Pacific Northwest
NATIONAL LABORATORY

Lighting the future

Presentation to DOE/IES R&D Workshop
Virtual Venue
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Naomi J Miller, FIES, FIALD
Designer/Scientist

U.S. DEPARTMENT OF ENERGY BATTELLE

PNNL is operated by Battelle for the U.S. Department of Energy

Lighting the future

Focus on people and the planet

- Day*light* and night*dark*
- Luminaires and finishes change over course of day
- Controls must become intuitive and seamless
- Energy issues
- Resource issues
- Power distribution
- Behavioral changes in individuals and community

Image: https://www.businessinsider.com/the-67-types-of-people-in-america-2016-

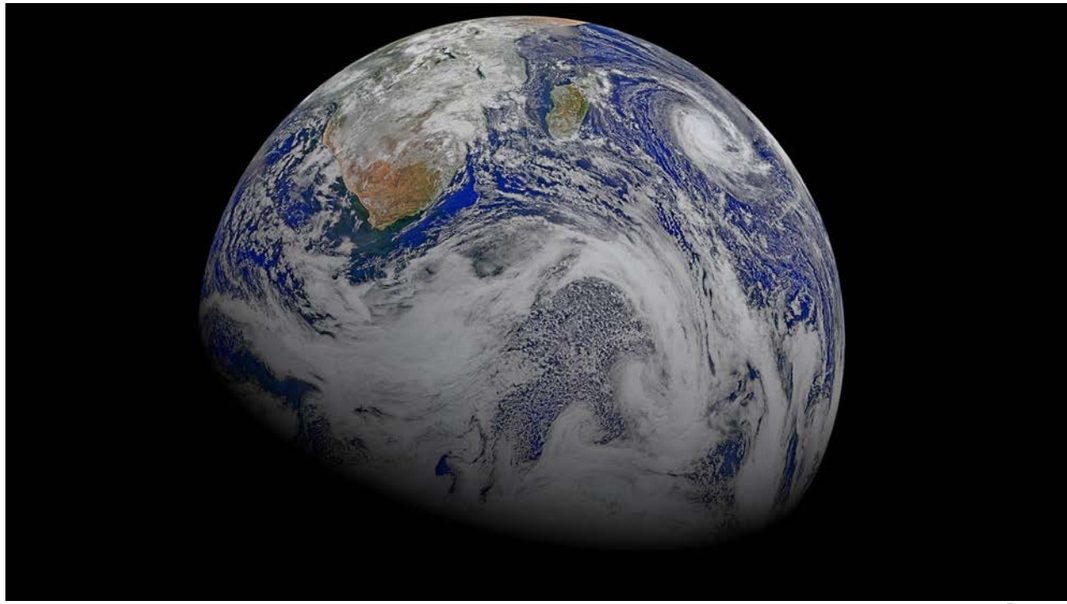


Image: https://www.pbs.org/wgbh/nova/article/nova-marathons-planet-earth/

Day*light* and Night*dark*

Lighted/unlighted environments responsive to human physiological needs:

- More extremes of light exposure, automatically
- More, larger, energy-efficient windows and skylights (new and retrofit)
- Can they have photovoltaic capabilities?
- Most are real. Some are faux, but bright, dynamic, and realistic
- Glass dims to dark at night

