Curtailment of Wind Energy Generators

by

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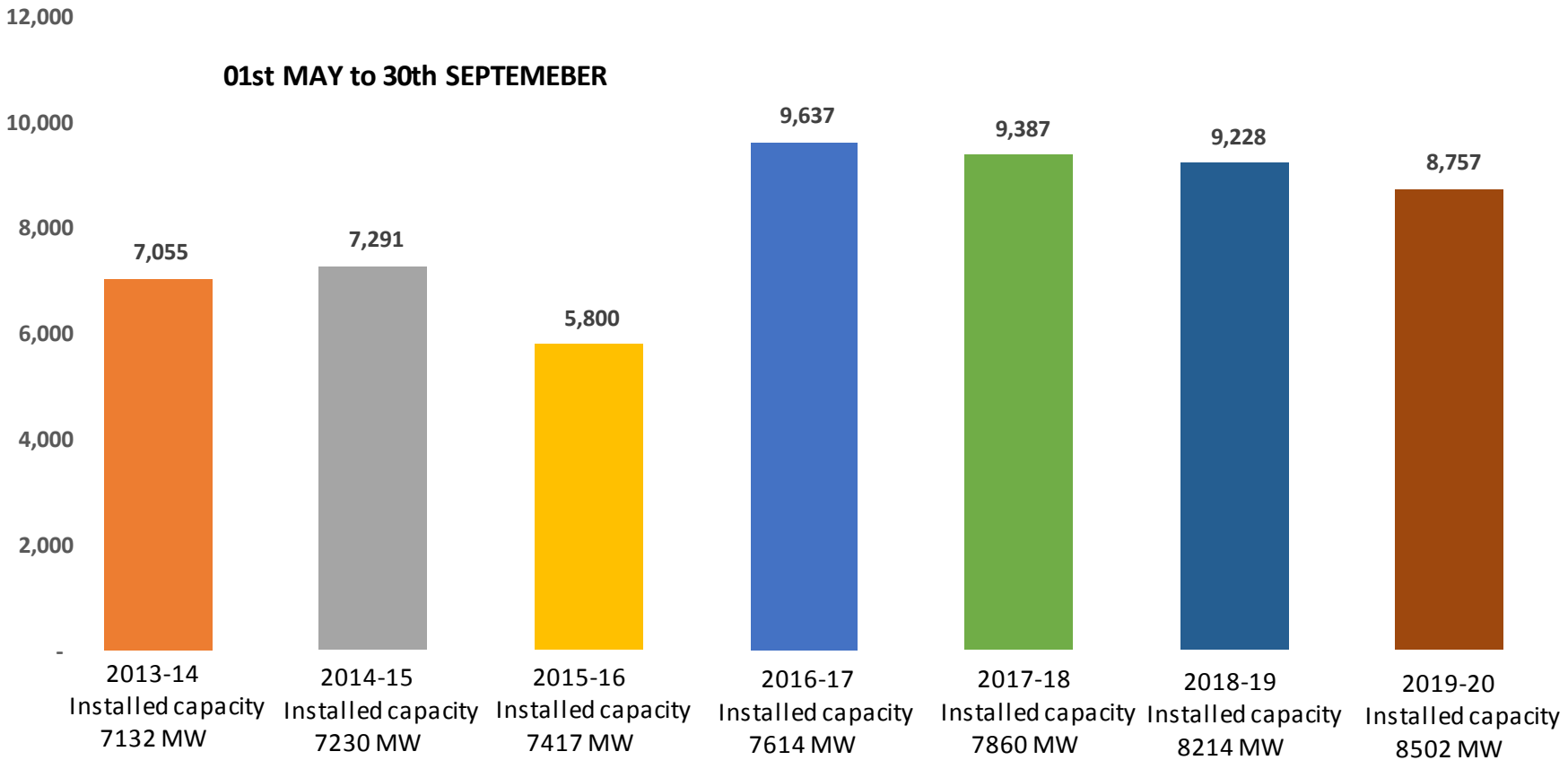
TN Wind Evacuation in MU



Evacuation Data

- Average wind Energy Evacuated in 2018 --- 81.8 MU
- Average wind Energy Evacuated in 2019 --- 66.4 MU (Drop of 18.8 %)
- Average Consumption of TN State in 2018 --- 293 MU
- Average Consumption of TN State in 2019 --- 296 MU (Marginal increase of 1%)
- Average Temperature of TN State in 2018 --- 27.3 ˚C
- Average Temperature of TN State in 2019 --- 28.7 ˚C (Marginal Increase of 5%)
- Average Rain fall of TN State in 2018 --- 2.6 MM
- Average Rain fall of TN State in 2019 --- 0.8 MM (Decrease of 69.2%)
- Average Curtailment of Wind Power in 2018 --- 1.87 Hrs. per day
- Average Curtailment of Wind Power in 2019 --- 3.52 Hrs. per day (Increase of 88.2%)

Reduction in Generation during 2019

- There is a marked reduction in aggregate wind energy generation during wind season 2019.
- Primary reason for drop in generation is back down of WEGs, particularly during the peak wind season.
- Back down hours between May and Sep (peak wind season) in 2019 increased by more than 100% compared to the same period in 2018.

