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Case Study of South Sulawesi - electrical issues of a cluster of SHP

IFRERA

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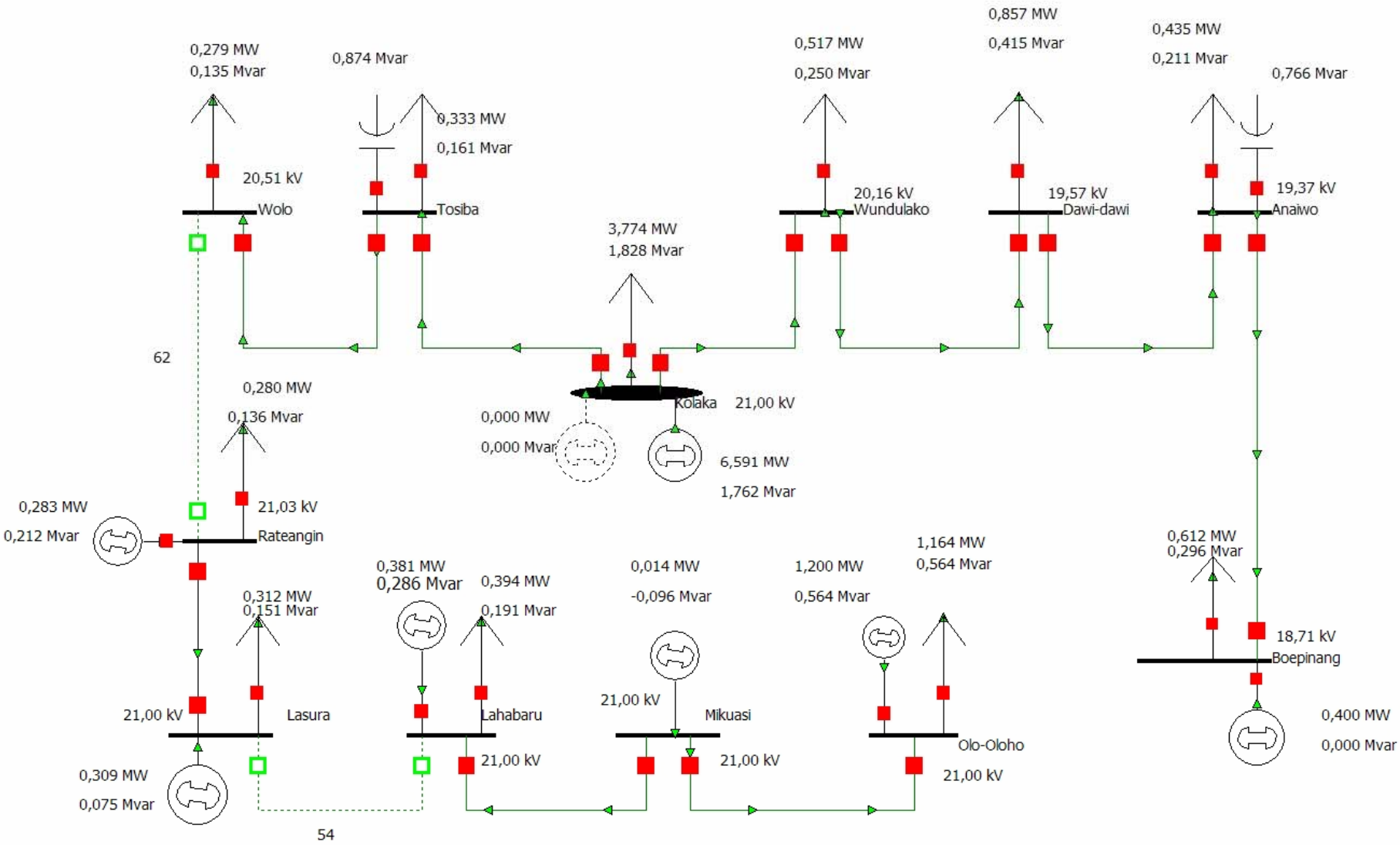
Task's specific objectives

- This study simulates different scenarios for proposed three systems up to 2020 with the objective to demonstrate its technical feasibility
- Propose a power strategy of three mini hydro power plants Mikuasi, Ratelimbong, Sambilambo

Power system in Sulawesi

- Kolaka system with several diesel generators (>10 MW)
- North Kolaka system with many small gensets (>5.3 MW)
- 20 kV long-stretched line
- Load is relatively small with load factor ~ 50%

