



Virtual Design Review

Travis Carter
Brandon Klenck
Peter House
Arnold Schaefer

Team 4: Visual Monitoring System for Danfoss Turbocor Compressor IGVs



FAMU-FSU COLLEGE OF ENGINEERING
MECHANICAL ENGINEERING

Danfoss IGV Monitoring System

Team 4



Travis Carter
Operations
Officer



Peter House
Lead Efficiency
Engineer



Brandon Klenck
Lead Mechanical
Engineer



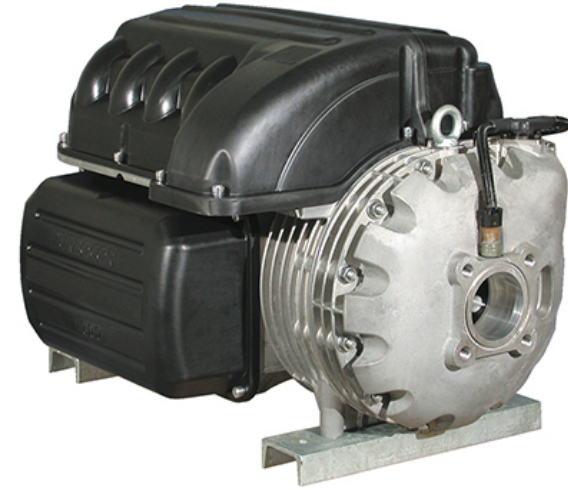
Arnold Shafer
Team Leader



Danfoss-Turbocor Compressors

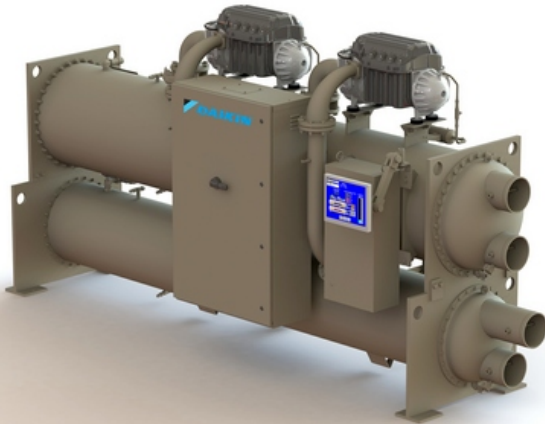
➤ Turbocor Compressors

- TT Series
 - 4 Different Models
 - 300, 350, 400, 500
- Magnetic Bearing
- Inlet Guide Vanes (IGVs)



Turbocor Oil Free Compressor

Chiller Application for Compressors



➤ Used in Chillers

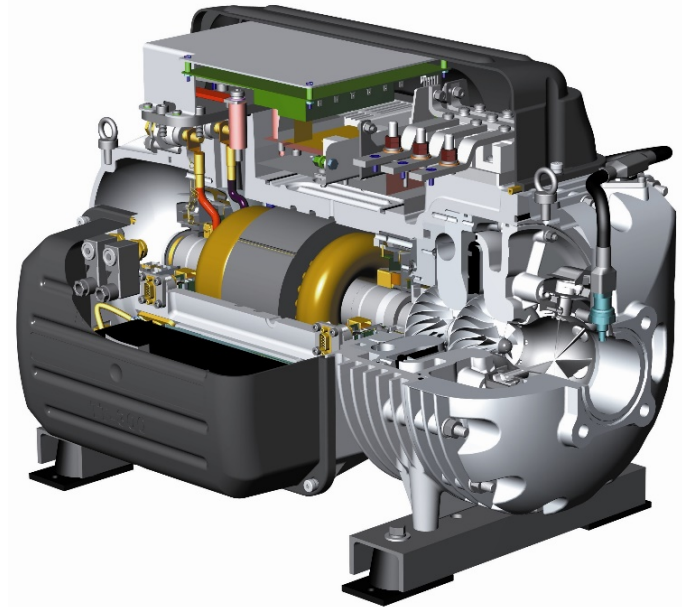
- Refrigeration Applications
- Comfort Cooling for Buildings
- 60 - 200 Tons

