Small Wind Turbines in the Built Environment Decommissioning Guide
Berkeley, CA, USA
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I would like to express my gratitude to the individuals who gave freely of their time and sage to make this document possible. Their assistance proved invaluable and propelled this effort. I would like to thank and recognize them for offering encouragement in making this important resource available to all parties seeking to learn what is required in performing a decommissioning of a small wind turbine in the built/urban environment.

This effort would not have been possible without the generous contributions, feedback and insights of Mick Sagrillo and Ian Woofenden.

I am mostly indebted to Paul Gipe who generously availed himself and girded me on, providing insightful comments, while I addressed a quandry of issues presented during this process.

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Generating renewable energy closer to where it will be used just makes sense, and creates an opportunity for the public sector to not only respond to climate instability, but to also improve their finances. Vanguards started installing utility scale wind turbines in the Altamont Pass in the San Francisco Bay area in 1981. During this time, there were incentives for other emerging renewables, like small wind turbines, to also be installed by the general public. No doubt there were challenges and risks, but also the opportunity for many rewards.

However, when a small wind turbine is poorly sited, the results can be worthless—and worse—it can become a safety hazard for the community. Wind turbines, be they utility scale or smaller, commercial or residential, are designed to last over 20 years. During their lifespan, a proactive maintenance regime can extend the operational lifespan of utility scale or smaller commercial and residential wind turbine generators to a 30 year operational life span.
...when a small wind turbine is poorly sited, the results can be worthless—and worse—it can be come a safety hazard for the community...

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### the aero power systems sl1500 wind turbine specifications

<table>
<thead>
<tr>
<th>Make, Model, Year</th>
<th>Aero Power Systems SL 1500 (1979)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Designer</td>
<td>Mario Agnello</td>
</tr>
<tr>
<td>Year Installed</td>
<td>1982</td>
</tr>
<tr>
<td>Type</td>
<td>Horizontal Axis Wind Turbine (HAWT)</td>
</tr>
<tr>
<td>Mast</td>
<td>Custom built 60' Solargy Tower Monotube (four telescoping sections fabricated with boiler steel ANSI reference unknown)</td>
</tr>
<tr>
<td>Orientation</td>
<td>Upwind</td>
</tr>
<tr>
<td>Blades</td>
<td>3 (wood)</td>
</tr>
<tr>
<td>Rotor Diameter</td>
<td>12 ft (3.66 m)</td>
</tr>
<tr>
<td>Weight</td>
<td>160 lbs (72.6 kg)</td>
</tr>
<tr>
<td>Rated Power</td>
<td>1.43 kW</td>
</tr>
<tr>
<td>Rated Power (max)</td>
<td>1.5 kW</td>
</tr>
<tr>
<td>Rated Wind Speed</td>
<td>23.9 mph - 25 mph (10.7 m/s)</td>
</tr>
<tr>
<td>Cut-in Speed</td>
<td>6 mph - 8 mph (3.6 m/s)</td>
</tr>
<tr>
<td>Cut-out Speed</td>
<td>101 mph (45 m/s)</td>
</tr>
<tr>
<td>Date Installed</td>
<td>December 1981</td>
</tr>
<tr>
<td>Date Commissioned</td>
<td>January 1982</td>
</tr>
<tr>
<td>Cost (circa 1980)</td>
<td>$3,000.00</td>
</tr>
<tr>
<td>Total Installation Cost</td>
<td>$12,000.00 (City of Berkeley estimate)</td>
</tr>
<tr>
<td>Total Charges</td>
<td>$17,000.00 (Amount actually paid)</td>
</tr>
<tr>
<td>Contact/Current Owner</td>
<td>Myra Wysinger</td>
</tr>
<tr>
<td>Location</td>
<td>3228 Idaho St., Berkeley, CA 94702, USA</td>
</tr>
</tbody>
</table>

---

**table 2: aero power sl1500 specifications**
historical summary

This Aero Power Systems SL1500 wind turbine generator (WTG) was installed in late 1981 in Berkeley, CA, USA. In spite of never having any maintenance, and although it was learned from the homeowner that it has been freewheeling, not generating any electricity for approximately ten years, this machine has not experienced a catastrophic mechanical failure event in over 30 years. To the best of the knowledge of the current homeowner, the reason it has been freewheeling is due to the fact that someone accidentally severed the brake cable.