Duration of back down hours - Summary

Substation	Apr-18 to Sep-18	Apr-19 to Sep-19
Substation-01	79	190.2
Substation-02	73.7	214.7

Duration of back down hours - Summary

Substation	Apr-18 to Dec-18	Apr-19 to Dec-19
Substation-01	85	307.3
Substation-02	76.5	305.8

Generation loss due to curtailment

S.No	Injection Point (CTU/STU) and name of substation)	Month	Total Curtailment (MU)	SLDC	MW connected	Grid loss per MW
1	110/22KV SubStation (CTU) Anthiyur SS, Poolakinar SS, Udumalpet SS	Apr'19	0.1153	Erode	47.9	0.102
		May'19	0.3122			
		Jun'19	0.5899			
		Jul'19	0.9846			
		Aug'19	1.3872			
		Sep'19	0.8414			
		Oct'19	0.6479			
2	110/22KV SubStation (CTU) Melkaraipatti SS, Thalayuthu SS	Apr'19	0.0539	Madurai	24.8	0.138
		May'19	0.2278			
		Jun'19	0.4453			
		Jul'19	0.7134			
		Aug'19	0.7299			
		Sep'19	0.7364			
		Oct'19	0.5075			
3	400/110KV SubStation (CTU) Kamatchipuram (10/1) SS	Apr'19	0.0877	Madurai	19.5	0.209
		May'19	0.2240			
		Jun'19	0.5695			
		Jul'19	0.7081			
		Aug'19	0.9014			
		Sep'19	0.7444			
		Oct'19	0.8318			
4	Sundankurichi 110 KV SS /11KV	Apr'19	0.000	Madurai	3	0.13
		May'19	0.028			
		Jun'19	0.090			
		Jul'19	0.086			
		Aug'19	0.123			
		Sep'19	0.034			
		Oct'19	0.009			
		Nov'19	0.000			
		Dec'19	0.020			
5	Sundankurichi 110 KV SS / 33kV Feeder	Apr'19	0.029	Madurai	7.5	0.30
		May'19	0.083			
		Jun'19	0.363			
		Jul'19	0.339			
		Aug'19	0.487			
		Sep'19	0.326			
		Oct'19	0.241			
		Nov'19	0.058			
		Dec'19	0.328			

Summary of Curtailment loss

Substation	MW	Grid Loss in MU
Substation-01	47.85	4.88
Substation-02	24.80	3.41
Substation-03	19.50	4.07
Substation-04	3.00	0.39
Substation-05	7.50	2.25
	102.65	**15.00**

Average loss of generation in units per MW **0.146** MU

Estimated generation loss for TN for installed capacity of 8502 MW **1243** MU

Estimated Loss of generation on account of curtailment in % **10%**

Increased instances of backdown in 2019

- Apart from increase in duration of back down hours the number of instances of back down has increased this year.
- This is attributed to the need to comply with sign change requirement
- Such frequent forced back down , besides causing generation loss, leads to increased premature failure of sensitive components in the WEG due to switching transients
- For example, in one substation, total number of interruptions during the period Apr to Dec-19 was 196 times while during the corresponding period in 2018 it was 91 times

Reasons adduced by SLDCs for backdown

1) Primary reason attributed by SLDC for back down is to maintain " Grid stability" and compliance to New DSM regulations.

- The recent amendment to DSM regulations requires SLDC to change deviation sign once every 12 time blocks (wef 1.4.2020 this will become once every 6 time blocks) or bring the deviation within + or – 10 MW. It is learnt that this sign change requirement is coming in the way of absorbing the RE energy.

Reasons adduced by SLDCs for backdown

- Amendment to DSM regulation has in effect partially taken away the benefits of the deviation limit of 250 MW fixed for RE rich states, as sign change will force them to back down even when the SLDCs operate within the permissible deviation limit of 150/250 MW

2) Deviation from forecast of wind energy generation

3) Reduction in overall demand/load

Deviation - Unavoidable

- 100% accurate prediction of weather data on a fifteen minute basis at different hub heights for estimating the generation of wind power is very difficult and not possible.
- When even with sophisticated tools, weather models have not been able to predict the rains accurately, to predict wind speed on a 15 minute block at varying hub heights is even more complex .
- Hence deviation from forecast cannot be avoided.