Presenter: Peter House



Problem Statement

- Currently No Visual for Inlet Guide Vanes (IGVs)
- Limited Angle Measurement
 - Stepper Motor is Used for Angle Control
 - No Feedback
- Problems with IGVs
 - IGVs Might Flutter or Vibrate
 - Possible IGV Breakdown



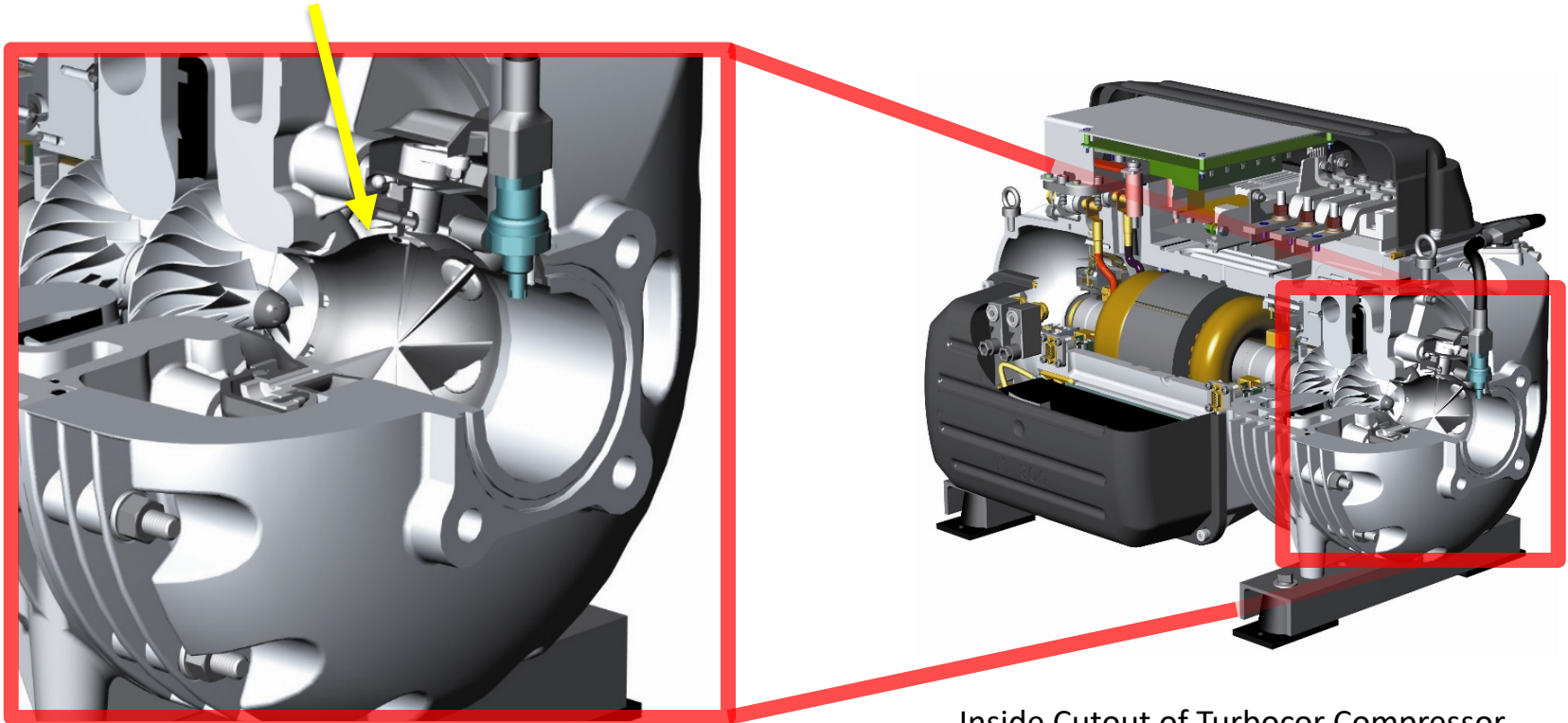
Inside Cutout of Turbocor Compressor

Presenter: Peter House



TT Series Compressor Detail

Inlet Guide Vanes (IGVs)



