Stakeholder Consultation Workshop

on

Detailed Procedure

of

control area wise performance

of

SRAS and TRAS

(to be submitted for information of the central commission)

Grid Controller of India Limited (Grid-India)
formerly known as POSOCO

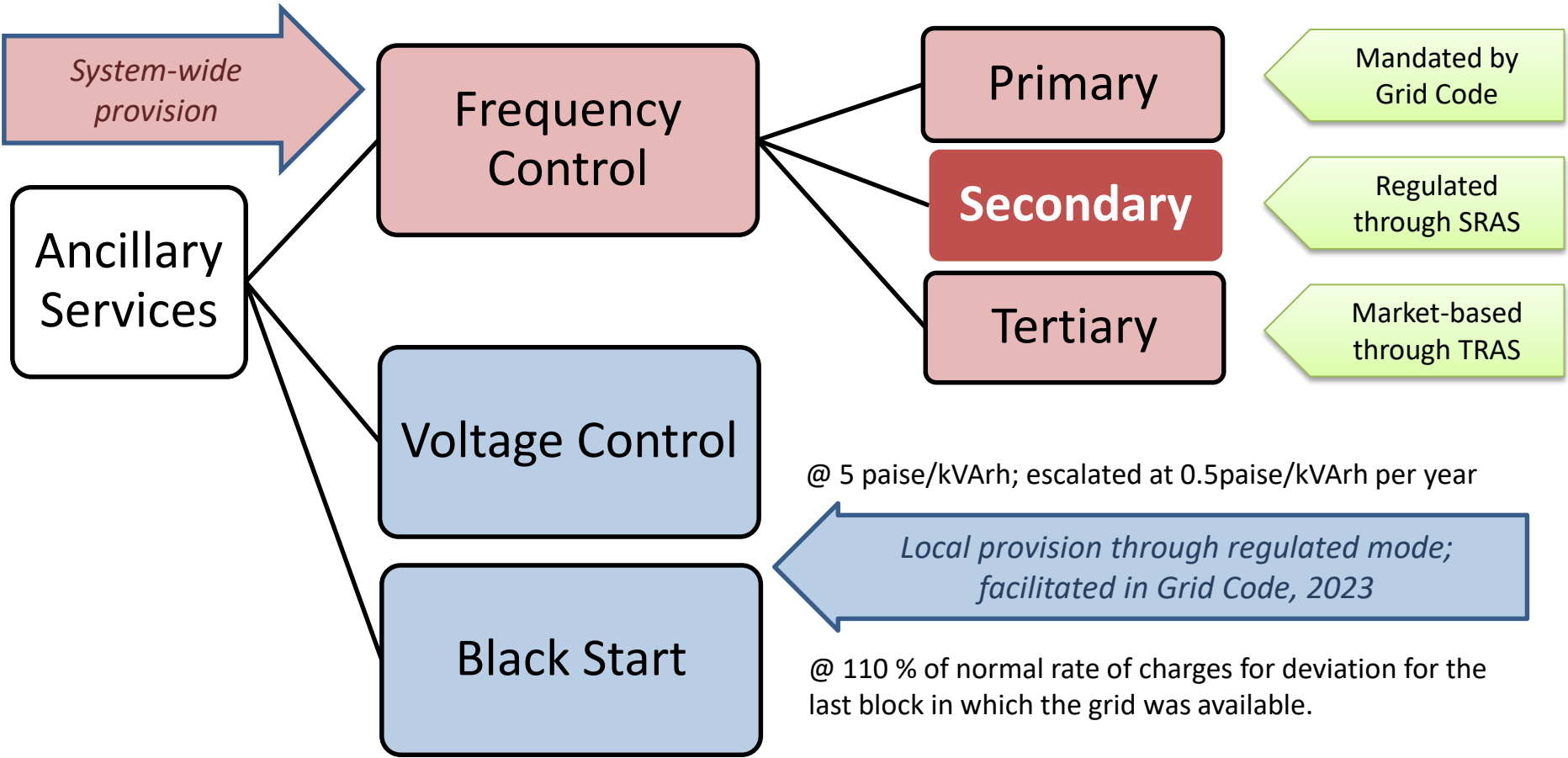# Enabling Regulations

- As per IEGC Regulation 30 (13),

Quote

"The control area wise performance of SRAS, TRAS providers shall be evaluated in accordance with the Detailed Procedure prepared by NLDC"
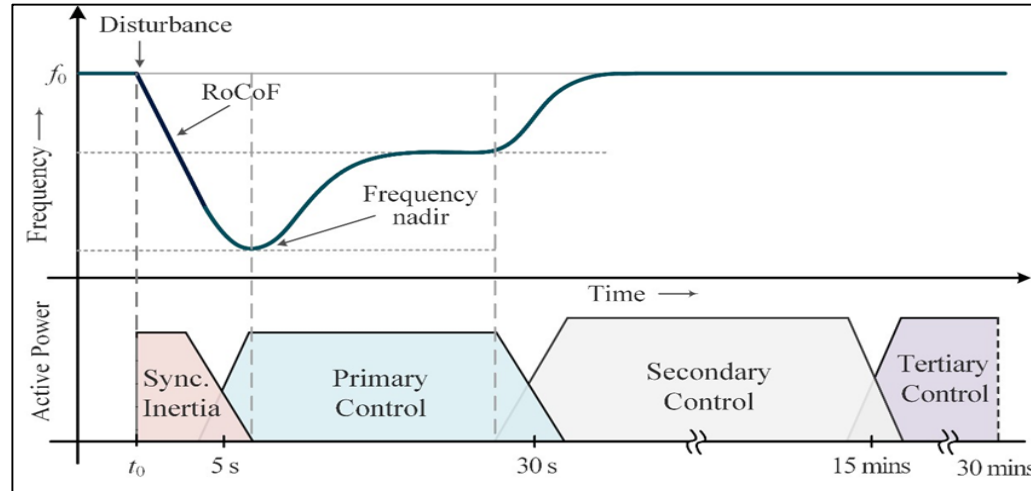
Unquote

- The performance evaluation of SRAS providers is already being done as per the CERC (Ancillary Services) Regulations, 2022 and the detailed procedure for SRAS.
  (https://posoco.in/download/detailed-procedure-for-secondary-reserve-ancillary-services-sras-2022/?wpdmdl=49193)

- The methodology for evaluating performance of TRAS providers has been formulated and aligned with the existing methodology of performance evaluation of SRAS providers.

  - Any deviation from schedule would be handled in line with the provisions under the CERC (Deviation Settlement Mechanism and Related Matters) Regulations, 2022.

Ancillary Services - Classification

System-wide provision

Ancillary Services

Frequency Control
- Primary → Mandated by Grid Code
- **Secondary** → Regulated through SRAS
- Tertiary → Market-based through TRAS

Voltage Control

Black Start

@ 5 paise/kVArh; escalated at 0.5paise/kVArh per year

Local provision through regulated mode; facilitated in Grid Code, 2023

@ 110 % of normal rate of charges for deviation for the last block in which the grid was available.

Frequency Control Ancillary Services

Reserve	Start of activation	Full Availability/ deployment	Ability to sustain the full deployment
Primary Response	Immediately as soon as frequency crosses the dead band	Within 45 seconds	Up to 5 min
Secondary control Reserve	Within 30 seconds after the receipt of Automatic Generation Control (AGC) signal	within 15 Minutes	Up to 30 min or till replaced by Tertiary Reserves
Tertiary control Reserve	Within 15 minutes of dispatch instruction from NLDC/RLDC	Upto 60 minutes	

Automatic Generation Control (AGC) in Brief

- Automatic and supplementary control mechanism, 24x7
  - To control frequency and tie-line flows
- Several signals exchanged with generators every 4 seconds
- AGC will help replenish the exhausted primary reserves
  - Be ready for any next contingency
- Efficient and automatic frequency control during high RE periods
- AGC will improve the reliability of the Indian power system.

