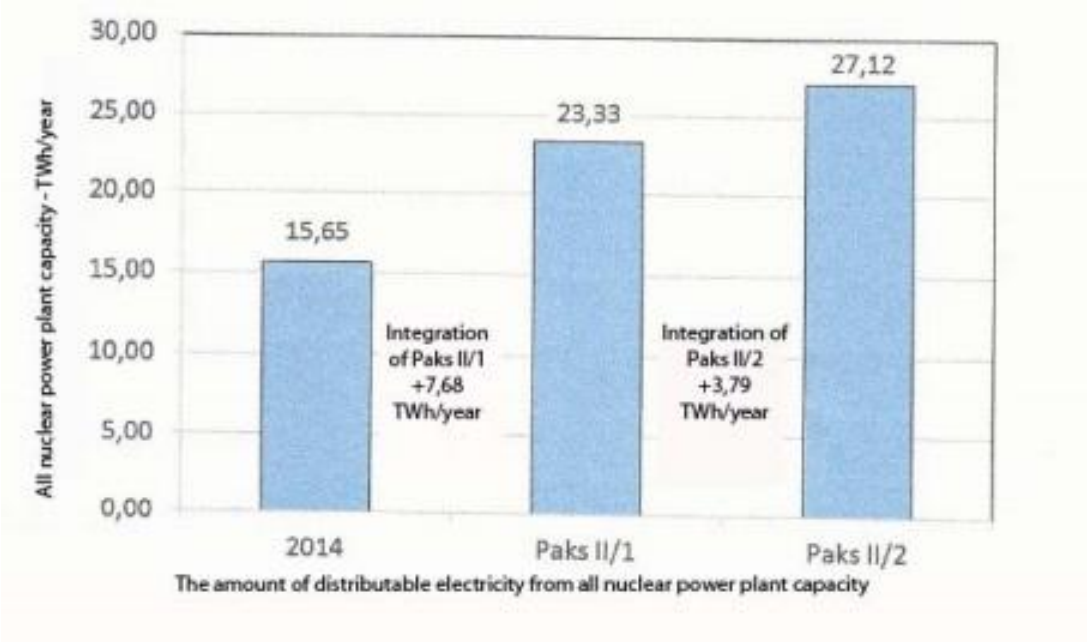
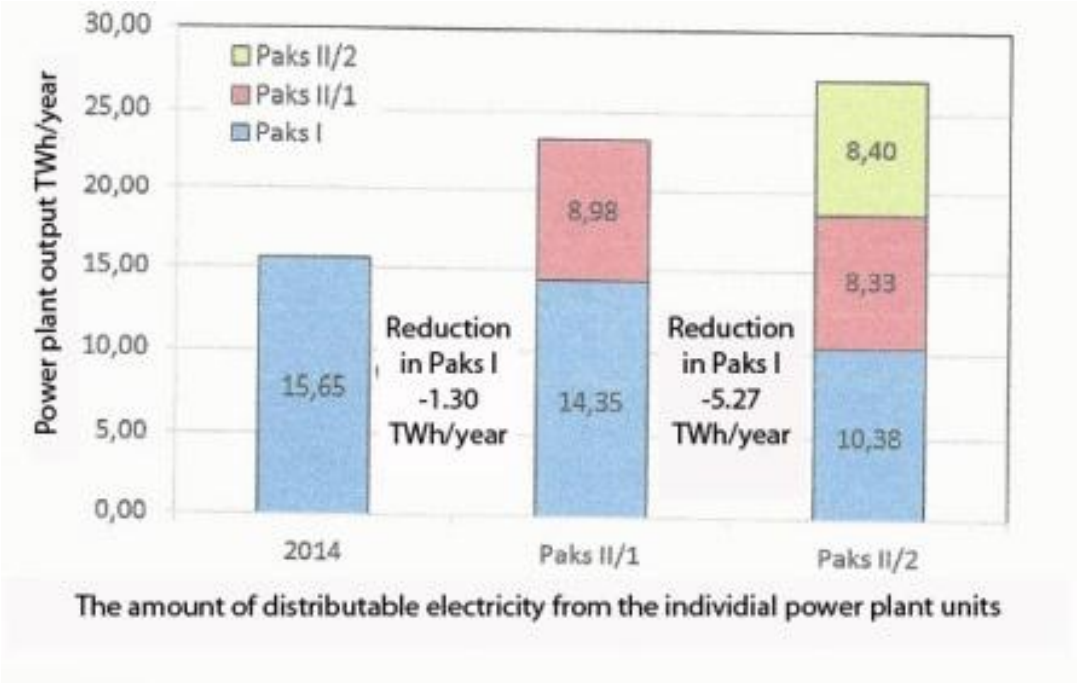
Notes to the issue of integrating the power plant expansion into the current system