Decommissioning a small wind turbine in the built environment is not an everyday occurrence. And, this particular location certainly would not be allowed by today’s standards for a small wind turbine in the built environment e.g. one acre of real estate is typically required. This wind turbine was installed in residential neighborhood with a medium height and density roughness profile, between semi-detached houses of mixed height. The base of the mast of this wind turbine is situated in very close proximity to electrical power lines and housing structures, making this decommissioning very challenging and involved.

A Public Records Act (PRA) Request was filed in March 2012 with the City of Berkeley Planning and Development Office for printed historical records on this wind turbine; nothing was available in the archives for retrieval. The only information about this wind turbine installation was obtained via interviews with the surviving Wysinger family members and from the scant 1982 City of Berkeley Zoning archives. The California Energy Commission (CEC), which approved an incentive payout, had a policy to dispose of documentation after four years. The CEC agent suggested contact be made with Pacific Gas and Electric (PG&E) and the California Public Utilities Commission (CPUC). Efforts were made to contact these agencies, and additionally did not net any information.

All technical information cited about this wind turbine installation is extricated from a March 1982
Berkeley Gazette article and from a digitized 8 mm film located in the family garage:

▷ “Family sets up city’s first residential windmill” Berkeley Gazette article
▷ YouTube 8 mm film of 1981/82 installation

In the 25 March 1982 Berkeley Gazette article, the developer over-sold the wind turbine performance by stating the wind turbine:

► would generate 400 kW/month.
► would cover 90% of the family’s Pacific Gas and Electric (PG&E) electricity bill.
► would be afforded a State of California 55% tax credit incentive from the California Energy Commission (CEC).
► would be entitled to have PG&E purchase excess power generated at $0.072/kWh over ten years.
► had a 125 mph cut out speed.
► would receive entitlements from PG&E, which included a purchase of excess power generated at $0.072/kWh over a 10 year period.

After just three months, the Wysinger family realized the wind turbine would not generate the amount of electricity the developer had promised. It was also learned that work was not completed on this installation, and legal recourse was pursued. So the family decided to decommission the wind turbine. However, they just did not have the financial means to do that—especially after the $12,000 they had dropped on the installation several months prior.

In early 2012, an independent consultant offered services to voluntarily perform discovery about where the decommissioning challenges lay. It turned...
out decommissioning a small wind turbine in the City of Berkeley had not been encountered in the past. Additionally it was learned that this type of a demolition was not of the familiar of any personnel in the City of Berkeley Building and Planning Department, Zoning and Occupational Health and Safety departments.

The plan and work required during the due diligence process revealed a great deal of involvement, which invariably was the dominant reason why past attempts by many others had fallen short, were never started and never completed. An additional note of consequence is the installation was left in a state of disrepair and unsafe for an untold number of years, never receiving any O&M (operations and maintenance). The state of the electrical infrastructure was also left in a dubious state. Additionally, there was a known fatal design flaw in the governor of this particular wind turbine, where it was unable to hold the blades if the pivot wore. [1]

In early March 2013, a qualified California License C10 Electrician was hired. The electrician ensured wires from the wind turbine were capped off, the hot connection in the respective mains was capped off, and the connections from the AC connections to the phasor-inverter were capped off. The wind turbine is now safe-off for anyone needing to climb up the mast without being concerned about the flow of electrons from the wind turbine, or from the PG&E electrical distribution network.