Single-line diagram – Base case

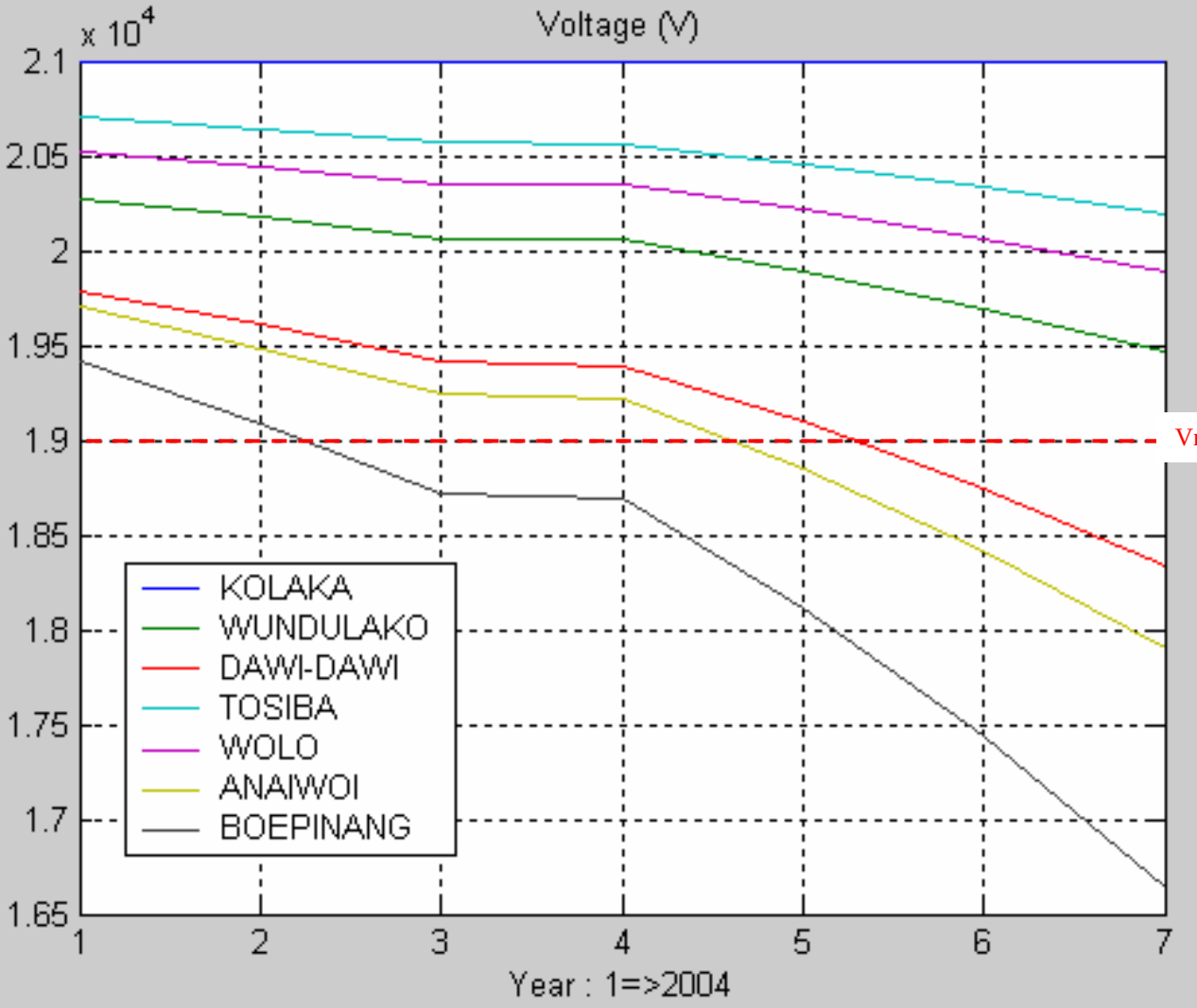


Approach and scenarios

- Kolaka system 2004 - 2020
- North Kolaka system 2004 - 2020
- Interconnected system 2004 - 2020

