Energy Storage Industry Learnings Forum
Workshop 2

November 27, 2020

Agenda

- Welcome and introduction
- Topic 1: Storage as a Transmission Alternative (SATA)
  - Hao Liu
  - Neil Cumming
- Topic 1 Discussion
- Topic 2: Sharing learnings from other jurisdictions on legislation, regulations and policy
  - Paula McGarrigle
  - Evan Wilson
- Topic 2 Discussion
- Break

Agenda

- Topic 3: Market qualification parameters, process, models and data (SCADA) requirements
  - Dan Gustafson
- Topic 3 Discussion
- Wrap up and next steps

Welcome and introduction

- Welcome
- Introduction

AESO Stakeholder Engagement Framework

ESILF transparency

- The ESILF recognizes not all of the AESO's stakeholders will be represented within the ESILF and to support the AESO's commitment to transparency, the following will be posted on the AESO website on www.aeso.ca:
  - Forum membership
  - Agendas
  - AESO or member presentations
  - Relevant discussion materials
  - Meeting summaries

Topic 1: Storage as a Transmission Alternative (SATA)

Transmission Energy Storage

AESO ESILF MEETING

NOVEMBER 27, 2020

ALTALINK
A BERKSHIRE HATHAWAY ENERGY COMPANY

SustainableElectricityApproved™
Canadian Electricity Association

Key Message

- **Both regulated <u>transmission storage</u> and third party owned non-wires-alternative storage (<u>NWA storage</u>) should be in AESO's tool box in order to minimize customer costs, ensure FEOC markets, and respect current industry and regulatory construct**
- **Recommend the AESO implement transmission storage now (independent to the NWA storage process under the AESO's energy storage roadmap)**
  - Take action to initiate the development of a NID for transmission storage as a preferred solution for a transmission problem
  - The Commission can then make a decision concerning using storage as a transmission asset.

Transmission storage and NWA storage are uniquely different applications

- **Transmission storage**
  - Designed to perform transmission functions (e.g. contingency support, maintain stability) as a “wires” solution
  - Its operation follows control signals from the transmission system
  - Typically designed/configured as a “power battery” (storage duration less than I hour)
  - Infrequent operation (e.g. frequency of operation is the same as the frequency of the contingency it mitigates.)
- **NWA storage**
  - Primary usage is to operate/participate in energy and/or AS markets
  - Follows market dispatch and may help address certain transmission issues from its market operations (e.g. alleviate transmission congestion)
  - Typically designed/configured as an “energy battery” (storage duration 3-4 hours or more)
  - Often involve frequent charge and discharge (e.g. daily cycles)

Transmission storage does not have FEOC concerns while NWA storage may (if not designed appropriately)

- **Transmission storage**
  - Owned by a TFO, fully controlled by the AESO, and does not participate in energy and AS markets
  - Its operation has negligible impact on FEOC markets due to infrequent charging/discharging. The effect of a transmission storage's operation is no different from the operational effects of other transmission facilities (e.g. losses from switching transmission lines)
  - May result in reduced need/volume of procuring certain grid services required to support safe and reliable grid operations (similar to that transmission facilities may reduce the need for TMR).
  - Uniquely qualified as a long-term transmission solution due to the flexibility to change its functions and to relocate if required by the AESO
- **NWA storage**
  - Used as a service, not as a long term solution performed by a transmission asset
  - Owned by a market participant and its operation involves frequent/large amount of energy charging and discharging incented by NWA contract payments in exchange for transmission benefit from its market operation (e.g. congestion relief)
  - Un-level playing field issues associated with the out-of-market payments
  - NWA contract renders risk of over commitment and unnecessary costs to consumers given the system conditions are continuously evolving while NWA performance and payments are pre-defined (NWA contract should be short term, 2-3 years)
  - Relying on NWA storage to address transmission issues that are best to be dealt with through the transmission storage will likely result in material FEOC concern

Transmission storage can be readily implemented under current industry and regulatory construct

