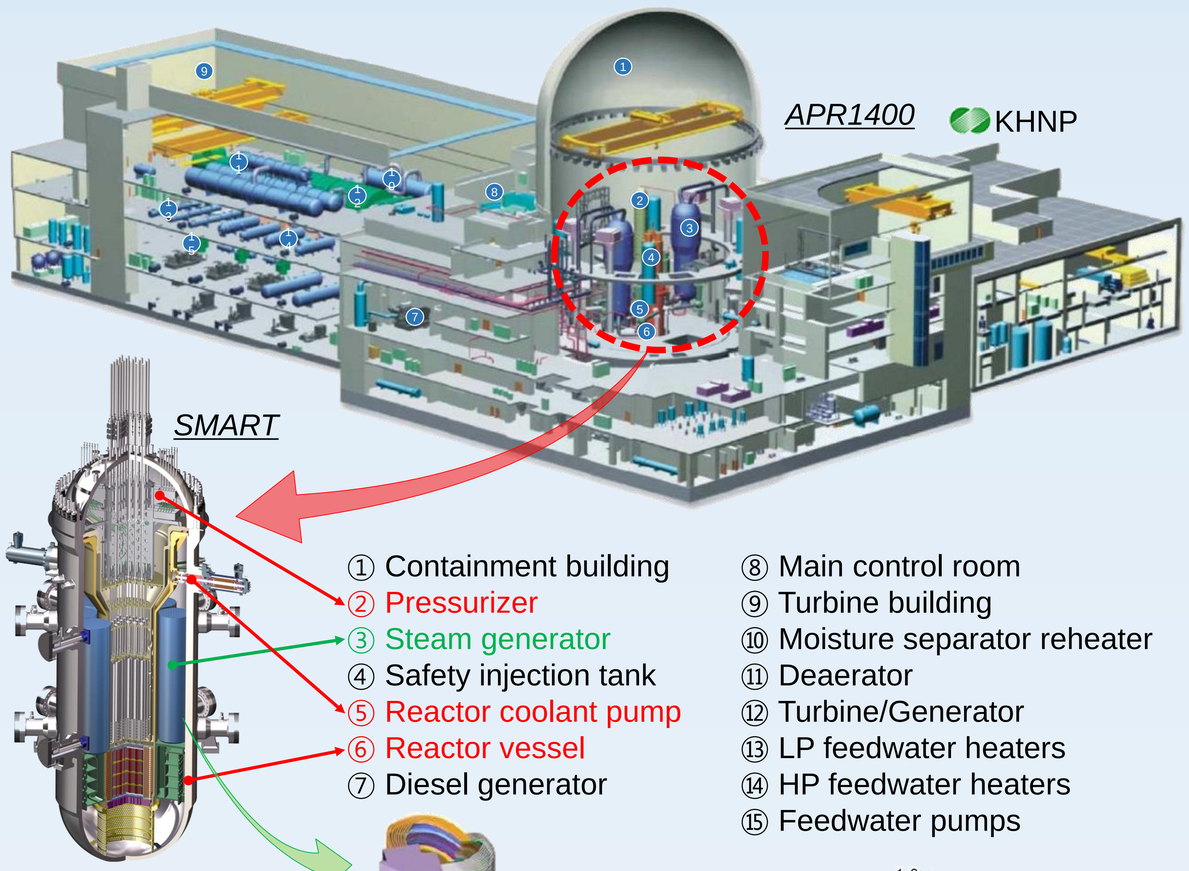
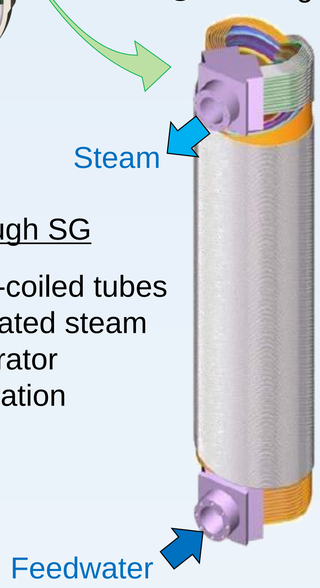
Preliminary Sizing of Printed Circuit Steam Generators with Zigzag Channels