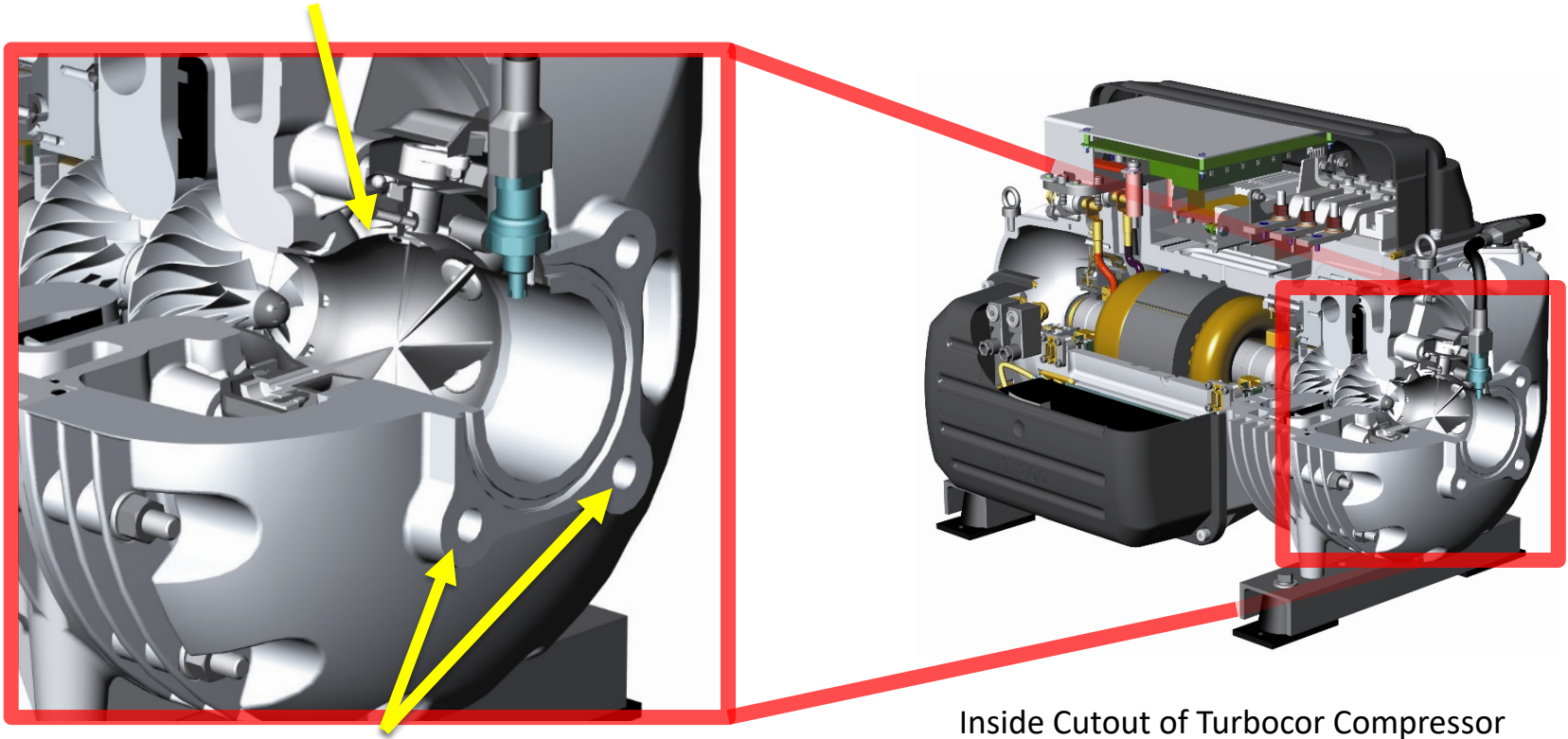
Inside Cutout of Turbocharger Compressor

Presenter: Peter House



TT Series Compressor Detail

Inlet Guide Vanes (IGVs)



