

# Universal Electrical Signature Analysis System (UESAS)

- - - **General Information (10/7/03)** - - -

*For more information, contact:*

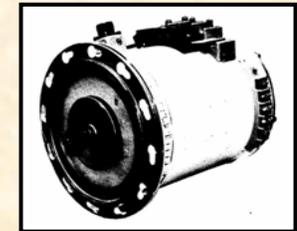
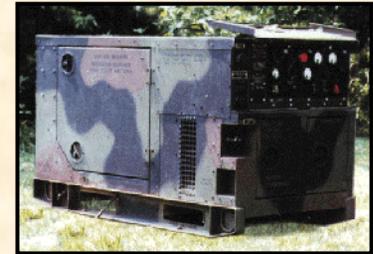
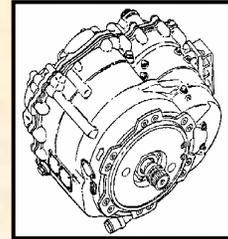
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# Background Information

- ORNL has pioneered an equipment condition monitoring technology called **Electrical Signature Analysis (ESA)**. The development of ESA has spanned over fifteen years and has benefited from the testing of a wide variety of devices:

- Air Compressors
- Textile Plant Motors
- Navy P-3C Generator
- Electric Fuel Injectors
- Variable Speed Motors
- Multi-Axis Milling Machines
- Diesel Engine Starter Motors
- NASA Propellant Control Valve
- Power Plant Pumps and Valves
- Navy Fire and Seawater Pumps
- Large Chillers, Blowers and Fans
- Helicopter Tachometer Generators
- Army Tactical Quiet Generator (TQG)
- Gaseous Diffusion Plant Compressors
- Electric Vehicle Motors and Alternators
- Consumer Appliances and Power Tools
- Heat Pump and Air Conditioning Systems
- Army Prototype Ammunition Delivery Systems
- Commercial Aircraft Integrated Drive Generator
- Air Force C-141 Fuel Pumps and Pitch Trim Actuators



