

Southern Company

Transmission

BA Operation for Loss of EMS

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Power Coordination Center Training



Your EMS *is* going to go down sooner or later



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What do we do then?

- Our goal, as trainers, is to make sure that our operators are prepared for this contingency
- This has the added benefit of giving them a greater understanding of their day to day operation. It makes them think about where all those numbers come from...



Focus will be on the BA

- Today we will train on how the BA will do his job if we lose the EMS system and any back up system you have.
- This same process needs to be applied to each function/console in your shop
- This same process needs to be applied to each tool in your shop

What are we going to learn?

By the end of this presentation you will be able to:

- Identify the information that *is* available when your EMS system goes down
- Use this information to manually calculate your ACE and system load
- Create a process to manually dispatch your resources
- Discuss solutions to mistakes that can be made in that process
- Develop a training program to prepare your operators for this contingency

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And we'll do this in two hours...☺



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Conditions

- Your EMS is down
- There is no AGC control
- There are no screens monitoring your ACE, generation totals, unit details, or load
- The only frequency monitor is plugged into a wall outlet.
- The capability to schedule interchange is still working
- OASIS, IDC, RCIS, and all communications are working
- Your corporate computer system is still working and you have access to your normal programs and references

Quick review of what Balancing Authority (BA) Operators do.



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They balance obligations with resources,...

Obligations include:

- Native load
- Firm Sales
- Reserve Sharing Agreements
- Generator Back Up Agreements
- Frequency
- Trans. Constraints/NNL
- Ramp Rates
- Environmental

Resources include:

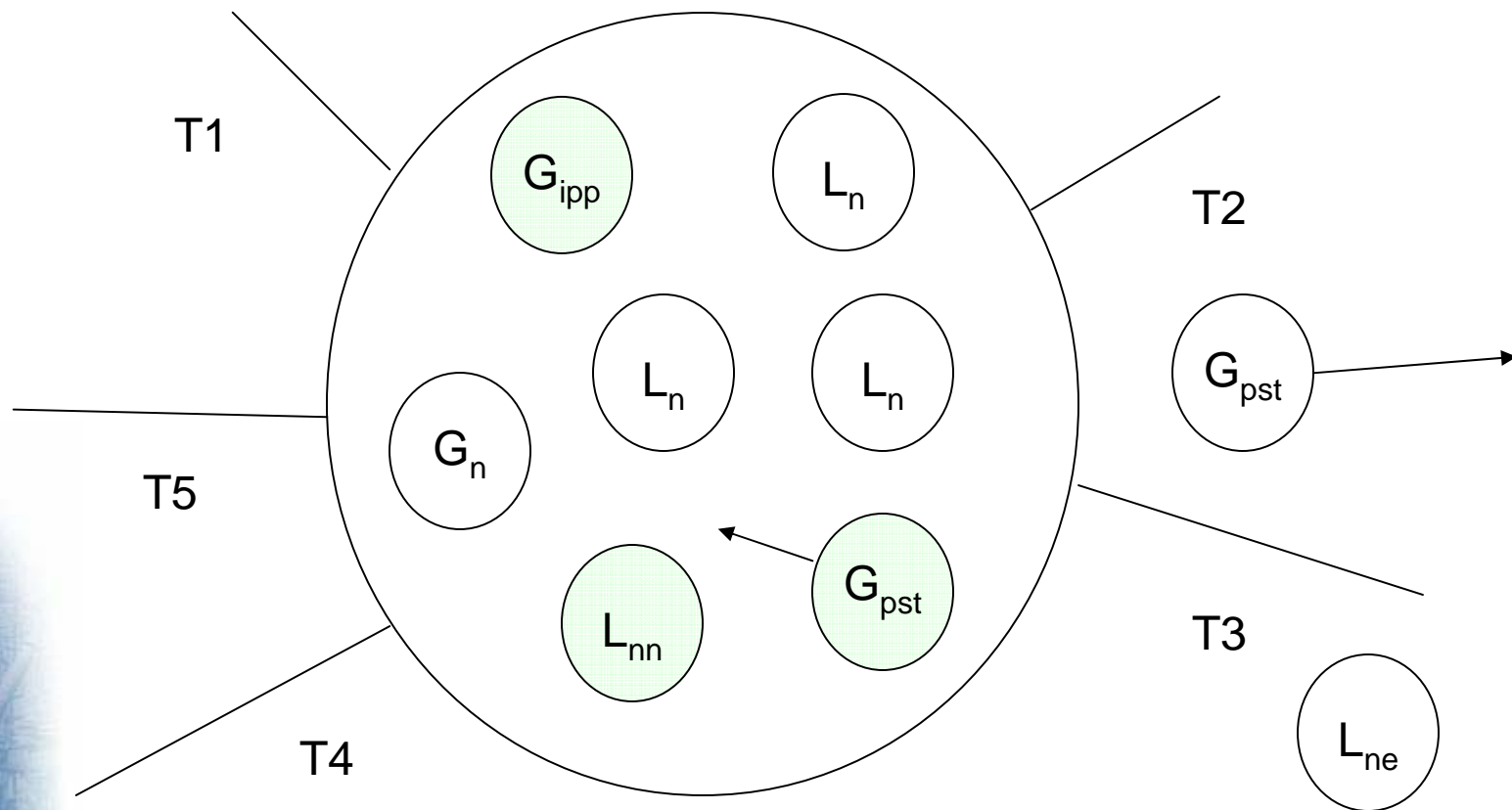
- Generation
- Reserve Sharing Agreements
- Firm Purchases
- Interruptible Contracts
- Station Service reductions
- Voltage Reductions
- Standby generation
- Environmental Exemptions
- Native Load