Variation in wind speed forecast - Impact on generation

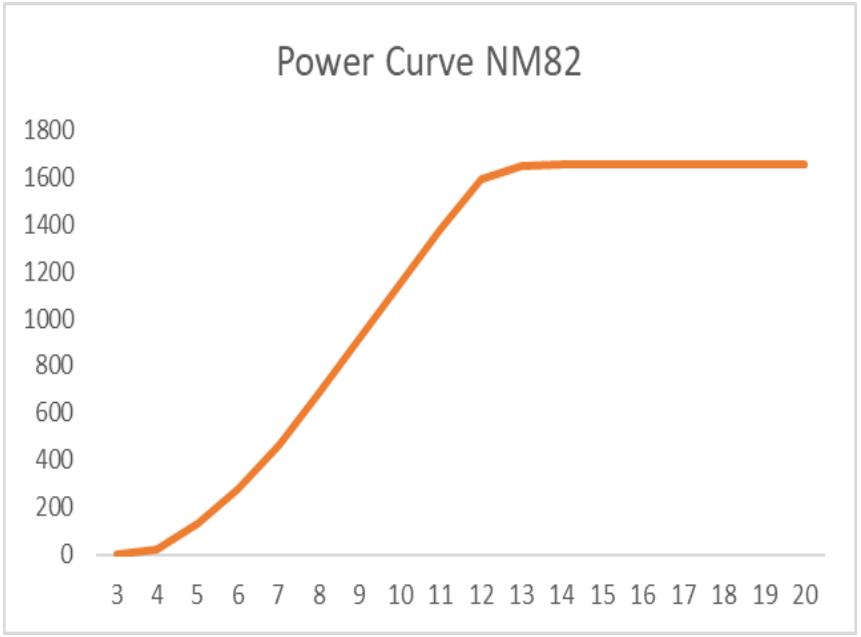
- The variation in generation on account of variation in wind speed is not linear.

- A 15% increase in wind speed could even result in a variation in generation more than 75%.

- Generally there would be instances of compensatory deviation across different sites that would minimize the overall deviation at the state level.

Small variation in wind speed leads to huge variation in generation

NM82 (1.65MW)			
Wind speed (M/s)	Power (KW)	% of Increase in WIND	% of Increase in Generation
3	0		
4	22		
5	129	25%	486%
6	280	20%	117%
7	465	17%	66%
8	683	14%	47%
9	916	13%	34%
10	1147	11%	25%
11	1379	10%	20%
12	1588	9%	15%
13	1643	8%	3%



Observation made by CERC / POSOCO Report

- The report of POSCO in its conclusion for Tamil Nadu, based on the 2013-14 data, declares that

  - Wind generation variability has negligible adverse effect on deviation from the schedule

  - Conventional generation change affects deviation 2-3 times more than wind generation, though in high wind season, the two are comparable.

  - Demand changes affects deviation 8-9 times more than wind generation, which drops to 3-4 times in high wind season.

Tamil Nadu Scenario

- Total installed capacity in TN-8502 MW
- Total No of wind substations -124
- Of which Distribution SS-66
- Generation capacity connected to Distribution SS-2007 MW
- Lowest WEG Capacity in SS-1.6 MW
- Highest capacity of SS-210 MW
- No of Mixed feeders -67
- Capacity in mixed feeders -480.3 MW

DSM regulations exempts inter state RE from sign change requirement

- Recognising that RE power is infirm, variable and intermittent , CERC has exempted the RE stations connected to RLDCs from sign change requirement under the DSM regulations.
- However such an exemption is not extended to intra state entities
- IWPA submits that CERC should extend the exemption in the regulation to RE power connected to intra state entities as well. This would imply that the sign change compliance would have to be made excluding the deviation from RE power.

DSM regulations exempts inter state RE from sign change requirement

- CERC has earlier fixed different deviation limits for SLDCs depending upon the installed capacity of RE.

- This was done after considering the ground level realities of the problems faced by RE rich states.

- A similar approach is now required for protecting the RE rich states to avoid back downs.

