

Primary Frequency Response (PFR) Survey

Per Unit Calculation Tool

Quick Tips

- 'Calculate' button on 'Calculations' and 'Results' tab will force the sheet to calculate. You must click this button to ensure the results are validated and imported into the 'Results' tab; it will not be otherwise.
- The sheet is not designed to automatically calculate. This is to eliminate cumbersome redundant calculations that may lengthen the calculation process.
- 'Manual' data entry is not recommended and should be used by only those that are unable to pull Historian data. It must be calculated per the procedure and imported directly.
- The more granular the data provided in 'Historian Data,' the better the scores will reflect the PFR provided by your Resource. Historian data should be pulled for **at least** 1-min before the $t(0)$ and **at least** 1-min after $t(0)$; the more data provided, the better the chart will show the response of your Resource.

Procedure

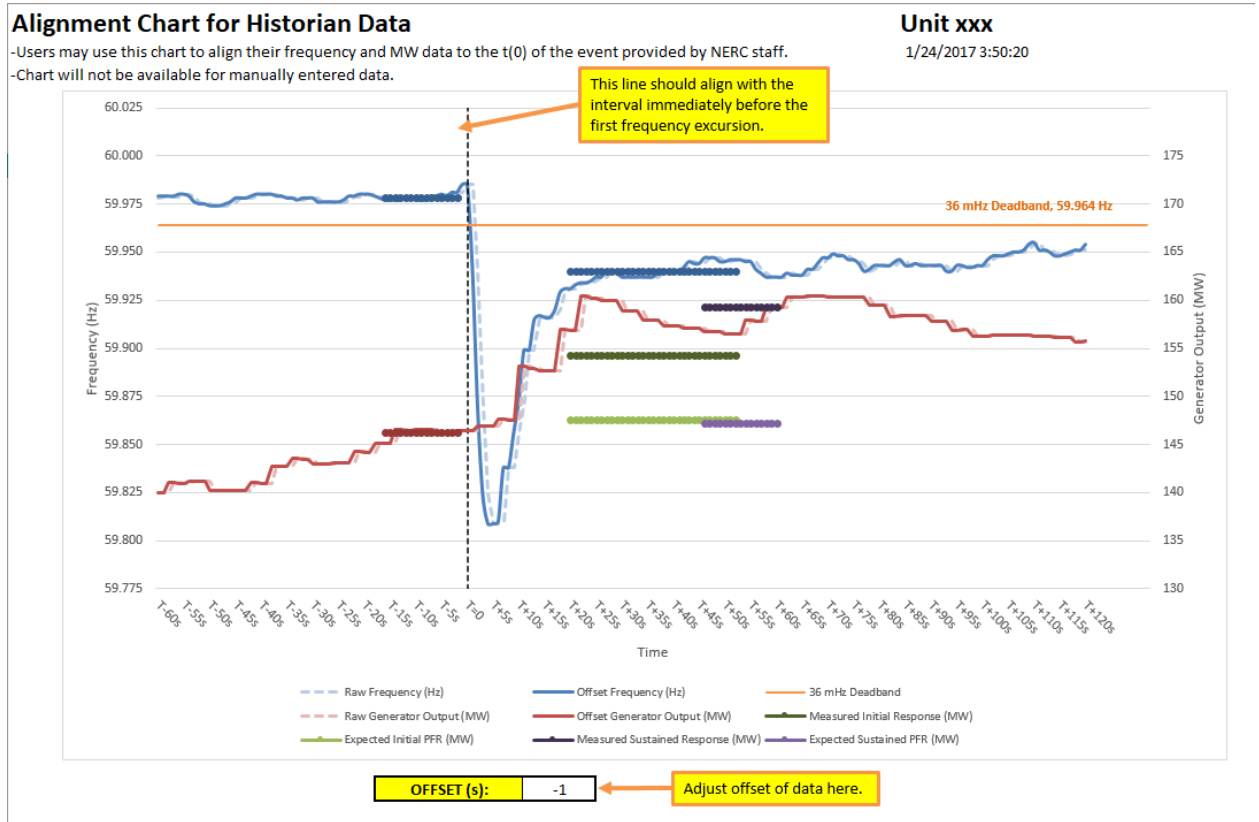
This tool is used to calculate the Primary Frequency Response (PFR) from individual Generation Resources during Frequency Measurable Events. The below steps will detail the procedure for entering the correct data, adjusting it, and calculating the resulting PFR scores for a Generation Resource.