- **Transmission storage deployment is consistent with Alberta's existing industry and regulatory structure for regulated transmission facilities**
  - No changes required.
  - Current regulation, rules and process regarding the development and operation of transmission facilities are readily applicable for transmission storage (NID, P/L, ownership, energy impact due to operation is accounted for as system losses, etc.).
  - Preventing TFO from owing transmission storage is not consistent with current industry and regulatory framework governing transmission industry in Alberta
- **NWA storage deployment requires policy and regulatory changes**
  - NWA storage must be clearly defined in order to be used effectively
  - Implementation requires T-reg and market rules change

Storage as a regulated wires asset is accepted in other jurisdictions with deregulated industry/market

- **MISO Storage as a Transmission-Only Asset (SATOA)**
  - Established a process for enabling storage as a regulated asset to provide transmission functions
  - Approved by FEOC following a robust stakeholder process
  - Operated under MISO's control, exclusively for transmission purpose
  - Do not participate in markets
  - Treated the same as other transmission assets (capacitor banks, transformer etc.)
  - Storages as NWA follow the NWA process to compete with regulated transmission solutions
- **Ontario – distributor ownership of energy storage**
  - OEB approved Toronto Hydro's proposal of owing/operating storage for distribution reliability purpose
  - OEB staff bulletin stated that distributors can own BTM storage if it is used for reliability purpose
- **Australia – utility owned storage used to optimize grid services; allow utility ownership with market functions leased out to third parties.**

Conclusion

- **Transmission storage and NWA storage are uniquely different applications**
- **Transmission storage does not have FEOC concerns while NWA storage may**
- **Transmission storage can be implemented under current industry and regulatory construct**
- **Storage as a regulated wires asset for wires functions is accepted in other jurisdictions with deregulated industry/markets**

Key Message

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STORAGE AS A DISTRIBUTION ALTERNATIVE

Neil Cumming

ESILF Workshop #2
November 27, 2020

FORTIS ALBERTA

Non-Wires Alternatives

- NWAs reduce demand on the system thereby alleviating a grid constraint which would traditionally be resolved by poles and wires infrastructure.
- Obligation to provide most cost-effective service – Non-Wires Alternatives are becoming cost competitive with traditional upgrades and should be evaluated as such.
- Key Question: What is the problem we are trying to solve?

