Wildlife Exclusion System (WES) Development

WCPS

WES – Spring 2017

VCHEC

WES – Fall 2018

BCPS

WES – Fall 2019

GCPS

WES – Fall 2020

ACCUG, Clarksville, TN
July 14-16, 2026

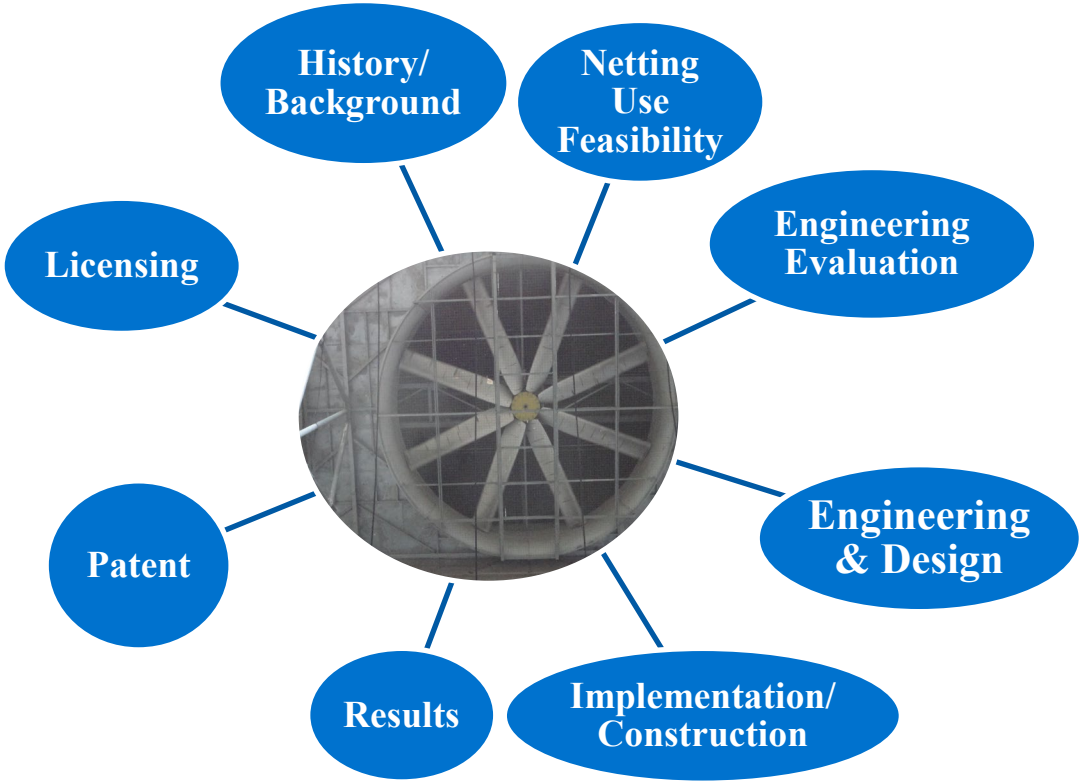
Riad Dandan
Principal Engineer - Dominion Energy

Cameron Riddell
President/ CEO - Bird Barrier America

Patent No.: US 10,925,277 B2

Dominion Energy

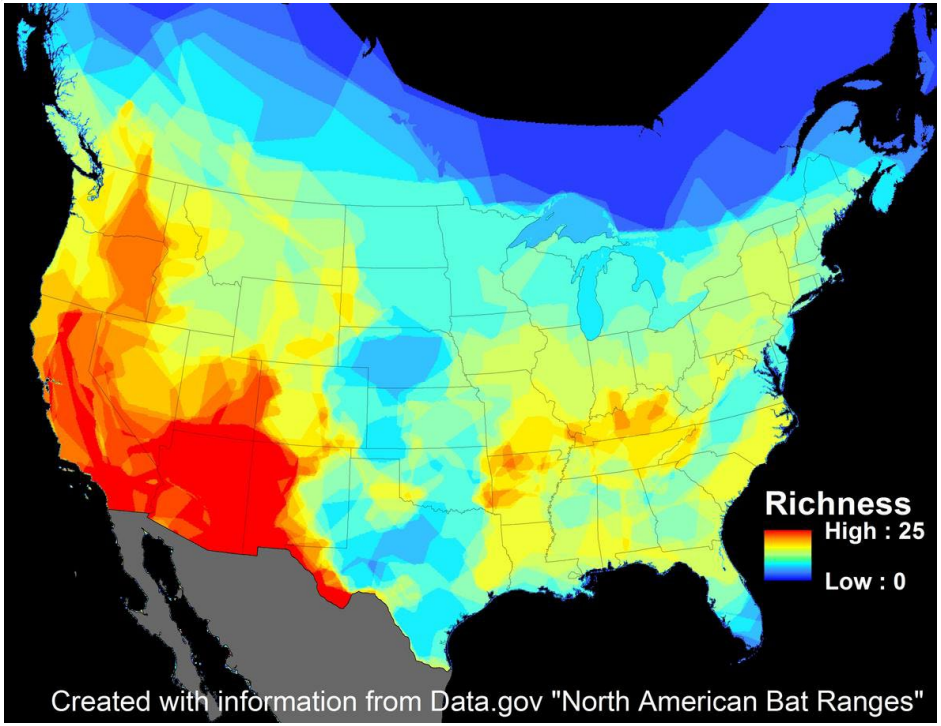
WES - Development



Patent No.: US 10,925,277 B2

Dominion Energy

History/ Background



Bat Population in the U.S.