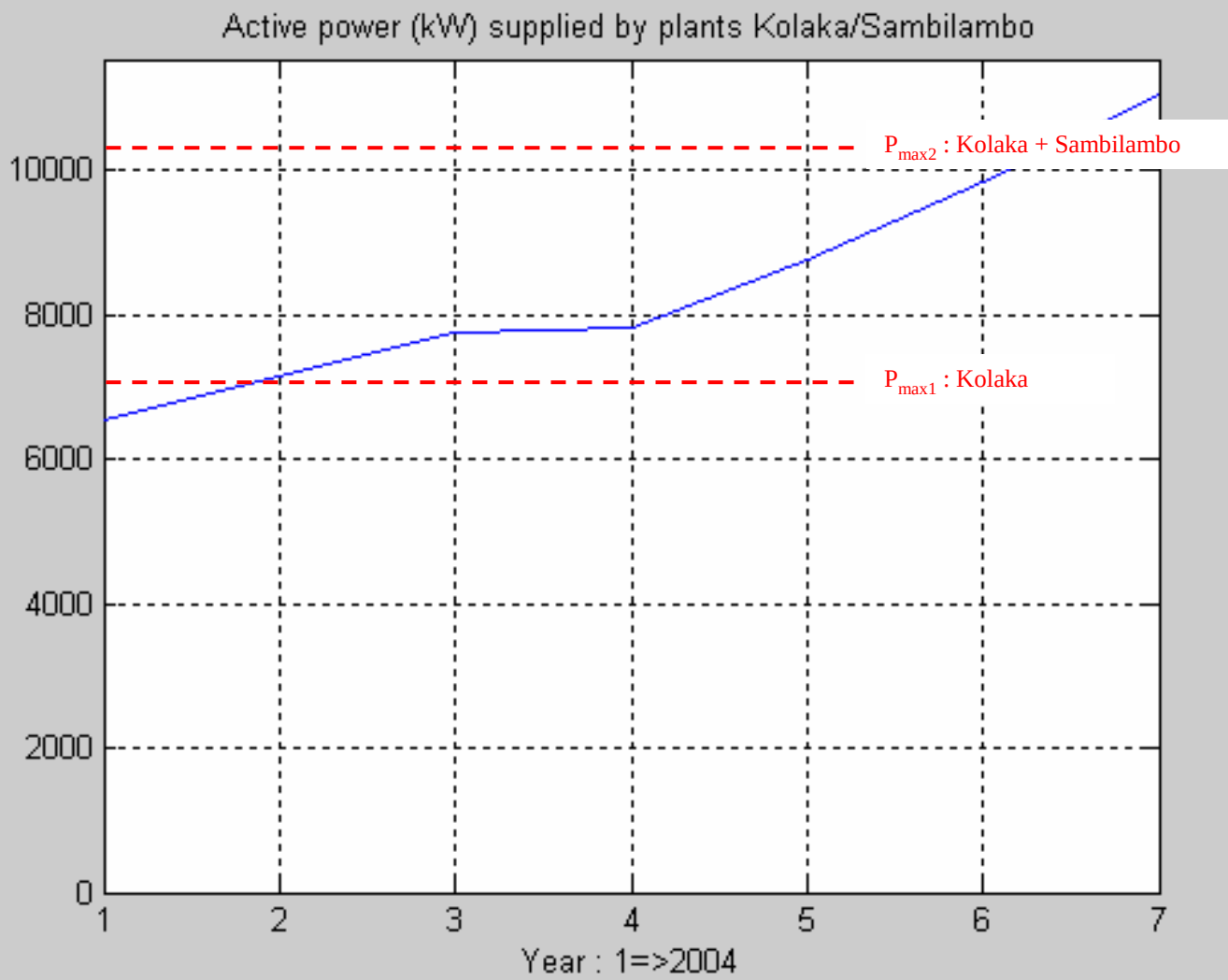
1. Base case for period
2. Install new capacitors
3. Install new generators
4. Line upgrade
5. Combined option of all measures

Kolaka system – Base case



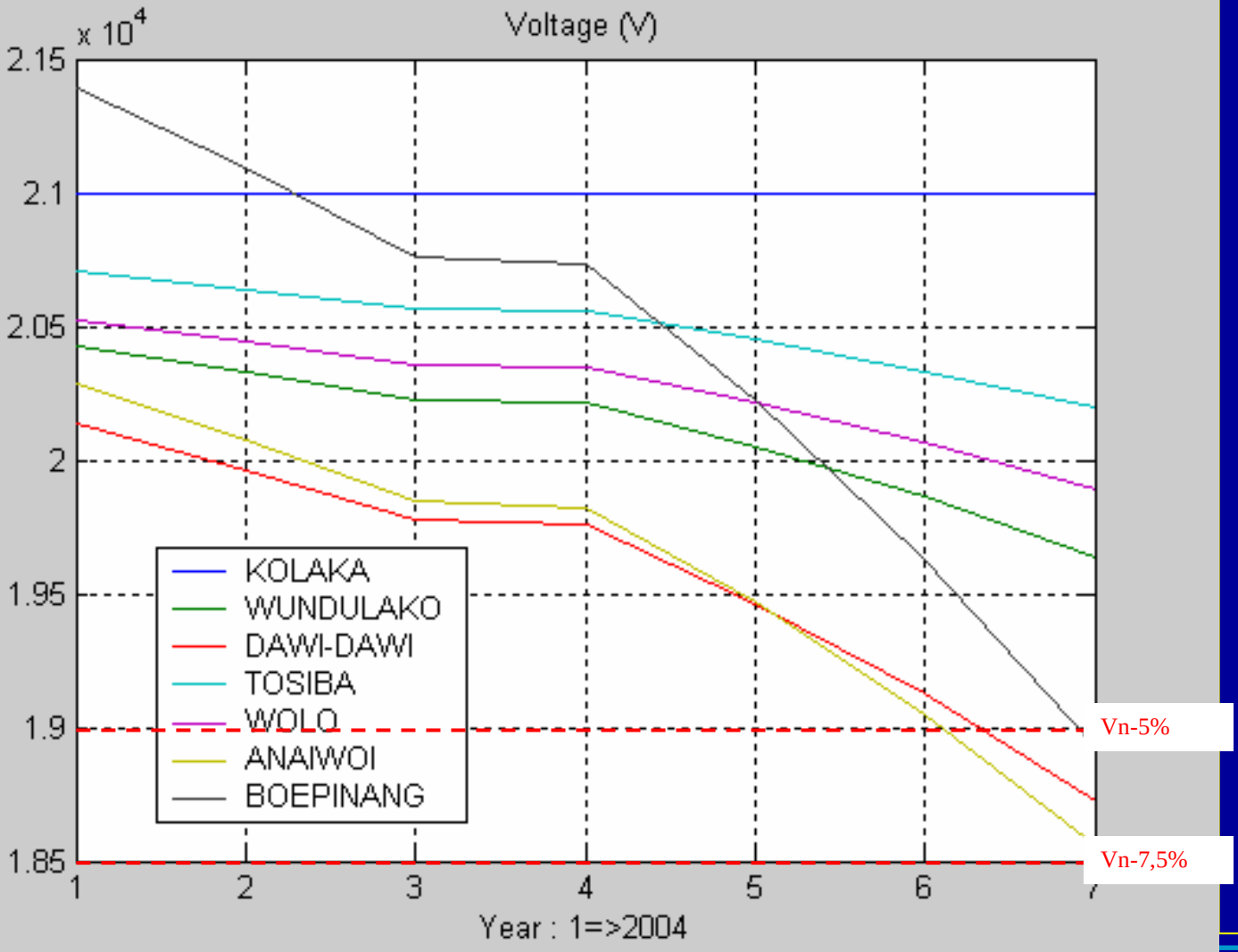
- Voltage drop in Boepinang is over the 5% in 2006
- Voltage drop for nodes Dawi-dawi and Anaiwoi will become critical over 5% acceptable level from 2009 under base case.
- Losses increase rapidly in 2008, due to significant voltage drop of the Kolaka system