The electricity import reaching up to approximately 40% and the import capacity of peak loads reaching up to 58% certain days, have put the political goal of decreasing energy dependency under pressure. Earlier development concepts that were based on gas-fired projects have now become unfeasible. The government seeks to solve lowering import-dependency, decreasing CO2 emissions and increasing energy safety by building two VVER-1200 type rated nuclear blocks, manufactured in Russia and each with the capacity of 1200 MW. The construction of the two new blocks is a fact; however, the conditions for integrating the blocks in the system and most efficient utilization have to be fulfilled in order to create a capacity producing highly utilizable and cheap electricity.

In theory, the new nuclear blocks in plan will be capable to produce and distribute electricity of 9.0 TWh/year. The constructions are adequate for power manoeuvring with keeping the allowed limits, cycles and variation intensities. From the public data of MAVIR, based on prognoses resulting from fifteen-minute interval assessments and on the limits of load-variability and overload-reversal, the summarized results of approximating calculations are the followings:





The amount of distributable electricity from the individial power plant units

With keeping the limits of load variability and overload-reversal, the amount of distributable electricity from the first block of the expansion (Paks II/1) may reach the theoretically possible value. After the construction of Paks II/1, distributable electricity can increase by 7.7 TWh/year. The second block of the expansion is less efficient and after the construction of Paks II/2 the amount of distributable electricity will only reach the magnitude of a 3.8 TWh/year growth.

The reasons primarily lie within the operational conditions of the less flexible existing blocks of Paks (Paks I); in addition, the reduction in production also comes with Paks I. The new flexible blocks will primarily exclude the capacity of Paks I from the operation of the system. The construction of the first block will confine the distributable electricity of Paks I by only 1.3 TWh/year, which does not appear to be a significant amount. However, the two new blocks together will cause a 5.3 TWh/year reduction in Paks I, which can, in turn, cause an income loss that is difficult to compensate.

In summary, from the perspective of Paks I, the planned expansion will confine the annual amount of distributable electricity to two-thirds of its current value (to ca. 10.4 TWh/year). The two new blocks of the expansion together could produce ca. 16.7 TWh/year of electricity.

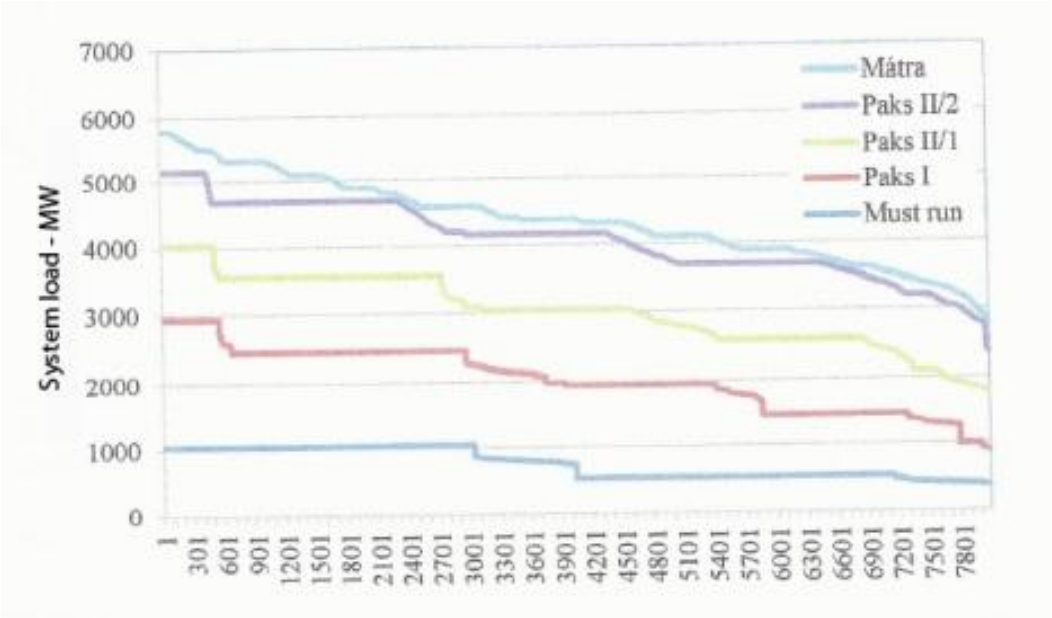
The reduction of expected effects would be particularly necessary with regard to the operation and productivity of Paks I. The idea that the conditions of system regulation could be met by the construction of peak load gas turbines seems unfounded. The reversal and the minimization or elimination of workload will make intervention necessary in periods of low production (during night time). In terms of system load a night time load of significant and controllable amount would be necessary. A significant portion of the countries around the world use pump-fed plants for this purpose, in part because they are technically adequate and in part because they are inexpensive. **With the adequate amount of pump-fed energy plant capacity, the gross production increase and the reduction in production of the Paks I can be restrained.**