- 1) Open 'PFR_Survey_Ver0.xlsm' or the latest version.
- 2) Fill out the enterable (highlighted yellow) fields on the 'Main Data Entry' tab (D3:D121,D131:D132).
 - a) Contributor Name
 - b) Contributor Phone Number
 - c) Contributor Email
 - d) Generator Operator
 - e) EIA 860 Plant Name (US Only)
 - f) EIA 860 Plant Code (US Only)
 - g) EIA 860 Generator ID (US Only)
 - h) GADS Generator Unit ID
 - i) Planning Case Bus Number
 - j) Interconnection (*dropdown selection*)
 - k) Balancing Authority (*dropdown selection*)
 - l) Generator Type (*dropdown selection*)
 - m) Generator Machine Base (MBASE)(MVA)
 - n) Inertia Constant (H)
 - o) Unit Droop Setting @ Time of Event
 - p) Unit Deadband @ Time of Event
 - q) Operating Mode at Time of Event (*dropdown selection*)
 - r) Maximum Operating Level (Pmax)(HSL) @ Time of Event
 - s) Minimum Operating Level (Pmin)(HSL) @ Time of Event

- 3) Select on the 'Main Data Entry' tab either 'Historian' if you plan on using Historian data in the tool to calculate the PFR scores or 'Manual' if you plan on calculating the key metrics using a standalone application before entering them (D31).
- 4) If you plan on using 'Historian' data in the tool to calculate the PFR scores, please select the time zone in which the timestamps of your Historian Data is from. This will ensure that the data read into the tool from your Historian Data will be correctly converted to UTC time (D32).
- 5) If you plan on using 'Historian' data, follow these following steps:
 - a) Prepare your Historian data per the following:
 - i) Pull the following fields for the Generation Resource.
 - (1) Timestamp
 - (a) Be sure to select the time zone in which the timestamps of your Historian Data is from (D32).
 - (2) Unit Frequency
 - (a) This should be in Hz (60Hz)
 - (3) MW Output
 - (a) Net output of the Generation Resource
 - ii) Pull data for no less than 1 minute before the t(0) listed as the Time of Frequency Event (UTC) (D27 on 'Main Data Entry') and no less than 1 minute after the t(0).
 - (1) More data will mean slower calculation speed and larger file size, too little data will impede your ability to correctly adjust your data.
 - (2) A good rule of thumb is to pull data for 5 minutes before t(0) and 10 minutes after t(0).
 - iii) Pull data at your fastest possible scan rate (i.e. 1s, 2s, or 6s)
 - (1) A good rule of thumb here is "garbage in, garbage out." The more granular the data, the more representative the PFR scores will be of the Generation Resources performance.
 - b) Paste the data, in the order stated above, in the 'Historian Data' tab under the Timestamp (UTC), Unit Frequency and MW Output column headers (starting at A8.)
 - c) To pull the Historian data into the calculation, click the 'Read Historian Data' button on the 'Main Data Entry' tab.
 - i) This may take a few seconds to read in the data completely. You will be notified when it is finished.
 - d) Go to the 'Chart' tab. The chart should show the frequency and the response from the Generation Resource using the data provided in the 'Historian Data' tab.
 - i) There should also be some lines representing different things, including:
 - (1) Measured Initial Response (MW): the response during the initial period minus the ramp adjustment factor.
 - (2) Expected Initial PFR (MW): the expected response during the initial period based on the provided droop, deadband, and Pmax settings.
 - (3) Measured Sustained Response (MW): the response during the sustained period minus the ramp adjustment factor.
 - (4) Expected Sustained PFR (MW): the expected response during the sustained period based on the provided droop, deadband, and Pmax settings.
 - (5) Raw Frequency (Hz) and Raw Generator Output (MW): the data provided, aligned with the t(0) of the event.

(6) Offset Frequency (Hz) and Offset Generator Output (MW): the data provided, aligned with the t(0) of the event, offset by the number of seconds selected in the Offset field on the 'Chart' tab (H34).

- ii) Enter the amount of Offset (s) needed to ensure that the black dotted line at t=0 line up with the first data point immediately after the beginning of the excursion of the event.



- e) Go to the 'Results' tab, click the 'Calculate' button.
 - i) The resulting P.U. Primary Frequency Response Performance (PUPFR) and P.U. Sustained Primary Frequency Response Performance (PUSPFR) scores are the Final scores of the PFR performance of the Generation Resource.
 - ii) If both of these scores are above the Minimum Acceptable Score (PU), the Generation Resource will receive a smiley, otherwise it will receive a frown.
- 6) If you plan on using 'Manual' data, follow these following steps:
 - a) Calculate each of the following numbers per the procedure and enter them (E36:E43).
 - i) Pre-Perturbation Average Frequency [T(-16) to T(-2)]
 - ii) Post-Perturbation Average Frequency [T(+20) to T(+52)]
 - iii) Post-Perturbation Frequency [(T+46)]
 - iv) Pre-Perturbation Average MW [T(-2) to T(-16)]
 - v) Post-Perturbation Average MW [T(+20) to T(+52)]
 - vi) Maximum MW Response [T(+46) to T(+60)]
 - vii) MW Response [T(-4)]
 - viii) MW Response [T(-60)]
 - b) Go to the 'Results' tab, click the 'Calculate' button.

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 - ii) If both of these scores are above the Minimum Acceptable Score (PU), the Generation Resource will receive a smiley, otherwise it will receive a frown.
- 7) **Save the workbook** with a name including the Generation Resources name in it as well as the date of the event. (i.e. 'PFR_Survey_Ver0_event date_plant_unit_name.xlsx')
- 8) For the PFR Summary Tool to work correctly, each file should have "PFR_Survey" in the beginning of the file name and be saved in the same folder.
- 9) Done!