

Grid Controller of India Limited (Grid-India)

(Formerly Power System Operation Corporation Ltd.)



Detailed Procedure for Evaluating Control Area-wise Performance of Secondary Reserve Ancillary Services (SRAS) and Tertiary Reserve Ancillary Services (TRAS) Providers

*Prepared in Compliance to regulation 30(13) of
Central Electricity Regulatory Commission (Indian Electricity Grid
code) Regulations, 2023*

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1.0 Background

- 1.1 Every entity shall undertake all appropriate measures to maintain its drawal/injection as per schedule. Each control area has to follow certain Frequency Response Performance (FRP) criteria, as specified in Central Electricity Regulatory Commission (CERC) (Indian Electricity Grid Code) Regulations, 2023 (hereinafter referred to as the "IEGC, 2023"), in order to maintain frequency within the IEGC stipulated band under normal operating conditions.
- 1.2 CERC (Ancillary Services) Regulations, 2022 have been operationalized in the Indian power system in 2022-23. Secondary Reserve Ancillary Services (SRAS) and Tertiary Reserve Ancillary Services (TRAS) have been introduced by CERC, and have been operationalized through respective Detailed Procedures for SRAS and TRAS by NLDC.
- 1.3 SRAS has been made operational w.e.f. 5th December, 2022. SRAS Providers are despatched through Automatic Generation Control (AGC) every 4 seconds by NLDC. SRAS dispatch gets incorporated in the net implemented schedule of the SRAS provider post facto.
- 1.4 The capability of a SRAS provider of providing response to SRAS signal within 30 seconds of receipt of the signal and providing the entire SRAS capacity obligation within 15 minutes and sustaining at least for the next 30 minutes shall be assessed in the closed loop testing carried out during the integration process.
- 1.5 The capability of a TRAS provider of providing TRAS within 15 minutes of despatch instruction and sustaining the service for at least next 60 minutes shall be on the self-certification basis and would be automatically tested during the continuous operation whenever such a situation may arise.
- 1.6 Performance based incentive is being provided to SRAS Providers, in line with the CERC (Ancillary Services) Regulations, 2022, and the NLDC Detailed Procedure for SRAS. Performance evaluation of the SRAS Providers shall be done on a daily basis.

- 1.7 TRAS has been made operational w.e.f. 1st June 2023. TRAS is dispatched through web-based scheduling system by NLDC every 15 minutes. TRAS dispatch gets incorporated in the net schedule of the TRAS Provider in real time.
- 1.8 Performance evaluation of the TRAS Providers shall be done on a weekly basis. Any deviation from schedule by the TRAS Providers would be handled in line with the provisions under the CERC (Deviation Settlement Mechanism and Related Matters) Regulations, 2022.
- 1.9 The gazette notification of IEGC, 2023 published on 11th July 2023, mandates evaluation of Control Area-wise Performance of SRAS and TRAS Providers. This procedure is prepared in compliance to the Regulation 30(13) of the IEGC, 2023.
- 1.10 SRAS performance evaluation procedure has been provided in detail in the SRAS Detailed Procedure issued by NLDC dated 5.12.2022 (herein after referred to as SRAS Detailed Procedure). The same has been reproduced with modifications in this detailed procedure.
- 1.11 TRAS performance evaluation procedure has also been aligned with the SRAS performance evaluation procedure, with some minor modifications explained wherever necessary.
- 1.12 The words and expressions used in the procedure shall have the same meaning as assigned to them in various CERC Regulations and associated detailed procedures.

2.0 Objective

- 2.1 The objective of this procedure is to lay down a procedure for evaluating control area-wise performance of SRAS and TRAS providers by the Nodal Agency i.e. NLDC in coordination with RLDCs and SLDCs.

3.0 Scope

- 3.1 The procedure shall be applicable to all SRAS/TRAS providers, RLDC, NLDC and RPC and other entities as provided in the IEGC, 2023.

4.0 Definitions

4.1 The words and expressions used in this procedure are defined in the Act or any other regulation specified by the Central Commission, unless the context otherwise requires, shall have the meanings assigned to them under the Act or other regulations specified by the Central Commission, as the case may be.

5.0 Roles and responsibilities

5.1 The Nodal Agency i.e. NLDC, in coordination with RLDCs, shall estimate the performance of SRAS & TRAS providers on daily basis or weekly basis, as applicable, as per the methodology specified in this procedure.

5.2 SRAS providers shall telemeter signals to the Nodal Agency as per the signal list given in the SRAS Detailed Procedure.

