Uniformization procedure.
Denote $h = \max_{i=\overline{0,W}} (-D_0)_{ii}$.
Then the matrix $P(n,t),\ n \geq 1$, can be represented in the following form:

$$P(n,t) = \sum_{j=0}^{\infty} e^{-ht}\frac{(ht)^j}{j!}K_n^{(j)},\ n \geq 0, \tag{1}$$

where the matrices $K_n^{(j)},\ n \geq 1, j \geq 0$, are calculated by recursion

$$K_0^{(0)} = I,\ K_n^{(0)} = O,\ n \geq 1,$$
$$K_0^{(j+1)} = K_0^{(j)}(I + h^{-1}D_0),$$
$$K_n^{(j+1)} = h^{-1}K_{n-1}^{(j)}D_1 + K_n^{(j)}(I + h^{-1}D_0),\ n \geq 1,\ j \geq 0.$$

Computation of transition probabilities
We consider the constant service time. In this case, the distribution function $B(t)$ has the form

$$B(t) = \begin{cases} 0, & t \leq b_1, \\ 1, & t > b_1. \end{cases}$$

- $\varphi_k(t) = \frac{(\gamma t)^k}{k!}e^{-\gamma t},\ k \geq 0.$
- $\hat{\varphi}_k(t) = \sum_{i=k}^{\infty} \varphi_i(t),\ k \geq 0.$
- $\varphi_k = \varphi_k(b_1),\ k \geq 0.$
- $\hat{\varphi}_k = \sum_{i=k}^{\infty} \varphi_i,\ k \geq 0.$
- $\sum_{i=0}^{\infty} P(i,t)z^i = e^{(D_0 + D_1 z)t},\ |z| < 1.$
- $\Phi(i,k) = \int_0^{\infty} P(i,t)\varphi_k(t)dB(t) = P(i,b_1)\varphi_k(b_1) = e^{-(h+\gamma)b_1}\frac{(\gamma b_1)^k}{k!}\sum_{j=0}^{\infty}\frac{(hb_1)^j}{j!}K_i^{(j)},\ \ i \geq 0,\ k \geq 0.$
- $\hat{\Phi}(i,k) = \int_0^{\infty} P(i,t)\hat{\varphi}_k(t)dB(t) = P(i,b_1)\hat{\varphi}_k(b_1) = e^{-(h+\gamma)b_1}\sum_{j=0}^{\infty}\frac{(hb_1)^j}{j!}K_i^{(j)}\sum_{l=k}^{\infty}\frac{(\gamma b_1)^l}{l!},\ \ i \geq 0,\ k \geq 0.$
- $N(m) = \int_0^{\infty} P(m,t)\gamma e^{-\gamma t}dt = \gamma\sum_{j=0}^{\infty}\frac{h^j}{j!}K_m^{(j)}\int_0^{\infty} e^{-(h+\gamma)t}t^j dt = \frac{\gamma}{h+\gamma}\sum_{j=0}^{\infty}(\frac{h}{h+\gamma})^j K_m^{(j)},\ \ m \geq 0.$
- $M(r) = \int_0^{\infty} e^{D_0 t}\varphi_r(t)D_1 dt = \int_0^{\infty} e^{D_0 t}\frac{(\gamma t)^r}{r!}e^{-\gamma I t}D_1 dt = \gamma^r(-D_0 + \gamma I)^{-(r+1)}D_1.$
- $\hat{M}(r) = \sum_{l=r}^{\infty} M(l) = \gamma^r(-D_0 + \gamma I)^{-r}(-D_0)^{-1}D_1,\ r \geq 0.$

Подскажите, нужно ли расписывать переходные вероятности следующим образом? Если да, то что еще можно упростить?

$$P\left\{(0,0)\to(j,k')\right\} = M(0)\sum_{n=0}^{j} N(n)\Phi(j-n,k') + N(0)\sum_{m=0}^{k'} M(m)\Phi(j,k'-m) =$$

$$(-D_0+\gamma I)^{-1}D_1\sum_{n=0}^{j}\gamma\sum_{l=0}^{\infty}\Big(\frac{h}{h+\gamma}\Big)^{l}\frac{1}{h+\gamma}K_n^{(l)}e^{-(h+\gamma)b_1}\frac{(\gamma b_1)^{k'}}{k'!}\sum_{m=0}^{\infty}\frac{(hb_1)^m}{m}K_{j-n}^{(m)}+$$

$$\gamma\sum_{j=0}^{\infty}\Big(\frac{h}{h+\gamma}\Big)^{j}\frac{1}{h+\gamma}K_0^{(j)}\sum_{m=0}^{k'}\gamma^m(-D_0+\gamma I)^{-(m+1)}D_1e^{-(h+\gamma)b_1}\frac{(\gamma b_1)^{k'-m}}{(k'-m)!}\sum_{l=0}^{\infty}\frac{(hb_1)^l}{l!}K_j^{(l)} =$$

$$(-D_0+\gamma I)^{-1}D_1\frac{\gamma}{h+\gamma}e^{-(h+\gamma)b_1}\frac{(\gamma b_1)^{k'}}{k'!}\sum_{n=0}^{j}\sum_{l=0}^{\infty}\Big(\frac{h}{h+\gamma}\Big)^{l}K_n^{(l)}\sum_{m=0}^{\infty}\frac{(hb_1)^m}{m}K_{j-n}^{(m)}+$$

$$\gamma\frac{1}{h+\gamma}e^{-(h+\gamma)b_1}\sum_{j=0}^{\infty}\Big(\frac{h}{h+\gamma}\Big)^{j}K_0^{(j)}\sum_{m=0}^{k'}\gamma^m(-D_0+\gamma I)^{-(m+1)}D_1\frac{(\gamma b_1)^{k'-m}}{(k'-m)!}\sum_{l=0}^{\infty}\frac{(hb_1)^l}{l!}K_j^{(l)},$$

$$k' = \overline{0, K-2};$$