Technology Comparison

Battery Storage

- Scalable
- Geographically flexible
- Limited duration
- Shorter asset life

Pumped Hydro

- Build it once
- Geographically dependent
- Long duration
- Longer asset life

Poles & Wires

» Build it once

» Geographically flexible

» Long duration

» Longer asset life

NWA Demonstration

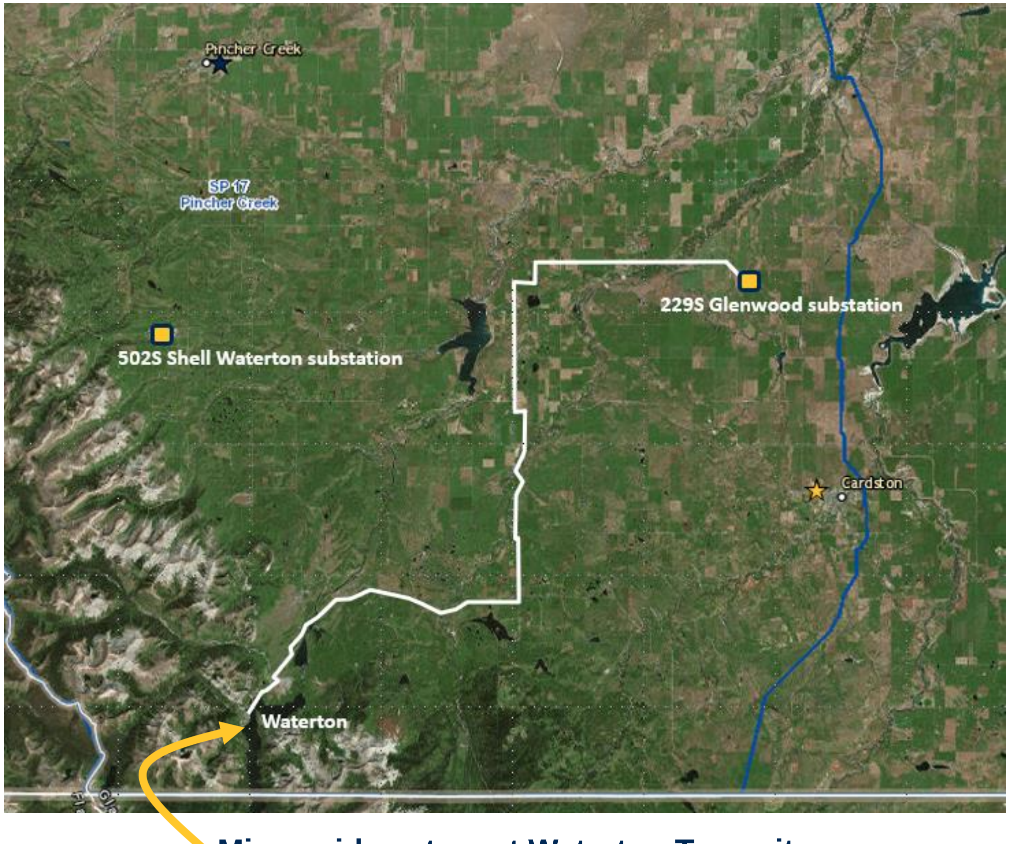
FortisAlberta Waterton Energy Storage Project

ALBERTA INNOVATES

EMISSIONS REDUCTION ALBERTA

Natural Resources Canada | Ressources naturelles Canada

Canada



Microgrid system at Waterton Townsite

» Problem: improve reliability to residents & visitors in Waterton
  - 74km radial distribution feed
  - Challenging natural environment

» NWA demonstration
  - Battery storage system to backup the townsite when grid supply is interrupted

» Knowledge sharing

Other Use Case Examples

Increase Hosting Capacity for Renewables

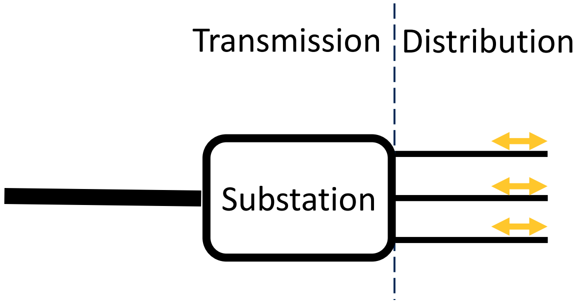
- NWAs can increase renewable generation penetration by reducing peak demand on the grid

Image: Toronto Hydro, tdworld.com

Storage as a Transmission NWA

- Aggregation of distribution-connected assets should be evaluated as a solution for Transmission system constraints

- Proper integrated planning will allow for the most efficient, cost-effective solutions



Future Distribution Market Development Questions

- Maintain flexibility of technology choice and ownership/operation structure
- Regulatory framework is key
  - No market exists for procurement of Distribution grid-services
  - Expand Distribution interconnection requirements to include performance requirements

Thank You

Discussion

Topic 2: Sharing learnings from other jurisdictions on legislation, regulations and policy

OTHER JURISDICTIONS IN ENERGY STORAGE

Presentation to ESLIF

Overview

- Review of additional jurisdiction
  - California
- Why California?
  - California has had a concerted effort to integrate energy storage since 2013
  - They have engaged a collaborative measured analysis of issues and an integrative process that allowed for timely responses.

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California – Why Storage?