Source: USGS.gov

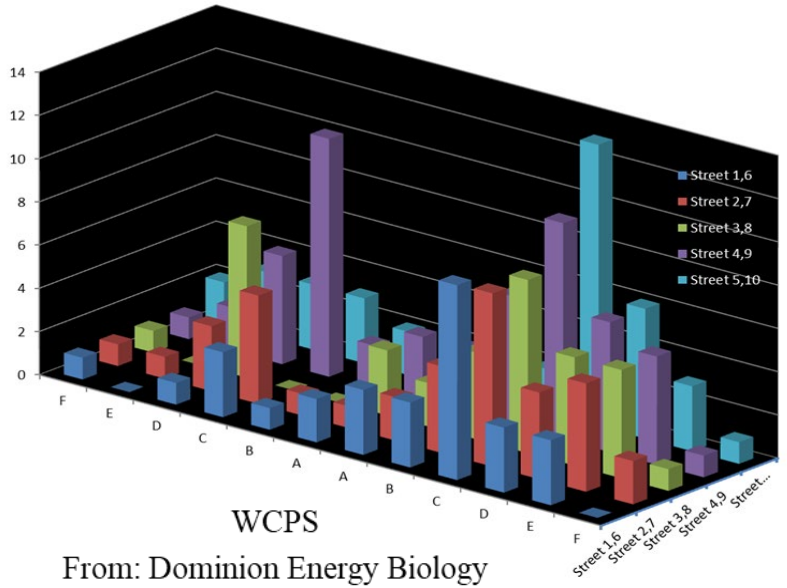
Patent No.: US 10,925,277 B2

Dominion Energy

History/ Background

At a glance, max bat mortality inside fan bays:

- WCPS (ACC - 60 fans) 200 bats in 2015.
- VCHEC (ACC - 60 fans) 110 bats in 2015.
- BCPS (ACC – 72 fans) 125 bats in 2016.
- GCPS (ACC - 80 fans) 497 bats in 2019.



WCPS

From: Dominion Energy Biology

Patent No.: US 10,925,277 B2

Dominion Energy

History/ Background

- Biology study by outside consultants shows powerful ACC fans air current was one of the contributing factors.

- Monitoring & Reporting program at WCPS, VCHEC, BCPS & GCPS was developed and managed by corporate biologist.

PS: reporting to Virginia Dept of Game and Inland Fisheries.

Shown below is a "fan bay". These are located above each individual fan. Picture at right is looking down on fan while standing on the catwalk at left. Bats (yellow markers) are found inside the fan bay on the deck surrounding each fan.

Source: Dominion Energy annual report 2016
by Matt Overton – corporate biologist

Patent No.: US 10,925,277 B2

Biology study recommendations (fall of 2015):

- Turning ACC lights off,
- Relocating lights,
- Installing acoustic monitors around the ACC (at VCHEC)…

None was effective….

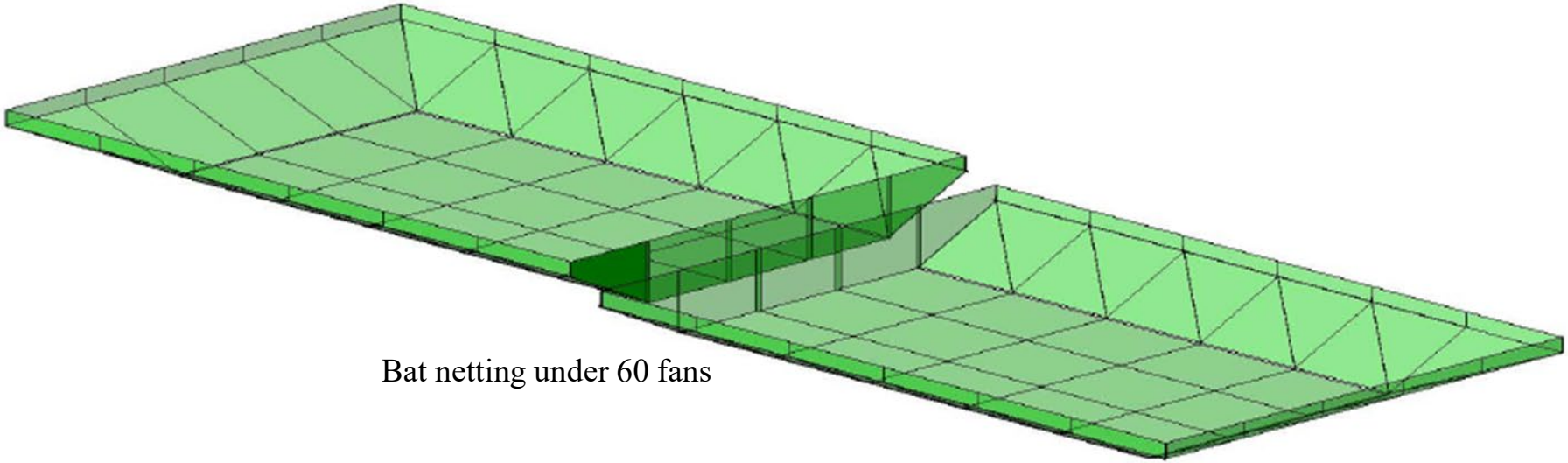
- The other recommendation was to install **Netting**.

"Install fencing or stiff netting around the ACC perimeter that extends from the fan bays downward to approximately 10 to 20 feet off the ground."

Dominion Energy - Power Generation Engineering (PGE) evaluated the recommendation of installing vertical netting on the ACC perimeter from fan bay down at least 76 ft (20 ft off the ground) and found the following concerns:

- Icing buildup on the vertical netting (fence):
  - Safety concern from falling ice sheets, &
  - ACC performance degradation from blocking air flow to fans.
- Potentially bats flying into the vertical netting, bat ecological system not detecting nets due to small twine diameter (10.5 mills):
  - Bat getting stuck on the vertical netting around the ACC.