... and they keep up with “reserves”,...

There are basically three kinds of reserves:

- “Operating” - These are the resources you can use between now and the end of the day. Some may not be online right now.
- “Spinning” - this is what you have online that will actually move. Some interruptible load can be counted here
- “Contingency” - This is what will move within 15 minutes to respond to a DCS.

...for the Balancing Authority Area.



When you first come on shift

- Look at the ACE and frequency
- Look at the system load and load ramp and review the system load profile for the present hour.
- Review the Spinning Reserves right now and see how long they will last
- Review Contingency Reserves for right now

Things the BA looks over next

- Review Operating Reserves for the day
- Review Purchase/Sales information for the day
- Review the IPP/Hydro/Pumper schedules for the day
- Review unit commitment report for the day

Things the BA looks over next

- Review weather
- Review online unit derate/problems info
- Review any transmission constraints on generation
- Look at the units that are online now and get a feel for where the reserves are and how fast they will load.

You develop a plan for the day

- You make sure that the spinning reserves don't run out before a schedule comes in or something else is loaded throughout the day.
- You compare the spinning reserves to the purchase/sales – internal and external - and other schedules and make sure there are no ramping rate problems through out the day

You develop a plan for the day

- You determine how you would make up the generation reserves lost for a DCS event.
- You determine how much non-firm purchase/sales there are and has a plan to pull back the sales and/or replace the purchases if needed.
- You discuss transmission constraints – inside and outside your BA area - with your RC

You develop a plan for the day

- You check his EMS for discrepancies.
- You begin to compare the actual load to the projected load and check the weather one more time.
- You update your back-up AGC!

You work the plan

- You keep one eye on the EMS screens and begins your paperwork for the day.
- The machine is economically dispatching the units.
- Everything you need to know is right there: reserves, schedules, unit status, ramp rates, ACE, frequency.

The Operator works the plan

- Life is good.
- You get that second cup of coffee, turn up the volume on the Weather Channel...
- ... and the screens all go black.



No problem...

- You calmly set the coffee cup down and turn to your back-up AGC system.
- ... and its screens are dead also.
- The day just got interesting.

Where do you start?

- You've already got a perfectly good plan. It just needs a few more steps:
 - Calculate ACE
 - Manually dispatch units for load/interchange ramps, and reserve sharing agreements (economic dispatch is down. Security constrained dispatch also... RC?)
 - Manually keep up with reserves
 - Respond to unit outages
 - Support the interconnection frequency
 - Track system load

Where to start?

- (continued...)
- Your obligations and resources have not changed; only the tools.
- You modify the plan



#1 Collect the Documentation

- Unit Commitment Report showing units expected online for the day as well as units expected to be taken offline for maintenance or reserve shutdown
- Purchase/Sales Report for the day showing firm and non-firm transactions
- Schedules for IPPs/hydro/pumpers

#1 Collect the Documentation

- (Continued...)
- De-rating/status information for online units
- Weather
- Load profile
- Transmission limitations

#2 Begin to document and dispatch...