Kolaka system – Base case



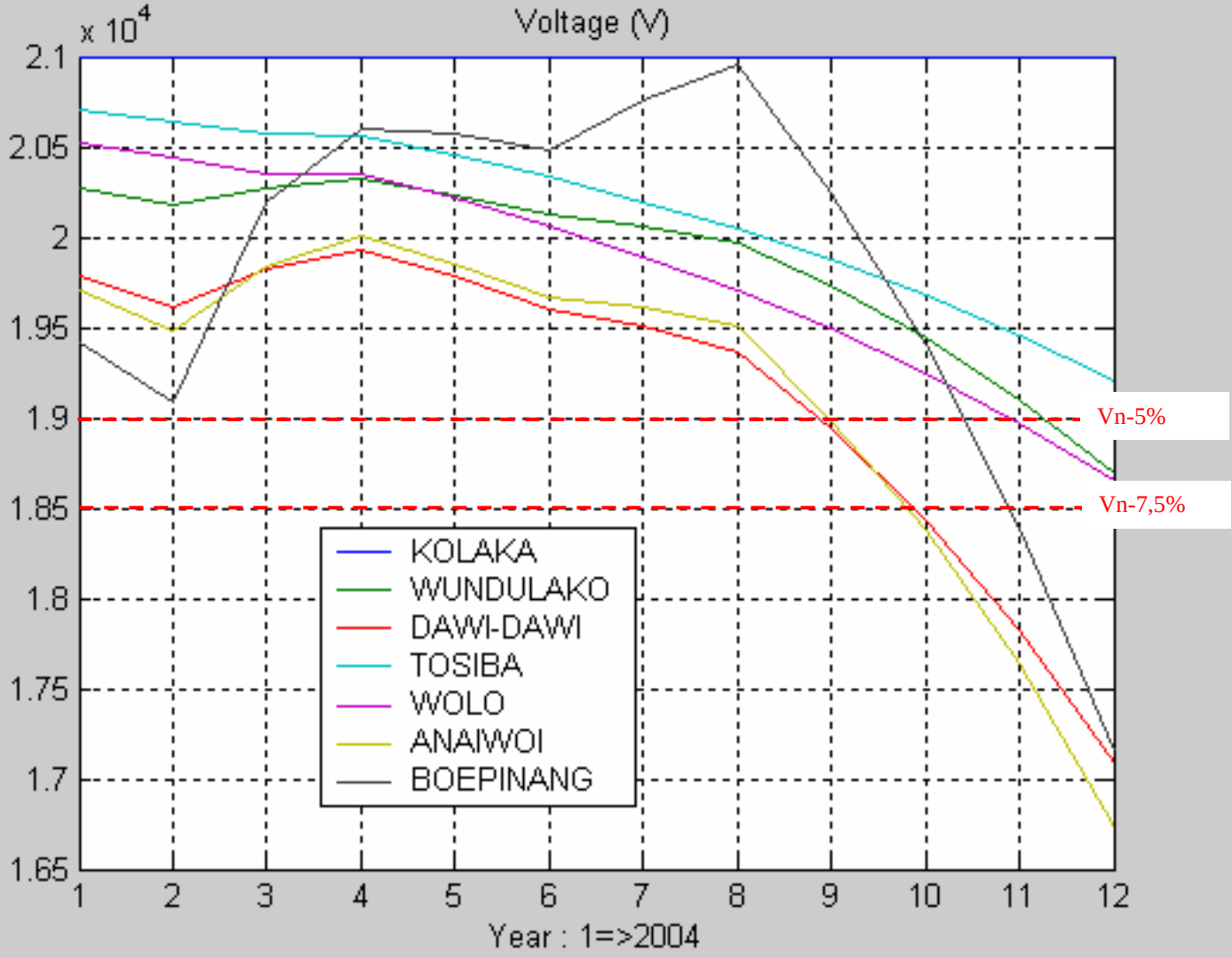
- Sambilambo should be operational from 2006 to ensure supply-demand balance.
- Even with Sambilambo, the generation capacity of the Kolaka system is not sufficient to supply the electricity from 2010 year ➔ The question of interconnection of Kolaka – North Kolaka became natural.

