



# ***FIELD TESTS OF A SYSTEM TO PREVENT IGNITION OF ORGANIC DUSTS ON COMBINE HARVESTERS***

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# Outline...

- Review of Laboratory Studies
- Review of Machine Concept
- Prototype Field Experience
  - 2012 Experiment
  - 2013 Experiments
- Next Steps

Late November 2013  
Near Presho, SD



# Laboratory Results

- Sunflower residue ignites at lower temps than other residue
  - Tests point to the pith in the stem that forms “white dust” under dry crop stem conditions
  - The fine dust has very high porosity and surface area
  - Sunflower dust begins to volatilize (smell) at temps as low as 428° F
- We have not been able to ignite dust on a surface with a static spark

# Ag. Dust Comparison

Mesh #	Particle Size (µm)	Ignition Temp. (Deg. F)	
		Corn Stover	Sunflower
50	710-300	608	554
100	300-150	590	536
230	150-63	590	536
500	63-25	572	500
500 Mesh Samples Volatilization Temp.		482	428
Volatilization Energy		67.85 (J/g)	75.11 (J/g)
Total Combustion Energy		12.48 (kJ/g)	13.77 (kJ/g)

# Prototype Concept

- Enclose the exhaust manifold, turbocharger, and exhaust pipe
- Draw air through a filter to remove organic dusts
- Pump clean air into the enclosure around the exhaust system
- Provide means to control the exit of air from the enclosure to manage heat transfer

# 2012 Prototype and Field Test

- Prototype developed to fit CaseIH 8120
- System installed on a cooperator's 8120 and operated throughout the fall 2012 season



# 2013 Installations

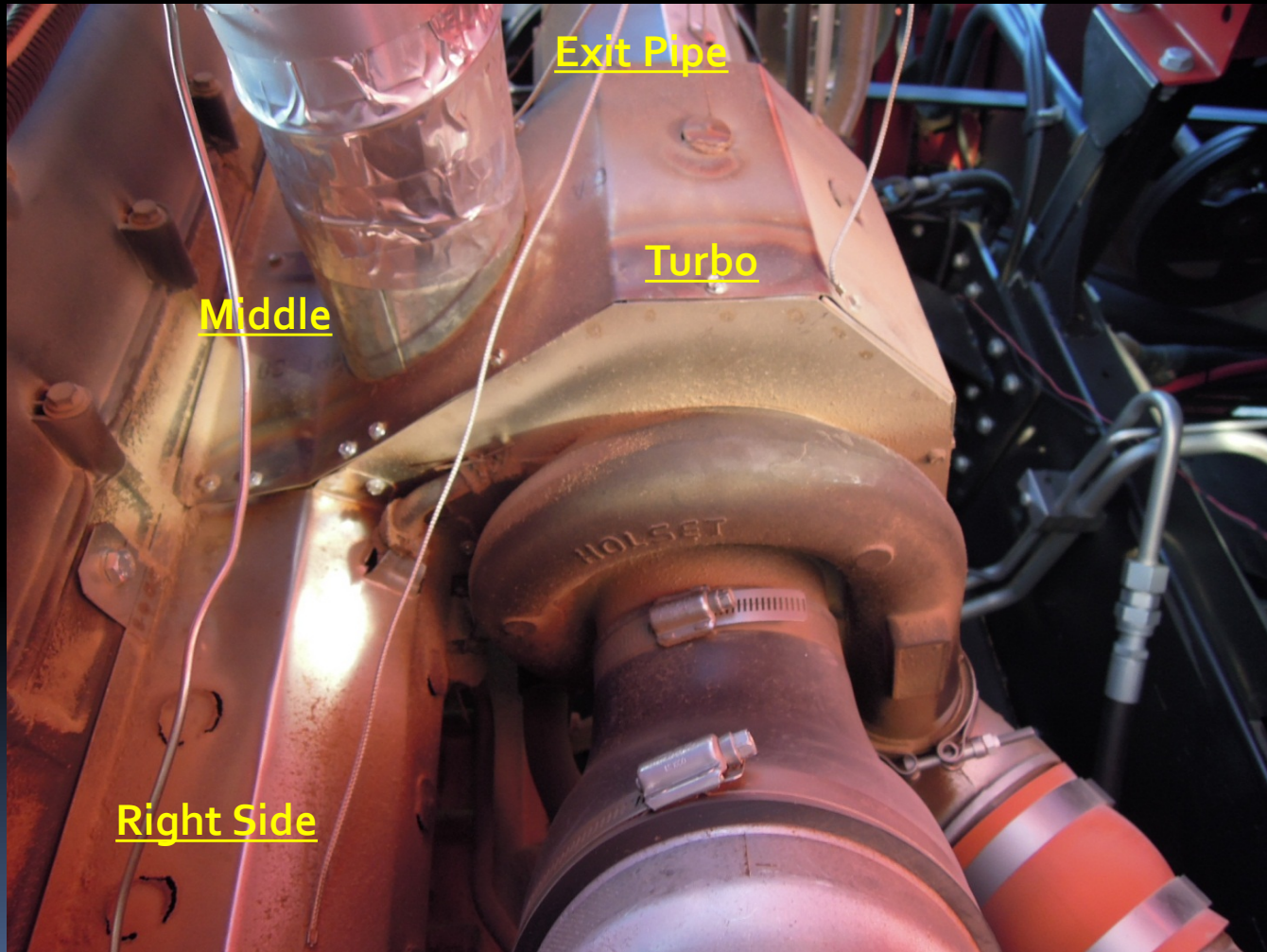
- Case IH 8120
- John Deere 9770
- Case IH 8230 Tier IV A
  - Twin City Fan mated to Donaldson air filter with Donaldson Spin Top to minimize filter load (no scavenging available)
- John Deere S680 (collect temps only)