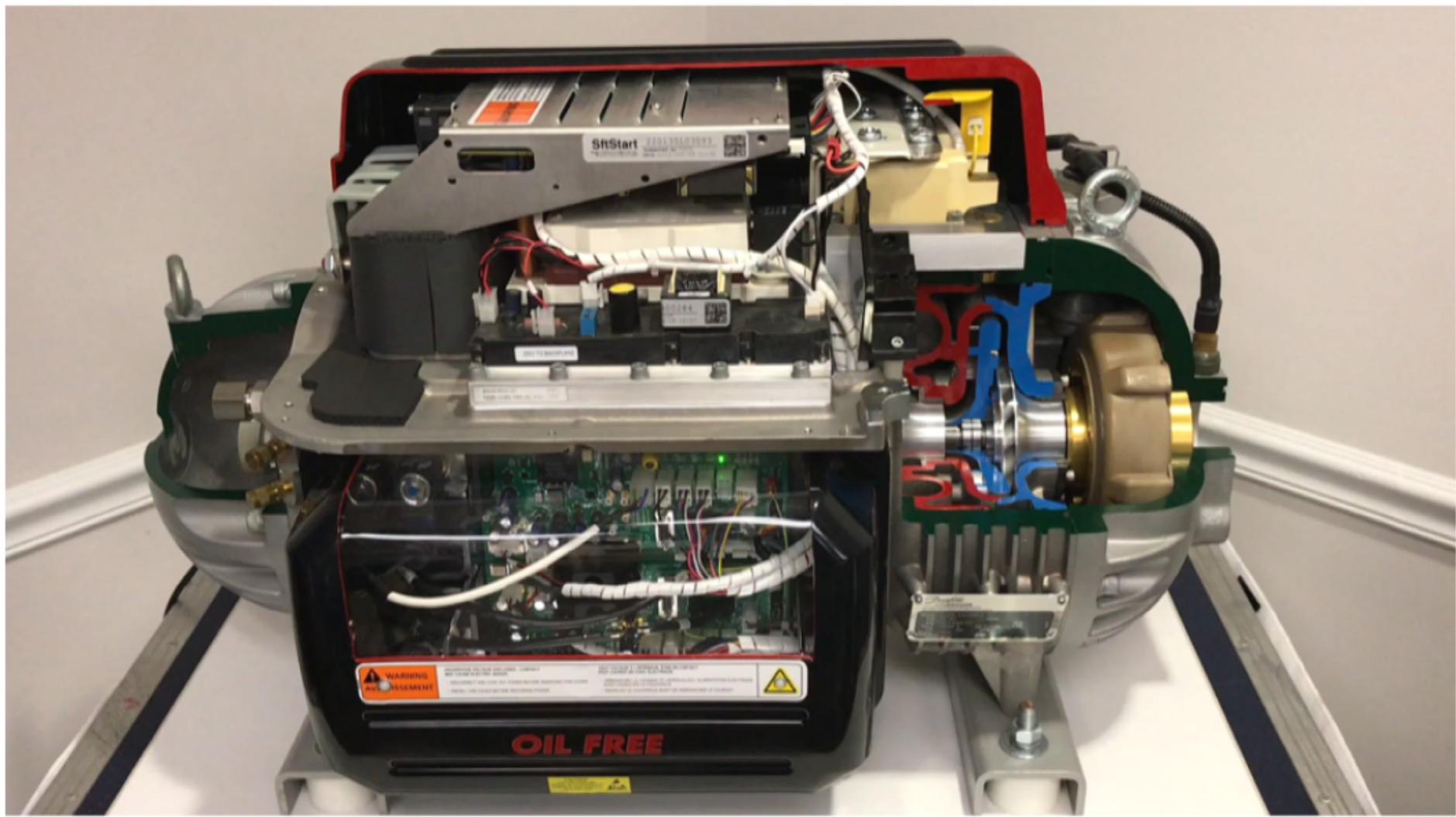
Inside Cutout of Turbocharger Compressor