Kolaka system – Voltage drop from 2004 to 2010 with 1800 kVAr installed in Boepinang



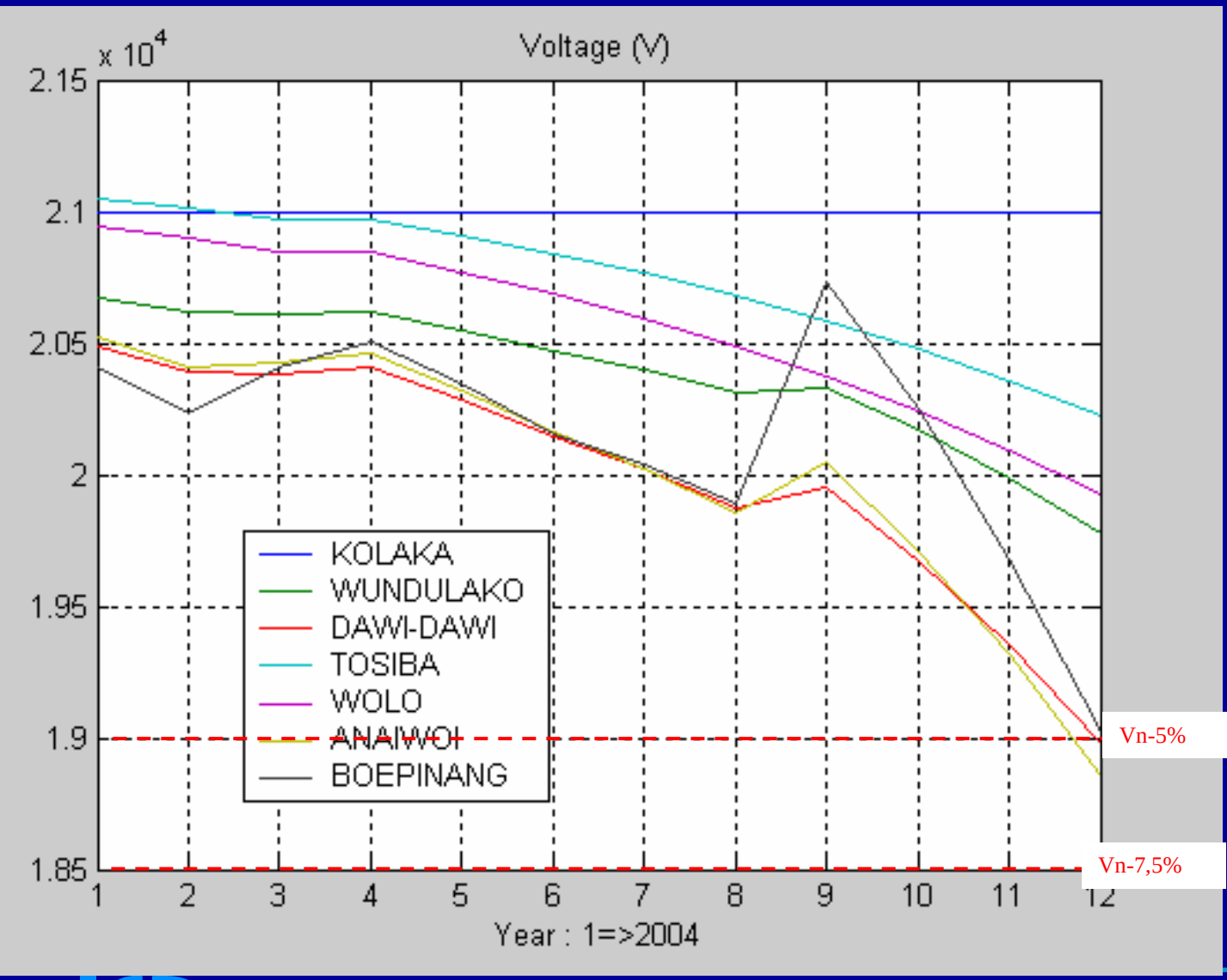
- One of the proposed solutions is to supply reactive compensation in Boepinang.
- With the installation of new capacitors of 900 kVAR, the voltage in Boepinang will drop less than 19 kV after 2009. Additional 900 kVAR in Boepinang will not solve the problem, as voltage drop after 2010 will pass again over the 5% limit.