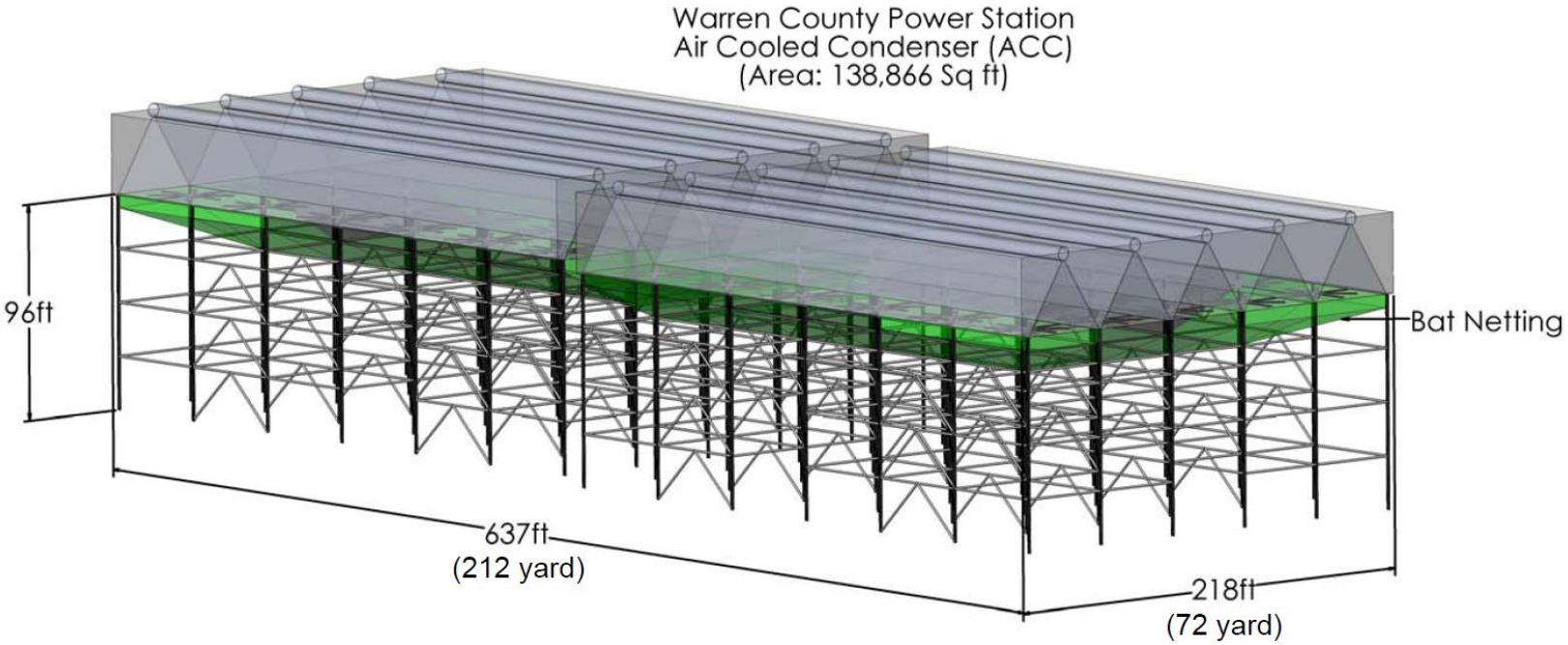
PGE netting concept to incase ACC fan bays



Bat netting under 60 fans

Patent No.: US 10,925,277 B2

Netting shown in green incasing the fan bays under the ACC.



Patent No.: US 10,925,277 B2

PGE conducted Failure Mode and Effects Analysis (FMEA):

- ✓ACC Thermal Performance,
- ✓ACC Fan motor power consumption,
- ✓ACC Structural, and
- ✓Netting Functional Design.

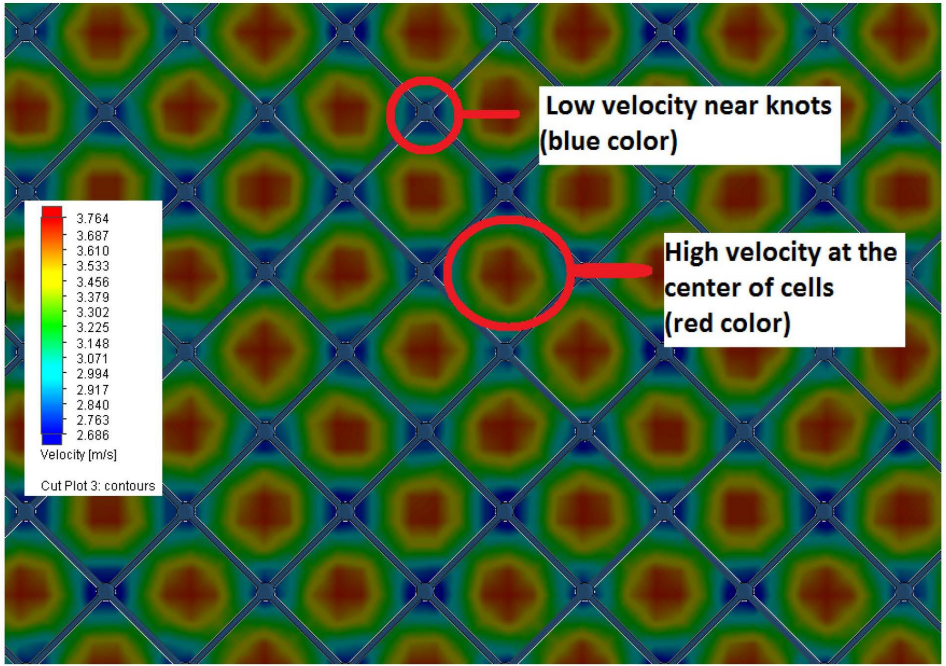
Patent No.: US 10,925,277 B2

ACC Thermal Performance:

Computational Fluid Dynamics (CFD) analysis was performed on the netting to determine the pressure drop across the net and air velocity at numerous elevation:

- ✓ Pressure drop across the net was negligible (0.18 mm WG).
- ✓ Effect on backpressure was also negligible (theoretically 0.2 to 0.3” Hg), however WCPS did not notice the difference during hot weather operation.

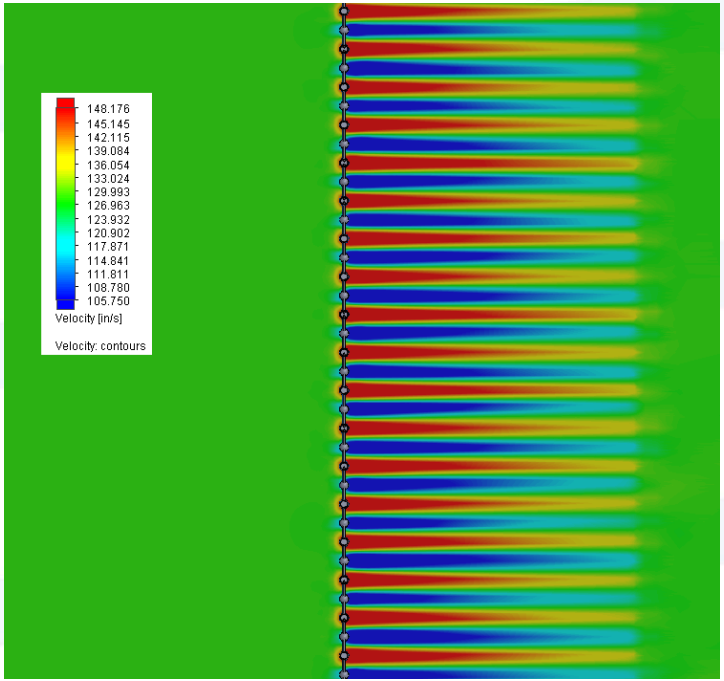
PS: SPG Dry Cooling (ACC vendor) analyzed the pressure drop data and determined that fan performance and backpressure change to be negligible.