Inlet Flange Attachment for Pipe
and Monitoring System for Testing

Presenter: Peter House



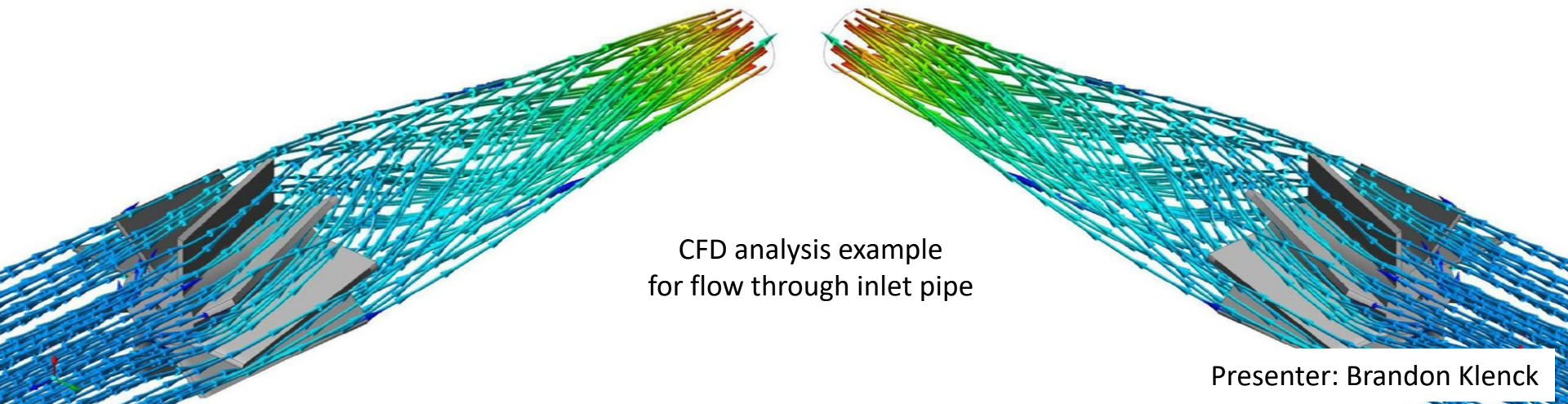
TT Series Compressor Video



FAMU-FSU COLLEGE OF ENGINEERING
MECHANICAL ENGINEERING

Project Scope - Objective

Design a system for real-time visual and position monitoring of the compressor inlet guide vanes



CFD analysis example
for flow through inlet pipe

Presenter: Brandon Klenck



Project Scope - Goals



- True Angle Measurements
- Detailed Visual Monitoring
- Minimize the Impact on Fluid Flow

Inlet View of the Turbocharger Compressor

Presenter: Brandon Klencck



Market, Assumptions and Stakeholders

- Primary Market
 - Danfoss Research and Development
 - Testing Facilities
- Assumptions
 - Purchase Monitoring Equipment
 - Will be used with the TT Series
- Stakeholders
 - Danfoss Test Lab
 - Design and Sales Team
 - Refrigeration Manufacturers



Danfoss Turbocor Compressor Testing Center

Presenter: Brandon Klencck



Customer Statements and Needs

| Customer Statements | Customer Needs |
|---|--|
| We want a visual of the inlet to monitor guide vane, slip, impedance, flutter and vane loss | Visual monitor allows for qualitative analysis of IGVs' status |
| We need an angle reading of the IGV that is better than the stepper motor | The angle reading is more accurate than the stepper motor |
| The camera needs to be in the center of the pipe | The view of the vanes is of the center of the inlet |

