



NWPP INADVERTENT INTERCHANGE SETTLEMENT EXAMPLE

Prepared for

The NAESB Inadvertent Interchange Payback Task Force

by

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1. INTRODUCTION

The NWPP provided real Inadvertent Interchange data to the JIITF for analysis as part of the JIITF's investigation. The data included Inadvertent Interchange data for 16 Control Areas on the Western Interconnection. A 17th Control Area was created to represent the remaining Control Areas on the Western Interconnection. The data spanned an 11-day period and included 264 hours of Inadvertent Interchange data for the interconnection. The data supplied also included actual frequency error for the interconnection. The adjoining Excel Spreadsheet was developed based on the data supplied.

2. SPREADSHEET DESCRIPTION

The WestSettlement spreadsheet is divided into a number of regions.

Region 1:

The first region is Column A and provides the hour. There are a total of 11 days of data including a total of 264 hours.

Region 2:

The second region includes Columns B, C and D and provides the basic interconnection data derived from the interconnection frequency error.

Column B is the Frequency Error. **Plus** indicates above scheduled frequency, and **minus** indicates below schedule frequency.

Column C is the Frequency Error squared. These values are used in the statistical fit of the data to normalize the frequency data.

Column D is the estimated value for control, \$ 0.10 per MW-Hz-Hr, times the frequency error for the hour divided by the average of the hourly frequency errors squared (variance of the frequency error). The values in this column provide the Frequency Control Component per MWh for the Inadvertent Interchange for the hour. This calculation is possible because there are enough degrees of freedom in the regression to allow the frequency error alone to indicate the value per MWh for the Inadvertent Interchange in the hour.

This price per MWh of Inadvertent Interchange is derived from Equations (11) and (21) in the Defining Good and Bad Inadvertent technical paper¹. These equations are repeated here with **II** substituted for **U**.

$$FCC_h \Rightarrow -10\overline{\beta_{i,h}} = \frac{\frac{1}{n} \sum (\mathbf{II}_i \times \overline{\Delta F_h})}{\frac{1}{n} \sum (\overline{\Delta F_h})^2} \quad (11p)$$

$$\text{FCC}\$_{i,j} = -10\overline{\beta}_{i,h} \times \text{PC} \times \mathbf{H} \quad \text{for Balancing Authority } \mathbf{i}, \text{ for Settlement Period } \mathbf{j}. \quad (21p)$$

If Equation (11) is substituted into Equation (21) the resulting equation can be decomposed into an hourly price component and an hourly Inadvertent Interchange component. This results in Equation (1) below.

$$\text{FCC}\$_{i,j} = \frac{\frac{1}{n} \sum (\mathbf{\Pi}_i \times \overline{\Delta F_h})}{\frac{1}{n} \sum (\overline{\Delta F_h})^2} \times \text{PC} \times \mathbf{H} \quad (1)$$

\mathbf{H} is equal to \mathbf{n} .

$$\text{FCC}\$_{i,j} = \frac{\frac{1}{n} \sum (\mathbf{\Pi}_i \times \overline{\Delta F_h})}{\frac{1}{n} \sum (\overline{\Delta F_h})^2} \times \text{PC} \times \mathbf{n} \quad (2)$$

Reconfiguring equation (2) into an Inadvertent Interchange Component, $\mathbf{\Pi}$, and an hourly price component, the second term below, the second term of equation (3) provides the information presented in Column D of the spreadsheet. This price can be multiplied by the Inadvertent Interchange of each Control Area to develop an estimated contribution of that hour's Inadvertent Interchange to the total settlement.

$$\text{FCC}\$_{i,j} = \sum \left([\mathbf{\Pi}_i] \times \left[\frac{\mathbf{n} \times \overline{\Delta F_h} \times \text{PC}}{\sum (\overline{\Delta F_h})^2} \right] \right) \quad (3)$$

Regions 3 through 19:

Regions 3 through 19 include the data from each of the 17 Control Areas (Balancing Authorities) included in the analysis. These Control Areas are numbered from 1 through 17.

Column A is the Inadvertent Interchange for the Control Area. Plus indicates Inadvertent Interchange OUT and minus indicates Inadvertent Interchange IN.

Column B is the absolute value of Column A. The sum of Column B is used in the summary statistics at the bottom of the Control Area's analysis to provide additional perspective for the values.

Column C is the signed Inadvertent Interchange times the signed Frequency Error. A negative value indicates "Good" Inadvertent Interchange and a positive value indicates "Bad" Inadvertent Interchange.

Column D is the Frequency Control Contribution for the Control Area for the hour normalized by the variance of the frequency error for the entire analysis period.

Column E is the dollar value of the Frequency Control Contribution of the Inadvertent Interchange for the hour for the Control Area. The total at the bottom of Column E is the total settlement for the Control Area for the Frequency Control Contribution for the entire analysis period. A positive value indicates a payment to the interconnection. A negative value indicates a payment from the interconnection.

Region 20:

Column F is the sum of the Inadvertent Interchange values for the 17 Control Areas on the Interconnection. If the sum is zero, it indicates that the Inadvertent Interchange values are valid for the interconnection.

Column G states "OK", if the value in Column F is zero. If the value in Column F is not zero, Column G will contain the word "ERROR".

Column H is the sum of the Frequency Control Contribution Dollars (FCC\$) for all of the Control Areas. The value indicates the net financial position of the interconnection after settlement.

3. OBSERVATIONS AND RECOMMENDATIONS

All of the Control Areas included in this analysis are easily meeting the CPS1 and CPS2 performance criteria. Most of the Control Areas have Frequency Control Component totals that are small because they have balanced control errors and are performing their share of the interconnection frequency control. The values associated with the Frequency Control Component are significant enough for some to cause changes in behavior for those Control Areas performing less than their share of Frequency Control and causing Inadvertent Interchange.

References:

- ¹ **Illian, H. F.**, "Defining Good and Bad Inadvertent", January 2002, Submitted to NAESB IPTF, February 15, 2003.