**Constraints of DRFCS-MAG**

To comply with the submission limit of no more than 10 pages, we present the constraints of the DRFCS-MAG model and their explanations, which were not elaborated in detail in the manuscript, as follows:

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| ***Parameters*** |  |
|  | Maximum power of CGU *g* / ESS *s* / HVDC *h*. |
|  | Minimum power of CGU *g* / ESS *s* / HVDC *h*. |
|  | Ramp-up / ramp-down limits of CGU *g*. |
|  | Minimum-up/-down time of CGU *g*. |
|  | Charge or discharge efficiency / duration of ESS *s*. |
|  | Maximum energy limit of ESS *s.* |
|  | Initial state of charge of ESS *s.* |
|  | Maximum / Minimum state of charge limits of ESS *s.* |
|  | Forecast power of load *d* / WT *w* at period *t*. |
| ***Variables*** |  |
|  | Charge / discharge state of ESS *s* at period *t*. |
|  | State of charge of ESS *s* at period *t*. |

1. **Constraints of CGUs**

The logical relationship between the startup and shutdown status of CGUs and their online status, power upper limit constraints, power lower limit constraints, ramp-up and ramp-down limits, minimum-up time constraints, and minimum-down time constraints are given in (1)–(6), respectively. The upward/downward regulation reserve constraints of CGUs are modeled as DR chance constraints, as shown in (7)–(8). These indicate that, under the worst-case distribution of the random variables, CGUs have at least a probability of  and , respectively, to meet the upward/downward regulation reserve required to respond to the forecast error.

















1. **Constraints of ESSs**

The power upper limit constraint, power lower limit constraint, the logical relationship between power sign and charging/discharging, the mutual exclusivity constraint for charging and discharging states, the relationship between the state of charge and output power variation, state of charge conservation constraint, upward reserve SOC constraint, and downward reserve state of charge constraint for ESSs are given in (9)–(16), respectively. Similarly, the upward/downward regulation reserve constraints of ESSs (17)-(18) are modeled as DR chance constraints, and they will not be repeated here.





















1. **Constraints of Power Balance**

The power balance constraint is shown in (19), where  indicates the relationship between HVDC *h* and Grid #*j*. When Grid #*j* is the positive direction end of HVDC *h*,  = 1; otherwise,  = -1. Since constraint (19) contains random variables, we need to further transform it. First, separate the random variables as shown in (20). Obviously, constraint (20) being satisfied is equivalent to both (21) and (22) being satisfied simultaneously.









1. **Constants of AC Line Capability**

The capacity constraint of AC lines is modeled as DR chance constraints. Constraints (23) and (24) ensure that the line power does not exceed its maximum forward and reverse limits with at least  and  probabilities, respectively.  represents the power distribution shift factor between CGU *g* and AC line *l*. The meanings of  to  are similar to that of  and will not be elaborated further.