# Case IH 8120 Manifold Cover



# View from Radiator Side



# Case IH 8120 Fan & Filter



# Deere 9770 Installation



07/31/13

**WARNING:**  
Keep fingers and eyes  
away from rotating  
machinery. Read  
operator and maintenance  
instructions prior to use.

**AVERTISSEMENT:**  
Gardez les doigts et les yeux  
à l'écart des pièces en rotation.  
Lisez les instructions  
d'opération et d'utilisation  
avant emploi.

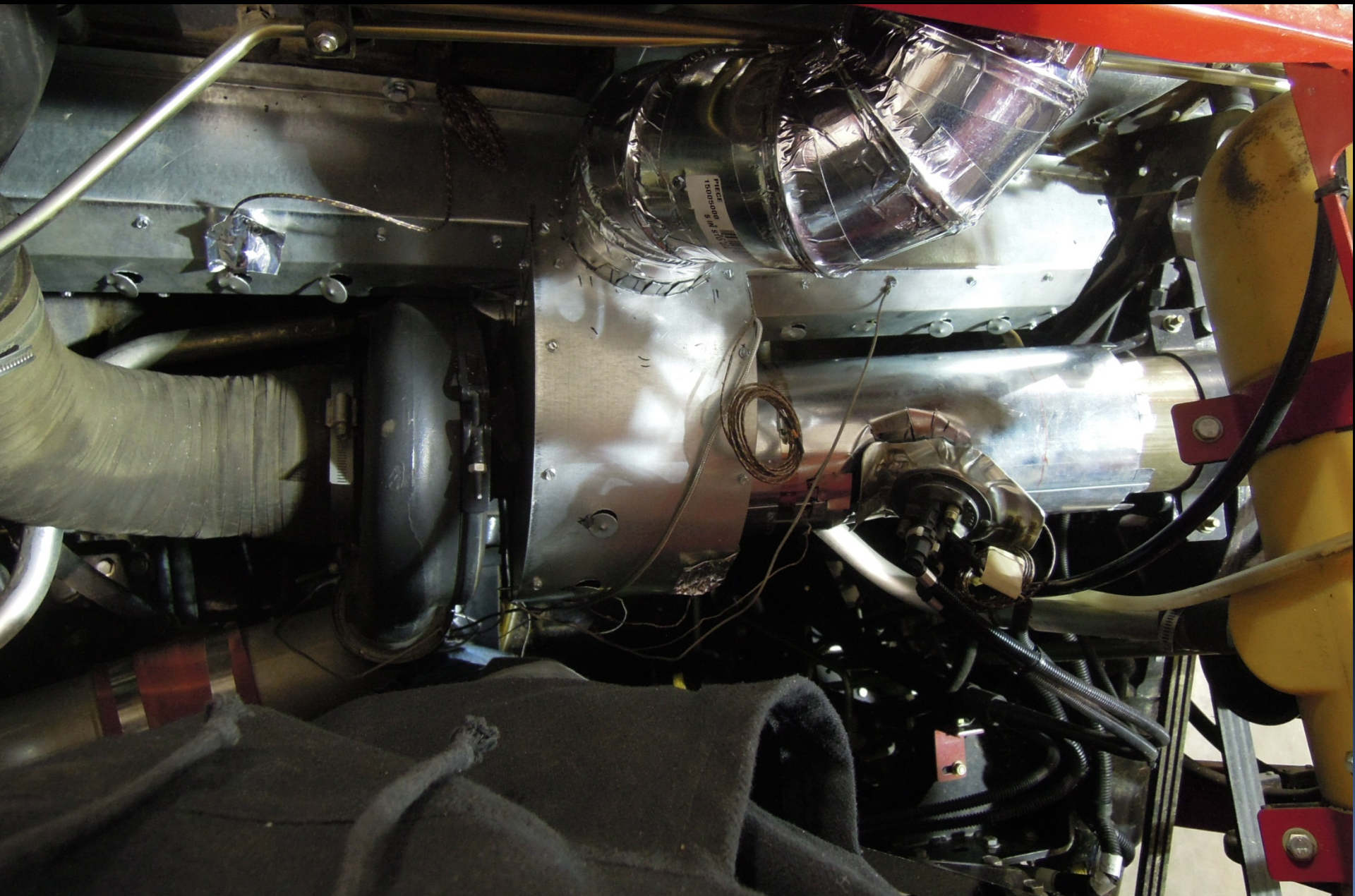
**ADVERTENCIA:**  
Mantenga los dedos y ojos  
alejados de la maquinaria  
rotativa. Antes del uso, lea las  
instrucciones de instalación y  
servicio.