Image:
Velux.co.uk

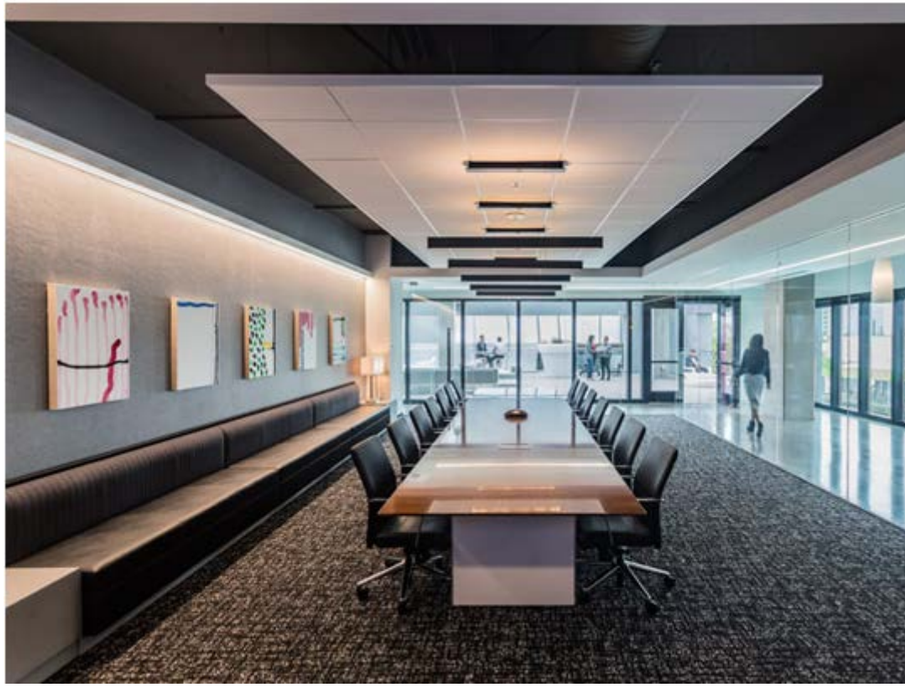
Image:
creelighting.com

Day*light* and Night*dark*

Luminaires and surfaces responsive to human physiological needs:

Day*light* and Night*dark*

- Luminaires and surfaces that shift intensity and warmth/coolness over the day
- Wall and ceiling finishes that morph in reflectance and light emission over time of day
- Luminaires/surfaces large enough to provide cheerfully bright light at the eye *without glare*
- Stationary luminaires that can optically shift distribution over the day to move light upward during day, downward in evening



