1 Formulation: Part I

Optimization equation

$$\min \sum_{k\in N}\sum_{i\in I}\left(\alpha \ln Q_i(k) + c(k)P_{0i}(k)\right) \tag{1}$$

$$\ln Q_i(k) = \ln(B) - \frac{E_A}{RT_i(k)} + z\ln\frac{W_{h,i}(k)}{V_i(k)} \quad \forall k \in 1..N, i \in 1..I \tag{2}$$

$$W_{h,i}(k+1) = W_{h,i}(k) + |p_{b,i}(k)|\Delta t \quad \forall k \in 1..N, i \in 1..I \tag{3}$$

$$E_i(k+1) = E_i(k) - p_{b,i}(k)\Delta t \quad \forall k \in 1..N, \forall i \in 1..I \tag{4}$$

$$P_{0i}(k) = d(k) - p_{b,i}(k) \quad \forall k \in 1..N, \forall i \in 1..I \tag{5}$$

$$\sum_{i\in I} P_{0i}(k) \le G(k) \quad \forall k \in 1..N, \forall i \in 1..I \tag{6}$$

$$E_{\min} \le E_i(k) \le E_{\max} \quad \forall k \in 1..N, i \in 1..I \tag{7}$$

$$0 \le W_{h,i}(k) \le W_{h,\max} \quad \forall k \in 1..N, i \in 1..I \tag{8}$$

$$-P_{\text{batt, max}} \le p_{b,i}(k) \le P_{\text{batt, max}} \quad \forall k \in 1..N, i \in 1..I \tag{9}$$

2 Temperature dynamics

$$\rho C V_B \dot{T}_i(k) = hA_s\left(T_i(k) - T_\infty\right) + R_B\left(\frac{p_{b,i}(k)}{V_i(k)}\right)^2 \quad \forall k \in 1..N, i \in 1..I \tag{10}$$

$$T_i(k) + \dot{T}_i(k)\Delta t = T_i(k+1) \quad \forall k \in 1..N, i \in 1..I \tag{11}$$

$$T_{\min} \le T_i(k) \le T_{\max} \quad \forall k \in 1..N, i \in 1..I \tag{12}$$

$$V_i(k) = V_{oc,i}(k) - I_i(k)R_B \quad \forall k \in 1..N, i \in 1..I \tag{13}$$

$$Q_{\text{cap, i}}(k) = Q_{\max}\left(1 - Q_i(k)\right) \quad \forall k \in 1..N, i \in 1..I \tag{14}$$

$$0 \le I_i(k) \le I_{\max} \quad \forall k \in 1..N, i \in 1..I \tag{15}$$

3 DP Formulation

Let $V(k)$ represent the cumulative capacity fade and power generation from time step k to total time N. We define control variables $I_i(k)$ as u_k $\forall i$ and state variables $T_i(k)$ as x_k $\forall i$:

$$V_k(x_k) = \min_{u_k, x_k}\left\{\sum_{i\in I}\left(\alpha \cdot Q_i(k) + c(k)\cdot\left(d_i(k) - u_i(k)\right)\right) + V(k+1)\right\} \quad \forall k \in 1..N \tag{16}$$

We finally establish the boundary condition:

$$V(N+1) = 0$$