NLDC AGC Software ←→ **Fiber Optic Cables** ←→ **Power Plant** → U1, U2, U3
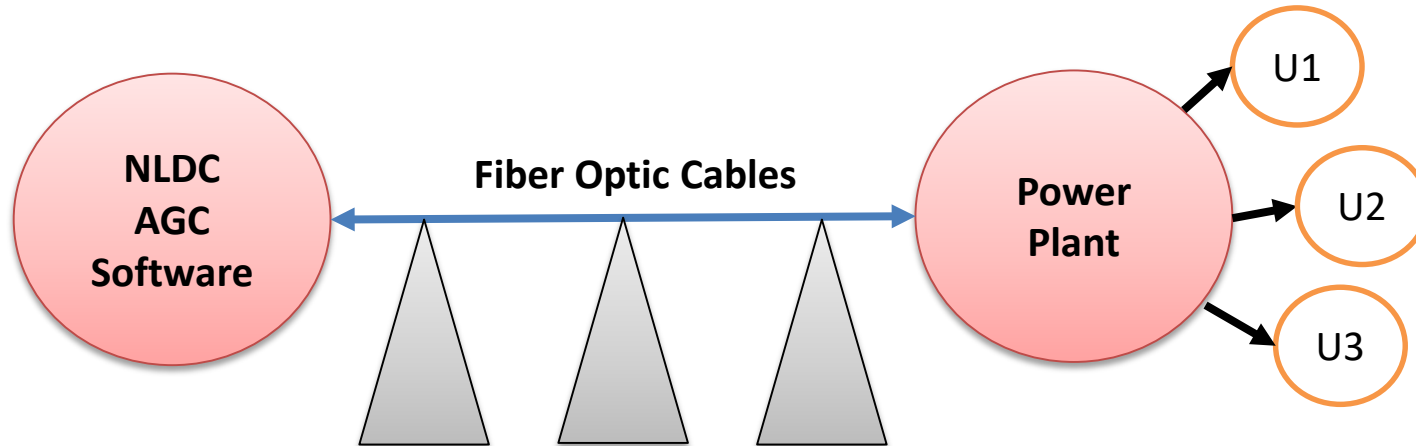
AGC Project Status (as on Aug 2023)
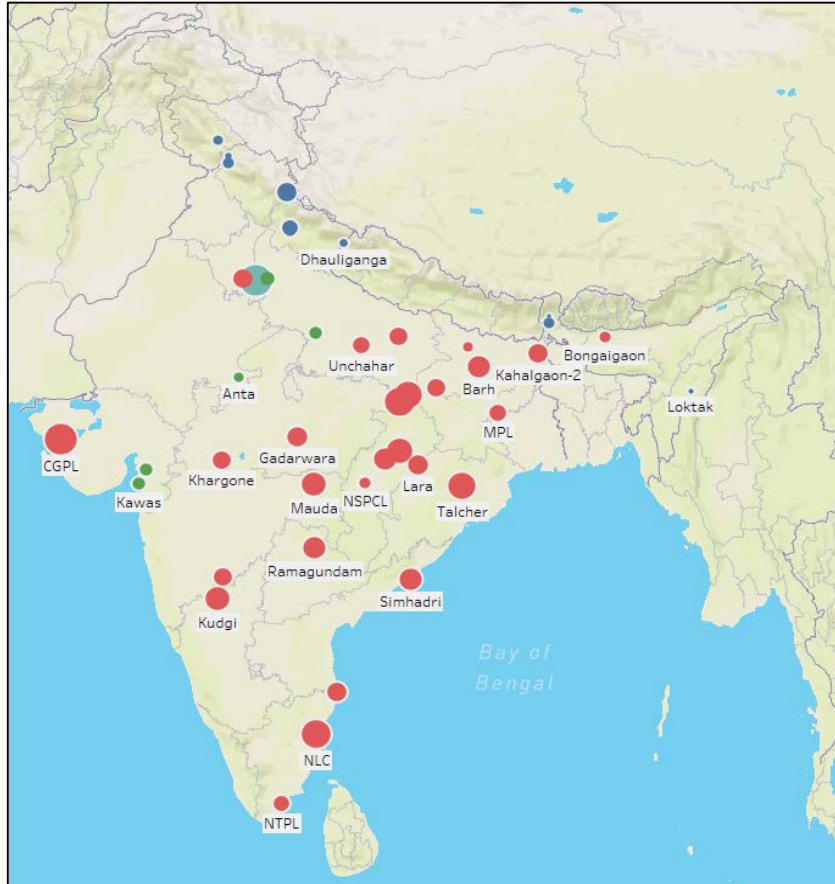
- Large size of the Indian power system
  - Pan India distributed
- 70 power plants with 67337 MW capacity under AGC
  - Coal, Gas, Hydro
- Far away plants in remote from Delhi!
  - NTPL 2760 kms
  - Loktak 2500 kms
- Robust communication infrastructure is important
- Up & Down Regulation up to 1500 - 2000 MW pan-India
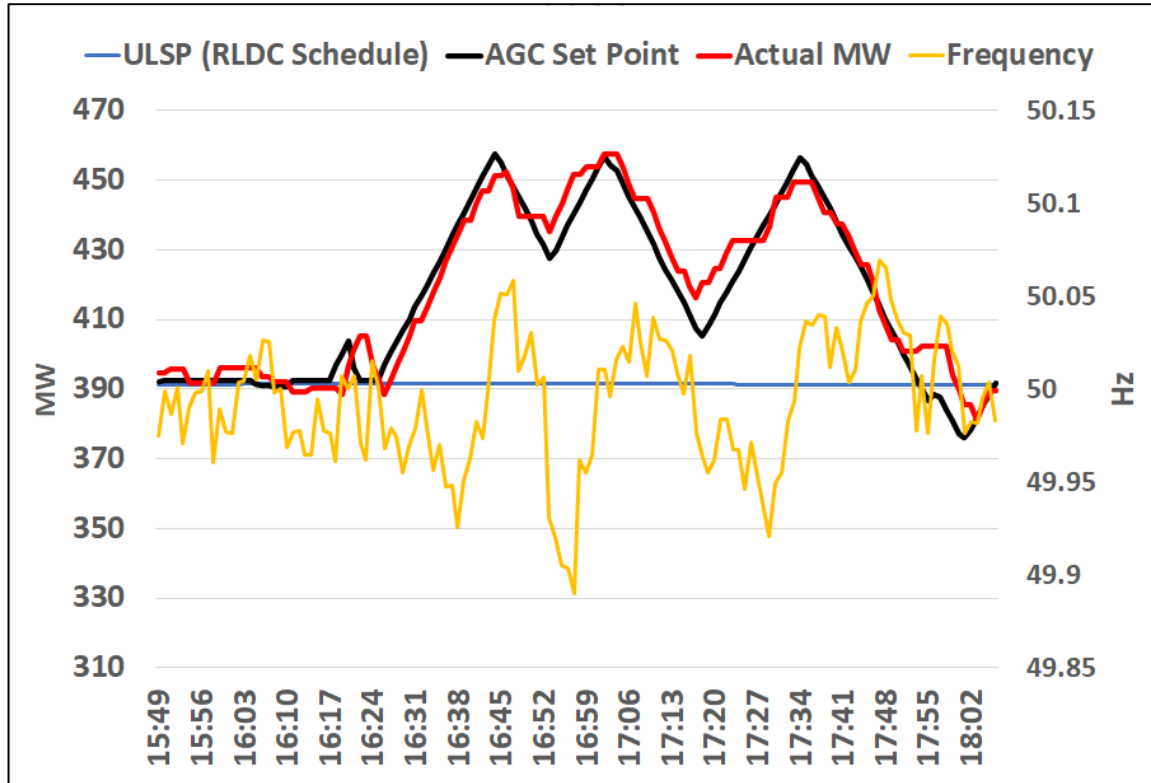
Area Control Error (ACE) Calculation