TO  
9

# Deere 9770 Fan & Filter



# Case 8230 Manifold & Turbo



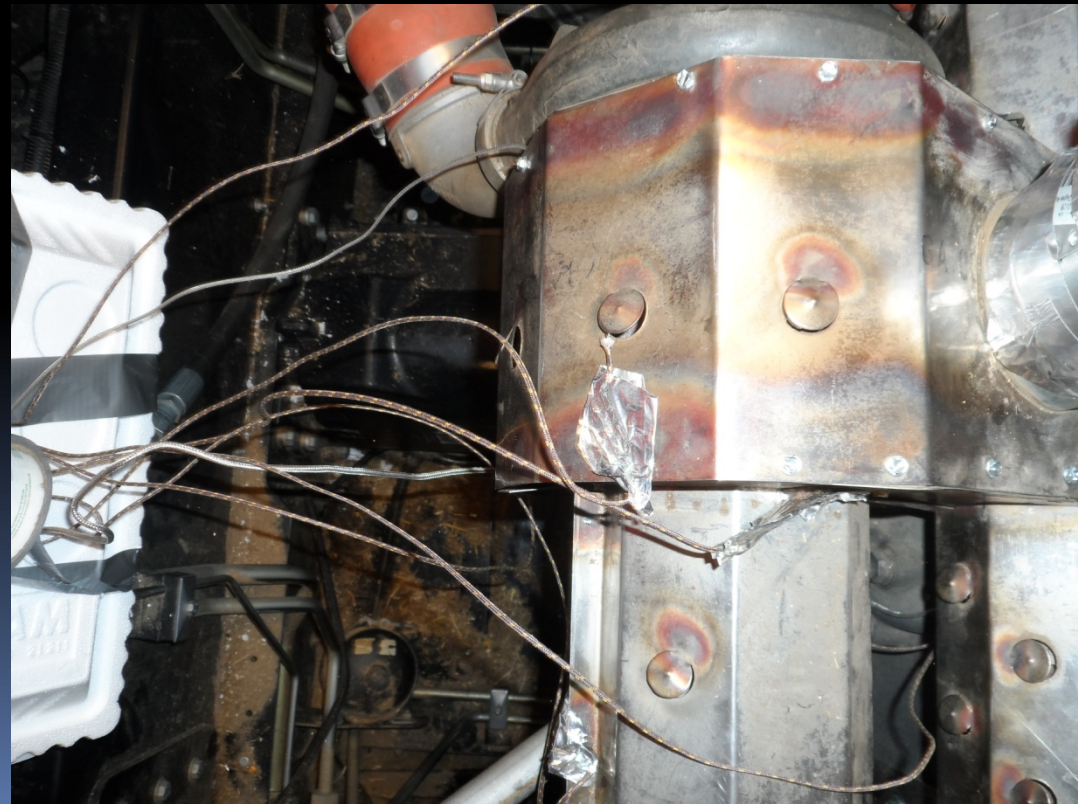


**Case 8230 Fan  
& Filter**