Balancing

- Balancing is another major issue faced by RE rich states now
- Political boundary happens to be electrical boundary
- European countries manage RE so effectively balancing across the countries
- Excess/shortage due to variable RE input to be absorbed without wastage

Lack of adequate balancing

- States with high RE penetration are not able to balance the variability , particularly intra day, with the available balancing resources. A pan India balancing mechanism (or at least regional balancing to start with) is required to be evolved for RE rich states
- Rate of ramp up/ down at times is not in sync with intermittency /variability of RE power and hence SLDCs find it difficult to accommodate the RE power and schedule RE power conservatively.
- Some times even when the actual generation is in line with the forecast, due to lack of adequate balancing, and due to sign change requirement back downs are resorted to by the SLDCs.
- Possibility of bringing the RE power under RLDCs as a separate control area to avoid back down and exempt states from DSM on RE power deviation can be explored. Balancing responsibility will not be of that of states and would pave way for full absorption of RE energy,

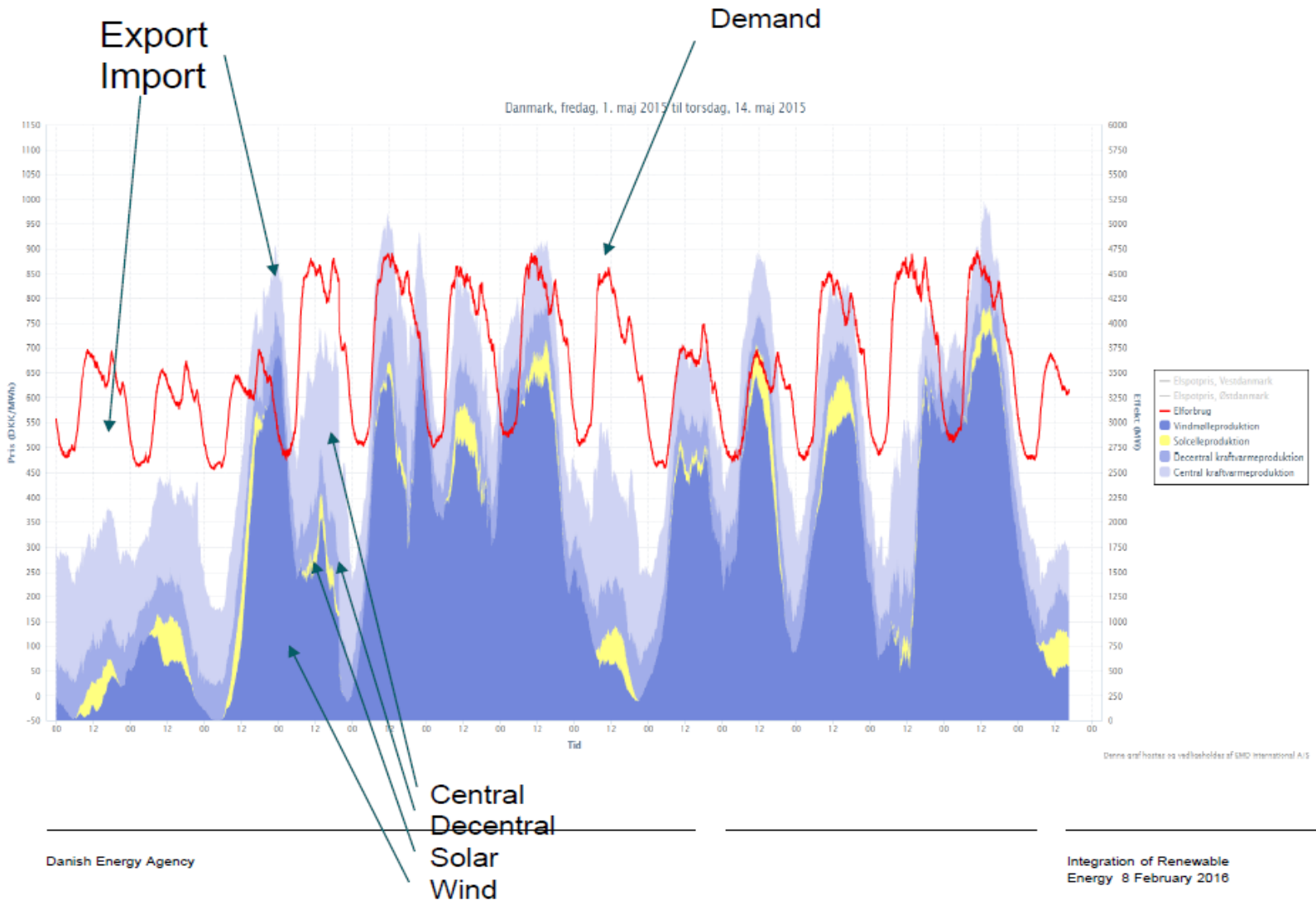
Suggestions for better compliance

- While there are real hurdles SLDCs are facing in integrating RE, there are also instances when the RE power is backed down for avoidable reasons
- SLDCs do not give any written instructions stating the reasons for back down. There is no transparency on the need to back down RE power
- Transparent data on a real time basis of generation from all sources to be mandatorily web hosted by all SLDCs. This will bring in better accountability on SLDCs to adhere to the MUST RUN and Merit order.
- Provide for compensation to RE generators by SLDCs / DISCOMs for illegal back down. MNRE already has sent letters in this regard
- Bring in two part tariff to all RE plants like in the case of conventional plants.