- Background
  - Energy storage connected directly to the ISO grid and resources connected directly to the distribution grid (DER) are growing and will represent an increasingly important part of the future resource mix.
    - California RPS requires all the state's electricity to come from carbon-free resources by 2045.
  - Increased energy storage at the grid level will optimize the grid, including peak reduction, contribution to reliability needs, or deferment of transmission and distribution upgrade investments.
  - Reduction of greenhouse gas emissions to 80 percent below 1990 by 2050 per California's goals. Integrating these resources will help lower carbon emissions; and can offer operational benefits.

California Energy Storage

- Growing number of participating resources no longer fit the traditional generator or load models, such as demand response and energy storage
- Energy Storage are different from traditional generator or loads
  - discharge energy in one interval as positive generation and consume energy in the next interval as negative generation.
  - current battery chemistries and storage control systems have demonstrated value since these resources can
    - move nearly instantaneously between positive and negative generation,
    - have very fast ramping rates, and
    - can be controlled to a high degree of precision and performance accuracy

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California Process - How

- Conscious effort since 2013 to eliminate barriers for Energy Storage.
  - The ESDER initiative's central focus is to lower barriers and enhance the ability of transmission grid-connected energy storage and the many examples of distribution-connected resources to participate in the CAISO market.
    - Workgroups, Stakeholder sessions with actionable items.
  - Change in laws, regulations, rules, update business practice manuals.
    - CPUC decision adopted 11 interim rules outlining how these multiple use applications should be evaluated, established a working group, to be convened by the CPUC energy division to develop actionable recommendations.
    - Numerous bills have passed AB2868 (2016) with the intention of deploying additional storage resources into the California Grid
- Held the promise of providing additional revenue streams to energy storage providers who in turn might develop innovative financing and service agreements to bring projects online.
- Concept of Multiple Use Assets (MUA) with the same energy storage facility.

California Targets

- Investor-Owned Utility Energy Storage Target to be contracted by 2020
  - Transmission – 700 MW
  - Distribution – 425 MW
  - Customer – 200 MW

Market Participation Models for Energy Storage

- Distributed Energy Resource Provider
- Proxy Demand Resource (PDR)
- Non-Generating Resource

Market Participation Models for Energy Storage

Proxy Demand Resource (PDR)

Proxy Demand Resource	PDR Load Shift Resource	Reliability Demand Response Resource	Participating Load
Includes Electric Vehicle Supply Equipment			*includes Pumped Hydro*
Not REM	Not REM	Not REM	

REM – Regulating Energy Management

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Market Participation Models for Energy Storage

Non-Generating Resource

Limited Energy Storage Resources	Dispatchable Demand Response	Generic NGRs
Battery and Flywheels		
REM ?? non-REM resources???	REM and non-REM resources	Only REM

REM – Regulating Energy Management

Market Participation Models for Energy Storage

Distributed Energy Resource Provider

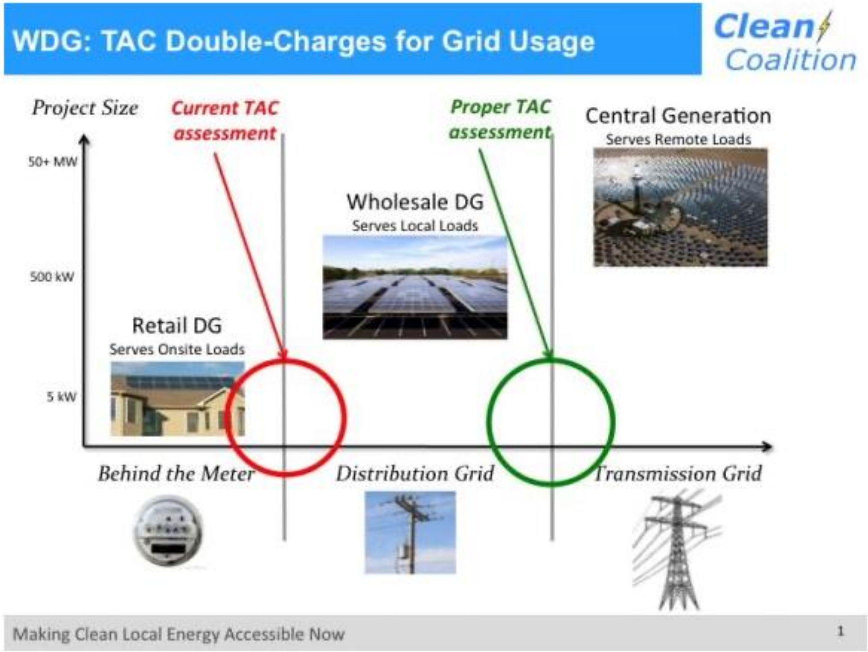
Proxy Demand Resource (PDR)				Non-Generating Resource		
Proxy Demand Resource	PDR Load Shift Resource	Reliability Demand Response Resource	Participating Load	Limited Energy Storage Resources	Dispatchable Demand Response	Generic NGRs
Includes Electric Vehicle Supply Equipment			*includes Pumped Hydro*	*Battery and Flywheels*		
Not REM	Not REM	Not REM	????	*REM ?? non-REM resources???*	REM and non-REM resources	Only REM