# Instrumentation

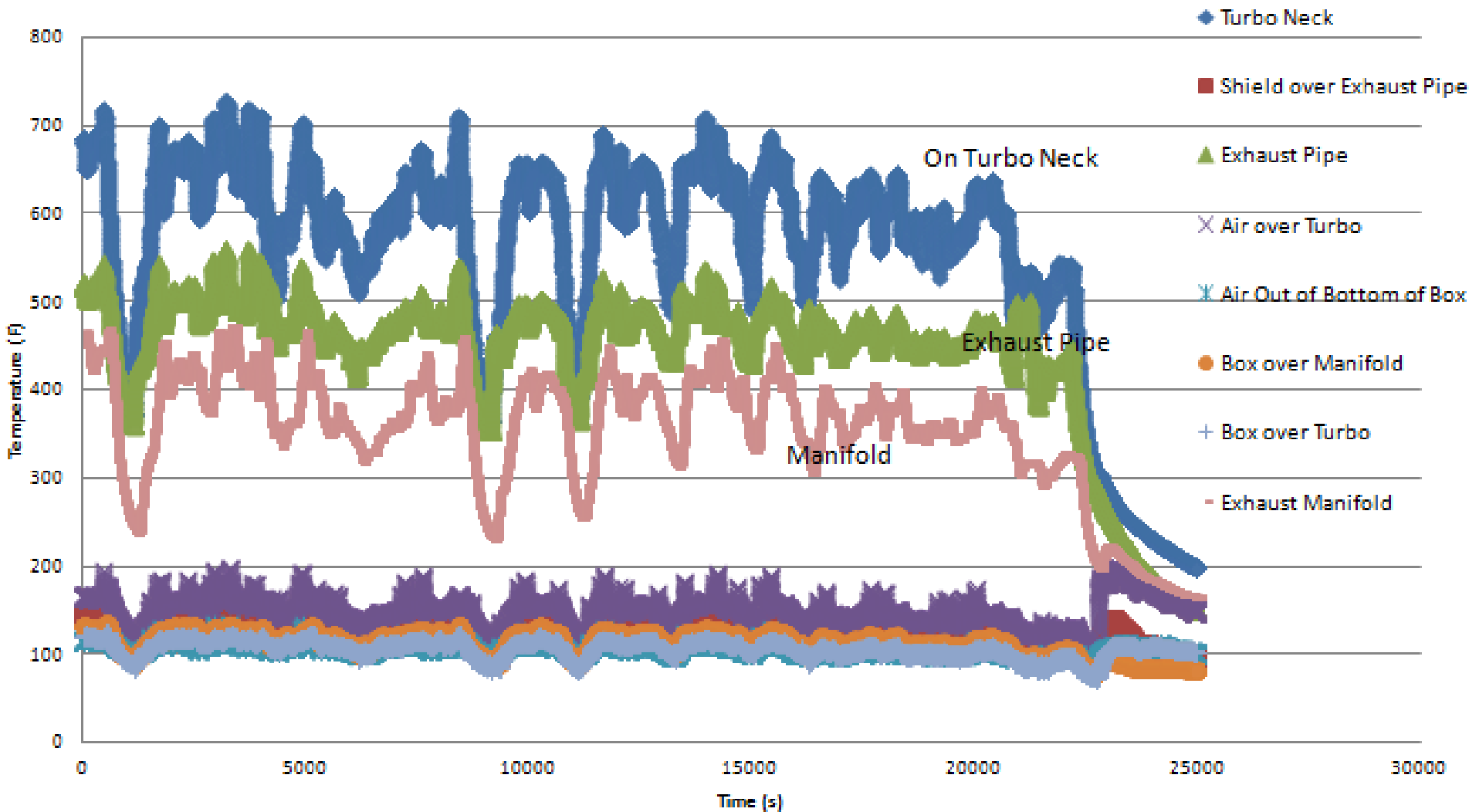
## 2014 Project

- Logging Temperature Data
- Logging CANBus Data
  - Temperatures and Engine Data