Region considered as an Area for secondary control

$$ACE = (I_a - I_s) - 10 * B_f * (F_a - F_s) + Offset$$
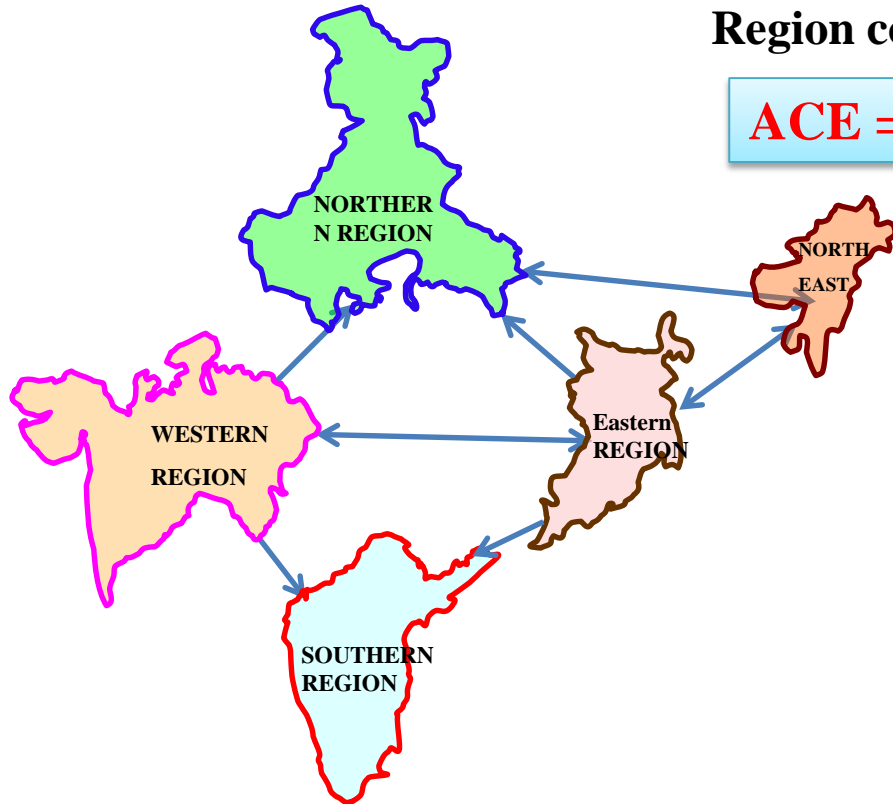
- ❖ I_a = Actual net interchange in MW (positive for export)
- ❖ I_s = Scheduled net interchange in MW (positive for export)
- ❖ B_f = Frequency Bias Coefficient in MW/0.1 Hz (negative value)
- ❖ F_a = Actual system frequency in Hz
- ❖ F_s = Schedule system frequency in Hz (default 50 Hz)
- ❖ Offset = Provision for compensating errors such as measurement error; default value zero
- ❖ ACE positive means area is in surplus and its internal generation has to back down
- ❖ ACE negative means area is in deficit and its internal generation has to increase