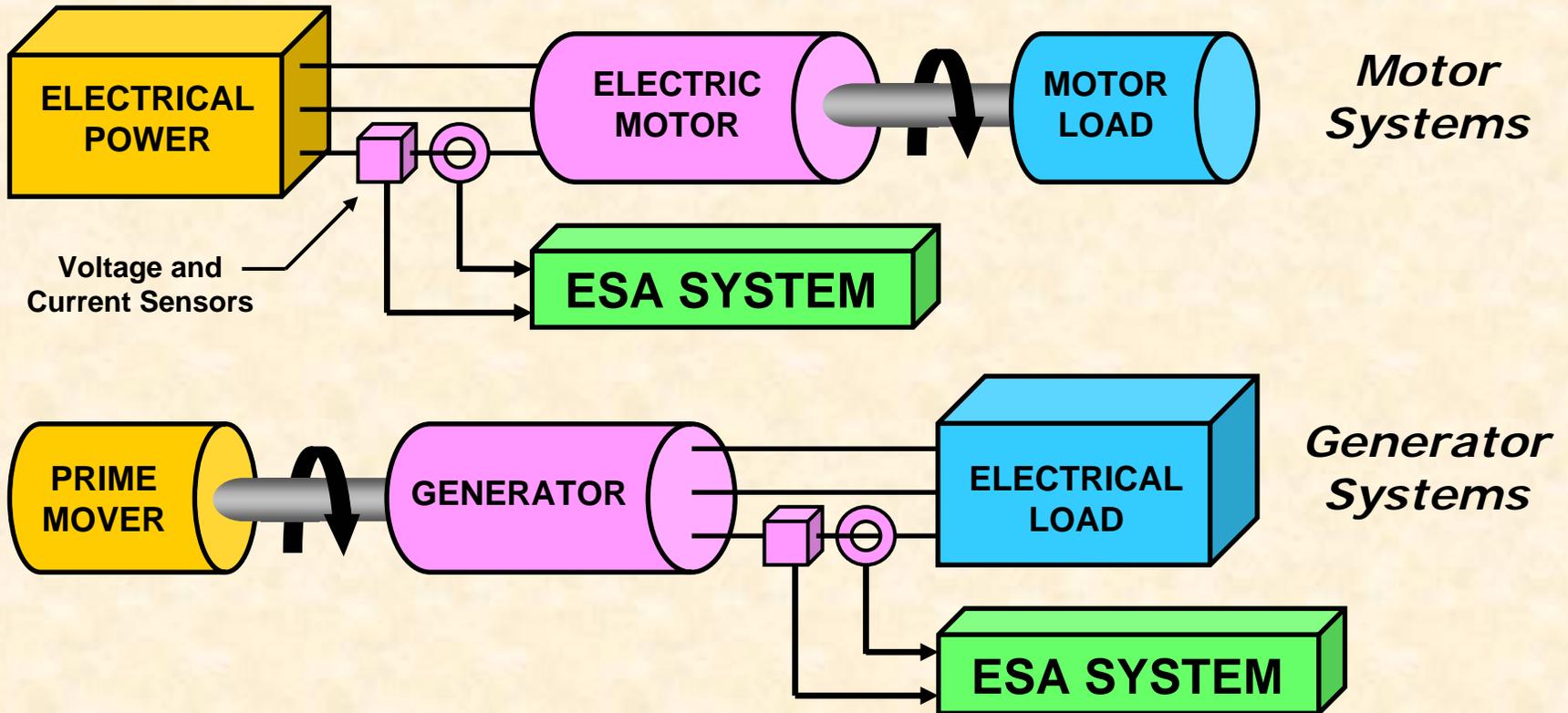
- ORNL is presently incorporating knowledge gained from this work into a **Universal Electrical Signature Analysis System (UESAS)** as a project for the **USAF Aging Aircraft Office**. Paul Keller is the PM at ASC/AAAV.

# Why Use UESAS for Aircraft Condition Monitoring?

- **ESA can enhance aircraft reliability and operational readiness by providing improved diagnostics (current condition) and prognostics (future condition) for critical aircraft equipment**
- **Increased aircraft availability; reduced down time**
- **Reduced mission aborts due to equipment failure**
- **Maintenance man-hours saved**
- **Improved ability to manage and plan maintenance**
- **Maintenance cost savings**
- **Prior to deployment verify equipment condition and identify equipment needing repair or replacement**
- **Reduce size of war fighter's kit needed for deployment**
- **Improved aircraft flight safety**

# How Will the UESAS Work?

- The motor (or generator) of the system under test will be used to provide the diagnostic signals, much like a built-in transducer.



- Variations in electric current or voltage will be analyzed and related to the electrical and mechanical condition of the tested system.

# How Big Will It Be?

- The UESAS will be about the same size as the Fuel Pump Condition Monitor (FPCM) that ORNL recently developed for use on C-141 electric fuel pumps.



***C-141 Fuel Pump Condition Monitor (FPCM)***

- Like the FPCM, the UESAS will be easily carried by one person, and will fit in the overhead compartments of commercial airplanes.



