

Spool-Sleeve Set Technology Development

Challenge



Steering left



Steering right

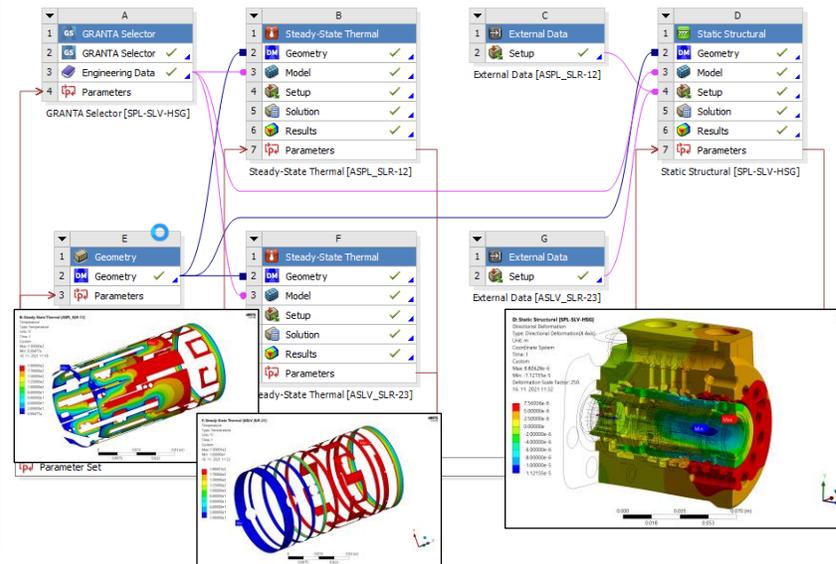
Spool-Sleeve Set Sticking Issue

- New sSteering Hydraulic Circuit **Differs Significantly** from Known Hydraulic Steering Technology
- The First Spool-Sleeve Sets Prototypes Shown Sticking Issues at **70 [bar]**
- In-sufficient **Hydrostatic Balance** at Spool-Sleeve & Sleeve-Housing Sealing Interfaces
- Sticking Risk Validation via Mangan-Phosphate (Mn-Ph) **Thin Coating 1÷2 [µm]**
- New ANSYS Methodology Development to Eliminate **Spool-Sleeve Sticking** & Minimize Leakage

CAE Methodology Development

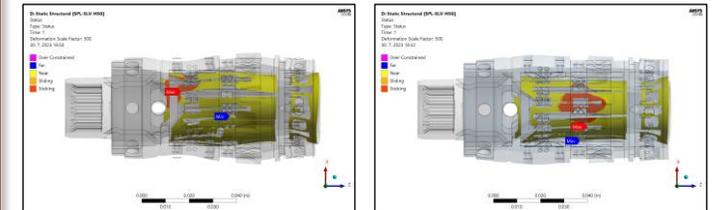
Advanced Coupled-Field Approach (Steady-State Thermal & Static Structural)

- Development of **Advanced (Coupled-Field)** Methodology
- Sealing Gap Pressure Fields via Thermal Analogy (FEM)
- **Extreme Time-Saving** - Thermal Analogy Instead of CFD (seconds vs. hours time-scale)
- **3D Surface-to-Surface Contact Gaps** (Clearance) Analysis
- **Production Clearance** as Simulation Input Parameter



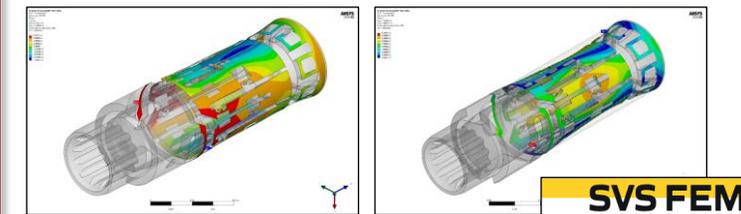
Evaluations & Impact

Sticking Risk & Contact Gaps Evaluation (ANSYS)



- Steering (Spool-Sleeve Set) **Core-Technology Development**
- Spool-Sleeve Set **Production-Optimized Design**
- **Fully-Eliminated** Sticking Issue & Spool-Sleeve Set Design Ready for **210 [bar]**

Spool Cylindricity @ Full-Hydraulic Load (ANSYS GDT)



- **ANSYS GDT** Used for Cylindricity Evaluations
- Cylindricity under **Full-Hydraulic Load 210 [bar]**
- **Excellent** Customer Support from SVS FEM during ANSYS GDT Development