Most of the authors' basic assumptions are well-explained; smooth seal faces, no tilting, no radial conduction and convection, laminar flow, axisymmetry, ideal fluid properties and no axial friction. Would they confirm that they also neglect deformation of the seal faces, liquid-to-vapor transition time, and inlet and exit losses? These are three further effects AECL has been analyzing recently in relation to our measurements of onset of "chattering" and "popping-open" of reactor coolant pump seals. Other important governing parameters appear to be roughness, axial friction at the secondary seal and nonaxisymmetric tilting. Thermal deformation is generally important because this affects the initial coning significantly.

I commend the authors for their approach. Their conclusions, necessarily limited by their assumptions, seem to be both sound and generally relevant to the problem of preventing "popping-open." My sole hesitation is the unqualified endorsement of positive coning, which in AECL's experience is not "good" under all conditions. The authors' comments would be appreciated.

Authors' Closure

The authors wish to thank Dr. Lebeck and Dr. Metcalfe for their insightful comments on our paper. As Dr. Metcalfe indicated, there are several limiting assumptions associated with or our model. These were necessary to reduce the problem to a (computationally) tractable from while still permitting squeeze film and thermal effects to be considered.

In response to Dr. Metcalfe's question, in addition to the stated assumptions inlet losses, phase change transition kinetics and thermoelastic deformations were not considered in the present model. Inlet losses are typically negligible under low leakage conditions, and the inclusion of seal deformations requires an additional iterative loop and hence would significantly increase the already excessive computational overhead. Nevertheless mechanical and thermal distortions eventually must be considered.

Dr. Lebeck indicated that contact load support and friction heating may be important for flat faced seals under most operating conditions. These effects certainly should be considered in situations where seals tend to collapse, but are moot in situations where seals tend to "pop" open. It is unclear whether contact is important for the range of film thickness examined herein, yet ultimately a revised model including contact effects must be developed to analyze the full range of seal operation.

Both Dr. Lebeck and Dr. Metcalfe requested further analyses of coned seals. Various coning slopes were analyzed, and none of the results indicated an unstable nor even cyclic response under laminar flow conditions. However, more recently the present model has been extended to track seal dynamics under turbulent flow conditions, and preliminary results indicate axial instabilities under certain operating conditions. Further analyses are forthcoming.