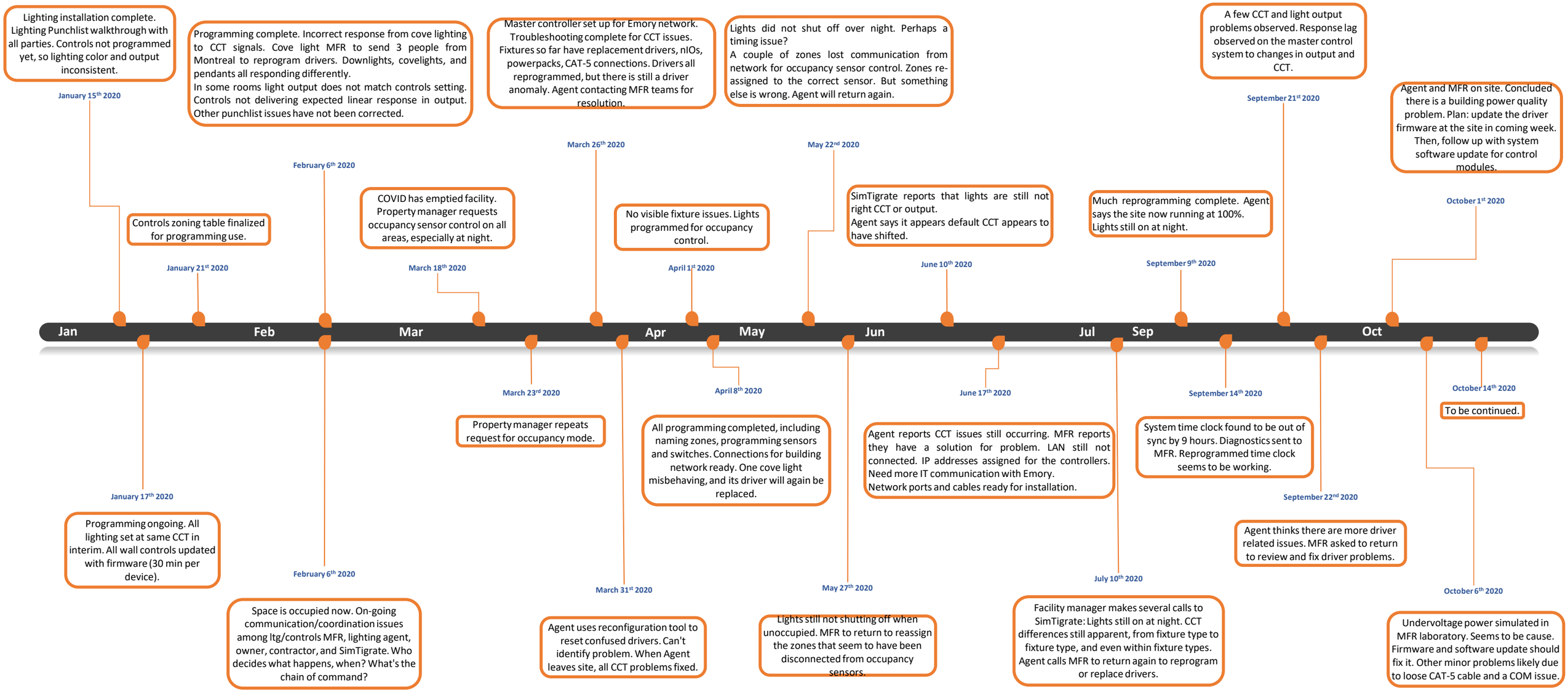
Images:
finelite.com

Controls

Inspiration for this section

- Cognitive Empowerment Program at Emory University, Atlanta GA. (Collaboration by SimTigrate Design Lab, Georgia Tech University)
- Color-and-intensity tunable lighting throughout floor (offices, training rooms, innovation center, exercise and therapy spaces, etc.)
- Lighting is controllable to study impact of lighting on learning, retention, and well-being of program participants and staff
- Automatic controls adjust lighting in spaces, in response to programming, time of day, and occupancy. Also tied-in to computer system to provide feedback on controls usage, power use, overrides, etc.
- Whole floor control system with local wall controls…and
- …just a few field problems…

Lighting Controls Timeline for the Cognitive Empowerment Program at Emory University (Project collaborators: SimTigrate Design Lab at Georgia Tech University)



Controls of the future

Image:
DOE Next Generation Lighting Systems

MUST be EASY to

- Compare features, estimate price, assess realistic performance
- Specify, along with comparable systems. We need a standardized vocabulary, capability list, and a magic interface gizmo that translates from one manufacturer's controls protocols and hardware to another
- Bid, for contractors and agents/distributors
- Order, for the distributor and agent
- Install: luminaire, interfaces, wall controls, system
- Commission, and troubleshoot, and troubleshoot some more
- Figure out and use, especially the naïve user
- Reprogram for a different user or function
- Upgrade software and hardware for security, bug fixes, or to next generation

