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Wind Turbine Reliability

AWEA Wind Power Asset Management Workshop

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DOE's Wind Program's mission includes coordination with stakeholders on activities that address barriers to wind energy use.

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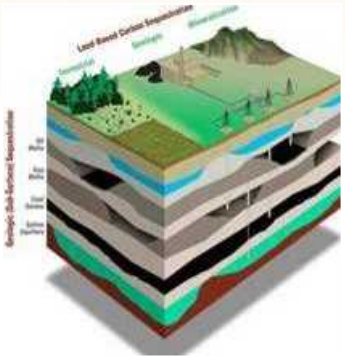
Sandia Energy Programs



Technologies include Concentrating Solar Power, Photovoltaics, *Wind,* Geothermal, Energy Storage, Well Construction, Reservoir Evaluation and Production, Storage and Transmission, Energy and Water, Fuel Utilization

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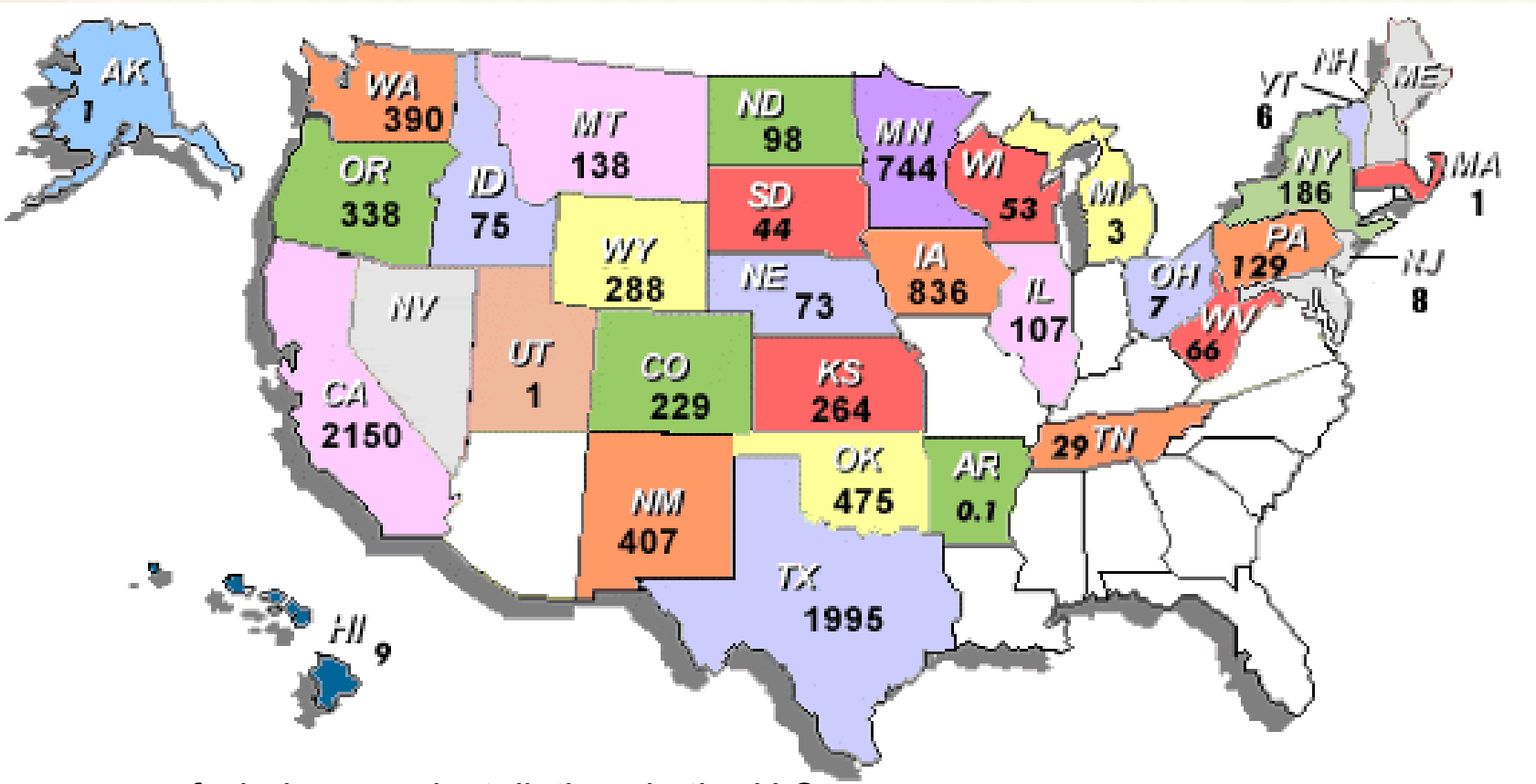
Reliability Analysis