Presenter: Peter House



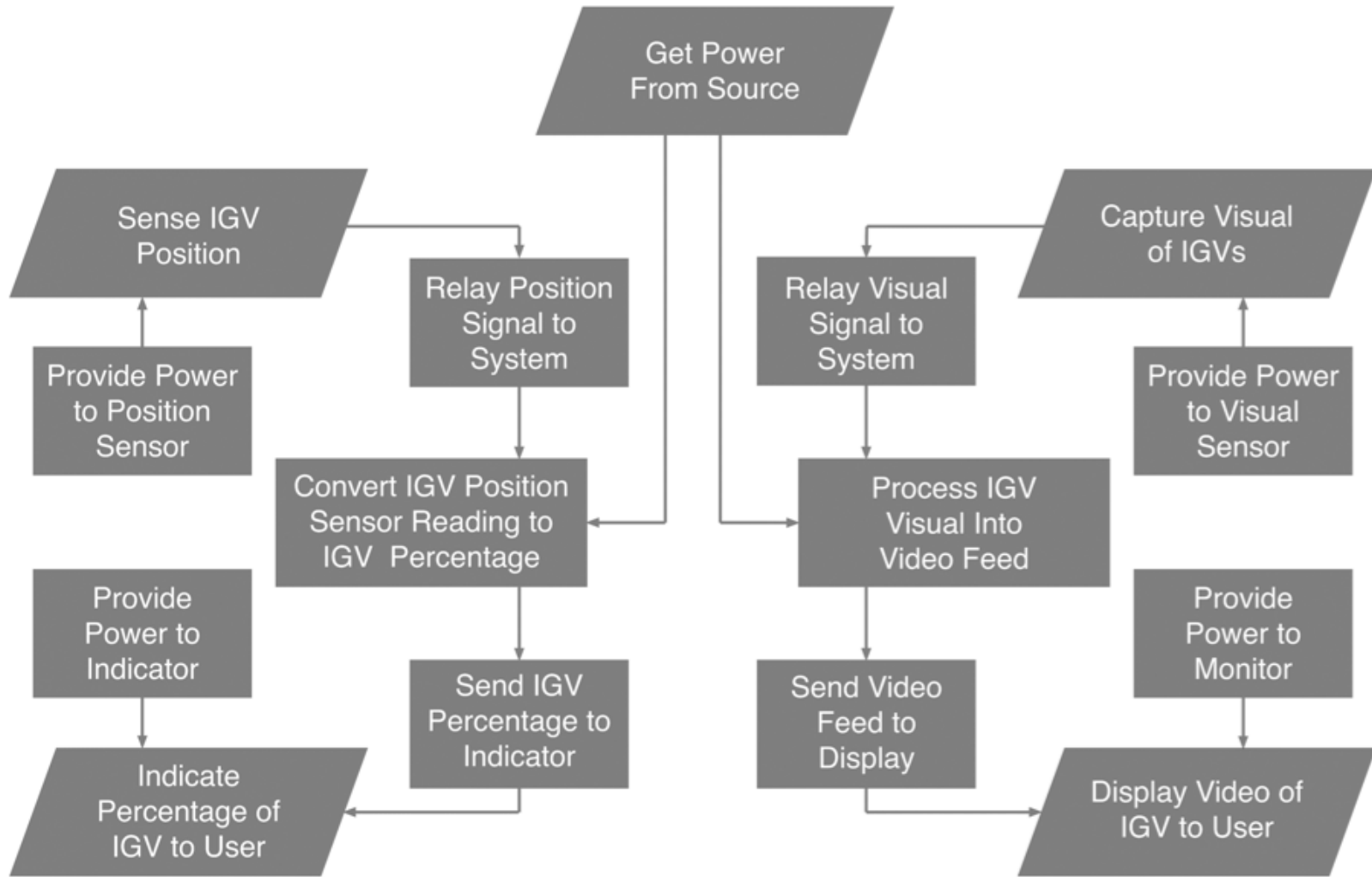
Customer Statements and Needs

| Customer Statements | Customer Needs |
|---|--|
| The device cannot break and have parts enter into compressor | System malfunction should not damage the compressor |
| The compressor inlet flow should not be impacted | The system allows normal flow into compressor |
| We want a visual of the inlet to monitor guide vane, slip, impedance, flutter and vane loss | Visual monitor allows for qualitative analysis of IGVs' status |

