Supplementary File of Manuscript "Optimal Defense Resource Allocation in Smart Grid: A Network Partition based Approach for Large-Scale Cases"

Algorithm 1 Pseudo-code of the initialization process in SMA-IP

Input:

- Size of the initialization pool Q

S1: Solve the surrogate problem (20) and obtain the first Q optimal solutions to form the initialization pool $\mathcal{IP} = \{\boldsymbol{\phi}_1^*, \ldots, \boldsymbol{\phi}_Q^*\}$

for $i = 1$ to Z **do**

S2: Randomly select one $\boldsymbol{\phi}_k^*$ from the initialization pool $\mathcal{IP}$ to create the $\boldsymbol{\phi}^{\mathbb{C}}$ component of the individual $\boldsymbol{C}_i$ according to (19).

S3: Repeatedly initialize the $\boldsymbol{b}$ component of the individual $\boldsymbol{C}_i$ over the feasible region $\mathbf{0} \leq \boldsymbol{b} \leq \boldsymbol{b}_{max}$ randomly until the entire individual meets the nonlinear constraints (5b).

end for

Output: The initialized population $\boldsymbol{C} = \{\boldsymbol{C}_1, ..., \boldsymbol{C}_Z\}^T$.

Algorithm 2 Pseudo-code of the SMA-IP

Input:

- Initialization pool capacity Q
- Threshold for reinitialization ζ.
- Maximum number of iterations T_{max}.

Initialize:

- Execute Algorithm 1 to create the initialized population $\boldsymbol{C} = \{\boldsymbol{C}_1, ..., \boldsymbol{C}_Z\}^T$.

for $t = 1$ to T_{max} **do**

S1: Assess fitness for every individual via (21).

S2: Calculate the iteration's best $J(\boldsymbol{C}^*(t))$ and poorest $J(\boldsymbol{C}^-(t))$ fitness values, and track the historically top individual $J^*(t)$.

S3: Calculate Ω based on (27).

S4: Derive $\alpha(t)$ and $\beta(t)$ based on (24) and (25).

for $i = 1$ to Z **do**

if $\rho_{i,1} < \zeta$ **then**

Reinitialize $\boldsymbol{C}_i$ using Algorithm 1.

else

Calculate $\pi_i(t)$ based on (26).

for $j = 1$ to L **do**

Update $C_{i,j}$ based on (23).

end for

end if

end for

end for

Output: Best individual $\boldsymbol{C}^*(T_{\text{max}})$ and corresponding fitness $J(\boldsymbol{C}^*(T_{\text{max}}))$.