Image:
Lightnowblog.com

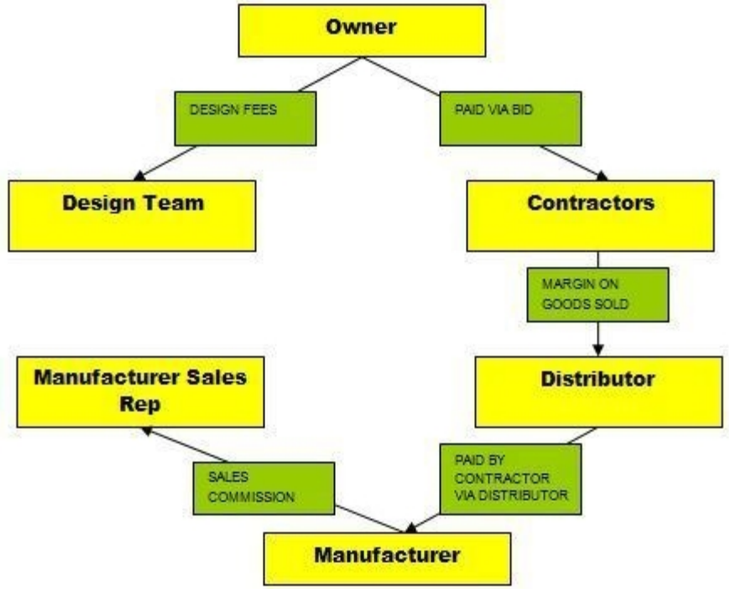


Image:
https://www.buildings.com/articles/30588/6-integration-tips-wireless-lighting-controls

Controls of the future

Sensors imbedded in lighting systems

- Lighting systems will have proximity sensors that communicate with neighboring proximity sensors, so that they gently raise and lower light levels when occupant is near, without startling anyone or making the space look forbidding
- These sensors can be overridden or modified upon voice or gesture command, within reason
- Sensor sensitivity must be tunable in-situ. One size does not fit all. Sensors should learn from user patterns
- All sensors will harvest energy from environment (temp changes, for example) so that you don't have a proliferation of batteries or constant power draw

- This applies to outdoor lighting, too!

Image:
DOE NGLS program

Controls of the future

Image:
HomeDepot.com

Controls are for people, not for aggravation:

- Seamless and intuitive – really
- Software giants have built empires on excellent computer-human interfaces
- There's perhaps a bit of getting used to each other, but eventually the user learns, and electronic device adapts, and they work together almost effortlessly
- Can we learn from them?

Image:
cnet.com

Image:
https://insideevs.com/news/328062/new-tesla-dashboard-concept-rendering/

Controls of the future

Making controls seamless is really hard!

- There must be standardization of bits, communication, and protocols for all of this to work
  - Color instructions
  - Dimming level instructions
  - Timing, rates of change, sequence of change, etc. in response to sensor signals
  - Etc.
- Need universal translators that can convert command signals from one manufacturers' system to another
- User interfaces must have common functionality
- Systems must be upgradeable. We should not have to dump these expensive systems every 5 years

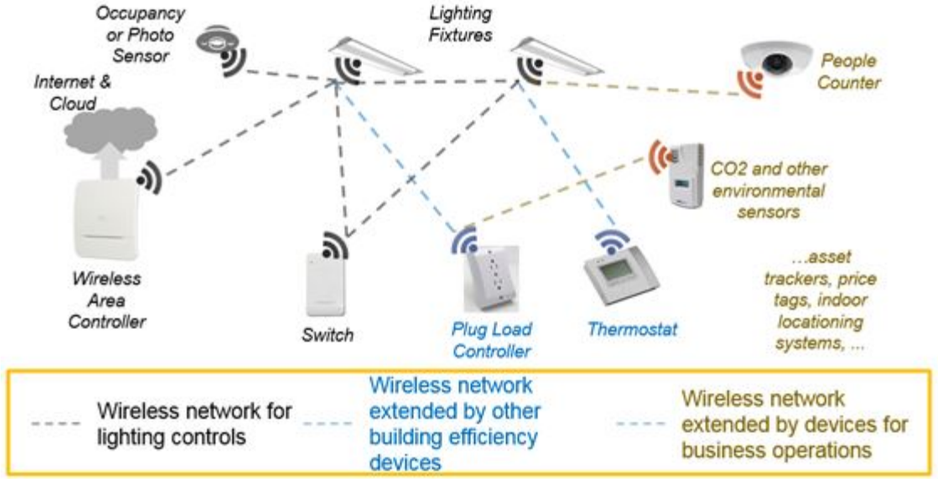
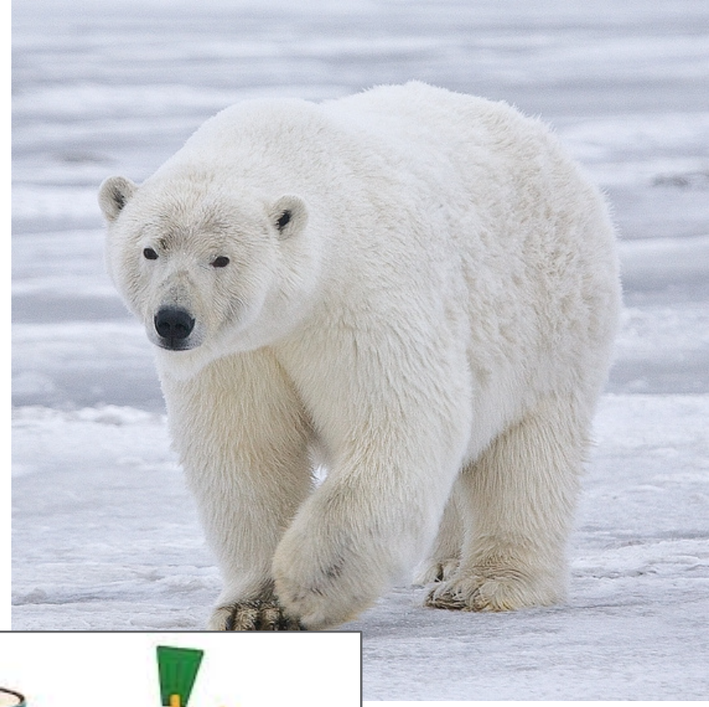