- Write down where you think your load was when the machine went down. We'll true it up later.
- Do the same thing for your reserves. You'll true them up also.
- Look at your load and schedule information and determine what generation changes are needed for the next thirty minutes.

#2 Begin to document and dispatch...

- (Continued...)
- If you don't know where your reserves are going to come from, contact your generation providers and find out. You may need to load CTs or hydro till you get this information.
- There is no AGC. Begin manually loading/un-loading units.
- Now you've got thirty minutes.

#3 Manual Calculations

- At the end of the thirty minutes you will need to manually calculate your ACE and see where the system is.
- You'll also need to manually calculate your system load and compare it to your projected load profile.
- You will also need to know how much, what kind, and where your reserves are.
- You'll also need to get ready for the next thirty minutes

Start with ACE

- Normally you get this every few seconds. Thirty minutes will work almost as well.
- If you normally accommodate multiple ramps within the hour you may want to temporarily suspend this.
- We will discuss several things you can do ahead of time to make this go a lot smoother, but first lets review ACE and Load

Another Real Quick Review

- Your Balancing Area (BA) is surrounded by tie lines
- The sum of the flows on all those tie lines is your “interchange”; the power flowing into or out of your system.
- Except for generation only BAs, there is load and generation inside your tie lines.

Quick Review of ACE

- If you are generating more than your load, power goes out the tie lines; less, then power flows in
- If you have load in another BA, or someone else has load in your BA, this is usually handled with “dynamic schedules”
- Similarly, if one of your generators is located out of your BA, or vice versa, this is usually handled with “pseudo ties”

Quick Review of ACE

- You neighbors have meters on the other end of the tie lines just like you do on yours. You must depend on them for this information. They should be able to give you the info on the entire interface. Individual line readings are not necessary.
- They should also have duplicate information on any pseudo-ties and dynamic schedules. If not, you can call plants directly for the pseudo tie information and use estimated loads for the dynamic schedules.
- Learn the details of where these numbers come from and how they are calculated.

Quick Review of ACE

- Power is bought and sold, then “scheduled” into or out of your BA.
- There are many schedules. These can be summed to a total scheduled power into or out of your BA just like the interchange was the sum of the tie flows.
- ACE is the difference between your actual flows and your scheduled flows, some allowances for interconnection frequency, plus any meter error.

Even Quicker Review of Load

- There are slides at the end of the presentation that go into detail on the load calculations; luckily, we don't have to go through that calculation every thirty minutes.
- We can use the ACE calculation for the first few estimates until you can get trued-up actuals for your generation and can make a more accurate load calculation.
- Remember: In this state of operation we are disregarding the frequency (with usual disclaimers)

Using the ACE to estimate Load growth

- $ACE = \text{Actual interchange} - \text{Scheduled Interchange}$
- $\text{Scheduled Interchange} = \text{Fixed Sched.} + \text{Dyn. Sched.}$
- We know the change in the Fixed Schedules and we can get good numbers for the Actual Interchange and the change in the Dyn. Schedules.
- This only leaves the load.
- Make gen. changes and adjust your load numbers.

Last Review

- $ACE = \text{Actual flows} - \text{Scheduled flows} - \text{Freq. contribution}$
- $\text{Load}_{\text{error}} = ACE_{\text{total}} - (\text{change in dynamic schedules})$
- $\text{Interchange} = \text{Net tie lines} + \text{net pseudo ties}$
- power “in” is neg. power “out” is positive
- Make some allowances for the losses between the Pseudo tie and the border and your done.

Five Steps

1. Gather the information
2. Estimate needed generation changes every thirty minutes
3. Manually dispatch resources
4. Calculate ACE and Load every thirty minutes
5. Review/modify your plan if you need to

Table Top Exercise!

Handouts 1 and 2



Review of Common Mistakes

- No checklist!
- When you ask for “actuals”, you get “schedules”.
- “In” from my perspective is “out” from yours.
- Pseudo-Tie and Dynamic Schedule sign errors

Review of Common Mistakes

- You don't need to have the readings on every tie line, you do need the total flows on the interfaces
- No prepared spreadsheet with notes.
- You've got the spinning reserves but they won't move.

Review of Common Mistakes

- Using gross generation instead of net generation
- Not allowing for JOU reserves that belong to someone else!
- Not allowing for losses to the state line for Pseudo-ties
- Not knowing where your system is.