5.3 TRAS providers shall telemeter the following signals to the respective RLDCs,

- i. Actual MW at ex-bus level
- ii. Governor MW at ex-bus level, factoring Governor On/Off status
- iii. Governor On/Off status

6.0 Methodology of evaluating the performance of SRAS Providers

6.1 Average of SRAS-Up and SRAS-Down MW data shall be calculated by the Nodal Agency every 5 minutes in absolute terms using archived SCADA data at the Nodal Agency. The SRAS provider shall send the AGC data of the previous week ending on Sunday mid-night to the Nodal Agency through email by every Monday in the format provided by NLDC as per the SRAS Detailed Procedure. The data would be reconciled with the data received from the SRAS Provider at the Nodal Agency and shall be used for performance assessment.

6.2 All measurements of secondary control signals from the Nodal Agency to the control centre of the SRAS Provider and actual response of the SRAS Provider shall be carried out on a post-facto basis using SCADA data.

- 6.3 The actual response of the SRAS Provider against the secondary control signals from the Nodal Agency to the control centre of the SRAS Provider shall be monitored by the Nodal Agency.
- 6.4 Performance of the SRAS Provider shall be measured by the Nodal Agency by comparing the actual response against the secondary control signals for SRAS-Up and SRAS-Down sent every 4 seconds to the control centre of the SRAS Provider measured using 5-minute average data.
- 6.5 When the power plant is in Remote mode, the Actual MW should follow the AGC Set Point. The performance metric is measured by plotting the Output versus Input. Actual MW, RULSP (Ramp Limited Unit Load Set Point), GMO (MW input signal to the Governor) are available through SCADA every 4 seconds at a gross level (before auxiliary consumption) from the dedicated RTU. The 4 seconds SCADA data is converted to five minutes average MW data. Consider Circuit Breaker Status (CB Status) and LR Status (Local/Remote) signals in calculations, although DeltaP calculated at the plant level automatically becomes zero when CB or LR Status is OFF. Take CB Status and LR Status at the start of each 5-minutes time block. Map CB status ON as 1 (Note that as CB is a double point signal, its ON value will be 2. Map the same to 1, for multiplication purposes in the formula). Similarly, Map CB Status OFF as 0. Local Remote status (LR) is a single point signal. Map Local as 0 and Remote as 1.

For 'n' units,

- Output = $\sum_{i=1}^n ((Actual\ MW_n - RULSP_n - GMO_n) * CB_n * LR_n)$
- Input = $\sum_{i=1}^n ((DeltaP_n) * CB_n * LR_n)$
- Plot a scatter plot of Output vs Input.
- 288 data points per plant for one day would appear on the scatter plot. Each data point (dot) represents the 5-minute time block performance of the SRAS Provider.

- Add a Trend Line ($Y=mX$) to the plot with Intercept=0. Display equation on chart. Display R^2 value also.
- Check the value of slope or 'm' in $Y=mX$. Ideal performance would be $Y=X$.
- Say the equation is $Y=0.8X$, then consider the performance as 80%. for that day. Performance would be evaluated for each day of the week. There would be one performance metric value calculated for the whole day for each SRAS Provider (see **Format SRAS-2**).
- If the GMO MW input to the governor data is not telemetered by the SRAS Provider, consider the value as zero.
- Note that a poor R^2 value (< 0.5) indicates that the trend line fits with a low confidence, and there may be some external factors, creating outliers, disturbing the actual response. Nodal Agency would keep monitoring and intimate the SRAS Provider to investigate the possible causes, if a sustained low value of R-square is noted. Presently, R^2 value is not being used in the incentive calculation process to keep the mechanism simple, however, R^2 would be constantly reviewed by the Nodal Agency for providing further feedback to CERC.
- If performance is more than 100%, clamp the value to 100%. More than 100% performance may also indicate poor control tuning and any other issue, Nodal Agency would keep monitoring and intimate the SRAS Provider to investigate the possible causes, if sustained over response is noted.

6.6 The Output MW data is derived from Actual MW, RULSP and GMO MW, which are all telemetered SCADA signals and may contain some noise. The method mentioned in **Annexure-I** would be used for filtering the Gross Output MW data while calculating the performance of the power plants under AGC. As a

result, there would be minimal or no manual intervention while carrying out these calculations.

6.7 The measured performance of an SRAS Provider under AGC shall be as under:

Measured performance of an SRAS Provider	Performance category
95% and above	Excellent
75% and below 95%	Very Good
60% and below 75%	Good
50% and below 60%	Average
20% and below 50%	Poor
Below 20%	Unsatisfactory

6.8 The overall performance of a gas-based power plant operating in the combined cycle would be based solely on the performance of the gas turbines.