IEEE Task Force Report. 2017. "Measurement, Monitoring, and Reliability Issues Related to Primary Governing Frequency Response," Technical Report PES-R-24, October. https://resourcecenter.ieee-pes.org/publications/technical-reports/PESTECRPTGS0001.html

Typical Power Plant Response

Ramp rate honoured, Smooth control of generation

15-min DeltaP data

TB	Avg MW	MWh
TB1	24	6
TB2	20	3
TB3	-12	-3
TB4	-24	-6

5-min DeltaP data

Sub-TB	Avg MW	MWh
TB1(1)	24	2
TB1(2)	-12	-1
TB1(3)	60	5

Methodology of evaluating performance of SRAS Providers…(1)

- Performance evaluation 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.

- Performance metric is measured by plotting the Output versus Input.

  ❑ Output = $\sum_{i=1}^{n}((Actual\ MW_n - RULSP_n - Gov\_MW_n) * CB_n * LR_n)$

  ❑ Input = $\sum_{i=1}^{n}((DeltaP_n) * CB_n * LR_n)$

Methodology of evaluating performance of SRAS Providers...(2)

- ✓ 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 (**Format SRAS-2**)

- • Noise filtering through normal distribution
  - – 99.7% values lie between (Mean-3*Standard Deviation) and (Mean+3*Standard Deviation)
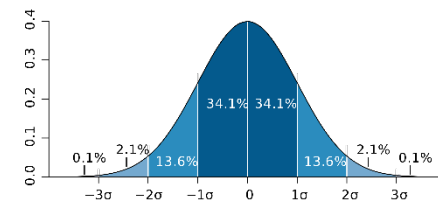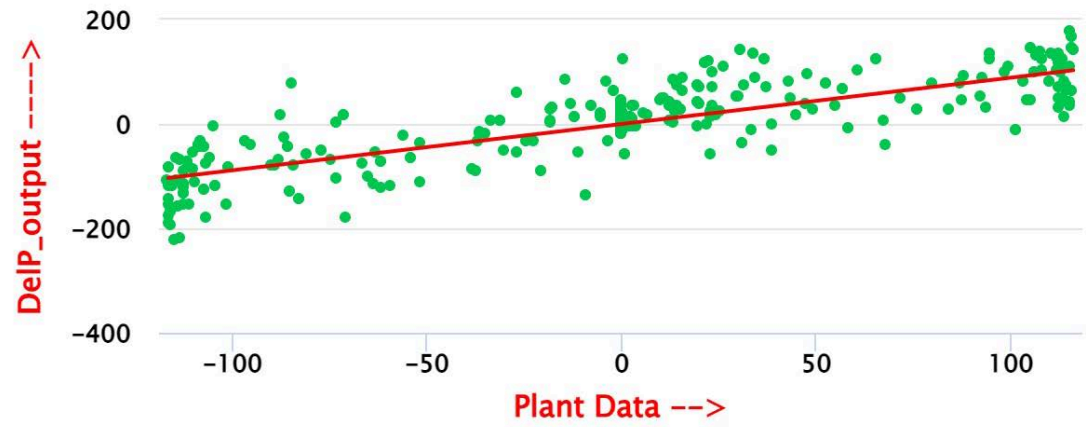
For 'n' units, <u>Output</u> = $\sum_{i=1}^{n}((Actual\ MW_i - RULSP_i - GovenorMW_i) * CB_i * LR_i)$

<u>Input</u> = $\sum_{i=1}^{n}((DeltaP_i) * CB_i * LR_i)$

Actual performance vis-à-vis secondary control signal for an SRAS Provider	Incentive Rate (paise/kWh)
95 % and above	(+) 50
75 % to below 95%	(+) 40
60 % to below 75%	(+) 30
50% to below 60%	(+) 20
20 % to below 50%	(+) 10
Below 20%	0

Y = 0.942X
R^2 = 0.688

Performance would be measured and monitored <u>daily</u> 288 data points per day

94.2 % performance
40 paise/kWh

- 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.

  - Details provided by Nodal Agency through respective RLDCs (Format-SRAS2) to RPCs.

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

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

- Incentive payment as per CERC (Ancillary Services), Regulation 2022.