Review of Common Mistakes

- Not trending your load
- How are pumpers considered in the load?
- *Not* using sum of all dynamic schedules in ACE calculation.
- *Using* sum of all dynamic schedules in load calculation (only want the load dyn.scheds.).

Review of Common Mistakes

- Not keeping good notes
- “hour ending” vs. “hour beginning” issues between the “schedule” and “real time” folks
- High load ramps and taking too long to get the interface “actuals”. (See the handout #4 on this)
- Not knowing their non-firm schedules

Review of Common Mistakes

- If you're using *estimated load*, you can use the calculated ACE to make adjustments to your load number....
- If you're using *actual generation* to calculate your load, do not allow for the ACE! Its just a control number...
- Whaaaa....? (See load explanation at the end of the presentation)

Developing a Training Program

- Put together a check list!
- Develop a spreadsheet for ACE and system load
- Get your people to use the numbers on their EMS screens and the spreadsheet to calculate/compare real-time ACE/system load.

Developing a Training Program

- Develop table top exercises based on your system.
- Give them simulated tie readings for increasing and decreasing loads compared to their plan for the day. Use bad data sometimes.
- Ask for all calculations and compare them to the actual loads you used for the simulation.

Developing a Training Program

- From time to time ask your people on shift where their system is and what's their plan – load, reserves
- Ask them what reserve changes they would need if they lost the AGC right then.
- Talk to the people ahead of time that you will be depending on for information. This trains them!

Developing a Training Program

- Who needs a simulator if you have the real thing?
 - When work load allows, sit down with your on-shift folks and ask them to estimate the generation changes needed for the next thirty minutes, then compare that to what was actually dispatched by AGC.
 - Same thing as above and throw in load calculations and trending.

Developing a Training Program

- If you have a simulator, give them the normal information they would have for the day, some time to get a feel for what they need and then turn the screens off. Also turn off the simulations AGC and trend the ACE to see how they do.
- Check their calculations from time to time.
- Drop a unit out, call a TLR with and without NNL, open a tie line, call on a RS Agreement.

Questions ?



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Calculating Load

- Like we discussed earlier, if you are only running for two or three hours without your EMS, use the ACE to adjust your load values. You know your fixed schedules and you can get actual interchange and dynamic schedule numbers from your neighbors. This only leaves load and a small error due to the timing of your readings.
- If you have to operate manually for a longer time, you need to true up the load by doing the long calculation using the total generation numbers as described in the following example.

Quick Review of Load

G_n = total gross native Generation in your metered BA

SS = total station service for above

L_n = native/network load

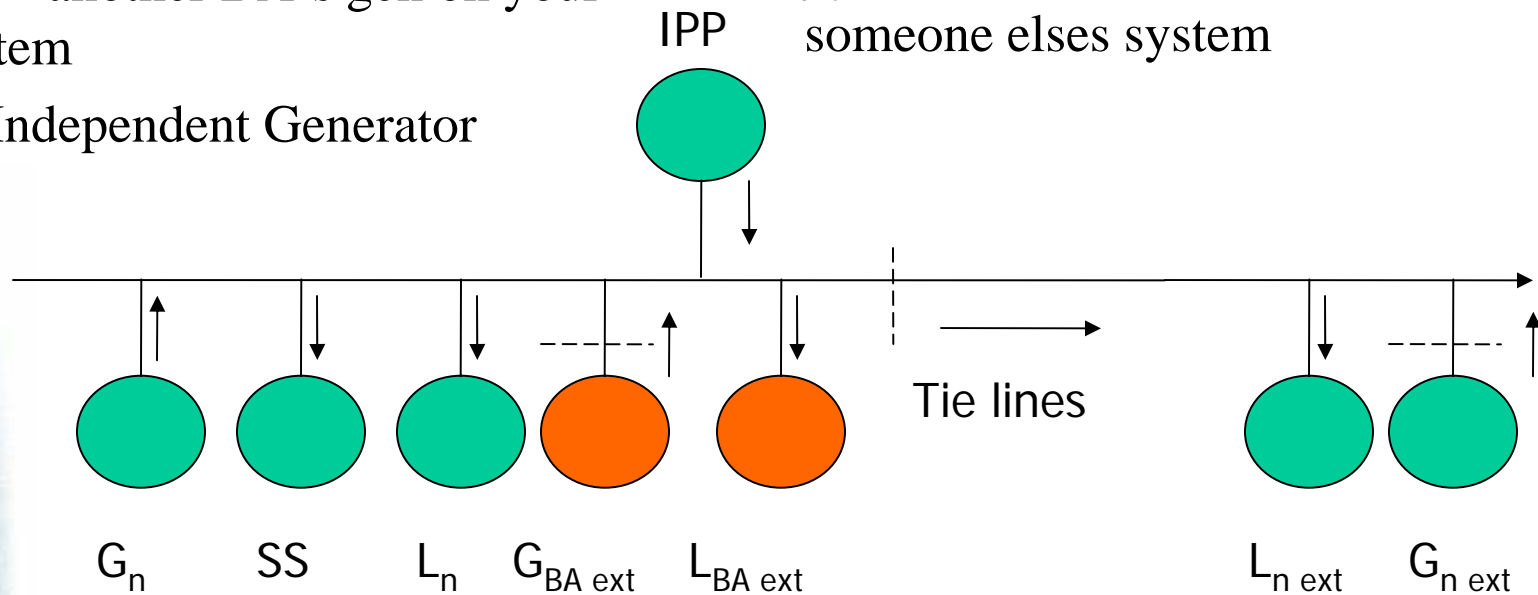
$G_{BA\ ext}$ = another BA's gen on your system

