Kirk Hudson - Managing Director Generation & Transmission, HRI Board Member
The Business Case

Use Operational Data to:
- Reduce operating cost
- Improve reliability
- Improve quality
Principles:

- Next frontier of hydro improvements will come from digital transformation
- Data is an asset. The more the better
- Tools are plentiful, really accessible and inexpensive
- Owners should optimize the value of their data by sharing costs and collaborating
Hydro owners are in different spots on the curve

Most are in the 3-5 area with very view in the 6-7 range
A data-driven collaborative formed and governed by hydropower owners.

Designed to empower hydropower owners to remain competitive in a changing electric system and market.

Focused on enabling hydropower owners to drive business value of digital transformation by:

- Aggregating operational data.
- Identifying technology development needs.
- Providing a collaborative forum to share tools and addressing culture change required to digitally transform hydropower.
Current Status:

**Proof of Concept Data Aggregation Platform Complete**

**Design guided by technical steering committee**

**Kirk Hudson, Chelan PUD**

**Lisa Martindale, Alabama Power/Southern Company**

**On-Boarded Seven Hydropower Plants from Across the U.S.**

**Aggregated data set available**

Initiating on-boarding new hydropower plants

**Daniel Rabon, USACE Hydropower Business Line**

- 110 Hydropower plants
- 489 units
- ~30% of U.S. hydropower capacity
How are we planning on using the HRI

- Leverage collective data to improve predictive and prescriptive models
- Collaborate on common solutions
- Understand what others are doing that may benefit us
- See the value of data others are collecting that we are not
So What Can We Do?

- Generator Cooling Model
- Bearing Model
- Anomaly Detection
- Data Driven Action
Generator Cooling Model

Inputs:
- Cooling water temperature
- Cooling water flow
- Stator current
- Ambient air temperature

Outputs:
- Stator winding temperature
- Cooler cleaning PM
Generator Cooling Model

Temperature Prediction Tool

- **Stator.Winding.Temp**: 79.80

- **Stator.Lifetime.Decrease.Factor**: 0.07

**Total Current (Phase A, B, and C):**

- **5,600** to **9,505**

**Stator Input Air Temperature (C):**

- **20**

- **30**

- **45**
Generator Cooling Model

Operationalize
- Build out individual stator section models
- Determine indicators where cooler cleaning needs to happen
- Run model based anomaly for all units
- Build other models:
  - Bearings
  - Oil volumes
Similar approach for generator cooling. Common model developed. Predicts bearing and oil temperature. Inputs:

- Unit power output
- Unit speed
- Cooling water temperature
- Shaft vibration
Immediately showed one unit is different, Why?
Anomaly Detection

Automate when things “look different” then they should:

Three approaches

• Single signal acts differently
• Results from study of one unit, used on another
• Predictive model
Anomaly Detection

Single signal acts differently

Normal Unit on and warm.

20-Dec-18 00:00:00
Results from study of one unit, used on another
Predictive model
Modeling Thoughts

It’s all about the data
- Digitize as much as you can, collect everything, store everything
- Measure fundamentals, not integrated results

Look at the entire system
- Predicting catastrophic failures is unlikely
- Better to focus on sub-systems

Accuracy of predictive analytics is limited by the size of the relevant dataset
- Higher degrees of accuracy can be achieved via aggregation

Patterns of interest are hidden within current operational tolerance
- The goal is understanding these patterns and taking action before alarms sound
Questions, Comments