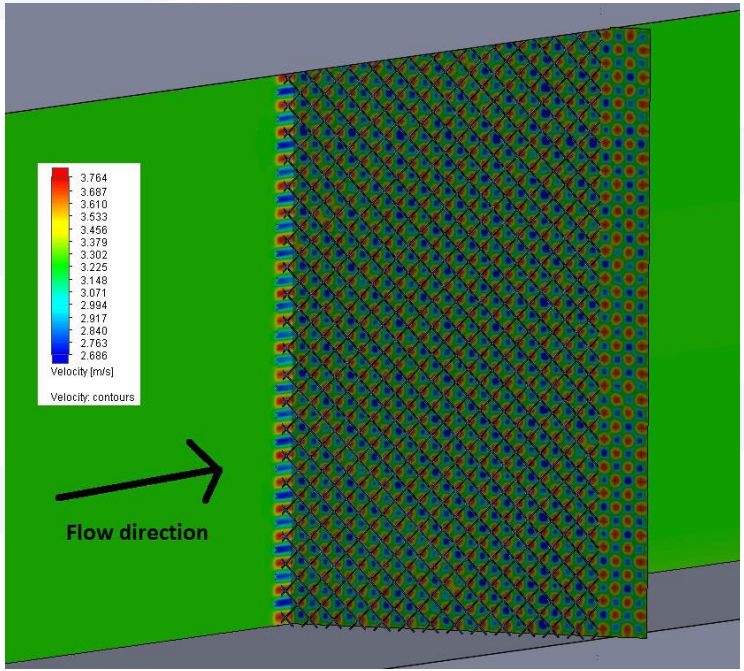


Air Velocity Plot
(from CFD analysis)

Engineering Evaluation

TRIMECH
YOUR ENGINEERING RESOURCE





Velocity Profiles
(air flow through the net)

Patent No.: US 10,925,277 B2

Dominion Energy

Fan Motor Power Consumption:

Using pressure drop from CFD data, analysis shows small theoretical current increase (1 to 2%),

✓ No measurable increase in fan current during several hot weather months at WCPS.

Structural Evaluation:

PGE – Structural performed structural analysis of the ACC super structure using the addition of the netting, its steel attachment and wind loading from the nets.

✓ Negligible load increase on ACC structure due wind load from netting for such large structure.

Functional Design:

One of the goals that were set in the CFD was to determine vertical air velocity at multiple (practical) elevations, in order to set the specs for net coverage.

✓ Selecting low upward air velocity of 7 MPH (so bats could overcome and not get pulled to the net) toward fan inlet.

✓ Selected practical elevation of 24 ft below fan inlet,

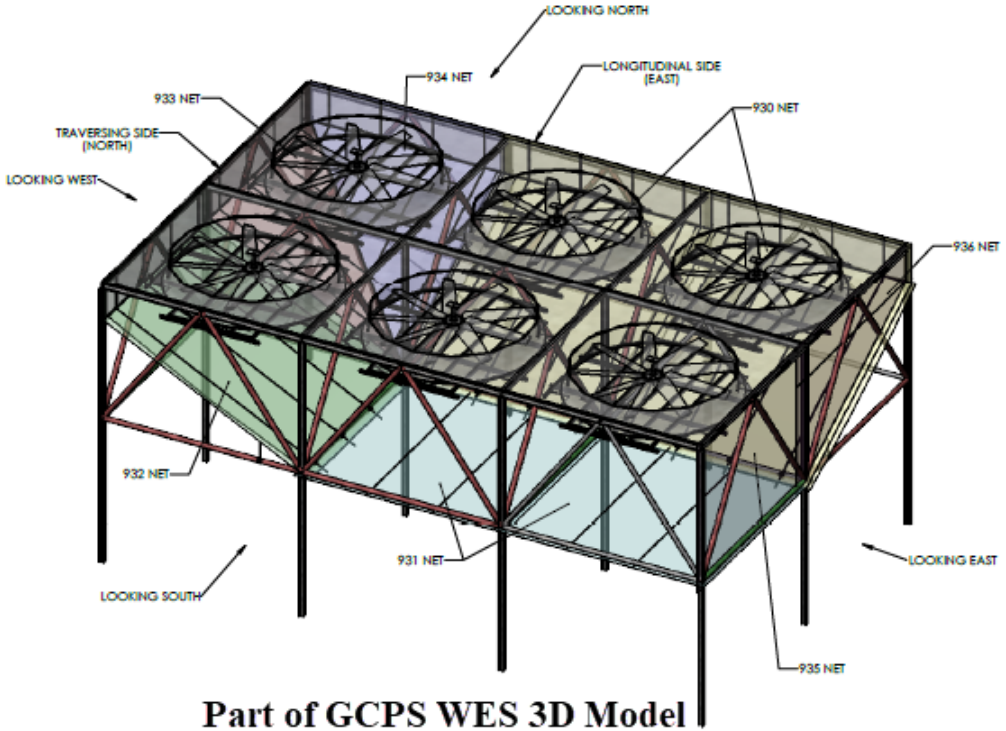
PS: Vertical component of air velocity near fan inlet is approx. 15 - 20 MPH. Bat could glide horizontally up to 40 MPH.