REM – Regulating Energy Management

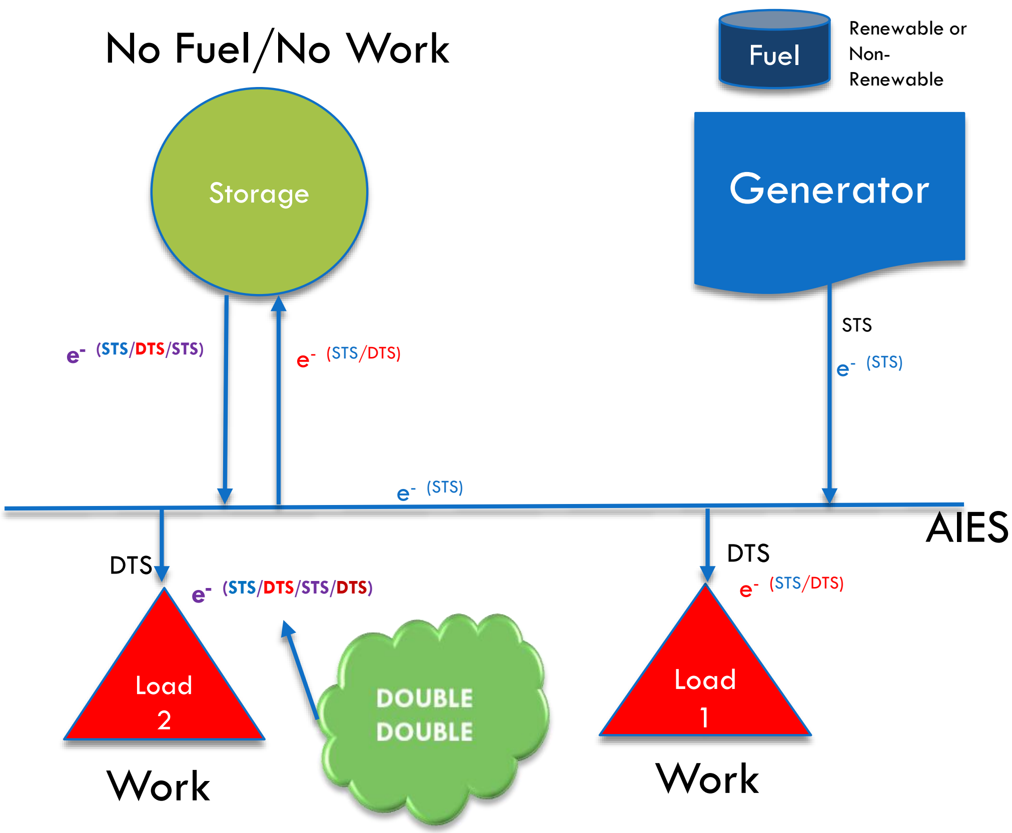
California - Transmission Access Charge

- The ISO currently allocates the TAC to each MWh of internal **end-use load** and exports to recover participating transmission owners' costs of owning, operating and maintaining transmission facilities under the ISO operational control.
- Currently the TAC is designed as a volumetric rate and is charged to **each MWh of internal load** and **exports**,
  where internal load is the sum of **end-use customer metered load** (also referred to as "gross load")
- 2016 – discussion regarding the transmission energy download being the determinant of transmission access charge. ("TED")
  - Remained with TAC at the End-Use load and not the transmission energy download.