Kolaka system – Voltage drop from 2004 to 2015 with additional 1200 kW installed in Boepinang



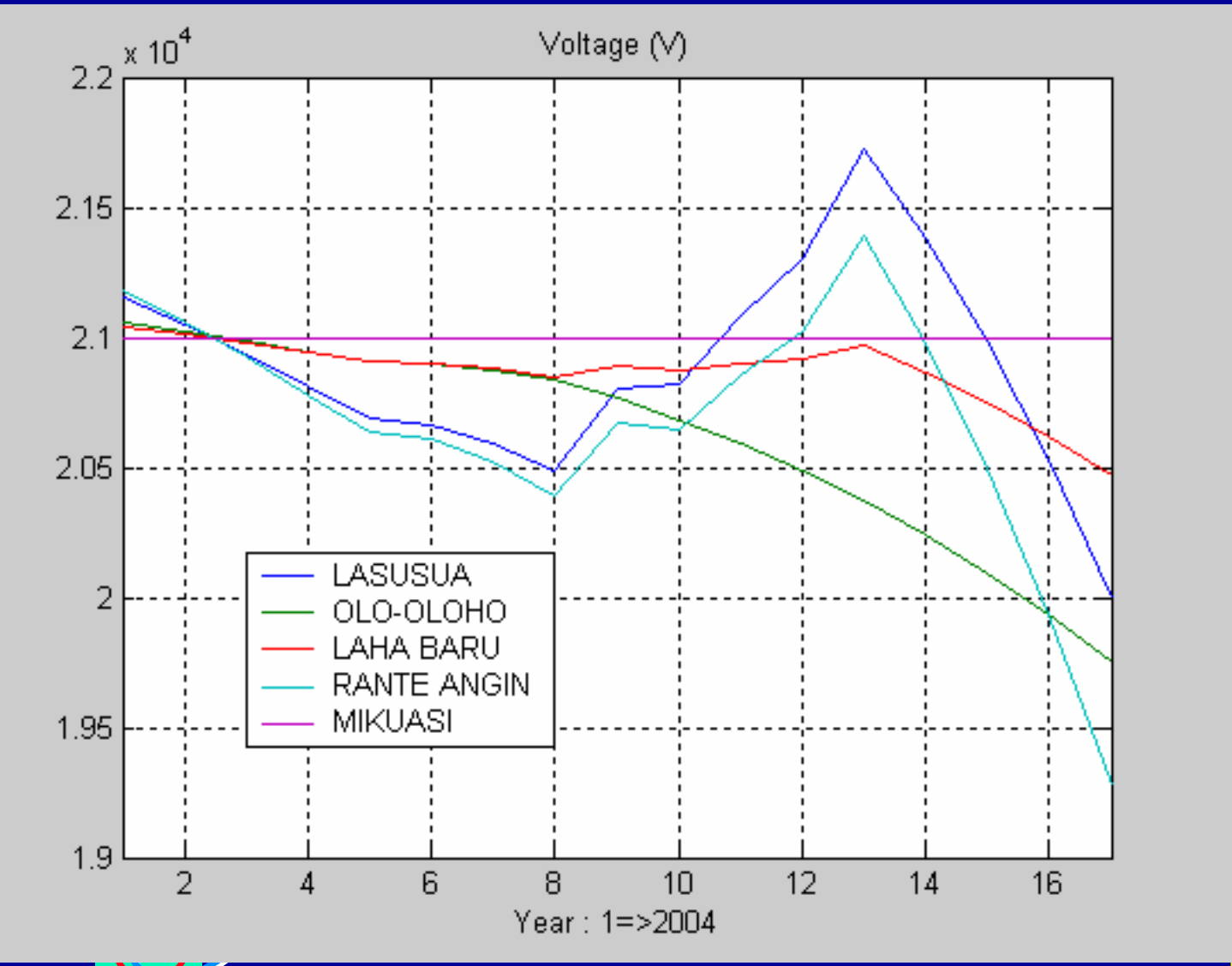
- The second proposed solution is to install additional diesel groups in Boepinang.
- It is clear that from the year 2013, Voltage drop at nodes Anaiwoi and Dawi-davi will become critical again.