Reliability assessments will have interfaces with all aspects of design, as well as O&M requirements and limitations, and life cycle costs

- **Initially, the system will be broken down into components, failures and understanding of failure modes and effects**
- **System reliability results are calculated using failures populated with real data, to do this….**
  - **Recruit partners**
  - **Obtain data**
    - Support AWEA O&M Users Group
    - Other groups/individual operators
    - SCADA
    - Input forms / Work orders
    - Interviews
- **Results of model analysis will initially be basic lifetime information, system mean time between failures, (MTBF), system mean time to repair (MTTR), availability**
- **Create models and estimate costs, identify key areas for attention**

Status of Wind Power in the US

These are the installations



Leading owners of wind energy installations in the U.S.

Source: AWEA

#1 FPL Energy – 3,192 MW
#2 PPM Energy – 518 MW
#3 MidAmerican Energy – 360.5 MW
#4 Caithness Energy - 346 MV
#5 Edison Mission Group – 316 MW
#6 Shell Wind Energy - 315 MW

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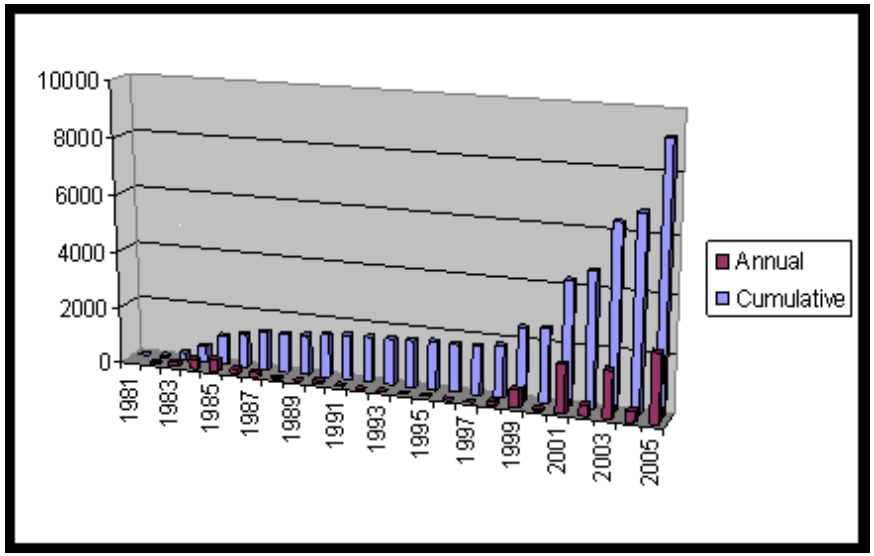
Manufacturers' Installed Capacity for the Past Five Years

These are the turbine manufacturers

2005	GE Energy 1,433 MW	Vestas 700 MW	Mitsubishi 190 MW	Suzlon 55 MW	Gamesa 50 MW
2004	GE Energy 171 MW	Mitsubishi 120 MW	Vestas 97 MW		
2003	GE Energy 903 MW	Vestas 359 MW	Mitsubishi 201 MW	NEG Micon* 129 MW	Gamesa 56 MW
2002	Vestas 175	NEG Micon* 98 MW	GE Energy 62 MW	Mitsubishi 61 MW	Bonus* 48 MW
2001	Vestas 653 MW	Enron Wind* 418 MW	Bonus* 278 MW	Mitsubishi 221 MW	NEG Micon* 119 MW