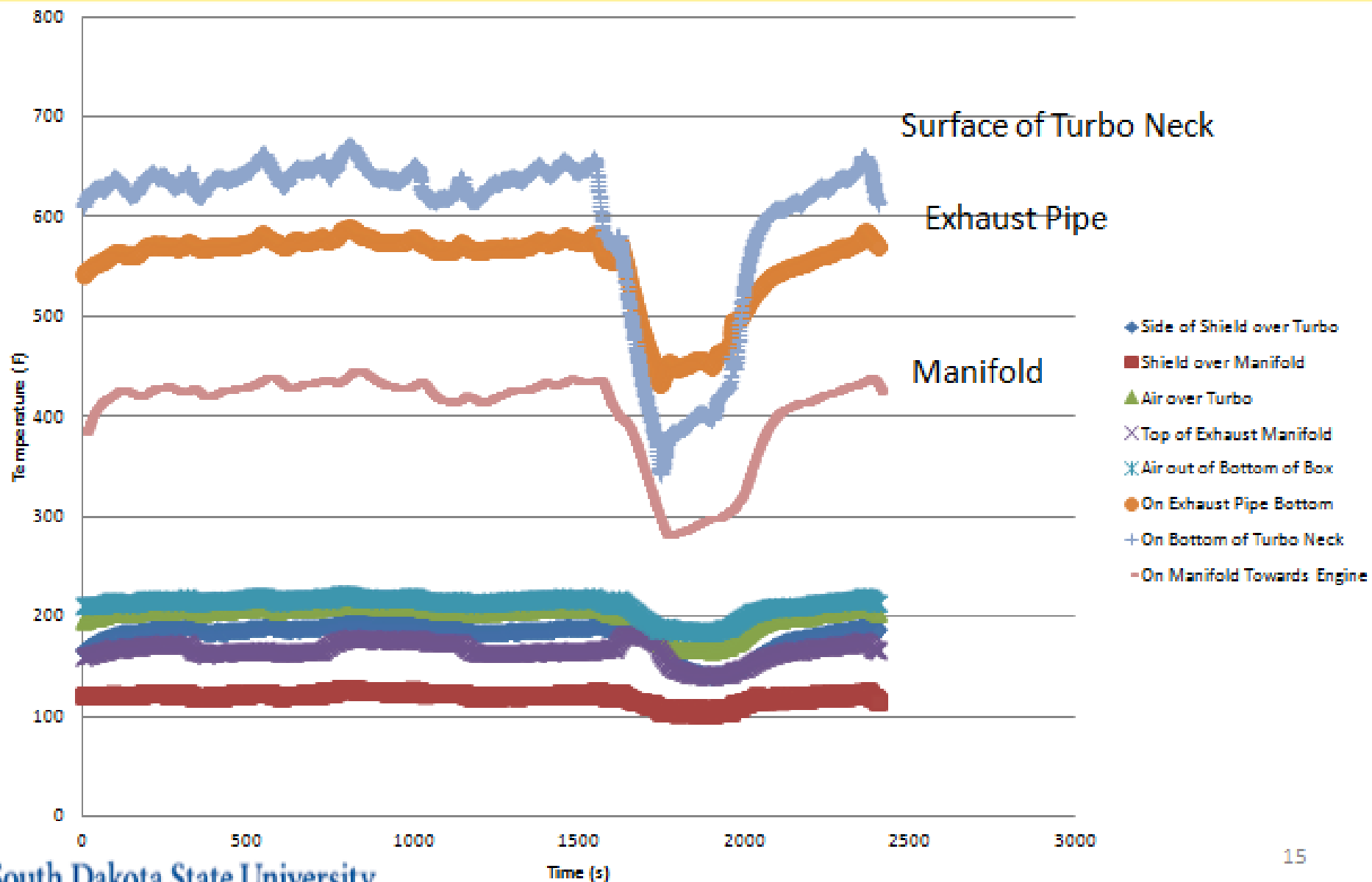




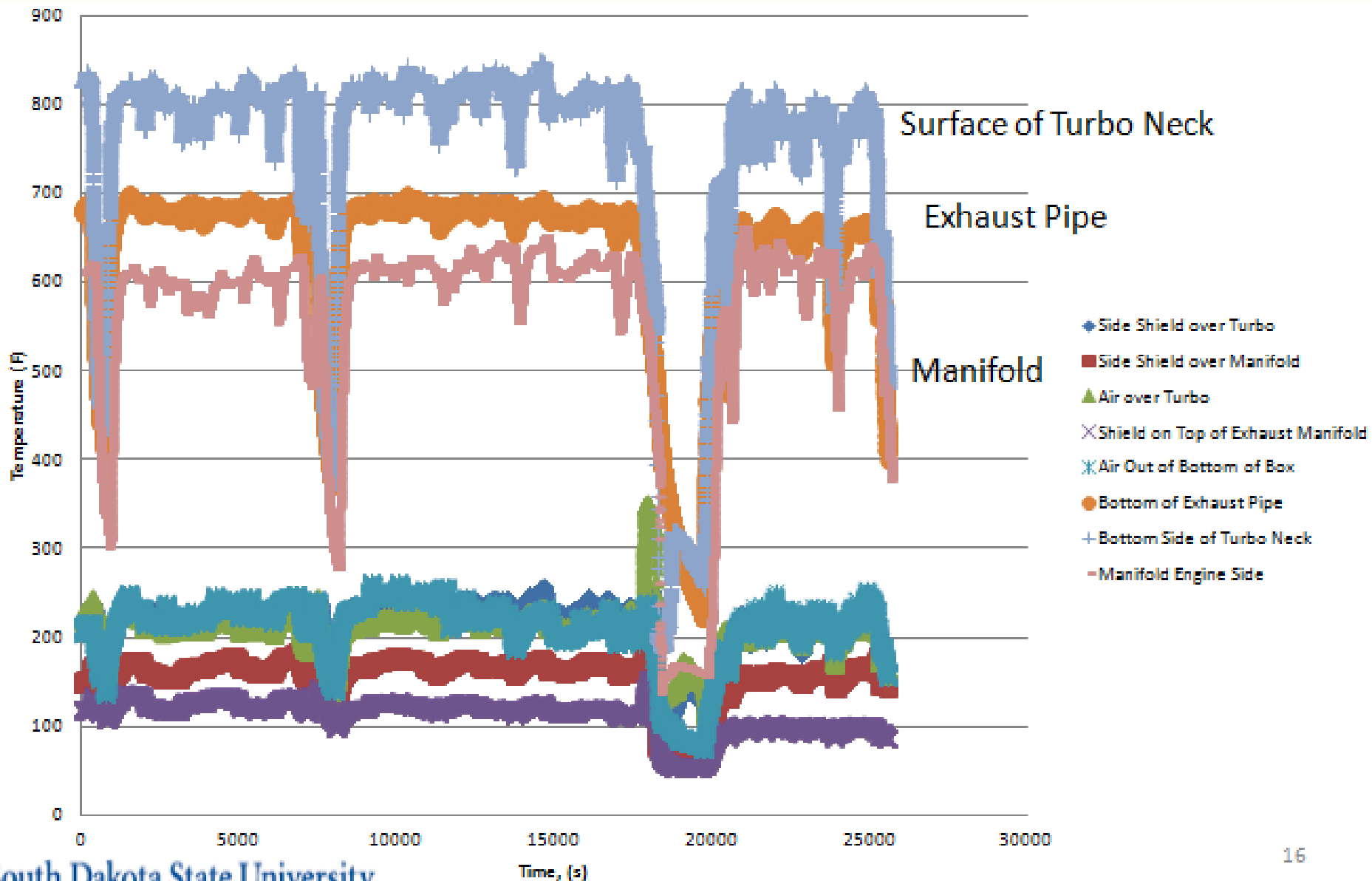
# Temperature vs. Time 9770



# Temperature vs. Time CASE 8120 with Fan Running



# Temperature vs. Time CASE 8120 with Fan Disconnected

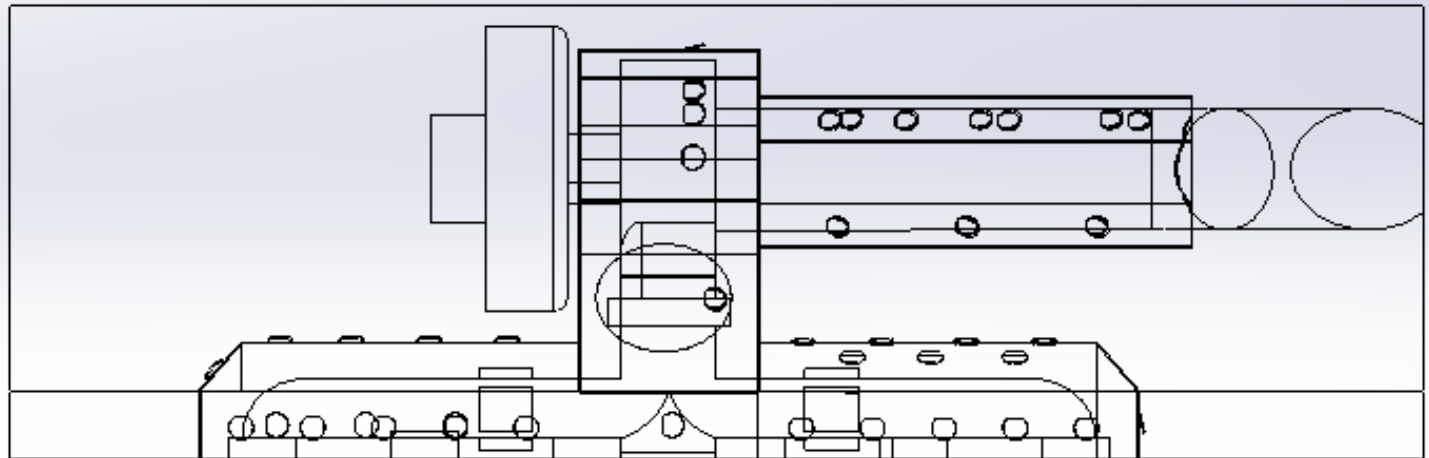


# Producers' Experience

- One fire on Deere 9770 (bearing failure)
- Shaft seal failure (drain required...) on 8120
- No fires with fan/filter operating
- Able to load the machine as the crop allowed
- Crop and field conditions were wet and cold with few fires across the region. Not a good test of the systems this year

# Next Step Research - 2014

- Computational Fluid Dynamics
  - Model
  - Simulation
  - Optimization
- Model may suggest smaller fan/filter setups on Machines



# Next Step Research - 2014

- Leave existing installations in place
- Add one or more systems with reduced fan and filter size to JD 9770 or other model
- Complete CFD model documentation
- Complete lab apparatus to test airborne ignition temps of sunflower dust

# Next Steps

- SDSU has filed a patent application on the system to allow for commercialization if possible
- Challenge to retrofit enclosures to multiple brands and models of the existing fleet
- Note that JD has implemented a system that filters air and pumps it to an enclosure around the Diesel Particulate Filter
- So far they are not protecting the turbo



Questions?

South Dakota  
Oilseeds Council

