

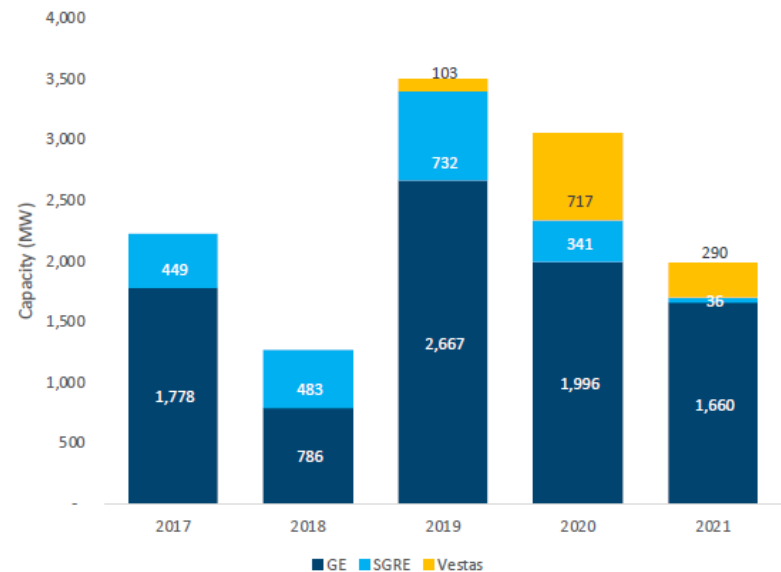
Repower EHS Lessons Learned Survey Results



In the last five years, as reported in American Clean Power's Annual Market Report for 2021, just over 12 gigawatts of land-based wind energy facilities in the U.S. have been partially repowered from 2015–2021. This has included extensive replacements and upgrades to turbine rotors and drivetrains, including longer blades, and new gearboxes, generators, and pitch and yaw drives, among other components. While the focus on repowering has traditionally been on market drivers and economics – utilizing new technologies, increasing energy production, and extending the life of wind assets – this report focuses on how to ensure the work is done safely.

In this report, you'll find lessons learned for development, construction, and operation of repowered facilities from the companies who have done the work. ACP hopes that by sharing these experiences more broadly, we can help with the industry's continuous improvement on safety performance.

Wind Power Partial Repowerings



Source: ACP Annual Market Report 2021

Project Stage: **Construction**

Category	Description of Issue	Impact	Mitigation/Recommendations	Recommended Action Item	Recommended Owner
Construction	Storage of dismantled towers and blades	Towers and blades left blocking work areas	Plan to remove all existing tower parts and blades from site to a recycle yard or temporary laydown yard off the project footprint.	N/A	Contractor
	Heavy traffic on roads with out-going tower sections and blades	Traffic gets delayed while towers are moving out and new towers are being delivered	Plan multiple routes with pullover areas or schedule deliveries in the morning and removal of old towers in the afternoon. Have roads built before tower sections will be moved.	N/A	Contractor
	De-energizing of towers	Towers off line before the demolition is needed causing Operator to lose money	Develop a full de-energization plan early with full circuit drawings and LOTO locations to ensure workers safety but allow operations time to plan shutdowns properly.	N/A	Contractor / Owner
Equipment	Older WTG Models may have components which specific rigging is no longer available.	Schedule delays	RFI / Partner with Owner or O&M teams to identify all component specific rigging, determine whether available and if not, work to begin fabrication/testing well before crane activities.	Identify needed rigging, especially component (ex. Rotor) specific rigging early to procure/fabricate and test before crane work	Contractor



Project Stage: **Construction** (continued)

Category	Description of Issue	Impact	Mitigation/Recommendations	Recommended Action Item	Recommended Owner
Safety	Damage inside of towers ex. loose or broken ladder brackets, hatch covers. Housekeeping from O&M.	Erection crews have encountered multiple issues with damaged parts inside of tower. This can lead to a work stoppage and or injury. Some O&Ms are very thorough with keeping towers clean and removing trash and tooling. Housekeeping is also an issue. If a tool or a piece of component is left in the nacelle, and that nacelle is removed, there is great potential for a dropped object.	Note anything that is damaged in the tower inspections and tower assessment before re-power work begins. Take careful note of housekeeping conditions. Turn documentation over to owner and/or O&M and make sure issues are resolved before re-power work begins.	Tower inspection checklist and Tower Assessment	Construction
	Dropped objects	A dropped object from the top of a WTG regardless of height could prove to be fatal.	Tower Assessment – Identify any locations with in the tower where the is a potential for dropped object and implement a mitigation. Implement a Controlled Access Zone (CAZ) as physical barrier on the ground to ensure the area is controlled. CAZ should be set up 25' from the tower and encompass the entire diameter of tower. With larger turbines, the CAZ may need to be larger (currently assessing this in the Large Turbine Task Force)	Use the Tower Assessment and implement a CAZ	Construction
	Safety/Training requirements differ between owner and contractors and subcontractors.	Delayed scheduled	Owners and contractors are in communication well before mobilization to project to ensure everyone is aligned on expectations. <ul style="list-style-type: none"> Owner/Contractor Training Requirements Alignment GWO Requirements 	As part of pre-planning create a template/document for owners and contractors to use to get aligned. Identify onerous (GWO) training requirements during contract/ schedule negotiations	Contractor / Owner / O&M – Partner