Kolaka system – Combined solution



- Upgrade of all lines to 150 mm²
- 900 kVAr of capacitors installed in Boepinang
- 500 kW of additional installed capacity in Boepinang

North Kolaka system – Voltage drop from 2004 to 2015

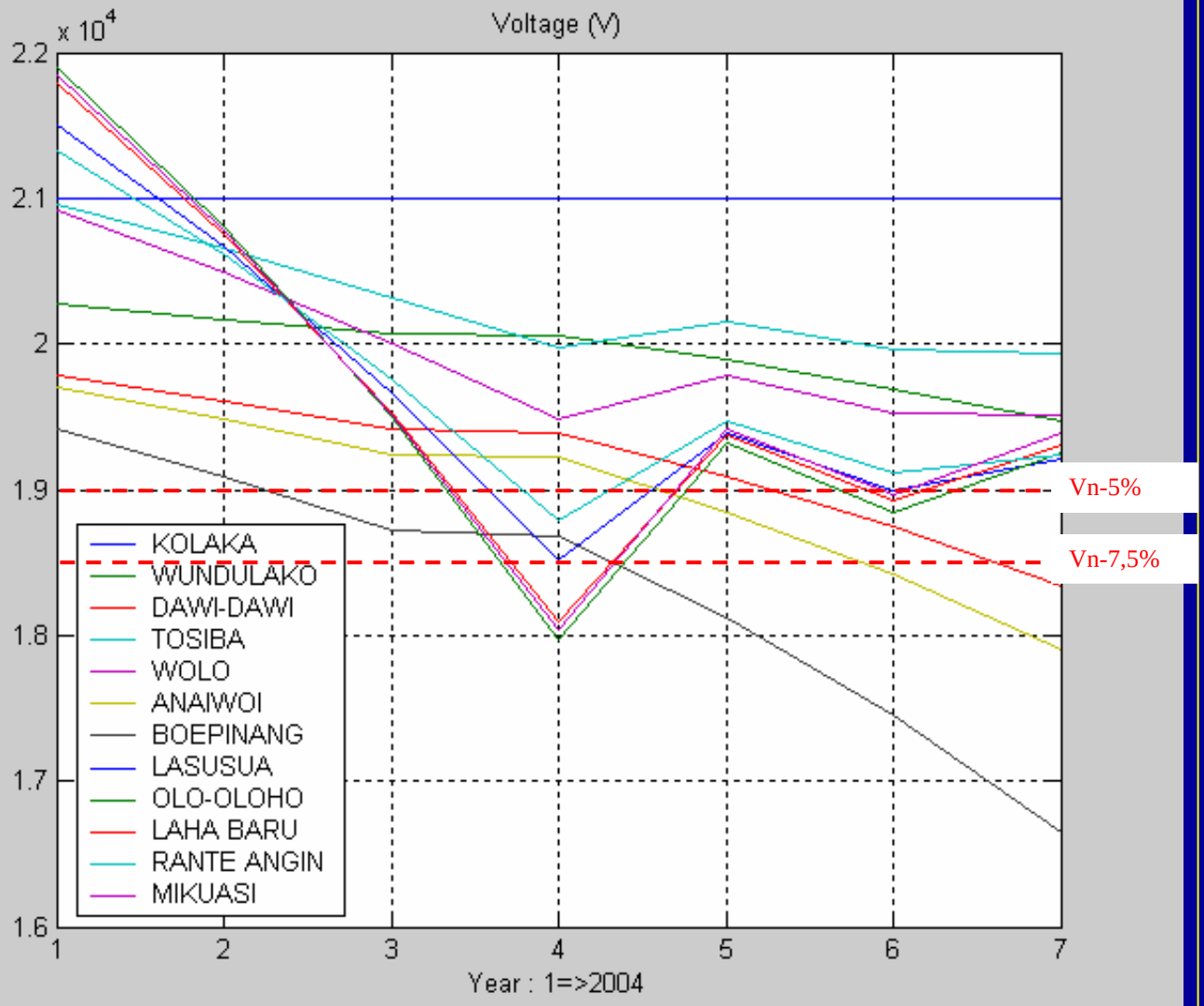


- It is obvious that there is a power shortage of installed capacity in the North Kolaka system
- from 2016, generation capacity of Mikuasi alone is not sufficient to assure the peak load if there was no Ratelimbong MHPP.