  - SRAS Provider shall be eligible for incentive based on the performance measured and the 5-minute MWh data calculated for SRAS-Up and SRAS-Down aggregated over a day

Actual performance vis-à-vis secondary control signal for an SRAS Provider	Incentive Rate (paise/kWh)
95 % and above	(+) 50
75 % to below 95%	(+) 40
60 % to below 75%	(+) 30
50% to below 60%	(+) 20
20 % to below 50%	(+) 10
Below 20%	0

Tertiary Reserve Ancillary Service (TRAS)

TRAS in Brief

- Ancillary Service comprising TRAS-Up and TRAS-Down and consists of spinning reserve or non-spinning reserve, which responds to despatch instructions from the Nodal Agency

- Replenishment for SRAS
  - Secondary reserves are to be restored back to their original level for preparation towards next contingency

- Price discovery based on the bids for TRAS-Up & TRAS-Down collected and provided by the Power Exchange(s), and TRAS requirement in the Day Ahead AS Market and Real Time AS Market.

- Activation by Nodal Agency based on the following triggering criteria
  - Secondary reserve through SRAS has been deployed continuously in one direction for fifteen (15) minutes for more than 100 MW
  - Balancing requirements arising due to forecast errors, contingencies, extreme weather conditions, load and net-load variations, renewable generation variation, ramp mismatches, congestion, system frequency profile and/or any other anticipated conditions affecting grid security.
  - Such other events as specified in the prevailing Grid Code.

Scheduling and Despatch of TRAS

- Triggering criterion for dispatch based on trends of SRAS dispatch and balancing requirements

- Dispatched 15-minute before the delivery period

- Dispatch based on inter-se merit order of the market price of the cleared bids of TRAS Providers

- Congestion-factored dispatch

- Dispatch added to schedules of inter-state TRAS Providers, and to state drawal schedules for intra-state TRAS providers

- Communication through Application Program Interface (API) / Scheduling Software

- Intra-State TRAS Providers can read and monitor the API in real-time

- Performance monitoring

- No transmission charges, losses and transmission deviation charges at inter-state level

Shortfall and Emergency Conditions

Shortfall Condition

- **All Section 62 generating stations** shall be deemed to be available for use by the Nodal Agency for SRAS/TRAS/both, subject to technical constraints
- **TRAS-Up**
  - Generating stations would be paid at the rate of 110% of their energy charges for TRAS-Up quantum dispatched
- **TRAS-Down**
  - Generating stations would pay back to pool 90% of their energy charges for the TRAS-Down quantum dispatched

Emergency Condition

- **In case of emergency conditions for reasons of grid security**
  - Nodal Agency may require any generating station to provide Ancillary Services

- **Such generating station shall be compensated at the rate of the**
  - Energy charge as determined under Section 62 of the Act or
  - Energy charge as adopted under Section 63 of the Act or
  - Compensation charge declared by the AS provider, as the case may be.

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Methodology of evaluating performance of TRAS Providers

- 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.

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

- Performance metric is measured by plotting the Output versus Input.

  - ❑ Output = $(Actual\ MW'_n - (RLDC\ Schedule_n - TRAS\ DeltaP_n) - AGC\ DeltaP'_n - Gov\_MW'_n)$

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

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

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

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

  - ❑ Input = $TRAS\ DeltaP_n$

Methodology of evaluating performance of TRAS Providers

- ✓ Plot a scatter plot of Output vs Input.

- ✓ 96 data points per plant for one day 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 (**Format TRAS-1**).

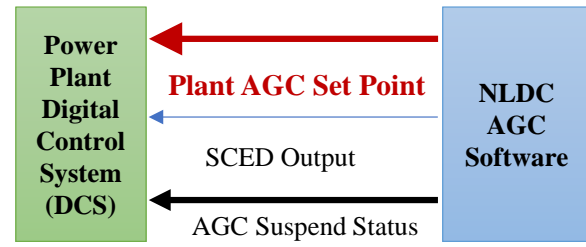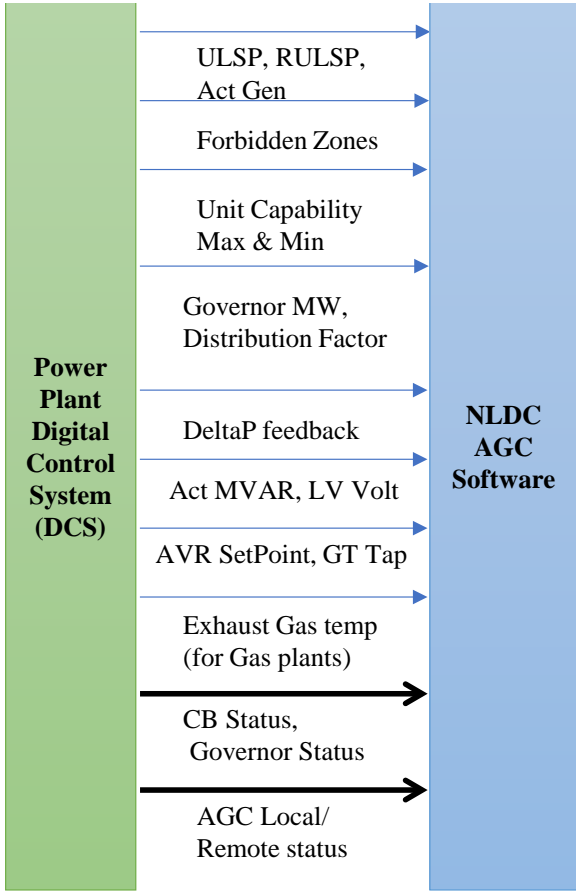- • Noise filtering through normal distribution