The conditions of fitting the expansion in the system have to guarantee the optimal utilization of the investment as well as the highest possible cost-efficiency; however, the highest possible utilization of the entire nuclear capacity also has to be guaranteed. The implementation of the new capacities will

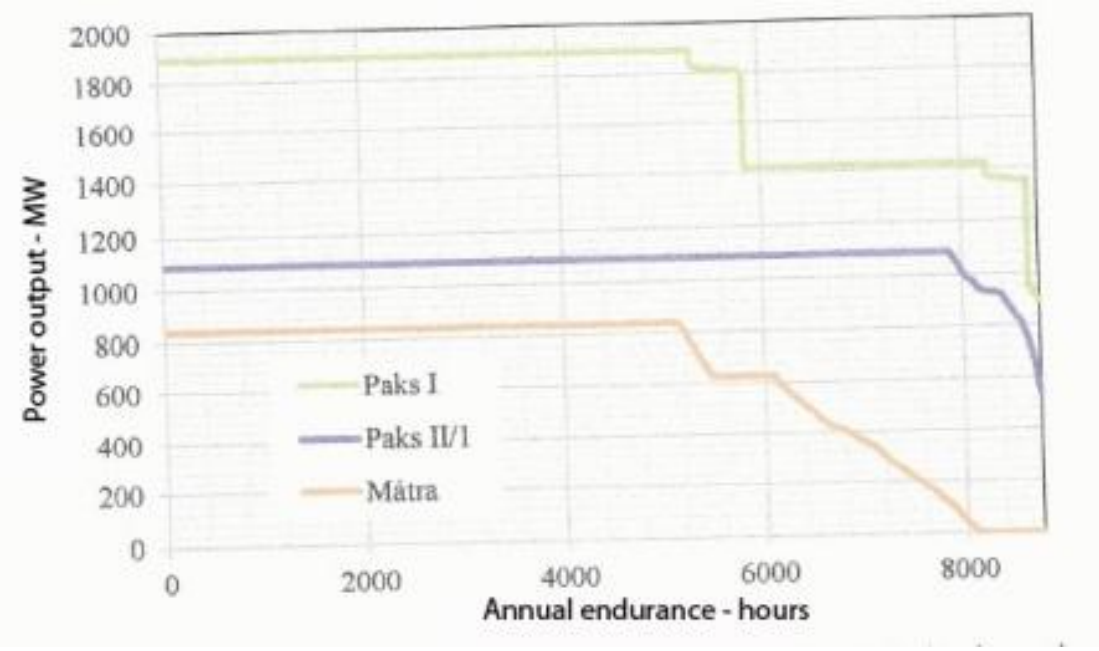
rearrange the structure of production, the consequences of which should be handled within their complexity and based on the lowest costs.