Source: AWEA

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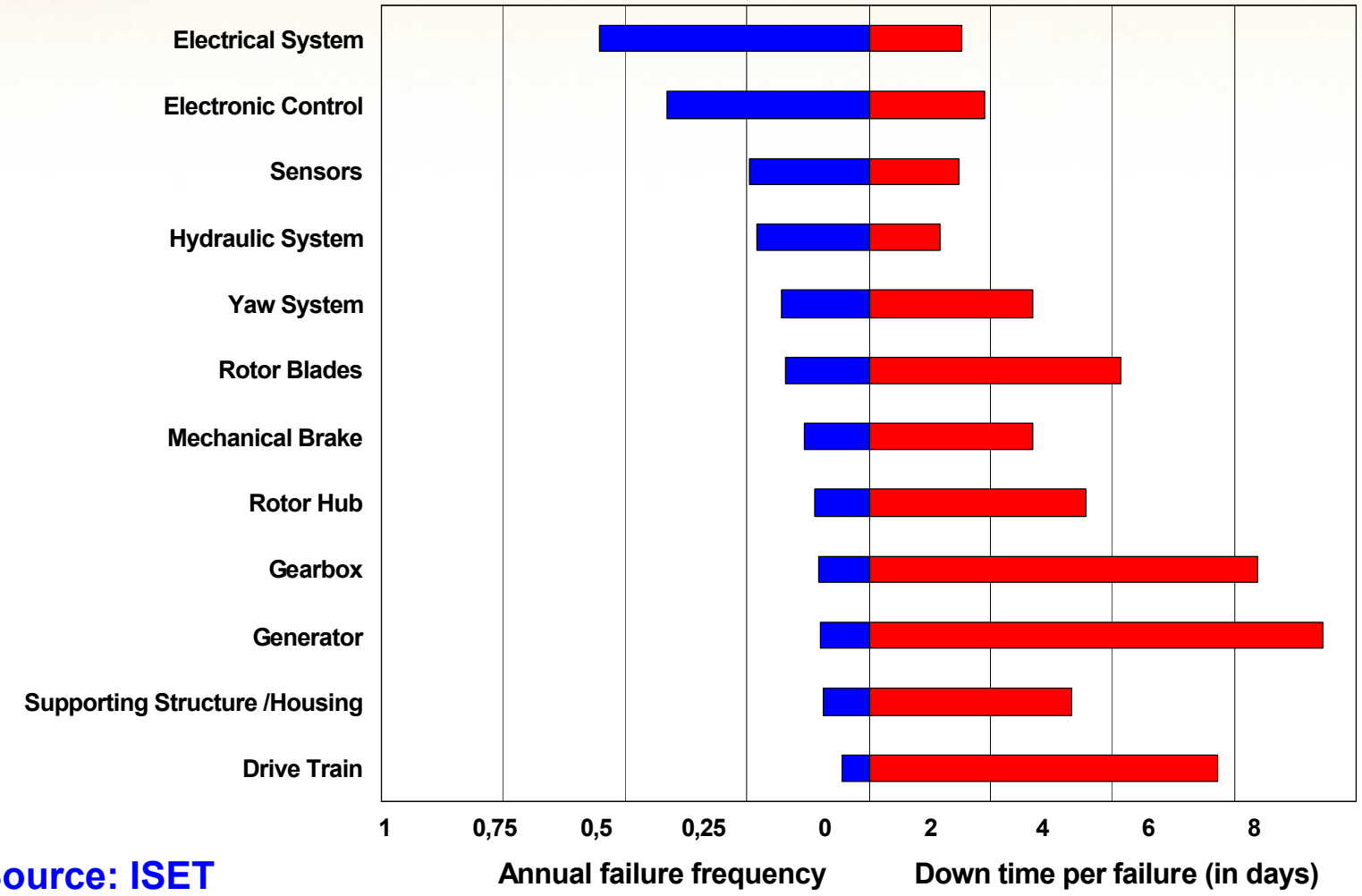