There was an ‘other structures’ clause in the homeowner’s insurance policy for coverage in the amount of $73,000. However, the homeowner was reluctant to pursue soliciting feedback from her insurance agent to see if this wind turbine fell under the auspice of an appurtenant structure and could be insured under a separate insurance policy for the decommissioning plan. Had she been willing to do this, these types of structures are assessed and charged at a lower rate. “Annual premiums are about $2.50 per $1,000 of value.” [2] Additionally, since homeowner’s insurance claims are typically for fire damage, this wind turbine is approximately 1.5 miles from the closest fire station, the likely insurance premium would be slightly lower than a wind turbine installed in a rural area.

It was also discovered that the cost to perform this decommissioning would be prohibitively expensive for the homeowner. Costs for this decommissioning were estimated at ~$20,000.00. (See “table 3: estimated costs for decommissioning an aero power sl1500 small wind turbine” on page 32) Because of all the involved complexity required for decommissioning this wind turbine, in early May 2013, the City of Berkeley Officials agreed to step-in and afford the homeowner guidance on how to best proceed.


Several small wind energy experts have emphatically shared that this turbine needs to come down post-haste before there is loss of life or property. As of this writing, this machine still has not catastrophically failed mechanically; a testament to its designer, Mario Agnello. However, all this time it has been derelict and dangerous, making its catastrophic failure imminent, and a potential public safety hazard. When this wind turbine is finally decommissioned, it is earmarked for donation for future study and research at the UC Berkeley Renewable and Appropriate Energy Lab (RAEL) Richmond, CA Field Laboratory.

NB: The following information is based on a projected time line. Unfortunately, a fundraising campaign conducted in behalf of procuring funds to pay for the costs of decommissioning this wind turbine fell short, so this case study only achieved completing Stage 3 of this process plan. Stages 4-8 are projections. The development phases for the decommissioning planning process follows (See “figure 1: decommissioning planning process” on page 31):

**Consenting Phase**

In the Consenting Phase, the aim is to clarify and understand the basis for any objections and the decommissioning risks, and where possible, identify potential solutions. This phase involves and includes:

**Stage 1**
- Site identified for decommissioning
- Preliminary research undertaken
- Preliminary permits applications investigated
- Public interaction and discussions with stakeholders

**Stage 2**
- Project scoped out
- Budget cost estimate
- Local planning authority engagement and opinions offered
- Identify challenges and restrictions
- Fund raising opportunities investigated for covering decommissioning costs
- Public interaction and discussions with stakeholders

**Stage 3**
- Site data measurements taken
- Project logistical and feasibility considerations investigated
- Initial, formal consultation with interested, potentially affected parties
- Assessments conducted including a historical assessment
Stage 4
- Formal permits submitted
- Submission of electrical grid de-energizing application with local utility, if needed
- If applicable, decommissioning plan application submitted

Review Phase
In the Review Phase, the aim is to address any outstanding objections received from key statutory professionals, officials and stakeholders, and to ensure that any objections identified are mitigated. This phase involves and includes:

Stage 5
- Reviews and modifications of the decommissioning plan
- Ongoing consultation with community and stakeholders
- Statutory objections addressed

Decommissioning Phase
In the Decommissioning Phase, the aim is to put into action the decommissioning plan. This phase involves and includes:

Stage 6
- Agreements and approvals for program plan is approved by authority under relevant permit or licensing conditions
- Final site decommissioning sign-off obtained
- Ongoing interaction with community and stakeholders

Stage 7
- Owner/Responsible party undertakes the decommissioning plan
- Wind turbine donated to local university for continued research
- Ongoing interaction with community and stakeholders

Stage 8
- Owner/Responsible party submits a report to the statutory bodies and local authorities about how the plan was carried out.
- Enumerate post-site activities
- Final plan program is approved under the permit issued
- Validation obtained from the local authority
**figure 1: decommissioning planning process**