- ✓ PGE set the netting design criteria:
  - ❑ Specified net size for each cell in the ACC based on cell size and height,
  - ❑ Specs for the 2” wide straps on the netting based on the wind loading,
  - ❑ Designed strap to netting configuration for perimeter (inclined), corner (inclined) and interior (horizontal) nets, and
  - ❑ Netting connection location to ACC structure and with adjacent nets.

- ✓ PGE provided:
  - ❑ Design and detail drawings for individual nets,
  - ❑ Designed and detail drawings for steel bracketry to attach the netting to the ACC structure, overcoming construction obstacles,
  - ❑ Bill of material of the entire system, including commercial items and specific hardware size, grade and finish,
  - ❑ Assembly drawings of the netting system for installation,
  - ❑ Steel attachment and netting detail installation instructions,
  - ❑ Torque specs for each size hardware to ensure fasteners from loosening, and
  - ❑ Preventive Maintenance Procedure.

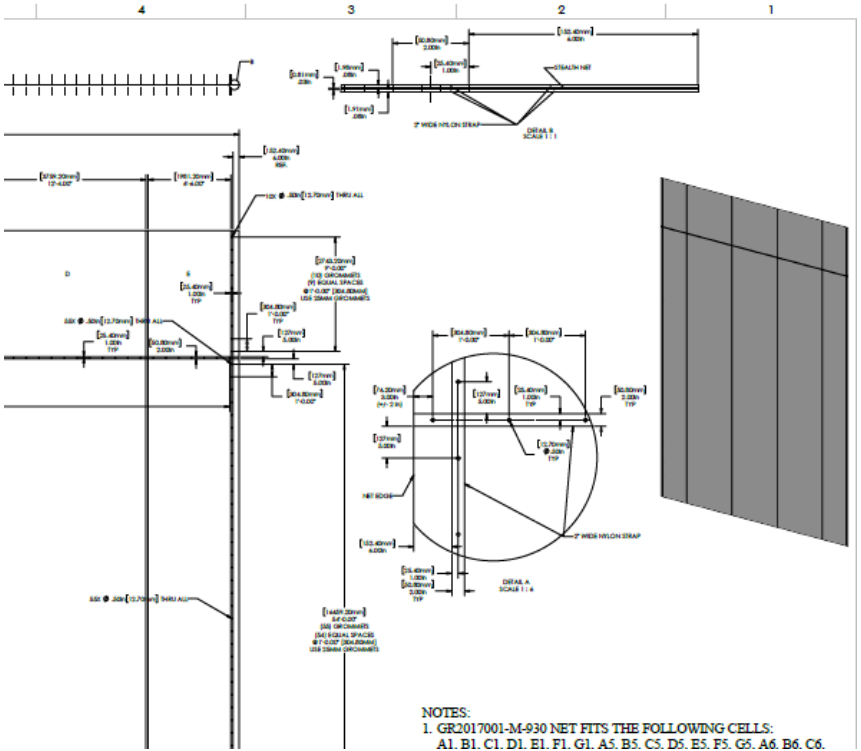
Patent No.: US 10,925,277 B2

WES - Development

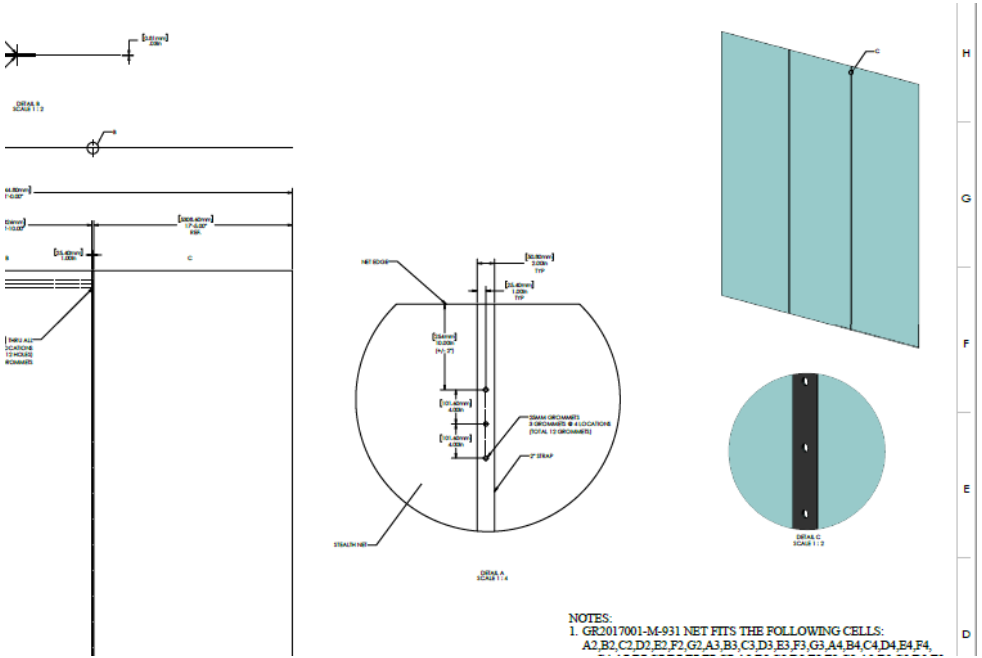


Part of GCPS WES 3D Model

Patent No.: US 10,925,277 B2



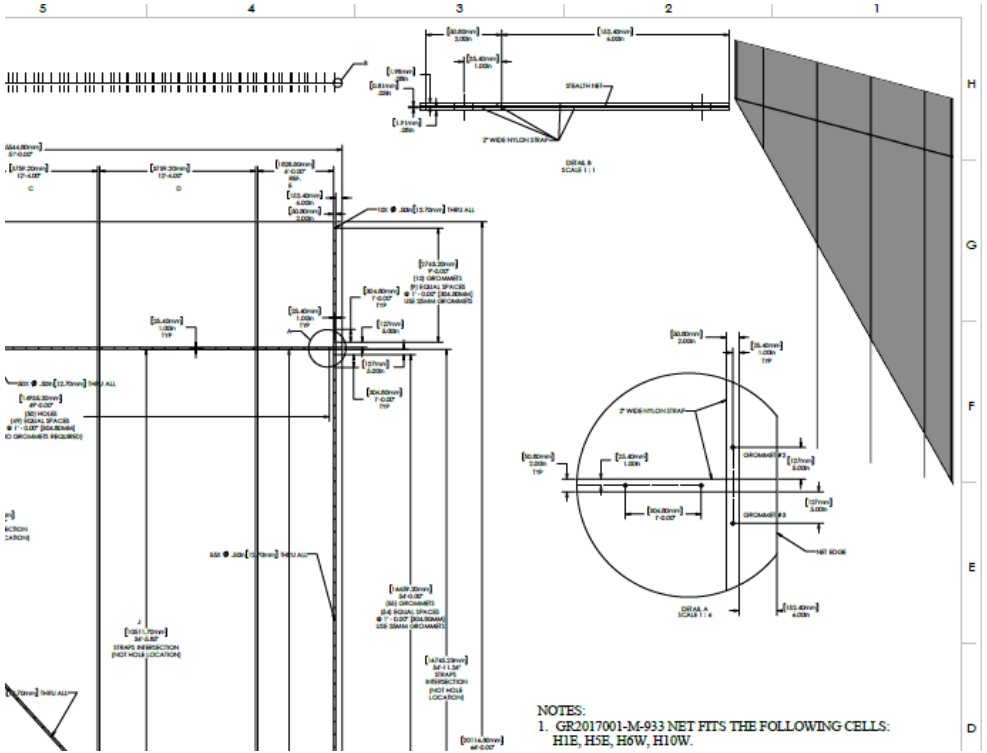
Patent No.: US 10,925,277 B2



Patent No.: US 10,925,277 B2

Engineering & Design

WES - Development



Patent No.: US 10,925,277 B2

Dominion Energy

PGE collaborated with Bird Barrier (netting vendor) for:

- Constructable netting (with the 2” wide straps),
- Reasonable tolerances and acceptable to fit design, and
- Quality control to assure fit up in construction.

PGE collaborated with Netting Installer for:

- Most efficient constructable netting system,
- Overcome construction obstacles, no drilling or welding on ACC structure,
- Ways to protect netting from wear near structure, mechanical or electrical components,