The results of the fifteen-minute interval assessments:

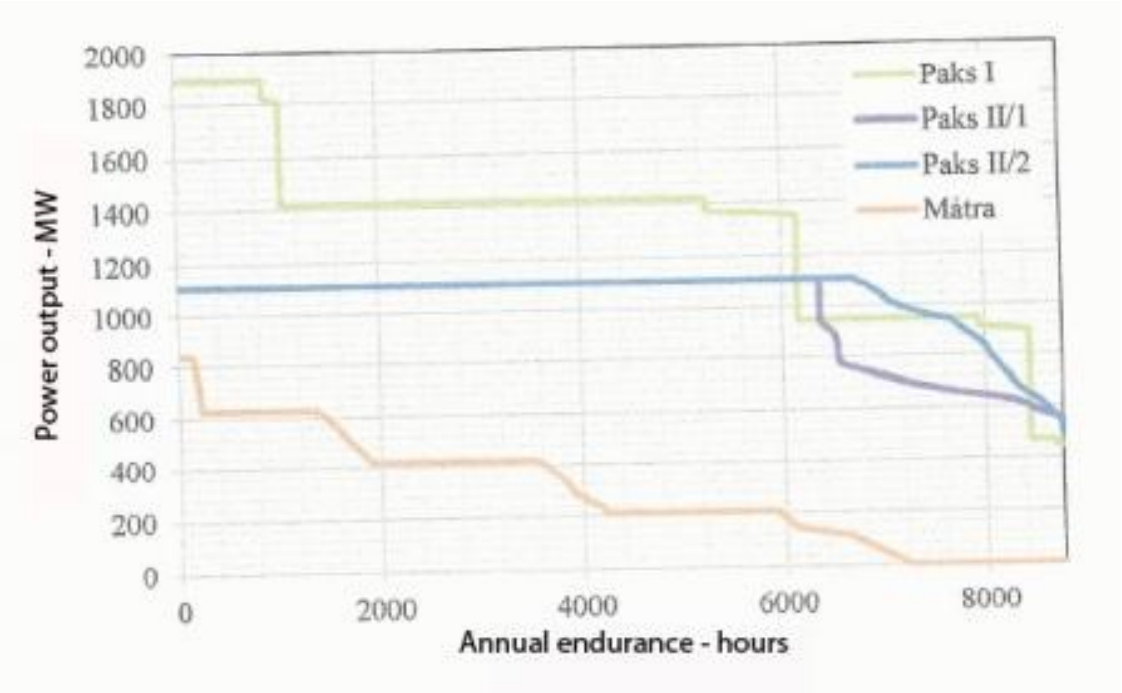
Based on the published fifteen-minute interval data of MAVIR the following load endurance will result for the special capacities by the year of the expansion:



The power output of the individual production units clearly shows the block load-reversals and block shut-downs seen on the previous table. The firs block of the expansion is relatively simple to integrate into the system. In the majority of cases the load-reversals of the new block can be kept within the allowed limits and shutting down one of the blocks of Paks I will only become necessary with 2000-2500 hours of endurance at most, especially on holidays and weekends.

