Energy – What’s the Alternative?

Thursday, February 28, 2013, 2:45 p.m.

Tim Zoltowski
AVP, Director of Machinery Breakdown
Zurich
Farmersville, Tenn.

Tim Zoltowski, assistant vice president and director of machinery breakdown risk engineering at Zurich Services Corporation, leads the risk assessment and loss prevention efforts for equipment breakdown risk engineering. Tim entered the insurance loss prevention field from the U.S. Navy, where he served onboard the USS Groton. He has been involved with equipment breakdown loss prevention efforts since 1997. He has significant experience in alternative energy being involved in risk management and problem solving for wind, solar and conventional power generation. Tim lectures as a guest speaker at industry venues including the General Meeting of the National Board of Boiler and Pressure Vessel Inspectors.

George Ingram
Vice President, Reinsurance
Zurich
Atlanta, Ga.

In 2013, George E. Ingram entered his 21st year in the insurance industry; the last 10 years being with Zurich. He heads the equipment breakdown reinsurance effort in the United Sates. After receiving his MBA from Georgia State University, George began his career in the property claims department of a national carrier. In addition to claims, he has worked in marketing and underwriting for both direct lines and reinsurance.

Session Description:
This insightful session will take a look at alternative energy and why we need it. Our speakers will explore the types of renewable energy sources and their effects and the new exposures associated with alternative energy.
Top Three Session Ideas

Tools or tips you learned from this session and can apply back at the office.

1. ________________________________________________________________

2. ________________________________________________________________

3. ________________________________________________________________
Energy – What’s the Alternative?

Session Outline

Overview

Alternative Energy Drivers
- Government Policy
- Financial
- Technology

Renewable & Alternative Energy Portfolio Standards

PACE
- Commercial – Emerging Programs
- Residential PACE 2008-2012

Types of Alternative Energy
- Solar
  - Types
  - Costs
  - Benefits
  - Possible Return on Investment (ROI)
  - Photovoltaic Power Plant Technology
  - Photovoltaic Power Plant Installation
  - Solar Map
- Wind Turbines
  - Parts
  - Generalized Cost of Wind Components
  - Causes of Loss
  - Power in the Wind
  - Wind Comments
  - Power Density in the Wind
  - Maps
    - Current Installed Wind Power Capacity
    - Annual Average Wind Speed at 80 m
    - Annual Average Wind Speed at 30 m
  - Wind Shear Effect
  - Cyclic Stress
  - Wind Turbine Blade Inspection
  - Lightning Damage
  - Condition Monitoring
  - Fire Damage
  - Liability

Underwriting Considerations
- Solar Power
  - Risks
  - Solutions
- Photovoltaic Plants Installed on the Ground Should Be Provided With Antitheft Devices
- Wind Turbines
  - Key Exposures
  - Main Possible Exclusions

Questions & Answers
Energy - What’s the alternative?

February 28, 2013

George E. Ingram,
Head of Equipment Breakdown Reinsurance

Tim Zoltowski,
Director of Equipment Breakdown, Risk Engineering

Alternative Energy Drivers

• Government Policy:
  • Energy Independence and Security Act of 2007
  • Certified Emission Reduction
  • Renewable Energy Credits

• Financial
  • Tax Credits
  • Property Assessed Clean Energy (PACE)

• Technology
Renewable & Alternative Energy Portfolio Standards

Source:
Center for Climate and Energy Solutions, formerly the Pew Center on Global Climate Change.

PACE COMMERCIAL – EMERGING PROGRAMS

www.pacenow.org
RESIDENTIAL PACE 2008 - 2012

PACE is a World Changing Idea........ Scientific American, 2009
2008 to 2012
✓ PACE pilots in CA
✓ 28 States
✓ FHFA
✓ Sonoma, Babylon, Boulder, Palm Desert
  • Nearly 3,000 EE/RE Projects
  • $65+ million
✓ WRCOG – Since Jan 2012
  • Over 1,200 applicants
  • $25+ million

Solar Energy

• Types of Solar Energy Conversion
  – Photovoltaic Cells (PV)
    – On the ground
    – Rooftop
    – Over parking lots

  Fully integrated

  Partially integrated
Solar Energy

- Types of Solar Energy Conversion
  - Photovoltaic Cells (PV)
    - On the ground
    - Rooftop
    - Over parking lots
  - Concentrated Solar Power (CSP)
    - Power Tower
    - Parabolic Trough
    - Linear Reflector