- Quality control measures to assure steel components from getting loose, fit up in construction.

StealthNet®

Bird Barrier®

- High density polyethylene (HDPE)
- Knotted for extra strength
- 3/8” squares block all birds and bats
- Resistant to UV breakdown
- Flexible, extremely durable in challenging climates
- Nylon strapping sewn to the netting

Patent No.: US 10,925,277 B2

WES shipping method for efficient installation

Patent No.: US 10,925,277 B2

WES steel brackets are clamped on structure
No welding on ACC structure

Patent No.: US 10,925,277 B2

WES prefabricated and kitted hardware coupled with associated fasteners for efficient installation

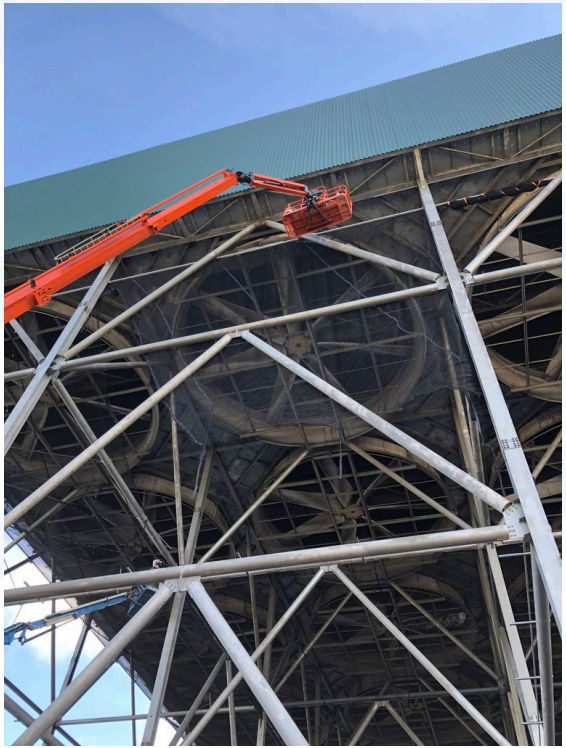
Patent No.: US 10,925,277 B2

Dominion Energy

WES is ready for a turnkey project

Patent No.: US 10,925,277 B2

WES is ready for a turnkey project



Patent No.: US 10,925,277 B2

Results

- ✓ WES was installed at WCPS in spring and fall of 2017, bat mortality dropped down in 2018 to 12*, and in 2019 to 7* (96.5% mortality reduction),
  - ❖ WCPS was exempt from monthly bat monitoring and reporting program in 2020.
- ✓ WES was installed at VCHEC in fall of 2018, bat mortality dropped down in 2019 and 2020 to 2* each (96.7% mortality reduction),
  - ❖ VCHEC was exempt from monthly bat monitoring and reporting program in 2021.
- ✓ WES was installed at BCPS in fall of 2019, bat mortality dropped down in 2020 to 5*, and in 2021 to 0 (100% mortality reduction),
  - ❖ BCPS was exempt from monthly bat monitoring and reporting program in 2022.
- ✓ WES was installed at GCPS in fall of 2020, and mortality dropped down in 2021 to 38*, and in 2022 to 4* (99.2% mortality reduction),
  - ❖ GCPS was exempt from monthly bat monitoring and reporting program in 2023.