Suggestions – summary

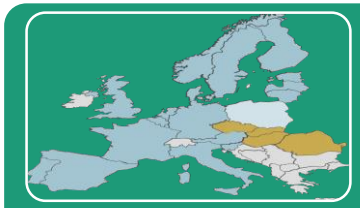
- Sign change exemption to be granted to intra state RE power as well
- Promote swapping of power from RE rich states to other states during the wind season/ surplus to absorb the available energy in full. Waive the transmission charges for such swapping transactions
- Create a pan India balancing mechanism
- Make AGC mandatory for all thermal stations
- Bring all RE power under RLDC a separate control area
- Make web hosting of real time data mandatory by all SLDCs
- Provide for compensation for back downs to RE generators. MNRE has already issued a letter to all states in this regard
- Reduction of technical minimum of state owned thermal plants also to 55%
- Green corridor by PGCIL
- Setting up of operational REMC by PGCIL before next wind season
- Provision of good forecasting by REMC
- Provision of real time generation data

Denmark Power Trend for 14 Days



Efficient integration of wind power on the way to 50% by 2020 through

Strong transmission grids and interconnectors



International electricity markets

Flexible generation system

Specialized forecasting and operational planning tools

TN Experience on Centralised Forecasting

Centralised Forecast

% of blocks within Range for Aggregated Forecast		
within 10%	10% - 20%	more than 20%
99.52%	0.34%	0.00%
99.68%	0.08%	0.00%
98.55%	1.07%	0.00%
83.46%	13.51%	0.17%
81.44%	15.02%	0.71%
73.12%	18.33%	4.71%
83.89%	10.30%	1.90%
70.00%	17.30%	9.11%
89.84%	6.03%	0.83%
83.87%	10.69%	1.92%
100.00%	0.00%	0.00%
98.90%	0.25%	0.85%
87.60%	**8.40%**	**1.79%**

Sub station wise Forecast

summary of Indivisual SS, % OF blocks within deviation band			
Within 10%	10%-20%	20-30%	>30%
73%	**15%**	**6%**	**6%**

NREL GTG Report

The Indian power grid is a single interconnected system; however, it is operated in a decentralized manner. Because the DISCOMs/SLDCs are scheduling plants within their own balancing area with limited knowledge of schedules of neighboring balancing areas, there is little coordination among DISCOMs/SLDCs across states, which represents an economic inefficiency. This uncoordinated commitment and dispatch among neighboring areas could, for example, result in two neighboring states running plants at part-load. A more efficient outcome would be if the more economic plant were to run at a higher (or full) output level, allowing the more expensive plant to be either turned down or shut off, depending on specific conditions. If this coordination were to occur only in the economic dispatch time frame, then the most likely outcome would be that the costlier unit would be dispatched down and the least costly unit would be dispatched up. If the coordination were to also include unit commitment, then it is possible that the costlier unit could be turned off or not started in the first place, allowing greater economic savings.

5 STRATEGIES TO IMPROVE RE INTEGRATION

While the previous section analyzed the impacts of adding 160 GW wind and solar to the power system with the operating characteristics of today, the objective of this section is to evaluate changes to power system operations that have the potential to more efficiently integrate variable RE. To evaluate these changes, we compare the impacts of the strategies on electricity production costs and RE curtailment. Introducing one change at a time to the model makes it possible to evaluate the benefit of specific strategies, either individually or in combination, to provide insights for decision-makers. All sensitivities are conducted on the 100S-60W scenario, unless otherwise noted.

The sensitivities we evaluated are listed in the following tables (Table 17 through Table 21) address five aspects of flexible operations:

- National and regional coordination of scheduling and dispatch
- Operation of coal plants
- Availability of transmission
- Availability of storage
- Availability of hydro energy.

Permission to attend OCC meetings

- We have been attending OCC meetings of SRPC during 2017 and 2018.
- We have not been permitted to attend the OCC meetings during 2019. (The reasons we do not know)
- We have been told that only SRPC members can attend the meetings
- We have applied for the Membership of SRPC. We are yet to receive the response

QUESTIONS?

Thank you for your attention.