Figure 3 shows the steam discharging flow through the MSSVs. Before the crash cooling began, the MSSVs opened and closed repetitively to prevent SG overpressure. However, after the manual opening of the MSSVs, the amount of discharge increased rapidly, after which the SG inventory and the pressure decreased, leading to decreasing in the amount of steam discharge. Afterward, the SG inventory was recovered by gravity water supply from the dousing tank, and the decay heat was removed through the SG u-tube.

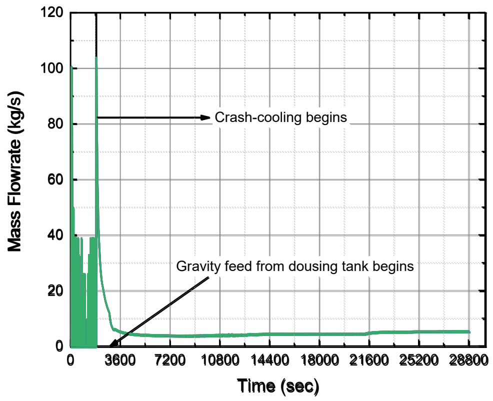

Fig. 3. Steam discharge flow through MSSVs.

As a result of the calculation, the water supply from the dousing tank was estimated to begin at about 2,850.0 s. As the cooling water from the dousing tank was supplied to the SG shell, and the water level of SGs was recovered with the level of the normal operating condition in about 11,480.0 s. It was also estimated that the cooling water in the dousing tank was depleted in about 21,310.4 s, and then the SG water level decreased again, as shown in Fig. 4.

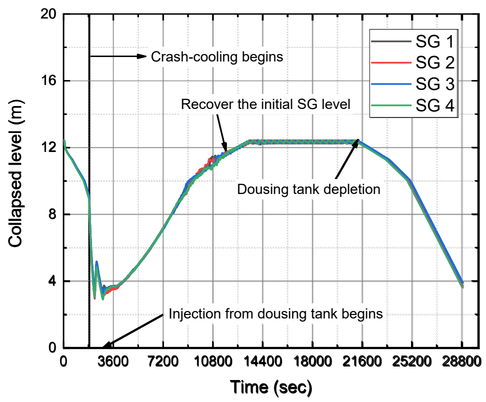

Fig. 4. Collapsed water level of SGs.

Figure 5 shows the maximum temperature of the fuel cladding and pressure tube. It was evaluated that due to the cooling water supplied from the dousing tank to the secondary-side shell, the SGs functioned as a heat sink, and the fuel cladding and pressure tube were maintained below the failure criteria.

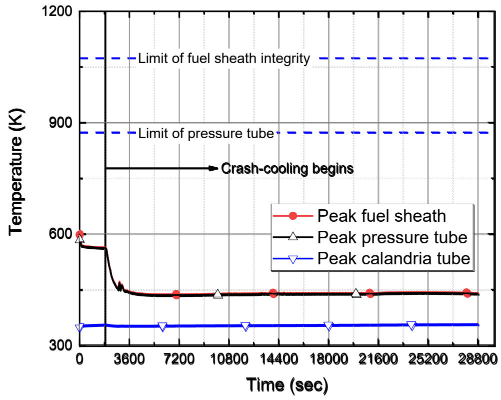

Fig. 5. Maximum temperature of fuel sheath and PT.

4. Conclusions

Based on the system model for simulating the SBO transient in a CANDU-6 reactor, the logic controllers of crash cooling using SGs, water injection from the dousing tank, and PHT pump seal leakage were developed. After confirming that the transient conditions were adequately applied, the overall behavior of the primary/secondary parameters such as pressure, water level, and flow rate during the transient period was analyzed. Through examining the system responses induced by crash cooling and water injection from the dousing tank, it was found that the calculation results by the improved model were reasonable in the present given conditions. Besides, under the given conditions of this study, it was evaluated that the integrity of fuel and fuel channels was maintained by the combined effect of SG depressurization, water supply from the dousing tank, and high-pressure emergency coolant injection.

Acknowledgments

This study was supported by the Nuclear Safety Research Program through the Korea Foundation of Nuclear Safety (KoFONS), granted financial resource from the Nuclear Safety and Security Commission (NSSC), Republic of Korea (No. 1805003).

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