Failure in performance by TRAS Providers

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

- 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.

- 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 by email.

Conventional power plant signal list for AGC

SRAS | **TRAS**

Power Plant Digital Control System (DCS) →

- ULSP, RULSP, Act Gen
- Forbidden Zones
- Unit Capability Max & Min
- Governor MW, Distribution Factor
- DeltaP feedback
- Act MVAR, LV Volt
- AVR SetPoint, GT Tap
- Exhaust Gas temp (for Gas plants)
- CB Status, Governor Status
- AGC Local/ Remote status

→ **NLDC AGC Software**

Power Plant Digital Control System (DCS)

- **Plant AGC Set Point**
- SCED Output
- AGC Suspend Status

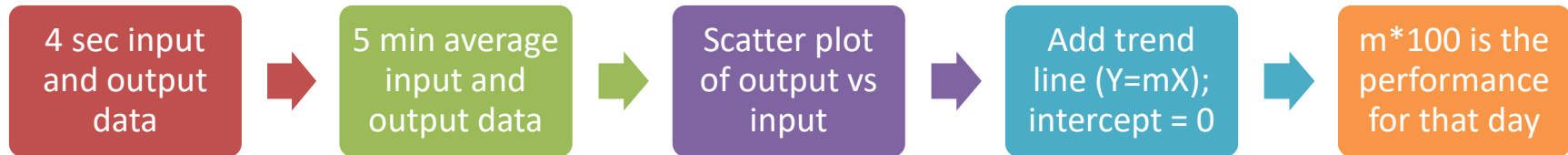← **NLDC AGC Software**

Signals to be exchanged for TRAS

- -Actual MW
- -Governor MW
- -Governor On/Off status
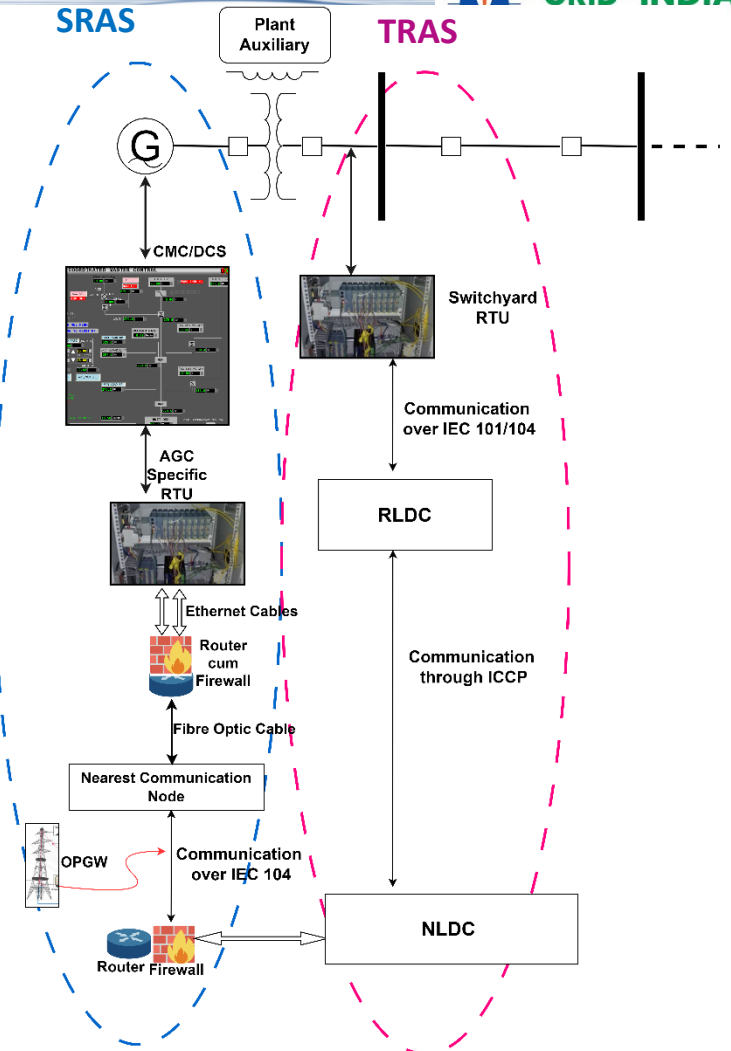
Performance Evaluation Methodology