### Decommissioning Planning Process

<table>
<thead>
<tr>
<th>Stage 1</th>
<th>Stage 2</th>
<th>Stage 3</th>
<th>Stage 4</th>
<th>Stage 5</th>
<th>Stage 6</th>
<th>Stage 7</th>
<th>Stage 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preliminary permit applications discussion with stakeholders</td>
<td>Detailed permitting discussions including proposed financial security measures</td>
<td>Initial consultation with interested parties and assessments conducted</td>
<td>Formal submission of permits (and plan application, if applicable)</td>
<td>Reviews and modifications of decommissioning plan</td>
<td>Final plan is approved by authority under relevant permit/license conditions</td>
<td>Owner/Responsible party undertakes decommissioning plan</td>
<td>Owner/Responsible party submits a report about how the plan was carried out, including post-site decommissioning activities</td>
</tr>
<tr>
<td>1-2 months</td>
<td>1 month</td>
<td>1 month</td>
<td>2-4 months</td>
<td>1 month</td>
<td>1 month</td>
<td>1 month</td>
<td>1 month</td>
</tr>
</tbody>
</table>

**Public Consultation**

- Permit Discussion 1
- Permit Discussion 2
### DECOMMISSIONING COST (in current dollars)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>Includes an asbestos survey and report, miscellaneous City of Berkeley paperwork, wind expert consultations</td>
<td>$2,262.00</td>
</tr>
<tr>
<td>(On-site) Wind Turbine Expert</td>
<td>2 days; pre-planning, decommissioning, 8 hours/day</td>
<td>$3,300.00</td>
</tr>
<tr>
<td>PG&amp;E</td>
<td>Budget for Utility Clearance an to de-energize circuits. Includes 3 PG&amp;E personnel for 8 hours</td>
<td>$7,000.00</td>
</tr>
<tr>
<td>City of Berkeley Permits</td>
<td>Electrical, Demolition, Zoning, Encroachment</td>
<td>$3,045.00</td>
</tr>
<tr>
<td>Crane</td>
<td>Includes the crane rental, operator, rigger for 8 hours</td>
<td>$2,800.00</td>
</tr>
<tr>
<td>Incidentals</td>
<td>Tools (cutting saw), miscellaneous</td>
<td>$2,500.00</td>
</tr>
<tr>
<td>CA Licensed C10 Electrician</td>
<td>8 hours x 2 days; 16 hours total</td>
<td>$1,500.00</td>
</tr>
<tr>
<td>Electrical Line Worker/Tree Climber</td>
<td>1 day, to assist the wind turbine expert 8 hours</td>
<td>$250.00</td>
</tr>
<tr>
<td>Hauling</td>
<td>For mast to the recycler</td>
<td>$160.00</td>
</tr>
<tr>
<td><strong>TOTAL REMOVAL COST</strong></td>
<td></td>
<td>$22,817.00</td>
</tr>
<tr>
<td>Salvage value of mast</td>
<td>1.5 to 2.0/NT @ $235.00 NT based on current market rate($325.50-$470.00)</td>
<td>-$470.00</td>
</tr>
<tr>
<td><strong>ESTIMATED COST OF DECOMMISSIONING</strong></td>
<td></td>
<td>$22,491.00</td>
</tr>
</tbody>
</table>

**Table 3: Estimated costs for decommissioning an aero power sl1500 small wind turbine**
appendix

Small Wind Turbines in the Built Environment Decommissioning Guideline
a - acronyms & abbreviations

CEC
California Energy Commission

CPUC
California Public Utilities Commission

C10
Classification identifier for California Electricians

EIA
Environmental Impact Analysis

ES
Environmental Statement

O&M
Operation & Maintenance

OSHA
Occupational Safety & Health Administration

PG&E
Pacific Gas & Electric

PRA
Public Records Act

SL1500
Model number for the Aero Power SL1500 wind turbine

WTG
Wind Turbine Generator

b - city of berkeley, ca, usa
permit & application exhibits

Exhibits follow on the next pages.