IPP = Independent Generator

$L_{BA\ ext}$ = another BA's load on your system

$L_{n\ ext}$ = your native load on someone else's system

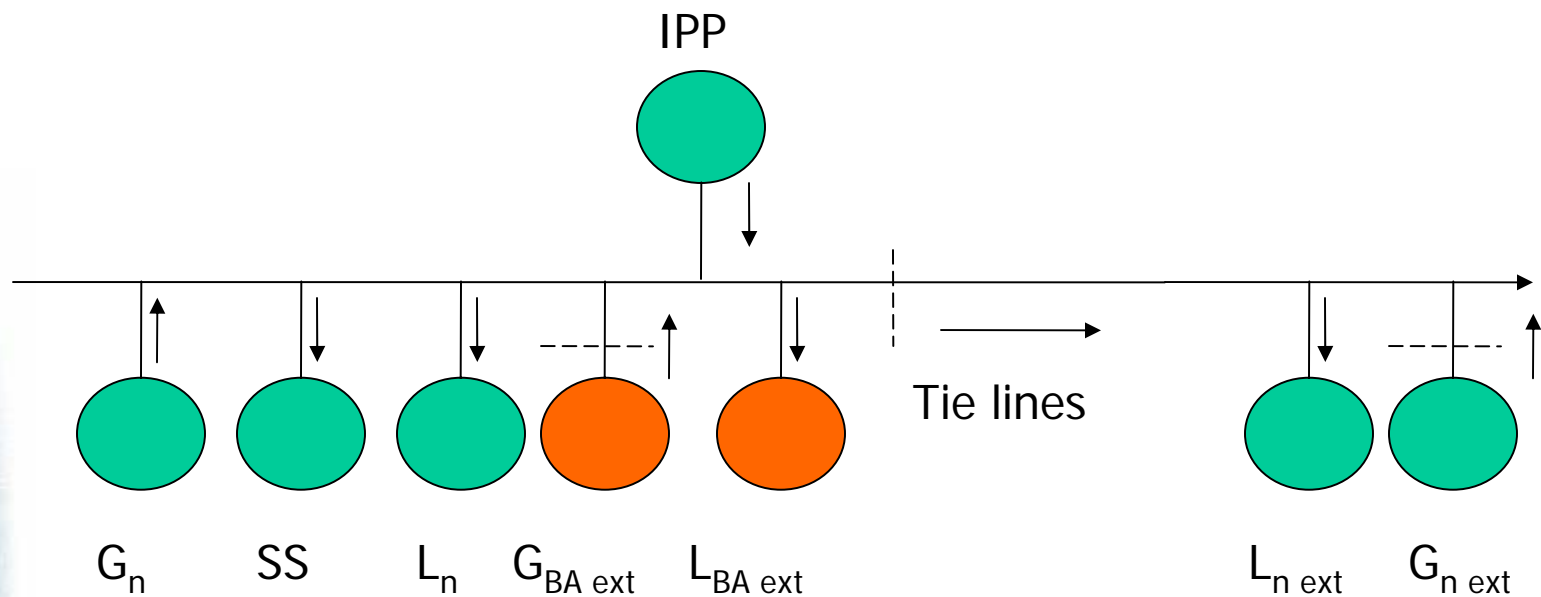
$G_{n\ ext}$ = your native generation on someone else's system