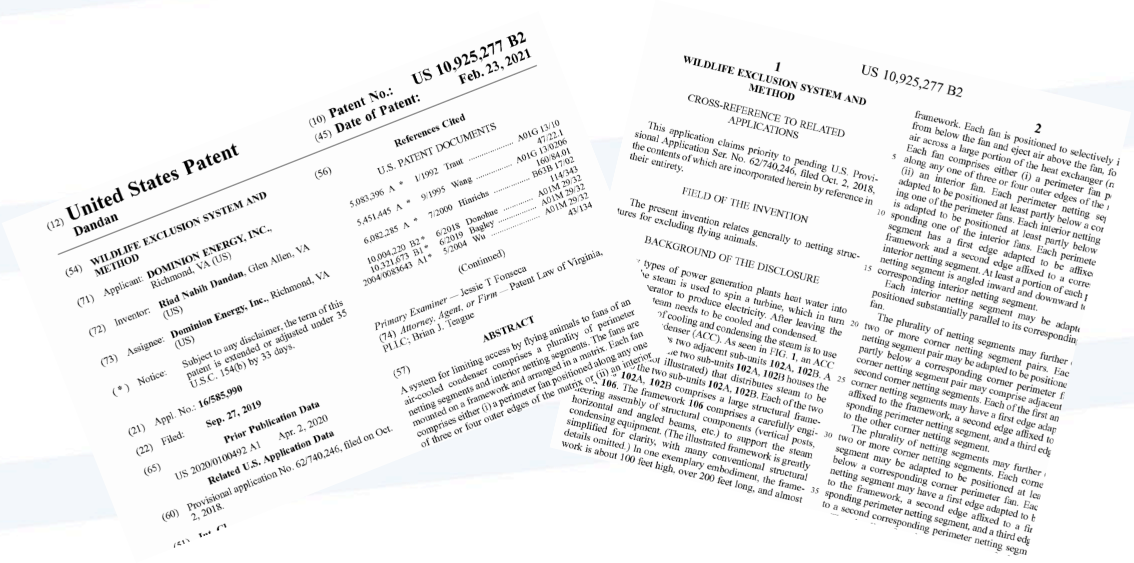
Around 6,537 bats have been saved so far

* Collected bats after the netting was installed were in advanced stages of decomposition, suggesting that these bats were killed before the netting was in place.

Patent No.: US 10,925,277 B2

WES - Development

WES Patent was issued in Feb 2021


(12) United States Patent
Dandan

(10) Patent No.: US 10,925,277 B2
(45) Date of Patent: Feb. 23, 2021

(54) WILDLIFE EXCLUSION SYSTEM AND METHOD

(71) Applicant: DOMINION ENERGY, INC., Richmond, VA (US)

(72) Inventor: Riad Nabih Dandan, Glen Allen, VA (US)

(73) Assignee: Dominion Energy, Inc., Richmond, VA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 33 days.

(21) Appl. No.: 16/585,990

(22) Filed: Sep. 27, 2019

(65) Prior Publication Data

US 2020/0100492 A1 Apr. 2, 2020

Related U.S. Application Data

(60) Provisional application No. 62/740,246, filed on Oct. 2, 2018.

(51) Int. Cl.

(56) References Cited

U.S. PATENT DOCUMENTS

5,083,396 A * 1/1992 Traut ... A01G 13/10 47/22.1
5,451,445 A * 9/1995 Wang ... A01G 13/0206 160/84.01
6,082,285 A * 7/2000 Hinrichs ... B63B 17/02 114/343
10,004,220 B2 * 6/2018 Donohue ... A01M 29/32
10,321,673 B1 * 6/2019 Bagley ... A01M 29/32
2004/0083643 A1 * 5/2004 Wu ... A01M 29/32 43/134

(Continued)

Primary Examiner — Jessie T Fonseca
(74) *Attorney, Agent, or Firm* — Patent Law of Virginia, PLLC; Brian J. Teague

(57) ABSTRACT

A system for limiting access by flying animals to fans of an air-cooled condenser comprises a plurality of perimeter netting segments and interior netting segments. The fans are mounted on a framework and arranged in a matrix. Each fan comprises either (i) a perimeter fan positioned along any one of three or four outer edges of the matrix or (ii) an interior

1 US 10,925,277 B2 2

WILDLIFE EXCLUSION SYSTEM AND METHOD

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to pending U.S. Provisional Application Ser. No. 62/740,246, filed Oct. 2, 2018, the contents of which are incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

The present invention relates generally to netting structures for excluding flying animals.

BACKGROUND OF THE DISCLOSURE

... types of power generation plants heat water into ... steam is used to spin a turbine, which in turn ... erator to produce electricity. After leaving the ... team needs to be cooled and condensed. ... of cooling and condensing the steam is to use ... denser (ACC). As seen in FIG. 1, an ACC ... two adjacent sub-units 102A, 102B. A ... two sub-units 102A, 102B houses the ... not illustrated) that distributes steam to be ... the two sub-units 102A, 102B. Each of the two ... 102A, 102B comprises a large structural frame... 106. The framework 106 comprises a carefully engi... neering assembly of structural components (vertical posts, horizontal and angled beams, etc.) to support the steam condensing equipment. (The illustrated framework is greatly simplified for clarity, with many conventional structural details omitted.) In one exemplary embodiment, the framework is about 100 feet high, over 200 feet long, and almost

framework. Each fan is positioned to selectively ... from below the fan and eject air above the fan, fo... air across a large portion of the heat exchanger ... Each fan comprises either (i) a perimeter fan p... along any one of three or four outer edges of the ... (ii) an interior fan. Each perimeter netting se... adapted to be positioned at least partly below a cor... ing one of the perimeter fans. Each interior netting ... is adapted to be positioned at least partly below ... sponding one of the interior fans. Each perimete... segment has a first edge adapted to be affixe... framework and a second edge affixed to a corre... interior netting segment. At least a portion of each ... netting segment is angled inward and downward t... corresponding interior netting segment. Each interior netting segment may be adapt... positioned substantially parallel to its correspondin... fan.

The plurality of netting segments may further ... two or more corner netting segment pairs. Eac... netting segment pair may be adapted to be positione... partly below a corresponding corner perimeter f... corner netting segment pair may comprise adjacent ... second corner netting segments. Each of the first an... corner netting segments may have a first edge adap... affixed to the framework, a second edge affixed to ... sponding perimeter netting segment, and a third edg... to the other corner netting segment.

The plurality of netting segments may further ... two or more corner netting segments. Each corne... segment may be adapted to be positioned at lea... below a corresponding corner perimeter fan. Eac... netting segment may have a first edge adapted to b... to the framework, a second edge affixed to a fir... sponding perimeter netting segment, and a third edg... to a second corresponding perimeter netting segm...

Patent No.: US 10,925,277 B2

Bird Barrier America is the authorized licensee of the WES technology beginning of 2026.