Conclusions for North Kolaka & Kolaka system

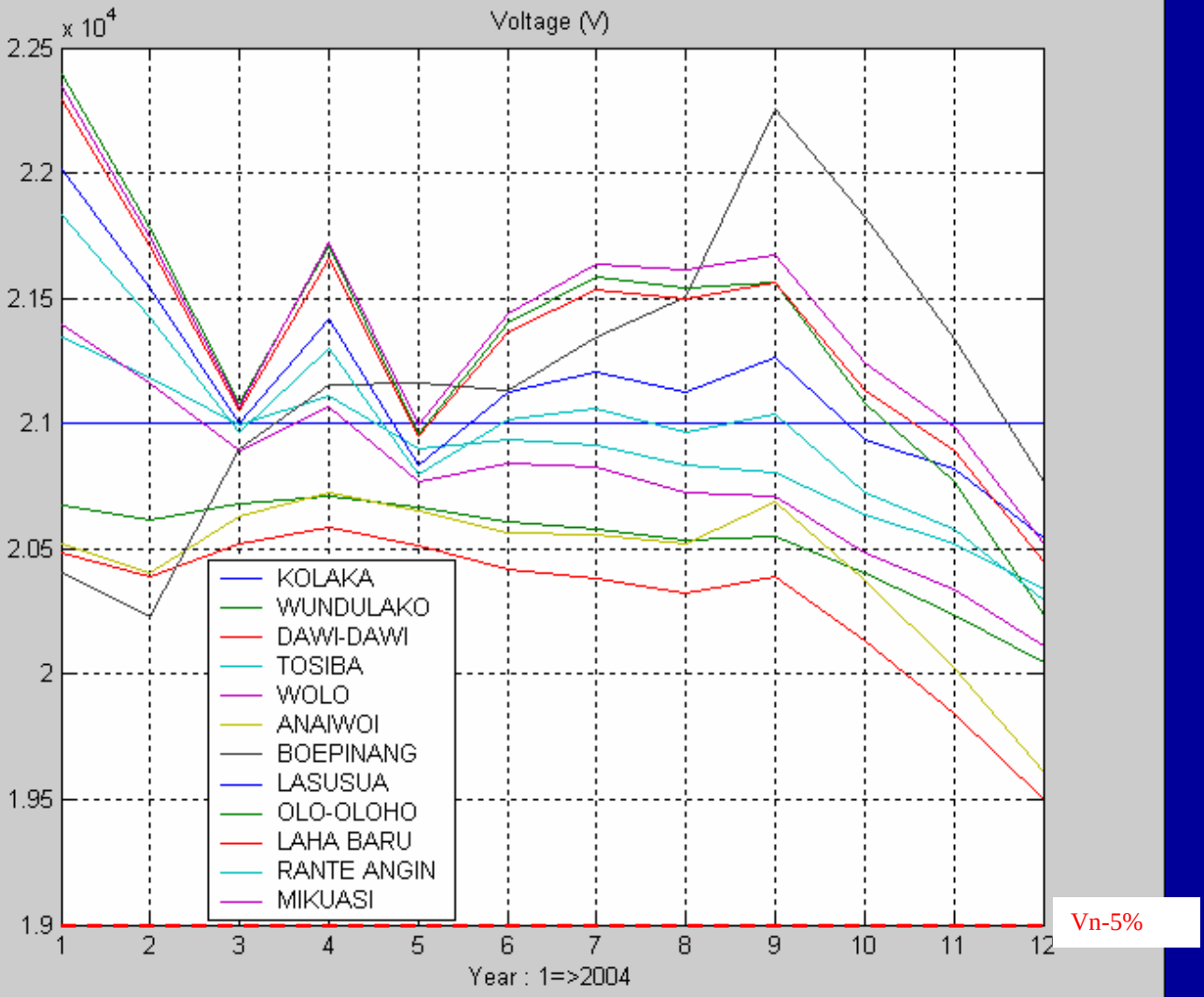
- The North Kolaka system faces no major technical problem until 2016. New additional capacity (Ratelimbong MHPP) will be needed from that year to assure power balance.
- The Kolaka system, however, has a problem with its node at Boepinang where its voltage drop is significant. Different options were examined individually but they can only move temporarily the problem up to 2010.
- We have examined a mix option for the Kolaka system, including upgrade of the overhead lines and installation of additional active and reactive power in Boepinang, to solve the technical problem. Our proposed configuration shows that there is possible technical solution to the Kolaka system. A further optimisation of the solution should be undertaken to find out a economical solution.

Interconnected system – Base case



- The voltage drop at Boepinang is out of limit from 2006.
- Moreover, voltage drop in the north part of the network are over 5% in 2007.
- Hopefully, this problem disappears with the commissioning of Mikuasi plant.

Interconnected system – Combined solution



- This last solution is a mix of the previous ones :
- - upgrade of all lines to 150 mm²
- - 900 kVAr of capacitors installed in Boepinang
- - a plant of 500 kW installed in Boepinang
- Concerning the north part, the most probable solution is to do the commissioning of Mikuasi plant as soon as possible.

Discussions on development strategy for power system

1. Develop SHP Sambilambo to meet the Kolaka demand and reduce operations of diesels in the system. Attention to the choice of generator (synchronous machine and multi-unit sizing)
2. Upgrade the line in the south by upgrading the conductor AC150 mm² (or equivalent, depending on local standards). Interconnect all isolated systems in the south Boeapinang and Kasipute with the Kolaka system. It may have problem with voltage variations and need of reactive compensation at the end of the feeder.
3. Upgrade the line in the north Tosiba – Wolo with AC conductor of 150 mm². Interconnect isolated systems Lasusua and Rante Angin to the system Kolaka.

Discussions on development strategy for power system

4. Develop SHP Rate Limbourg (a comparison with an alternative of the development of Mikuasi first). With this development, the system Kolaka become more stable, more reliable. No more need for diesels at Lasusua (may be for back-up purpose).
5. Construct one line connecting Lasusua – Lahabaru systems. This northern line become too long for a voltage level of 20 KV. It need to perform detail analysis and solution to protect the system : protection scheme or segmentation of line...
6. Develop SHP Mikuasi and connect it to the system. The Kolaka system is fully interconnected

The step 5 and 6 can be change the order, depending on detail analysis of system performance and stability.