Types vs. Capacity

- Photovoltaic Cells
  - On the ground (1 to 5 MW)
    - 1 MW, 5-7 acres, 9000 panels, 150 homes
    - 5 MW, 50 acres, 50,000 panels
  - Rooftop (100 KW to 2 MW)
    - 100 KW, 600 panels, 15-20 homes
    - 1.6 MW, 9200 panels
- Concentrated Solar Power
  - Power Tower (Up to GW range)
  - Linear Fresnel Reflector (Up to 200 MW)
  - Parabolic Trough (10-200 MW)
Costs

- Installed costs are approximately $3.60 per kW
  - Flush Mount Systems are lowest cost per kW ($3.49)
  - Ballasted Roof Mount Systems are highest ($3.74)
- State rebates can be as high as $1.90 per watt AC
- Installation, taxes, fees are approximately $1.50 per watt

- Grid tie system adds $3.40 per kW

Benefits

- 1 MW System with annual output of 1,600 MWh
  - Yearly rebates of $240,000
  - $0.150 per kWh
  - 6 hours per day
- 100kW System with annual output of 162 MWh
  - Yearly rebates of $18,000
  - $0.111 per kWh
  - 6 hours per day
- 80 kW system with annual output of 90 MWh
  - Yearly rebates of $27,000
  - $0.301 per kWh
  - 3.5 hours per day
Possible Return on Investment (ROI)

- New Jersey for example
  - Average electricity rate - $0.117
  - Savings at 90,000 kWh (3.5 hour per day) - $10,530
  - Rebates of $27,000
  - Total annual savings $37,530
- Cost of system $7 per kW - $178,500 (50 kW system)
  - 4.76 years
- California for example
  - Average electricity rate - $0.125
  - Savings at 1,600,000 kWh (6 hour per day) - $200,000
  - Rebates of $240,000
  - Total annual savings $440,000
  - 7.6 years ROI

Photovoltaic Power Plant Technology

- Types of PV Cells
  - Monocrystalline
  - Polycrystalline
  - Thin film
Photovoltaic Power Plant Installation

Solar Energy

Energy Conversion (Solar Cell)

Energy Inversion (DC → AC)

Energy Storage (Battery)

Energy Use

Energy Distribution

Energy Sell Back

This map was created by the National Renewable Energy Laboratory for the Department of Energy.
Wind Turbines
Generalized Cost of Wind Components by %

Wind Turbines
Causes of loss
POWER IN THE WIND

• Power is proportional to wind density
• Power varies to the cube of wind speed
• Betz Law says the load must be optimized to get the best power output. If the load is too small the power is lost in the wake. If the load is too large the flow becomes obstructed and starts to bypass the blades (about 60% is optimal).
• Power Density Graph is comprised of the power of each wind speed times probability of wind speed (Weibull Distribution)

WIND COMMENTS

• In general, annual average wind speeds of 5 m/s (11 mph) are required for grid-connected applications.

• Annual average wind speeds of 3 to 4 m/s (7-9 mph) may be adequate for non-connected electrical and mechanical applications such as battery charging and water pumping.

• Wind Power Class ratings of 4 or higher are preferred for large scale wind plants. (7.5 m/s & 16.8 mph)
POWER DENSITY IN THE WIND *
American Wind Energy Association

- Grey area is power that can be expected in the wind.
- Blue area is the power that can be converted to mechanical power – (16/27ths – Betz Law)
- Red is electrical power a specific turbine can produce at this site.
- Cut in / Cut out speeds (3 to 5m/s & 25 m/s).

United States - Current Installed Wind Power Capacity (MW)

This map was created by the National Renewable Energy Laboratory for the Department of Energy.
United States - Annual Average Wind Speed at 80 m

Wind resource map developed by NREL with data from AWS Truepower.

United States - Annual Average Wind Speed at 30 m

Wind resource map developed by NREL with data from AWS Truepower.
• Wind Speed varies with height.
• For a wind turbine with a hub height of 40 meters and a rotor diameter of 40 meters, you will notice that the wind is blowing at 9.3 m/s when the tip of the blade is in its uppermost position, and only 7.7 m/s when the tip is in the bottom position.