Methodology for SRAS providers

| 4 sec input and output data | → | 5 min average input and output data | → | Scatter plot of output vs input | → | Add trend line (Y=mX); intercept = 0 | → | m*100 is the performance for that day |

Methodology for TRAS providers

| 10 sec input and output data | → | 15 min average input and output data | → | Scatter plot of output vs input | → | Add trend line (Y=mX); intercept = 0 | → | m*100 is the performance for that day |
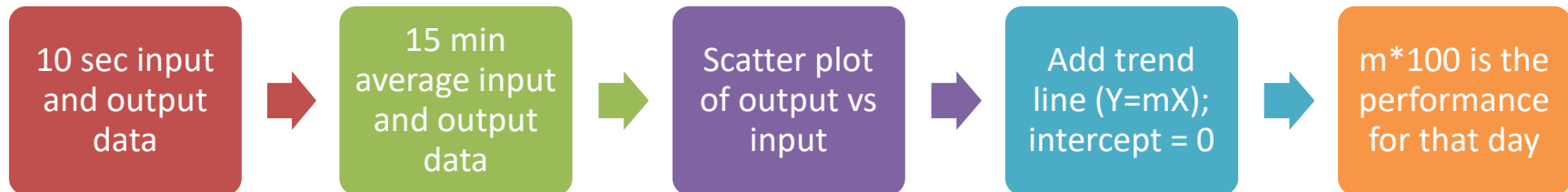
Noise filtering through normal distribution

Comparison in performance evaluation

Attribute	Performance Evaluation – SRAS providers	Performance Evaluation – TRAS providers
Signal exchange	with NLDC	with respective RLDC
Signal level	Gross level	Ex-bus level
Resolution	4 seconds	10 seconds
Performance calculation interval	5 minutes	15 minutes
Periodicity	Daily	Daily
Methodology	Input vs Output scatter plot	Input vs Output scatter plot

Regulations & Procedures

1. Central Electricity Regulatory Commission (Indian Electricity Grid Code) Regulations, 2023.
1. Gazette
2. Notification
3. Gazette - effective date 1.10.2023 (Gazette No. 575)
4. Notification - effective date 1.10.2023

2. Central Electricity Regulatory Commission (Ancillary Services) Regulations, 2022.
1. Gazette
2. Notification
3. Statement of Reasons
4. Gazette - effective date 05.12.2022 (Gazette No. 546)
4. Notification - effective date 05.12.2022

3. Detailed Procedure for Secondary Reserve Ancillary Services (SRAS) – 2022.

https://posoco.in/download/detailed-procedure-for-secondary-reserve-ancillary-services-sras-2022/?wpdmdl=49193

4. Detailed Procedure for Tertiary Reserve Ancillary Services (TRAS) – 2023.

https://posoco.in/download/detailed-procedure-for-tertiary-reserve-ancillary-services-tras/?wpdmdl=51157

5. Draft Detailed Procedure For Estimation of the Requirement of Secondary Reserve Ancillary Service (SRAS) and Tertiary Reserve Ancillary Service (TRAS) at Regional Level (Last date for comments: 12th Sep 2023)

https://posoco.in/download/draft-detailed-procedure-for-estimation-of-the-requirement-of-sras-and-tras-last-date-for-comments-12th-sep23/?wpdmdl=53305

Thank You !

Questions
Suggestions
agcnldc@posoco.in
ancillary@posoco.in

Format-SRAS-2: SRAS Providers Performance Statement

(To be issued by concerned RPC)

Week: …………………………….

Sl No	SRAS Provider(s)	Date1 Actual performance (%)	Date2 Actual performance (%)	Date3 Actual performance (%)	Date4 Actual performance (%)	Date5 Actual performance (%)	Date6 Actual performance (%)	Date7 Actual performance (%)	Remarks (Disqualification period)
1									
2									
3									
…									
…									
	Total								

Back

Format-TRAS-1: TRAS Providers Performance Statement

Week: …………………………….

Sl No	TRAS Provider(s)	Date1 Actual performance (%)	Date2 Actual performance (%)	Date3 Actual performance (%)	Date4 Actual performance (%)	Date5 Actual performance (%)	Date6 Actual performance (%)	Date7 Actual performance (%)	Remarks (Disqualification period)
1									
2									
3									
…									
…									
	Total								