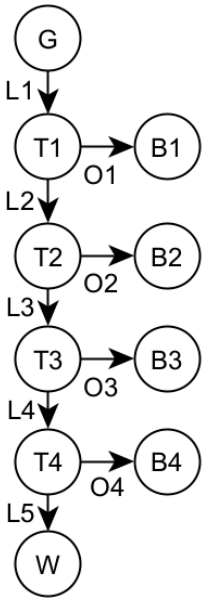
Operations Research Software Second Test Retake

January 9, 2026

An electricity company is planning to renovate its power network. All power is generated from a single generation station (G), with an output of **1000 MW**. Then the generated power goes through a sequence of transformers (T1,T2,T3,T4), and finally lands in a power waste pile (W). Each transformer also powers a city block (B1,B2,B3,B4).



Each edge represents a physical cable with a given carrying capacity (in megawatts) and length (in km). The goal of the electricity company is for the power to go to the consumers (city blocks B1,B2,B3,B4), and not to go to the power waste pile (W). Therefore they would like to renovate their infrastructure, and they are planning to upgrade **3** of their 9 cables. If a cable is upgraded, its carrying capacity increases by **200 MW**. However they can only upgrade at most **500 km** of cable in total, as that's the amount of copper they have available.

If there is a split in the route, the electricity company also has to decide how many megawatts of electricity flow towards one of the directions. (The rest will flow in the other direction.) For example, if 1000 MW arrives at T1 and we decide to send 400 MW towards B1, then 600 MW will flow towards T2.

Each cable has the following length carrying capacity (before the upgrade):

	L1	**L2**	**L3**	**L4**	**L5**	**O1**	**O2**	**O3**	**O4**
length =	247	279	206	230	38	54	71	65	67
capacity =	960	840	670	680	400	200	150	160	300

Each city block has a minimum electricty it requires and a maximum amount of electricity it can use (in MW):

	B1	**B2**	**B3**	**B4**
minUsage =	60	50	70	55
maxUsage =	220	335	240	410

Formulate the problem in an XPress Mosel program!

- Create variables for which main line (L) cables and which output (O) should be upgraded; as well as how many kilowatts pass through each main line (L) and output (O) cable!
- Make sure each city receives electricity between its own minimum and maximum!
- Make sure to upgrade exactly **3** cables! (Upgraded cables increase their carrying capacity by **200 MW**.)
- Make sure not to upgrade more than a total of **500 km** of cable!
- Make sure that at each junction, the total amount of electricity that comes in is equal to the amount that goes out!
- Make sure each cable carries electricity up to its (new) carrying capacity!
- Make sure we start with 1000 MW of power (that's how much flows through cable L1).
- Minimise the amount of power lost! (Which is equal to the amount of power going through cable L5.)

Print out which cables got upgraded and how many MW of power flow through each cable!

All above tables are available from the `network.dat` data file on the website.

Send your solution (.mos file) to `pfeiferd@math.bme.hu`.
Title your e-mail "ORPL Test Retake - NAME, NEPTUN", where NAME is your name, and NEPTUN is your Neptun code. Include your name in the Mosel file name, and the Mosel file you created.