SRAS Providers shall not place any redundant lag filters or low pass filters which might delay the start of the power plant response beyond 30 seconds. Any non-compliance would automatically affect the performance of the SRAS Provider, measured every day.

7.0 Methodology of evaluating the performance of TRAS Providers

7.1 TRAS-Up and TRAS-Down dispatch instructions shall be considered by the Nodal Agency every 15 minutes in absolute terms using archived data at the Nodal Agency.

7.2 The measurement of 15 minutes average MW injection/drawal of TRAS Provider shall be carried out using 10 second archived SCADA data.

7.3 Performance of the TRAS Provider shall be measured by the Nodal Agency by comparing the 15 minutes time-block wise actual response against the TRAS dispatch instruction. When the TRAS despatch instruction to a power plant is

zero, the corresponding output shall be considered zero for the purpose of performance evaluation. Thus, only those time blocks shall be considered for performance evaluation in which TRAS despatch instruction is given by the Nodal Agency.

7.4 Performance metric is measured by plotting the Output versus Input. All the values for calculating input and output will be considered at the ex-bus level.

7.4.1 For plants participating in SRAS, Actual MW, GMO and AGC DeltaP data are available at gross level at NLDC. The auxiliary consumption of such TRAS providers shall be duly factored in the Actual MW, AGC DeltaP and GMO for the purpose of performance evaluation.

7.4.2 For other TRAS providers, Actual MW and GMO MW data available at respective RLDC shall be used. GMO MW has to be wired by the power plants to send to RLDCs through IEC-101/104, if not wired already. RLDCs shall send the GMO MW data to NLDC through ICCP.

7.4.3 For evaluating performance, 10 seconds SCADA data shall be converted to 15 minutes average MW data. For a TRAS Provider 'p',

$$\bullet \text{ Output} = (Actual\ MW'_p - (RLDC\ Schedule_p - TRAS\ DeltaP_p) - AGC\ DeltaP'_p - GMO'_p)$$

where, Actual MW'_p is the 15-minutes MW average ex-bus generation

TRAS DeltaP_p is the applied TRAS MW quantum for the 15-minute time-block

AGC DeltaP'_p is the 15-minute MW average ex-bus AGC DeltaP, if applicable

GMO'_p is the 15-minute MW average input to governor, calculated at ex-bus

$$\bullet \text{ Input} = TRAS\ DeltaP_p$$

• Plot a scatter plot of Output vs Input.

- 672 data points per plant for one week would appear on the scatter plot. Each data point (dot) represents the 15-minute time block performance of the TRAS Provider.
- Add a Trend Line ($Y=mX$) to the plot with intercept=0. Display equation on chart. Display R^2 value also.
- Check the value of slope or 'm' in $Y=mX$. Ideal performance would be $Y=X$.
- Say the equation is $Y=0.8X$, then consider the performance as 80% for that day. Performance would be evaluated for each day of the week. There would be one performance metric value calculated for the whole day for each TRAS Provider (see **Format TRAS-1**).
- If the GMO MW input to the governor SCADA data is not available at NLDC/RLDC, consider the value as zero.
- Note that a poor R^2 value (< 0.5) indicates that the trend line fits with a low confidence, and there may be some external factors, creating outliers, disturbing the actual response. Nodal Agency would keep monitoring and intimate the TRAS Provider to investigate the possible causes, if a sustained low value of R-square is noted. R^2 would be constantly reviewed by the Nodal Agency for providing further feedback to CERC.
- If performance is more than 100%, clamp the value to 100%. More than 100% performance may also indicate poor control tuning and any other issue, Nodal Agency would keep monitoring and intimate the TRAS Provider to investigate the possible causes, if sustained over response is noted.

7.5 The Output MW data is derived from Actual MW, RLDC Schedule, AGC DeltaP, TRAS DeltaP and GMO MW. Except RLDC Schedule and applied TRAS DeltaP,

the above parameters are telemetered SCADA signals and may contain some noise. The method mentioned in **Annexure-I** would also be used for filtering the Output MW data while calculating the performance of the power plants under TRAS.

7.6 The measured performance of a TRAS Provider shall be interpreted as under:

Measured performance of a TRAS Provider	Performance category
95% and above	Excellent
75% and below 95%	Very Good
60% and below 75%	Good
50% and below 60%	Average
20% and below 50%	Poor
Below 20%	Unsatisfactory

8.0 Failure in performance by SRAS Provider

8.1 Poor Performance Metric indicates an underlying problem such as restrictive/conservative limits imposed by the SRAS Provider on the AGC Signal, incorrectly tuned control systems, lack of understanding of the SRAS operating guidelines etc.