Sign Conventions are the same

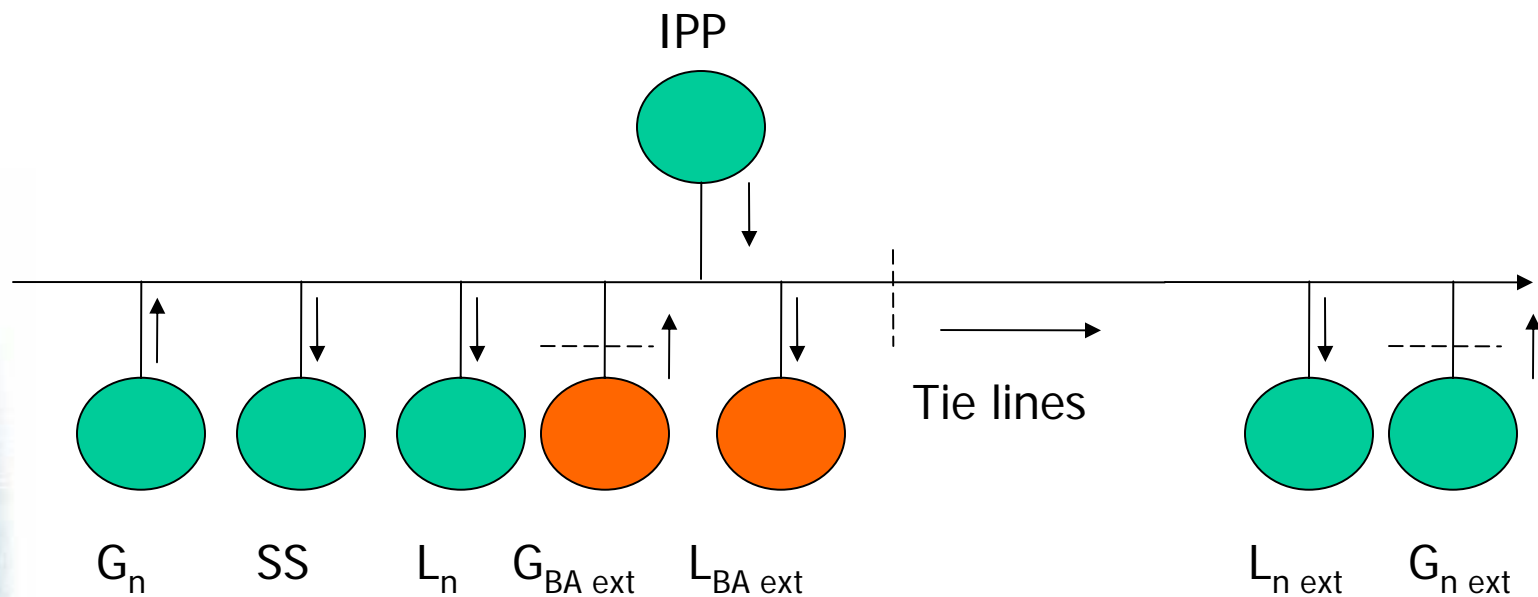
Power into your BA is negative

Power out of your BA is positive



System Load

- $L_{\text{total}} = L_n + L_{n \text{ ext}}$
- $L_{\text{total}} = G_{\text{total}} - \text{SS} - L_{\text{BA ext}} - \text{total ties} + L_{n \text{ ext}}$
- $\text{Total Ties} = \text{tie lines} - G_{\text{BA ext}} + G_{n \text{ ext}}$
- $G_{\text{total}} = G_n + G_{n \text{ ext}} + \text{IPP}$