• Components which are repeatedly bent, such as rotor blades, may eventually develop cracks and ultimately break.
• A German Growian machine (100 m rotor diameter) had to be taken out of service after less than three weeks of operation.
• Metal fatigue is a well known problem and therefore not favored for rotor blades.
LIGHTNING DAMAGE

- Statistically, lightning caused 4 – 8 faults per 100 turbine years in Northern Europe and up to 154 faults in southern Germany.
- 33% of faults were to wind turbine blades with the remainder to telecommunication & electrical system.
- 7 – 10% of all strikes involved wind turbine blades.
- Non-conducting blades, without lightning conducting components, are often struck by lightning and suffer major damage.
- Highest impact of lightening is power surges damaging power converters.
CONDITION MONITORING

- Control System
  - Sensors to monitor machine parameters such as temperatures, speeds, fluid levels, line phase imbalance, voltage levels, and tower vibration.
- Vibration Monitoring
  - Full spectrum signature analysis
  - Acoustic system for “shock-pulse” readings
- Fluid contamination Monitoring
  - Ferro Magnetic debris
  - Laser light counted particles
  - Differential pressure across a filtering screen

CONDITION MONITORING

- **Blades**: strain, temperature, lightning detection, crack detection
- **Gearboxes**: Vibration, temperature, fluid level, and oil cleanliness monitoring
- **Generators**: Temperature, voltage, current, phase imbalance
- **Electrical**: Line phase imbalance, voltage and current levels
- **Bearings**: Vibration

*More cost effective as turbine size increases.*
FIRE DAMAGE

• Remove combustibles.
• Fire Detection & Suppression
• Limit sources of ignition.
  – Shield Mechanical Brakes

LIABILITY

• Blade pieces thrown at almost 200 mph

• Tower collapse
### Solar Power
#### Underwriter considerations

<table>
<thead>
<tr>
<th>Risks</th>
<th>Risks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photovoltaic modules thefts</td>
<td>Natural events, fire</td>
</tr>
<tr>
<td>Natural events (hailstorm, windstorm)</td>
<td>Damages to the surrounding properties</td>
</tr>
<tr>
<td>Fire (particularly for plants installed on a roof)</td>
<td>Third party Liability</td>
</tr>
<tr>
<td>Damages due to manufacturer risks</td>
<td>Theft during erection period</td>
</tr>
<tr>
<td>Inverter / Electrical station</td>
<td>Supplier guarantee</td>
</tr>
</tbody>
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### Solar Power
#### Underwriter considerations

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<tr>
<td>Antitheft devices</td>
<td>Endorsement for the modules stocked in the job site</td>
</tr>
<tr>
<td>Photovoltaic modules certified by ISO / CEI</td>
<td>Works involving surrounding properties</td>
</tr>
<tr>
<td>Serial losses endorsement</td>
<td>Antitheft devices</td>
</tr>
<tr>
<td>It is necessary to analyze inverter number to avoid bottleneck</td>
<td>Fire Fighting facilities for the photovoltaic modules installed on the roof</td>
</tr>
</tbody>
</table>
Photovoltaic plants installed on the ground should be provided with one of the following antitheft devices:

Headless-bolts;

Modules installed with proper glue to their own support;

Electrical devices that allow modules to be recognised solely by their own inverter;

GPS system in order to localize modules;

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**Wind Turbines**

**Underwriter considerations**

- **Key exposures**
  - Mechanical breakdown
  - Maintenance
  - Lightning
  - Storm and wind gusts (gear box)
  - Flood damage (e.g., foundations, transformers)
  - Tower damages (due to blade failure)
  - Collapse of crane (during construction/servicing)

- **Main possible exclusions**
  - Mechanical breakdown
  - Faulty workmanship and Design
  - Wear and tear
  - Gradual Deterioration
  - Inherent Vice
  - Latent Defect
  - Loss Covered Under Warranty
  - Serial losses
  - Loss or lack of wind
  - Subsidence, Settling, Cracking and Expansion of Foundations (these can be induced via the vibratory effect of the turbines)
  - Replacement Power
  - Overspeed (damage caused by the disconnection of safety devices)
  - Inability of machine to reach rated output.
  - Additional time lost for unavailability of: spare parts, onsite hoisting lifting equipment
Thank you

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