Project Stage: **Construction** (continued)

Category	Description of Issue	Impact	Mitigation/Recommendations	Recommended Action Item	Recommended Owner
Safety (continued)	<p>Tower and tooling dimensions. While using hoist systems, either internal or external, can create a problem if the tooling/equipment being raised is larger than the dimensions of the tool hatch.</p> <ul style="list-style-type: none"> Older Models Machine Dimensions Lacking 	<p>If the tooling or equipment required for updated components is too big to fit through the hatch, there can be damage to the tooling, hatch, and/or hoist system.</p>	<p>Work with O&M teams to identify ALL tower specifications</p> <p>Assess the dimensions of the tool hatch vs. the dimensions of tooling. Also assess weight restrictions of hoist. Assess tooling, pumps, etc. to see if they have pick points. If not, will they fit in a large tool bag, or need its own special bag.</p>	<p>Tower Assessment, early contact with component supplier and site O&M teams.</p>	<p>Contractor / Owner / O&M – Partner</p>
	<p>Out of date, or unknown One-Line Diagrams - leading to LOTO (isolation) issues for Contractors and Project Owners</p>	<p>Out of date, or unknown One-Line diagrams specific to each WTG can cause serious injury if the LOTO (isolation) plan is incomplete or ineffective.</p>	<p>Partner with onsite O&M teams to ensure correct and updated One-Line diagrams prior to creating the LOTO (isolation) plan.</p>	<p>RFI / Partner with O&M teams</p>	<p>Contractor / Owner / O&M – Partner</p>
	<p>Major component exchange being conducted uptower vs a full nacelle exchange</p>	<p>Prolonged time for team members to be uptower. In summer months heat exposure magnifies the possibility of a dropped object.</p>	<p>Work with the owner and supplier in pre-construction to see if nacelle swap is possible. If not, create a heat plan specific for uptower work and a dropped object prevention plan.</p>	<p>N/A</p>	<p>Contractor / Owner / O&M – Partner</p>
	<p>Buried Utilities</p>	<p>Schedule delays, Potential Spill</p>	<p>Report all suspected changes in ground conditions. Different color in ground conditions with uniform shape may indicate a recent excavation or trenching operation, with buried or unmark utilities.</p>	<p>Include a visual ground inspection into all pre-mobilizations at a turbine sites.</p>	<p>Contractor / Owner / O&M / Land Owner</p>

Project Stage: **Development**

Category	Description of Issue	Impact	Mitigation/Recommendations	Recommended Action Item	Recommended Owner
Environmental compliance	Not performing proper Hazardous Materials Assessment	Decommissioning contractors and Waste Generators (contractor or owner) can be cited by environmental compliance agencies for improper handling of hazardous waste in waste streams – large fines and delays to project.	Perform Hazardous Materials Assessment during project development	Perform Hazardous Materials Assessment during project development	Contractor / Owner
Design	Redesign of roads for large cranes and heavy loads	Operations not able to get to operating towers while heavy civil is going on.	Plan road detours and temporary road access ahead of time	N/A	Owner / Contractor



Project Stage: **Operations**

Category	Description of Issue	Impact	Mitigation/Recommendations	Recommended Action Item	Recommended Owner
Safety	Aerial Agriculture Work	Health and Schedule	Before beginning work, establish a documented and coordinated communication plan for the schedule of work related to Aerial Chemical application operations inside the boundaries of the wind farm. Project managers down to the front line workers need to pre-plan work when they are in the Aerial application area.	Add section into Contract/MSA regarding property owner coordination and documentation of what is planned to be applied to the fields where WTG's are located. Coordinate schedules to best of abilities, but communicate schedules with a warning plan, that allows crews to leave fields before aerial application begins.	Contractor

