

Incorporation of Transmission Losses using BMN Coefficients

To determine economic scheduling of generating plants and calculate accurate marginal costs, the effect of transmission losses must be included. The total system losses are represented by loss (BMN) coefficients, normally referred to as B coefficients. The B coefficients approximate the system losses as a quadratic function of the generator real powers, to a hypothetical load center. The penalty factors (incremental loss) for each plant are in turn derived from the B coefficients.

Penalty factors are a function of the incremental loss and give the relative impact on losses from different generation points. It is the amount of generation at a source required to source 1 MW to the load center. A penalty factor greater than 1 indicates a line loss associated with supplying the load while a penalty factor less than 1 indicates a line loss savings.

BMNs are a set of coefficients, in matrix form, that are used in a loss formula to approximate total system losses. Each row and column of the matrix corresponds to a source point. All the generators at a plant or generators in close proximity can be lumped together. This equivalent generation is referred to as a **source point**. The methodology used is based on an accurate transmission model and a solved loadflow, referred to as the base case. The loss model assumes a hypothetical load center, or equivalent load, which is represented mathematically by an equivalent circuit. Penalty factors are referred to this load center.

Once the BMN coefficients are generated, the system losses become a function of the generator outputs only. It is this direct relation in terms of B coefficients that makes them suitable for the dispatch function. The BMNs would accurately represent the system losses if the actual system conditions match with the base case conditions. However, the losses are approximate for any other operating condition.

To capture operating conditions as accurately as possible, the BMN coefficients are updated on a seasonal basis. In addition, separate on-peak and off-peak BMN coefficients are derived for East system. One load pattern is used for the West system because of the relatively flat pattern. The accompanying three sets of coefficients are identified as follows:

1. BmnEastDay.csv - BMN coefficients for East System Day
2. BmnEastNight.csv - BMN coefficients for East System Night
3. BmnNorthWest.csv - BMN coefficients for West System

Layout of B Matrix

There are 40 source points in the East system and 19 in the West system. The B matrix is a symmetric matrix dimensioned 40x40 and **only the upper half of the matrix is used**. The first row of the B matrix has 40 entries, the second row has 39, ..., and the last row has 1 entry, for a total of 820 data items.

For the daytime coefficients, the file would fill BMNE(820,1). For the nighttime coefficients, an identical but separate file would fill BMNE(820,1). A third file for the West system would fill BMNW(210).

Layout of BMN Coefficient File

The BMN coefficients in the attached text files are organized in columns of six. This means that the first row of the B-matrix is filled with the first 6 lines of the coefficients, plus 4 entries in line 7. The second row of the B-matrix (39 entries) is filled with the next 6 rows, lines 8 to 13 and 3 entries in line 14, etc. Any entry in the last line (corresponding to a given matrix row) which is empty is filled with zero. For example, the first row of 40 coefficients occupies 6 full lines plus 4 of the 6 entries in line 7. The remaining 2 entries in line 7 are zero-filled. Each new row of the matrix starts with a new line of the file.

Source Points

The following are source points for the east and west systems:

SOURCE POINTS - EAST

1 NEW YORK
2 MICHIGAN
3 L33P
4 ST. LAWRENCE
5 LOWER OTTAWA 230 KV
6 LOWER OTTAWA 115 KV
7 UPPER OTTAWA
8 WE TIE(WAWA)
9 KEITH
10 HEARN
11 LAKEVIEW
12 LAMBTON
13 NANTICOKE
14 BRUCE
15 PICKERING
16 BECK1(60HZ) ALLN DECEW
17 PGS BECK2(60HZ)
18 HOLDEN
19 DES JOACHIMS
20 CHENAUX, MT.CHUT

21 CHATS F., ARNPRIOR
22 B.CH, CAL, STW, MSSP
23 SAUNDERS
24 AC60
25 OTTER, LLNG, SMOK, HARM, KPL
26 AUBERY
27 WELLS
28 RAYNER R. ROCK
29 L.NOTCH
30 C-S-NB
31 BUCH F/C
32 MANBY CTU
33 DARLINGTON
34 SC20 SC25
35 LENNOX
36 PROVENCHER
37 ROUYN
38 KIPAWA
39 CANYON 25HZ
40 BECK F/C

SOURCE POINTS - WEST

41 PINE PORTAGE
42 CAMERON
43 ALEXANDER
44 AGUASABON
45 SILVER
46 KAKABEKA
47 EAR F.
48 MANITOU
49 CARIBOU
50 W.DOG
51 THUNDER BAY
52 TH BAY CTU
53 CALM LK.
54 STURGEON F.
55 MANITOBA 230
56 EW TIE
57 FT. FRANS 115
58 MANITOBA 115
59 ATIKOKAN
60