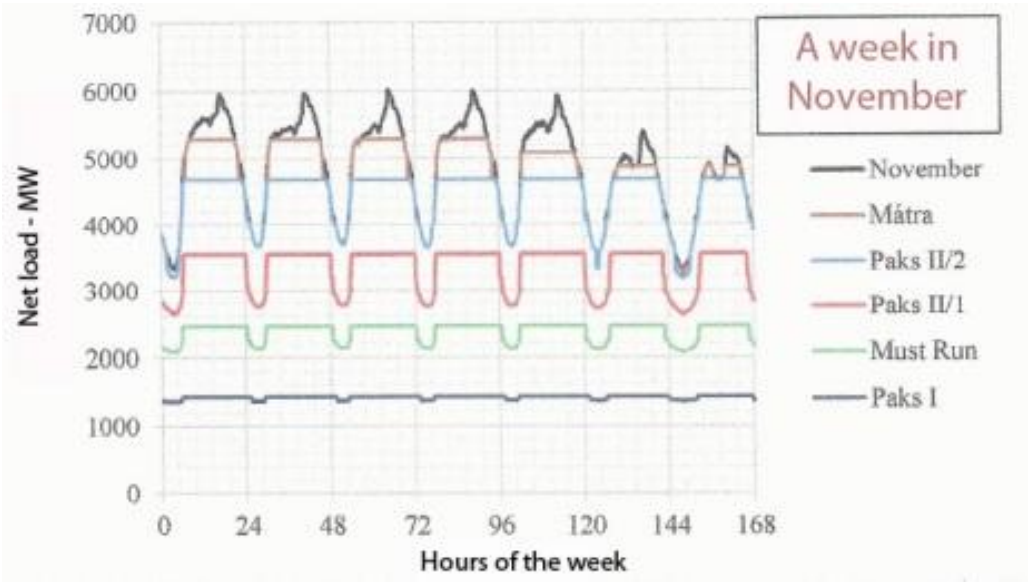


After the integration of the second block of the expansion an essentially different situation will emerge. The operation of all four blocks of Paks I will only be possible with 1000 hours of endurance. On holidays and weekends only a two-block operation of Paks I will be feasible. In extreme cases, a one-block operation may become necessary as well.

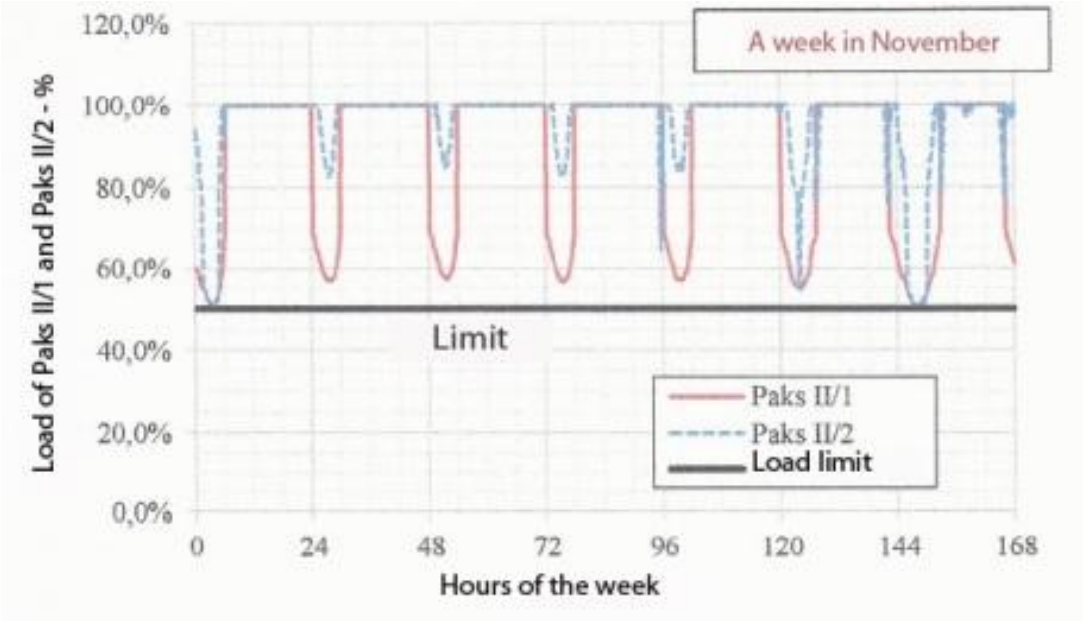


The approximating assessments conducted with the load model are weekly load cycles – they have been conducted with 168-hour intervals. In order to give an approximate model for the entire year, typically the load prognosis of the second week of each month has been selected and the energy amount and endurance of 12 weeks has been calculated. In case of a more detailed analysis, an 8760-hour complete period needs to be modelled.

Tracking the load can be seen in the following example of a typical week. After the implementation of the second block of the expansion, the majority of tracking the load can be secured by the blocks of Paks II/1 and Paks II/2.



After the implementation of the second block of the expansion, the majority of tracking the load can be secured by the blocks of Paks II/1 and Paks II/2. The daily overload reversal can be kept within the allowed limits.



Summary:

In summary, an inevitable condition of the two-block Paks expansion is balancing out loads and reducing minimal night time loads. If a solution is not implemented, the effects can be:

- approximately 5 TWh/year reduction in production in Paks I
- approximately 2 TWh/year reduction in production in the blocks of Paks II compared to the technically possible value

Finding the adequate solution is the primary interest of Paks I, because a 30-35% reduction can cause market severe loss of competivity and economic difficulties.

The economic value of 7 TWh/year is so significant that disregarding it cannot be reasonably justified.