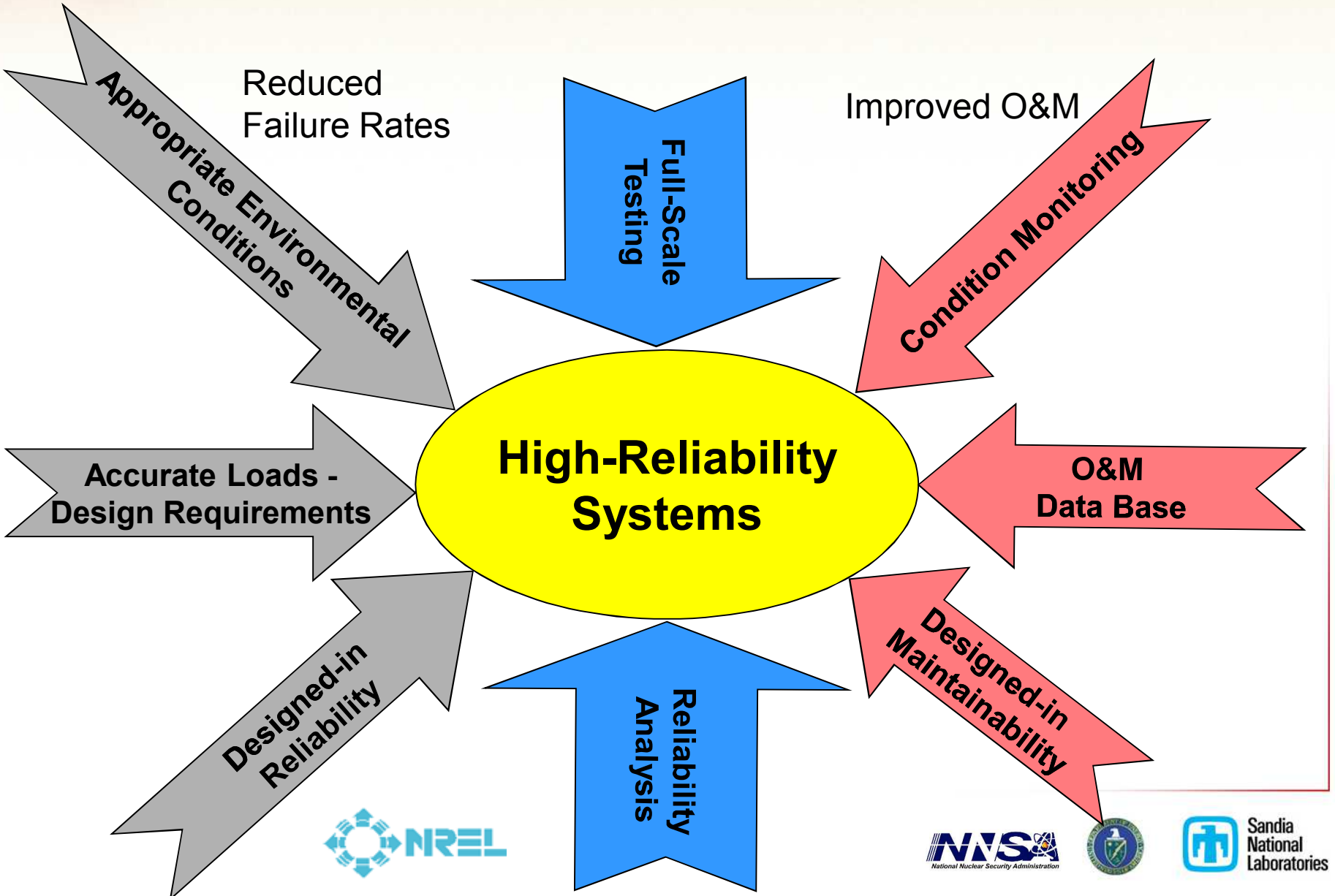
Affected Components and Downtime