Seok Kim* and Sang Ji Kim*

*Korea Atomic Energy Research Institute

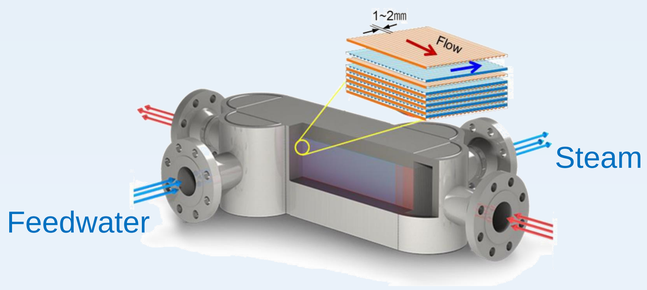
Background





Once-Through SG

- Helically-coiled tubes
- Superheated steam
- No separator
- No circulation

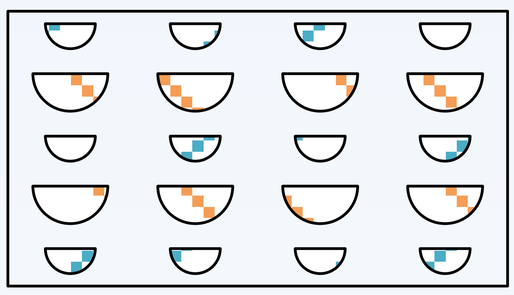


Printed Circuit SG

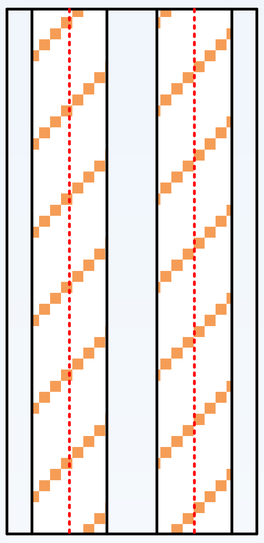
- Micro channels
- Diffusion bonding
- Larger heat transfer area
- Smaller SG volume

Numerical Methodology for Performance Evaluation

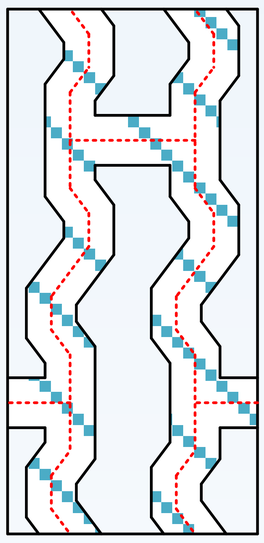
Cross-sectional View



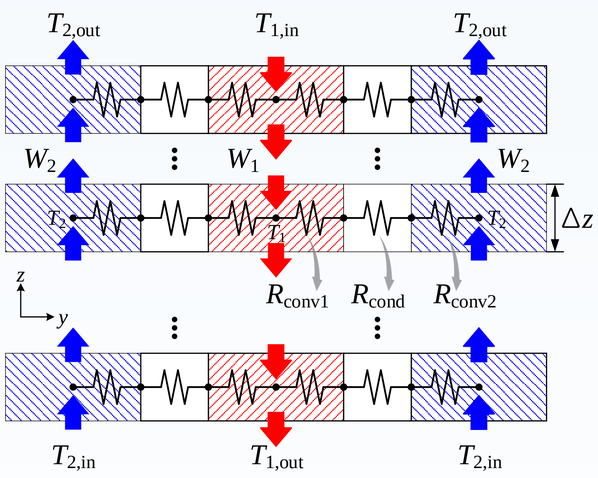
Primary-side Floor



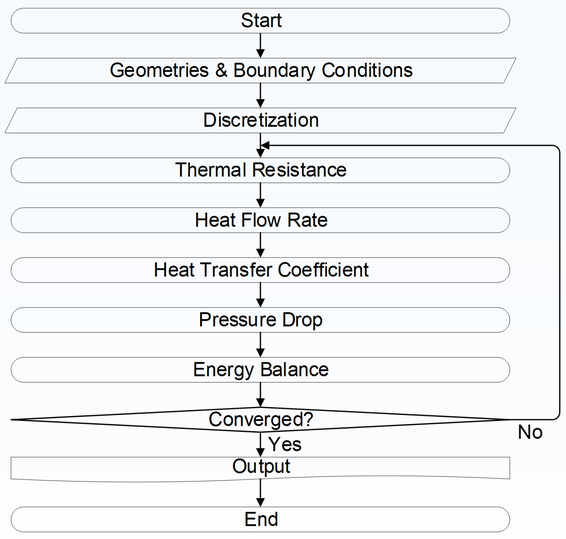
Secondary-side Floor



Thermal Network Model [1]



Algorithm [1]