California discussion on where the transmission charges should be measured.



Alberta - Charging DTS and STS on Energy Storage doubles up the charges on this electricity.



Generators pay STS. These electrons have paid for STS $[e^{-\ (STS)}]$

Load receives electrons that have already been loaded with STS. $[e^{-\ (STS)}]$

Then load pays DTS so the final consumed electrons have had both STS and DTS payments $[e^{-\ (STS/DTS)}]$

Energy storage currently gets charged DTS to charge (treated as a load) and the same electricity delivered back to the grid is also charged STS.
Now we have $e^{-\ (STS/DTS/STS)}]$

Load purchasing from the storage facility through the grid would now have to pay DTS, on top of electricity that has already now paid DTS, and STS <u>twice</u>. DOUBLE DOUBLE

Power used from energy storage has had twice the DTS and the STS applied.

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Conclusion

- California is a jurisdiction that is intent to incorporate significant volumes of energy storage.
- Evolving regulations for energy storage
- Conscious effort to remove barriers for distributed energy and energy storage
- Transparent choice on location of transmission charges for end-use load.

The Canadian Renewable Energy Association

The Canadian Renewable Energy Association was established on July 1, 2020 when the Canadian Wind Energy Association and the Canadian Solar Industries Association united to create one voice for wind energy, solar energy and energy storage solutions.

What We Do

The Canadian Renewable Energy Association is the voice for wind energy, solar energy and energy storage solutions that will power Canada's energy future. We work to create the conditions for a modern energy system through stakeholder advocacy and public engagement. Our diverse members are uniquely positioned to deliver clean, low-cost, reliable, flexible and scalable solutions for Canada's energy needs.

Today's Presentation

- CanREA has staff members engaged on storage files across Canada.
- This presentation represents a scan of all the ongoing storage work and engagement in the provinces in which we are active or are monitoring, with support from our members.
- Generally speaking, we're seeing provinces take the following approaches:
  - Pilot projects
  - Procurements
  - Consultations
  - Rule Changes

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Ontario

- The Ontario IESO has proposed interim revisions to their market rules, in order to include energy storage.
  - The IESO Board meets on December 9 to approve these draft revisions.
  - Upon approval, these interim rules will be implemented in Q1 2021.
  - These temporary rules relate to interim design features are contained in a dedicated section.
  - Topics include: registration; provision of regulation service and operating reserve; energy offers and bids; and revisions to dispatch data.
  - Other rule changes are expected to be permanent and generally reflect the expansion of existing terms, definitions or rules to include energy storage.
  - Market Renewal changes are scheduled to be deployed in Q1, 2023. Long term storage design will be implemented after that.

Nova Scotia

- Nova Scotia Power has begun to consider the opportunities for and impact of energy storage in their long-term planning processes.
- The September 2020 Integrated Resource Plan included consideration of energy storage.
- Currently, they do not consider storage as a replacement for firm capacity due to short durations.
- The IRP includes plans to monitor costs in order to inform future modelling assumptions.
- Current modelling results in:
  - 30 to 60 MW of storage by 2025.
  - Up to 120 MW by 2045.

Quebec

- Hydro Quebec 2020-2024 strategic plan includes deployment of storage to facilitate cleaner energy in remote communities.
- Various pilots and demonstration projects are underway to study storage across the province, including:
  - Blainville: pilot studying energy management including peak shaving and VTG.
  - Hemmingford: pilot storage project installed at substation.
  - Lac-Megantic: storage facility installed to support the regional microgrid.
  - Quaqtag: pilot underway to support off-grid demonstration project.
- Hydro Quebec, in partnership with Mercedes, has also opened a research Center of Excellence in battery materials.
- Hilo, a new subsidiary, to provide turnkey smart energy services to residential and business customers.