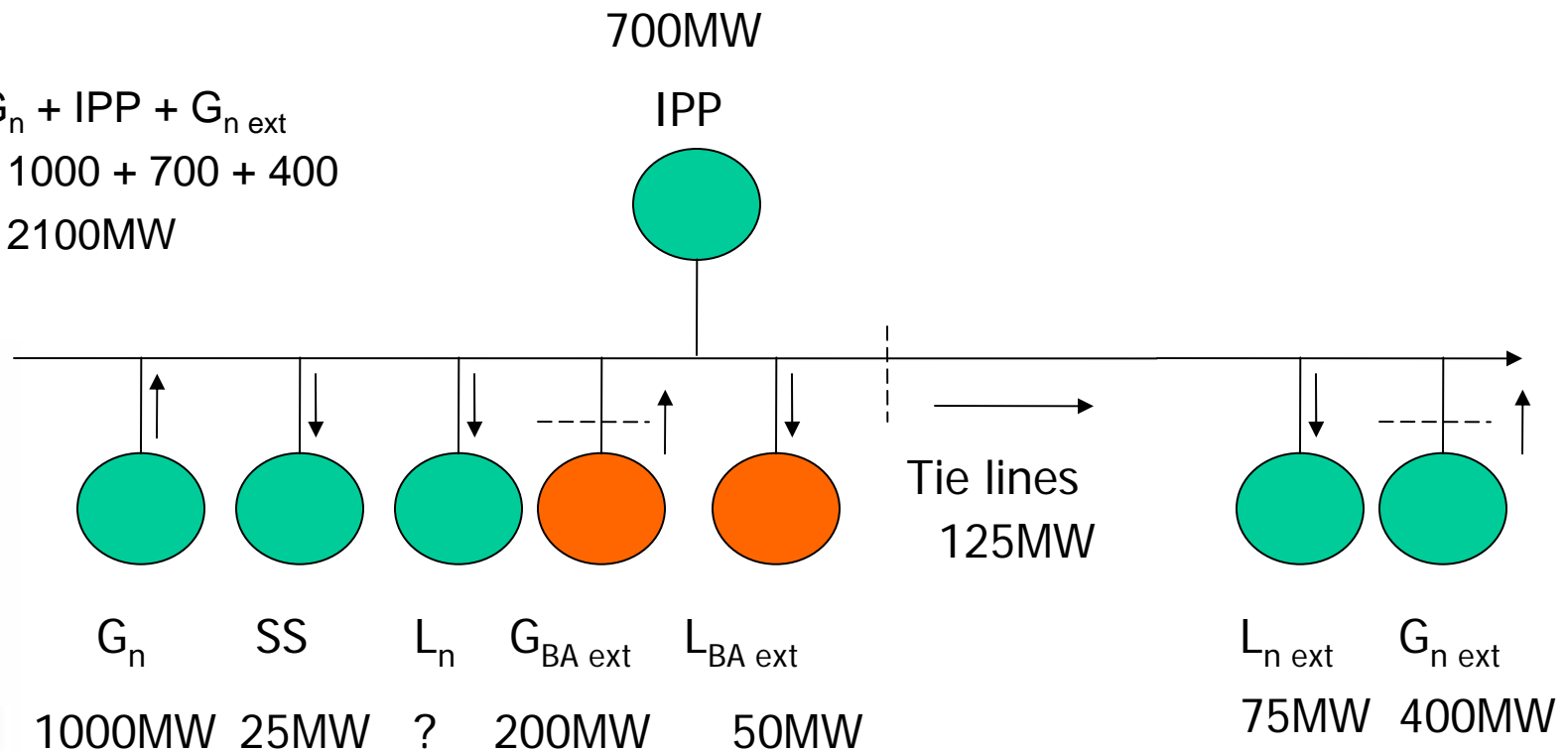


Add some numbers

$$\begin{aligned} \text{Total Ties} &= \text{tie lines} - G_{\text{BA ext}} + G_{\text{n ext}} \\ &= 125 - 200 + 400 \\ &= 325\text{MW} \end{aligned}$$

Fixed Schedules = 300 out

$$\begin{aligned} G_{\text{total}} &= G_{\text{n}} + \text{IPP} + G_{\text{n ext}} \\ &= 1000 + 700 + 400 \\ &= 2100\text{MW} \end{aligned}$$



Now you know your native load

$$L_{n \text{ total}} = G_{\text{total}} - SS - L_{\text{BA ext}} - \text{Total Ties} + L_{n \text{ ext}}$$