8.2 Performance below 20% for two consecutive days by an SRAS Provider shall make the SRAS Provider liable for disqualification for participation in SRAS for a week by the Nodal Agency. The details of such SRAS provider and the period of disqualification shall be provided by the Nodal Agency through respective RLDCs (Format-SRAS2) to RPCs.

8.3 Respective RPCs shall publish the same (Format-SRAS2). Supporting data as per mutually agreed format shall be furnished by NLDC to RPCs, as per the detailed procedure of SRAS. If disqualified by the Nodal Agency, an SRAS Provider shall

be eligible to participate in SRAS again only after rectification of the issues and providing satisfactory explanation by email.

- 8.4 Violation of directions of the Nodal Agency for SRAS under these Regulations shall make the SRAS Provider liable for penalties.

9.0 Failure in performance by TRAS Provider

- 9.1 Respective RPCs shall publish the performance of TRAS Providers as per **Format-TRAS-1** on a weekly basis.

- 9.2 Performance below 20% for two consecutive days by a TRAS Provider shall make the TRAS Provider liable for disqualification for participation in TRAS for a week by the Nodal Agency.

- 9.3 If disqualified by the Nodal Agency, a TRAS Provider shall be eligible to participate in TRAS again only after rectification of the issues and providing satisfactory explanation through e-mail to the Nodal Agency.

Annexure-I: Filtering Output MW data through Normal Distribution

The Output MW data derived for the performance evaluation of SRAS and TRAS Providers contain telemetered SCADA signals, which may contain some noise. The below simple method would be used for filtering the Output MW data.

1. Convert the raw 4sec MW data to 5 min/15 min average MW data using the historian and scripts
2. Collect the 5 min/15 min average MW data into MS Excel files.
3. Read the output MW 5 min average/15 min average MW data into the NoSQL database.
4. Read the gross output data into an array and create a copy.
5. Calculate the Mean and Standard Deviation (σ) of the data of gross output MW
6. Calculate
 - a. (Mean-3*Standard Deviation)
 - b. (Mean+3*Standard Deviation)
7. If the raw copy data \geq to that of Clause 6.a. as calculated above and raw copy data \leq 6.b to that of Clause 6.a. as calculated above, then do not change the data.

Else replace the raw copy data with the implemented DeltaP plant data.