Presenter: Peter House



Functional Decomposition



Presenter: Brandon Klencck



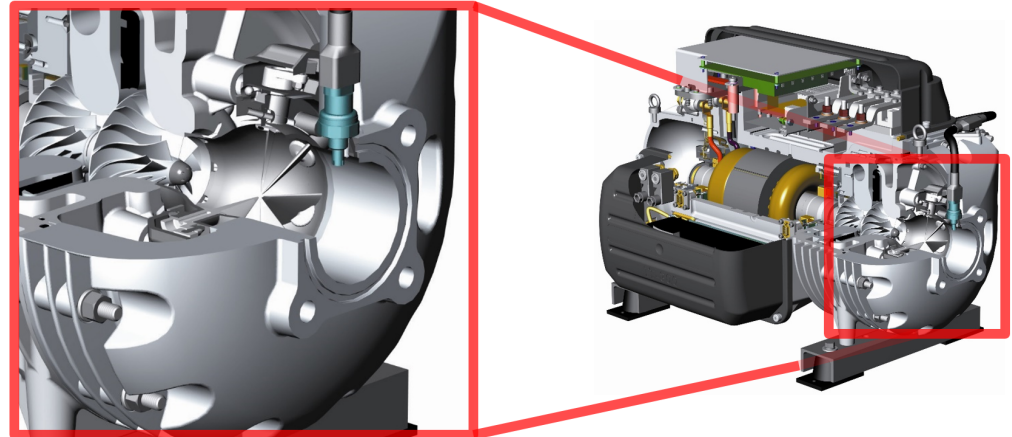
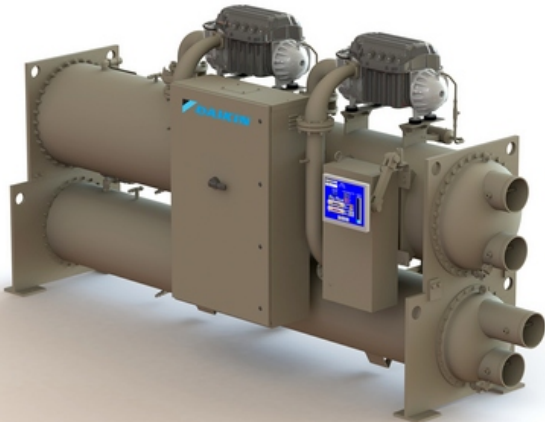
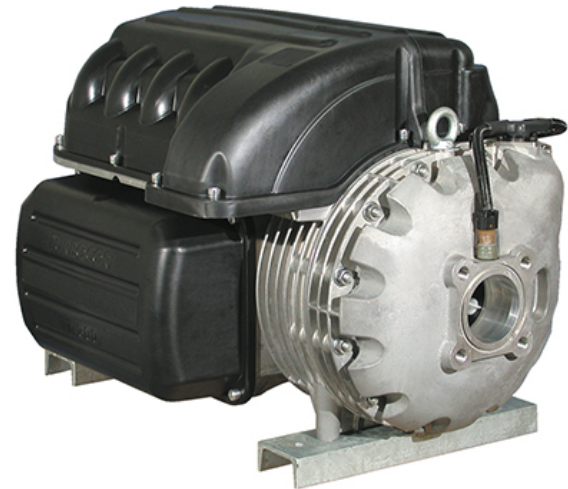
Summary

- Danfoss Turbocor Compressor
 - Application in Refrigeration
 - Magnetic Bearing, Oil-Free Compressors
- Project Scope – Inlet Guide Vein Monitoring System
 - Reliable Angle Measurements
 - High Quality Visual Monitoring
 - Minimize the Impact on Fluid Flow
- Market, Assumptions and Stakeholders
- Customer Needs
- Functional Decomposition

Presenter: Brandon Klencck



Thank You for Your Time. Questions?



Work Cited

- Turbocor® Centrifugal Compressor Manufacturer | Danfoss. (n.d.). Retrieved October 08, 2017, from <http://airconditioning.danfoss.com/products/compressors/turbocor/#/>
- Magnitude® Magnetic Bearing Centrifugal Chillers. (n.d.). Retrieved October 08, 2017, from <http://www.daikinapplied.com/chiller-magnitude-magnetic.php>
- FEA/CFD Analysis and Simulation. (n.d.). Retrieved October 08, 2017, from <https://www.pinterest.co.uk/caddmodelling/feacfd-analysis-and-simulation/http://www.contractingbusiness.com/residential-hvac/danfoss-opens-indoor-climate-test-center>



Customer Statements and Needs

| Customer Statements | Customer Needs |
|--|--|
| Parts like sensors and cameras need to be serviceable | The system components can be replaced or serviced |
| No sonic or magnetic interference and cannot negatively influence the compressor's performance | The system allows normal operation of the compressor electronic subsystems |
| The vanes need to be lit to see them | Vanes are all clearly visible |