# What Type of Systems Will Be Monitored by the UESAS?

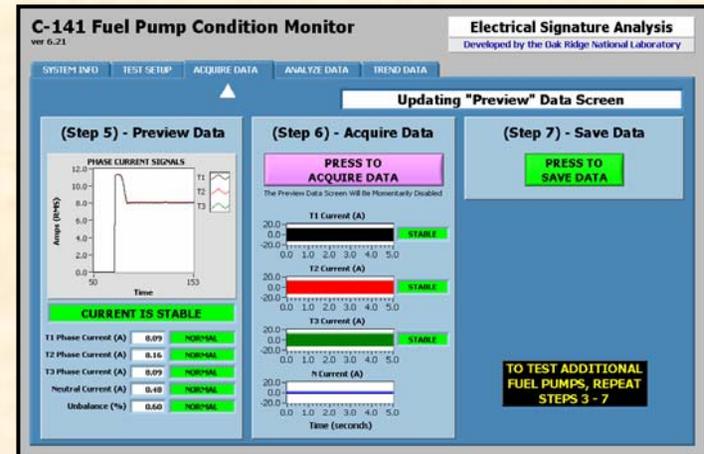
- While the FPCM was customized for exclusive use on C-141 fuel pumps, the UESAS will provide the flexibility needed for effective use of ESA on a large number of electromechanical devices.
- The UESAS will be able to monitor any equipment having one or more electric motors and/or electric generators.
- Initial systems to be monitored by the UESAS will be selected early in the development project. Examples of systems that could be selected are fuel pumps, hydraulic pumps, generators, generator constant speed drives, integrated drive generators, electro-mechanical actuators, and jackscrew drives.
- A major benefit of ESA is that the monitored equipment does not need to be directly accessed, just the electrical wiring leading to the equipment.
- Five UESAS units will be produced and provided to the Air Force Aging Aircraft Office.

# What Will Be Involved in Using the Equipment?

- Once the electrical wiring has been located for the equipment to be tested, probes are momentarily clamped around the wiring or to the terminal.



- Like the FPCM System, The UESAS will provide the user with software menus and step-by-step instructions.
- The quality of the acquired data will be checked before it is saved.
- Once saved, the data can be analyzed immediately or at a later time.



FPCM Data Acquisition Screen

# How Will Data Be Recorded and Tracked?

- **The UESAS will record data and other vital test information on the system's disk drive.**
- **After tests have been completed, data can be transferred to another computer or server via the Universal Serial Bus (USB) or Ethernet connections.**
- **Test data can be backed up directly from the UESAS to CD media using the built-in CD-writer, or to a portable hard disk via the USB connection.**
- **Test data can be organized in a single database, that could be accessed from remote locations using the Internet. Data availability can be controlled as desired.**
- **Condition indicators are provided by the UESAS system that can be tracked by USAF to assess trends in condition of equipment under test.**
- **ORNL will track and report on the use of the five UESAS units and the test data obtained by the system users.**

# What About Supportability?

- ORNL will provide technical support to the UESAS user community throughout the development program. ORNL will provide assistance as needed to insure the successful application of ESA technology through the use of the UESAS units.
  
- ORNL will:
  - Provide phone and e-mail consultations
  - Post helpful information on a UESAS Internet site
  - Provide UESAS training - see "*What About Training?*"
  - Organize a symposium where user experiences are discussed
  - Insure the availability of UESAS spare parts
  
- Long-term support can also be provided.

# What About Training?

- **Once the UESAS has been developed, training and other guidance will be provided in several formats:**
  - **Classroom and field instructions**
  - **Internet**
  - **UESAS user's manual**
  - **Help provided within the UESAS software**
  - **Technical support - see "*What About Supportability?*"**
- **The system will be easy to use.**
  - **Prior experience with USAF maintenance personnel has shown that after 1 hour of training a USAF technician can acquire and store data.**
- **Training details have yet to be determined but can be customized to meet user needs.**

# Summary

- ORNL is presently developing a Universal Electrical Signature Analysis System (UESAS) for use by the Air Force.
- The UESAS will incorporate ESA technology, developed by ORNL during many years of component testing, into a rugged, portable system that is easy to use.
- ESA uses motors and generators as built-in transducers. No additional sensors are necessary; only access to equipment electrical wiring.
- Five UESAS units will be produced and provided to various Air Force organizations.
- Test data recorded by the UESAS will be easily backed up and can be transferred to other computers when desired.
- ORNL will provide technical support to the UESAS user community throughout the development program. Long-term support can also be provided.
- Once the UESAS has been developed, training and other guidance will be provided in several formats to insure the successful application of ESA technology to selected Air Force systems.