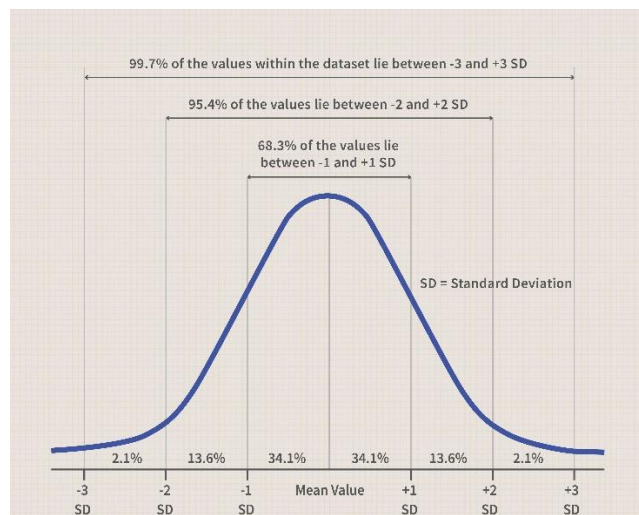
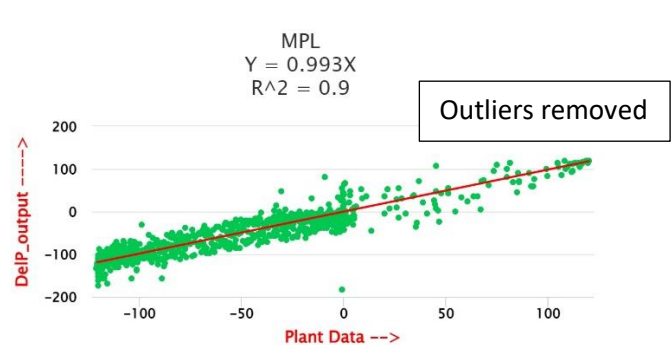
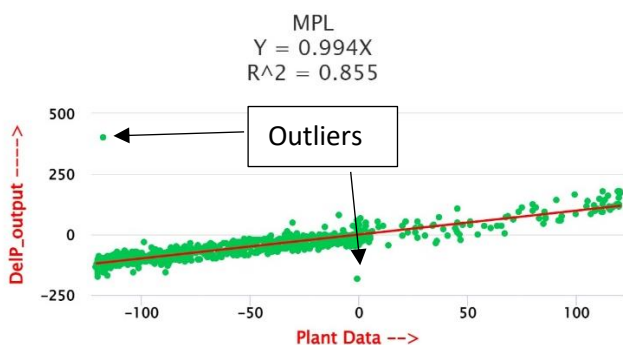
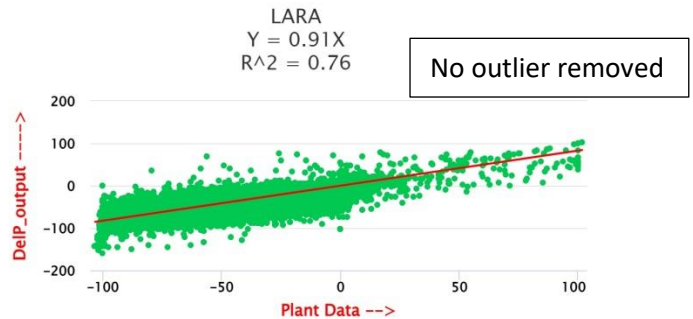
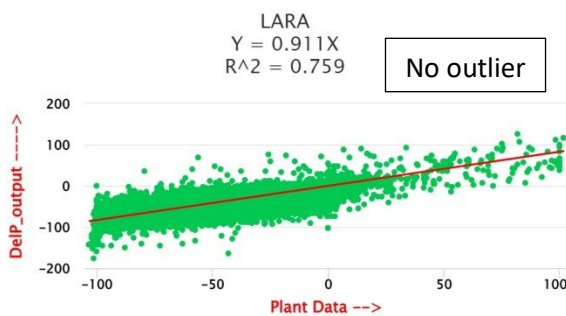
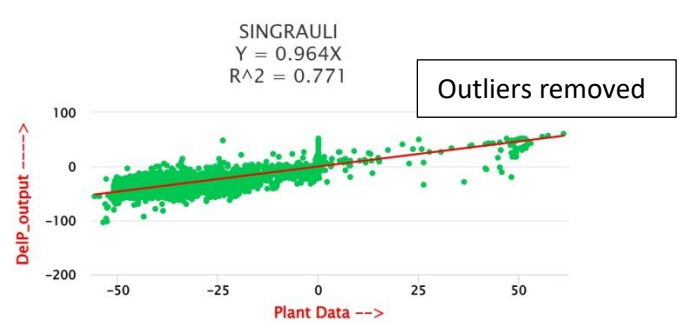
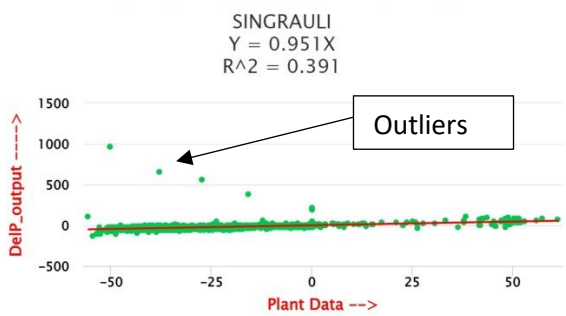


Figure 2: Normal Distribution

8. Because of the above procedure, 99.7% values remain unchanged. The 0.3 % of the outliers in the SCADA data would be replaced with the implemented SRAS/TRAS DeltaP input data, thereby improving the confidence level of the linear trend line. The resulting data may show either a higher, lower or the same performance, varying on a case-to-case basis. Examples of power plant performance before after this data filtering is given below.

Before filtering

After filtering



Format-SRAS-2: SRAS Providers Performance Statement

(To be issued by concerned RPC)

Week:

S I N O	SRAS Provid er(s)	Date1	Date2	Date3	Date4	Date5	Date6	Date7	Remarks (Disqualif ication period)
		Actual perfor mance (%)	Actual perfor mance (%)	Actual perfor mance (%)	Actual perfor mance (%)	Actual perfor mance (%)	Actual perfor mance (%)	Actual perfor mance (%)	
1									
2									
3									
...									
...									
	Total								

Format-TRAS-1: TRAS Providers Performance Statement

(To be issued by concerned RPC)

Week:

S I N O	TRAS Provid er(s)	Date1	Date2	Date3	Date4	Date5	Date6	Date7	Remarks (Disqualif ication period)
		Actual perfor mance (%)	Actual perfor mance (%)	Actual perfor mance (%)	Actual perfor mance (%)	Actual perfor mance (%)	Actual perfor mance (%)	Actual perfor mance (%)	
1									
2									
3									
...									
...									
	Total								