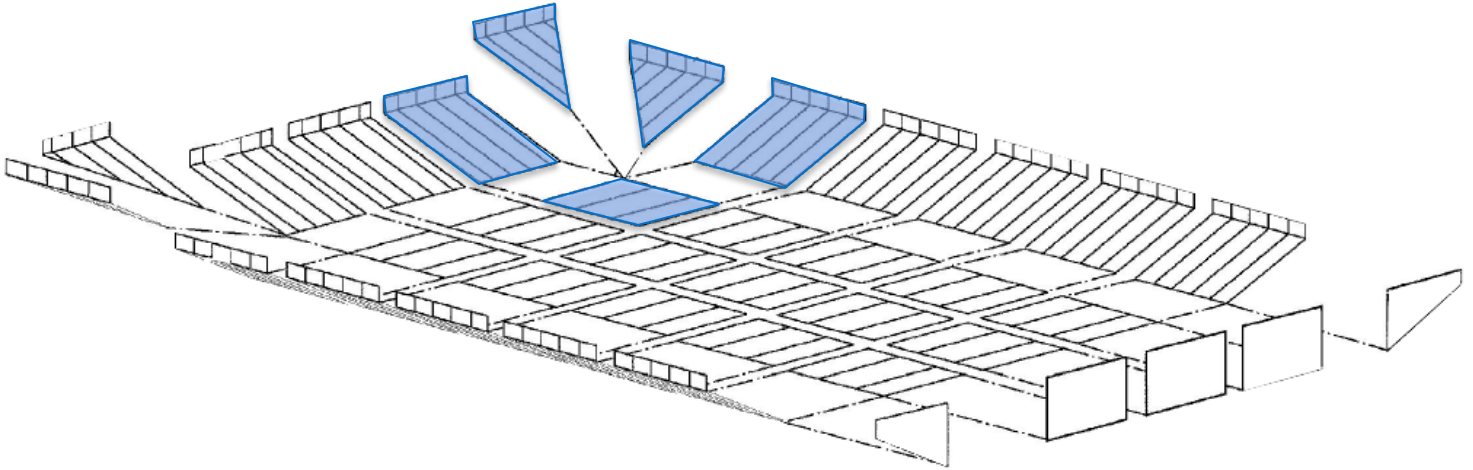
WES Patent No. 10925277

WES is ready for a turnkey project

Patent No.: US 10,925,277 B2

WES - Development

WES netting is designed as a modular system to facilitate installation, maintenance, and replacement

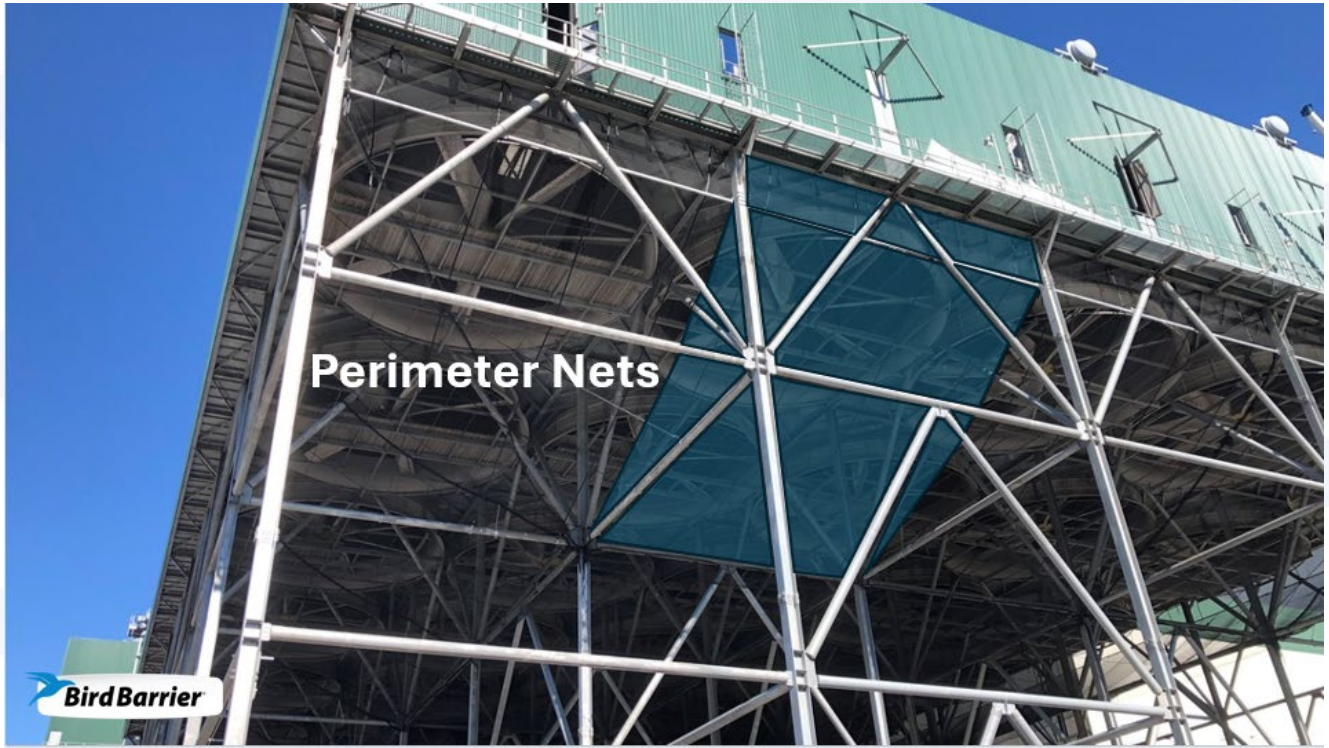


Bird Barrier

Patent No.: US 10,925,277 B2

Dominion Energy

WES is ready for a turnkey project



Patent No.: US 10,925,277 B2

WES is ready for a turnkey project

Patent No.: US 10,925,277 B2

StealthNet®

- Innovative design features to survive the elements
- Nylon strapping (like seatbelts) is stitched throughout the netting providing reinforcement and an installation method that is dramatically stronger than traditional methods.
- StealhNet is strong but susceptible to chafe
- All chafe points have been eliminated with the introduction of:
    - Nylon straps bolted to components
    - Strap tensioners
    - Custom mounting to protect netting area

Patent No.: US 10,925,277 B2

Patent No.: US 10,925,277 B2