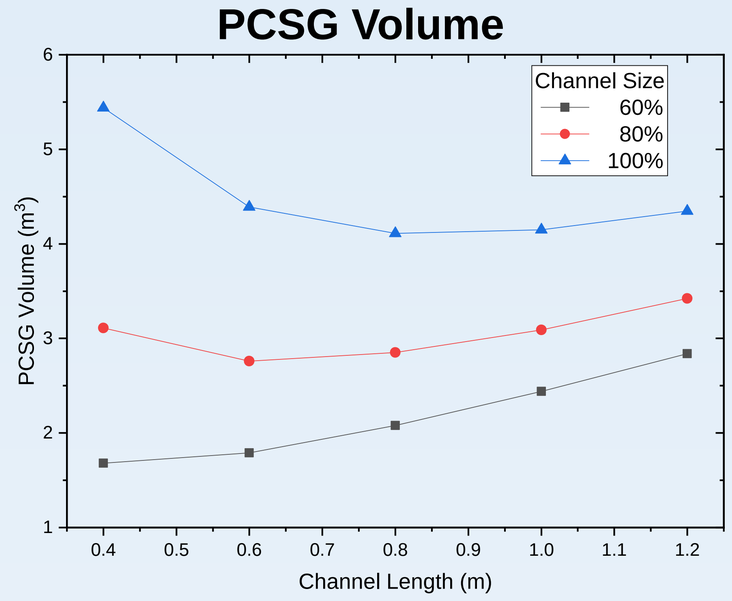


Test Matrix

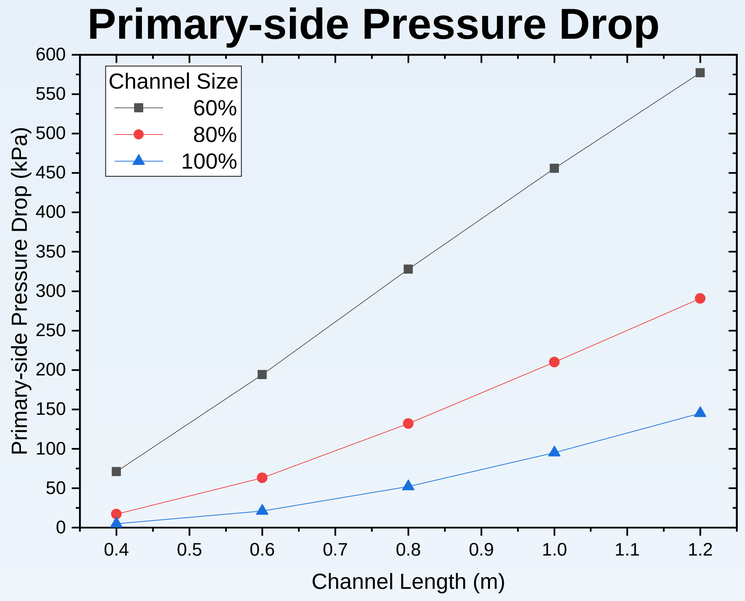
Channel size	Channel Diameter	
	Primary side	Secondary side
60%	1.8 mm	1.2 mm
80%	2.4 mm	1.6 mm
100% (Reference)	3.0 mm	2.0 mm

Heat Transfer Duty: 365 MWt

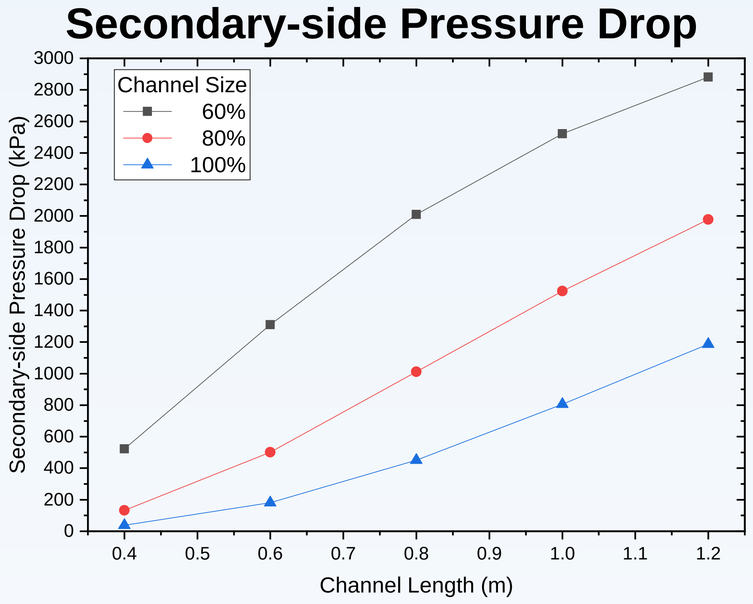
PCSG Volume



Primary-side Pressure Drop



Secondary-side Pressure Drop



Conclusions

- Decreasing the channel size results in the smaller PCSG volume, since the heat transfer becomes enhanced and the wall conductive thermal resistance is reduced as the channel size is scaled down.
- However, the flow velocity in each channel increases, hence the pressure drop increases as the channel size decreases.
- The optimum channel length minimizing the PCSG volume becomes shorter as the channel size decreases.

References

[1] S. Kim, Y. I. Kim, S. J. Kim, Methodology of Unit Channel Thermal-Hydraulic Analysis for Performance Evaluation of Printed Circuit Steam Generators, Proceedings of the KSME Fluid Engineering Division 2019 Spring Conference, Gangneung, pp. 221-222, 2019.

KAERI 한국원자력연구원 Korea Atomic Energy Research Institute