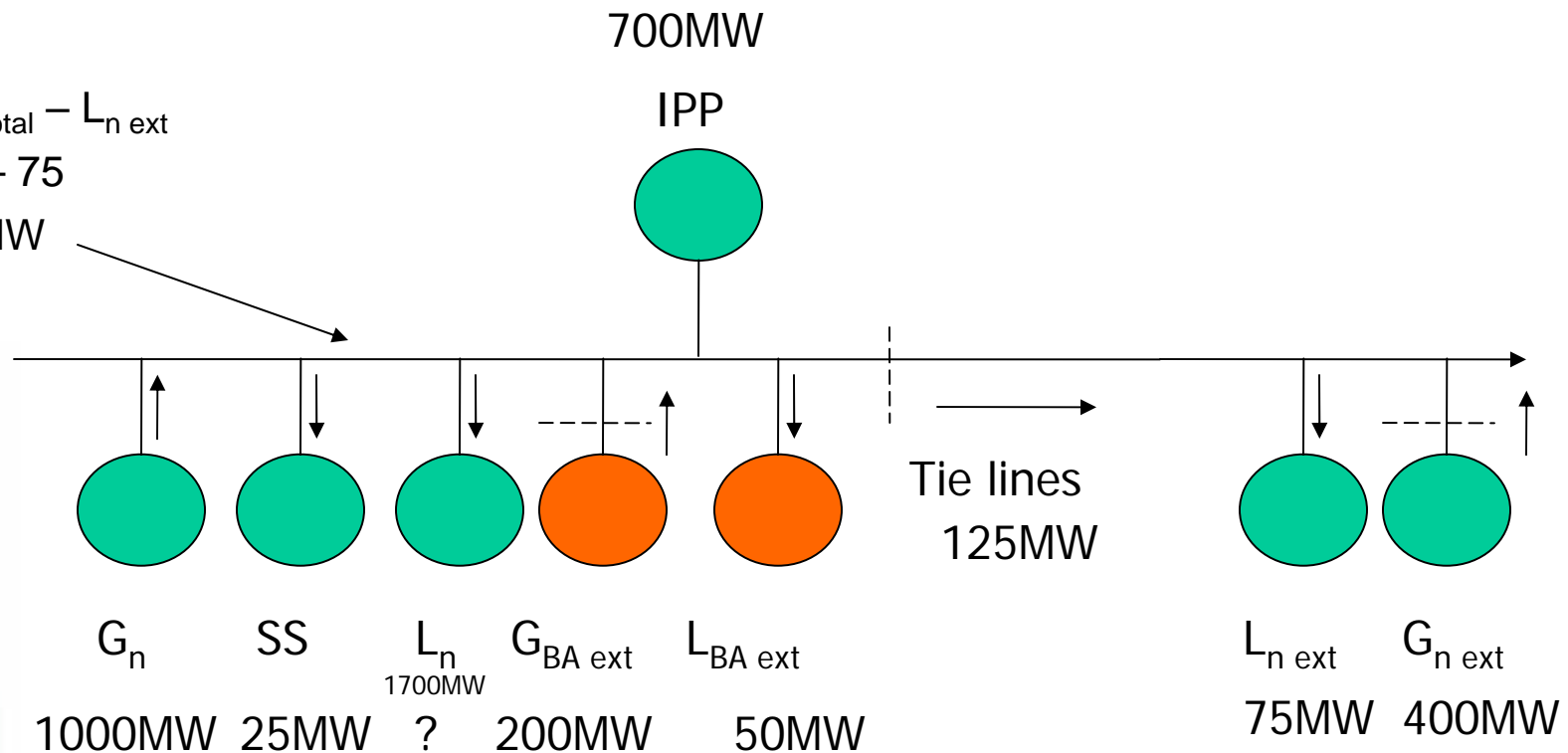
$$= 2100 - 25 - 50 - 325 + 75$$

$$= 1775\text{MW}$$

$$L_n = L_{n \text{ total}} - L_{n \text{ ext}}$$

$$= 1775 - 75$$

$$= 1700\text{MW}$$



Example of Loss of EMS/AGC check list

1. Call EMS support personnel!
2. Bring up “ Loss of EMS Spreadsheet”
3. Gather information:
 - A. Plan for the day
 - B. Hydro/pumper/IPP schedules
 - C. Purchase/Sales schedule
 - D. Unit Commitment report
 - E. Load profile for the day along with any available historic load information
 - F. Weather
 - G. Known unit problems
 - H. Known transmission problems
 - I. Last know system load number
 - J. Last known reserve numbers
 - A. Contingency
 - B. Regulating
 - C. Operating
 - K. Unit loading info
4. Estimate load growth/drop for next 30 minutes
5. Manually dispatch units/update reserve numbers
6. Calculate ACE at end of thirty minutes
7. Calculate new load number
8. Update Reserves
9. Review plan for the day and update as needed
10. Begin process again for the next thirty minutes