Source: ISET
Paul Kühn 04/2006

Failure Rates and Downtimes

What is Required to Develop High-Reliability Systems?



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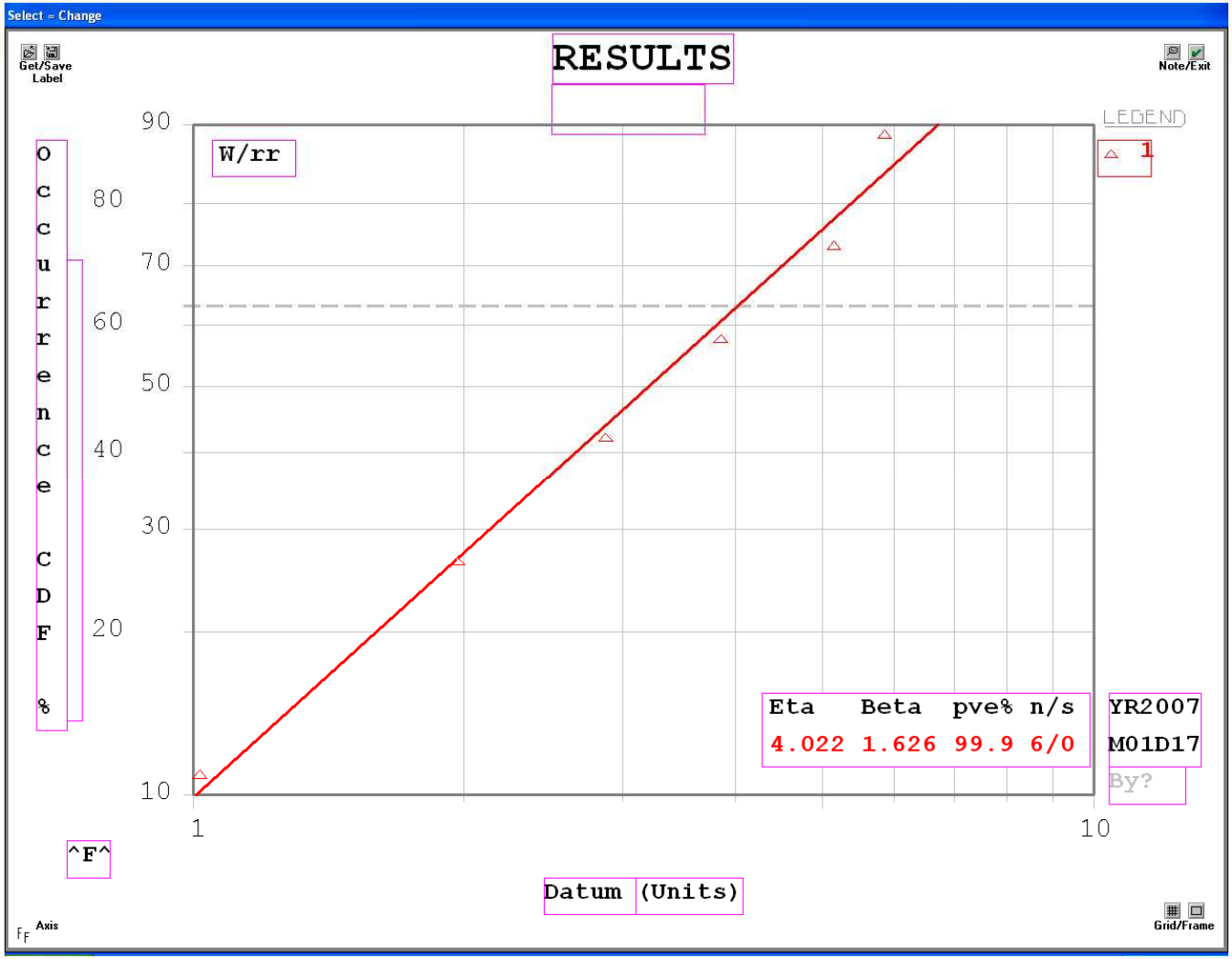
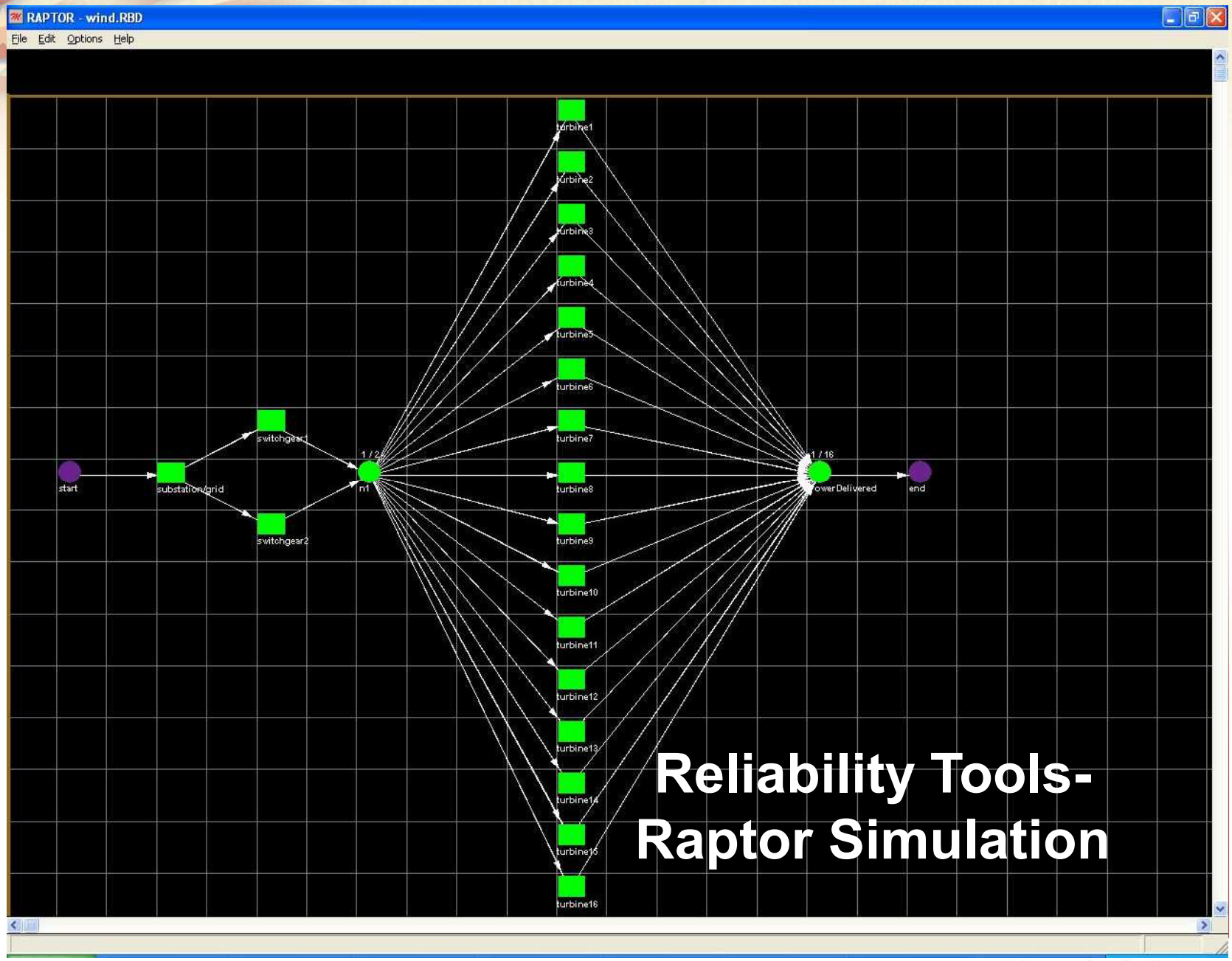
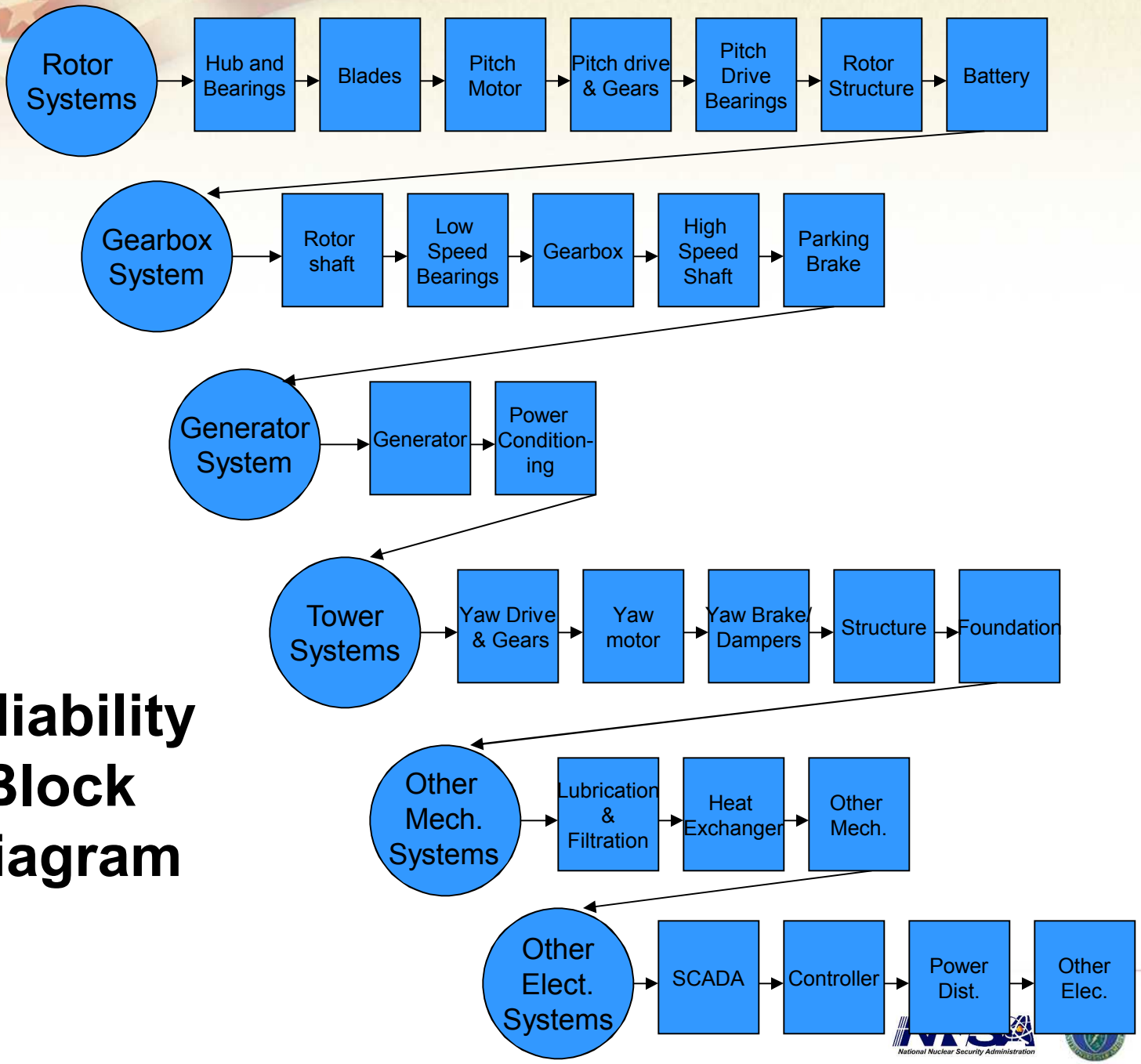
Reliability Tools -- Weibull





Reliability Block Diagram



DATA needs

- Failure data
- Repair / Replacement data
- Performance data
- Power/loads
- Condition monitoring

Resources/Partnering

- Data Base Development and Implementation
- Data partners
  - -AWEA O&M working Group
  - -UWIG O&M Working Group
  - -Individual Operators
  - -Manufactures

Initial Products

- Baseline Averages
- Analysis products
  - -MTBF
  - -MTTR
  - -Availability
  - -Parts Consumption
  - -Lifetimes

Where Do We Go From Here?

- Delphi Process meeting
  - Report/Model
- Data Collection/Database
- Reliability Workshop

  September 2007

  in Albuquerque

  See: www.sandia.gov/wind

The value comes in having the opportunity to do something to prevent the failure from occurring…Thus prediction becomes part of the process of "designing the future"

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