Image: Daintree/GE

Lighting the future

Image: https://simple.wikipedia.org/wiki/File:Polar_Bear_-_Alaska_(cropped).jpg



Other crystal ball issues:

- Energy – It continues to be a critical issue for climate change. Keep working on efficacy, controls, overlighting
- Resources – Use less
  - Flexibility, reconfigurability, upgradability
  - Tinkertoys/Legos
- Lighting should not go to landfills

Image: pinterest.com

Image: https://time.com/3931946/lego-sustainable-materials/

Lighting the future

Image:
pinterest.com

Other crystal ball issues:

- Power distribution – No more conduit or j-boxes
  - SSL lighting is low power, low voltage
  - Let’s figure out standardized plug ‘n play systems

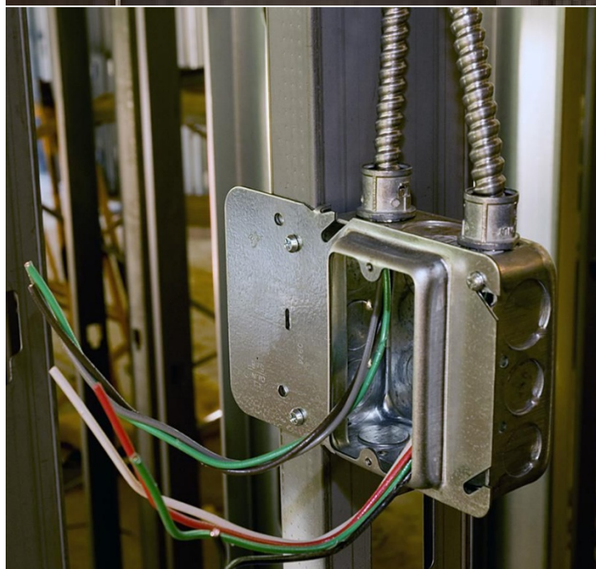


Image:
https://www.thespruce.com/
why -use-conduit-1152894

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Lighting the future

Behavioral changes – Educate the community on health

Mimic light exposure on a camping trip

- Wake up when sky lightens
- Sun is small but intense light source, but the sky and clouds also reflect light
- When the sun sets, the light gets warmer, then disappears
- Light a campfire for warmth and light.

Glacier National Park

Pixabay.com

- Go to bed with only stars and moon in sky (zzzzzzz).

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Thanks for the attentive eyeballs!

Naomi J Miller, FIES, FIALD
Designer/Scientist
Naomi . Miller @ pnnl . gov

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