Saskatchewan

- This summer, SaskPower released an RFI for a Battery Energy Storage System procurement:
  - The BESS is intended to balance some level of variability in the province and manage flows travelling across the tie line with Manitoba.
  - According to SaskPower, there are control issues due to highly variable loads within the province, increasing renewable generation and unscheduled flows across the tie line.
  - They are seeking a 20 MW/20 MWh solution, comprising two independent 10MW/10MWh units.
- Further procurement details have not yet been announced, but the process has made further progress with the SaskPower board.
- The target in-service date is mid-2022.

British Columbia/Manitoba

British Columbia

- BC Hydro installed a 1 MW battery in Field, BC in 2014.
- In 2015, they released an "Energy Storage Project Outreach Report" reporting enhanced customer supply reliability in that region.

Manitoba

- Consider their hydro capacity as storage to complement mid-west US renewable generation.

Questions?

ewilson@renewablesassociation.ca

Canadian Renewable Energy Association
WIND. SOLAR. STORAGE.

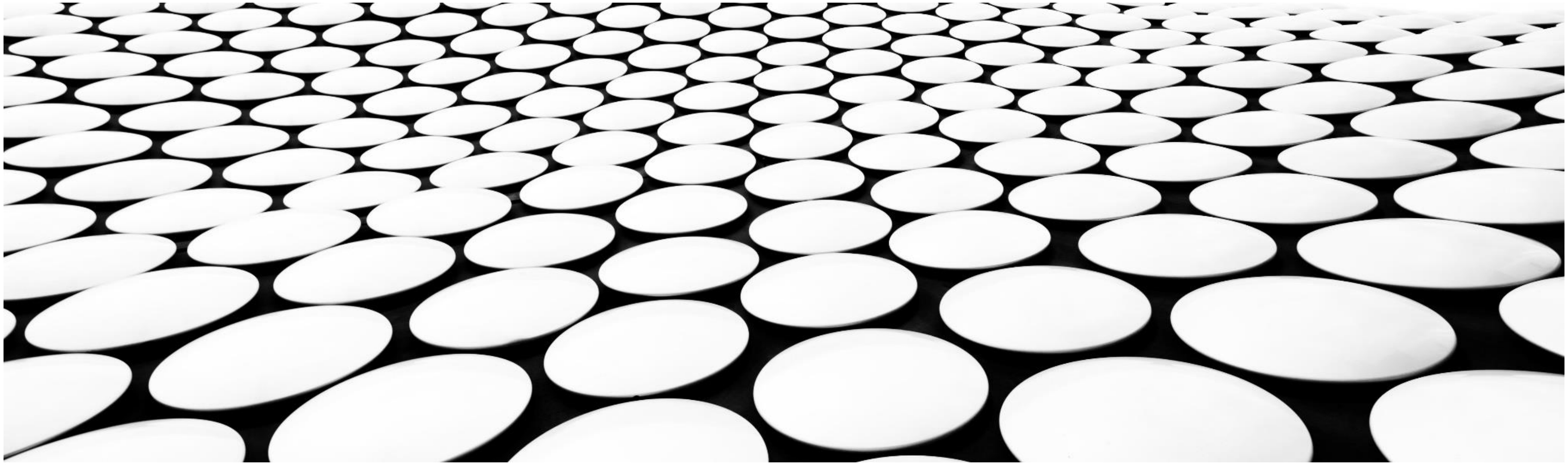
Association canadienne de l'énergie renouvelable
ÉOLIEN. SOLAIRE. STOCKAGE.

Discussion

Topic 3: Market qualification parameters, process, models, and data (SCADA) requirements

SCADA AND MODELING

HOW TO GUIDE



SCADA – (MODELS TO FOLLOW)

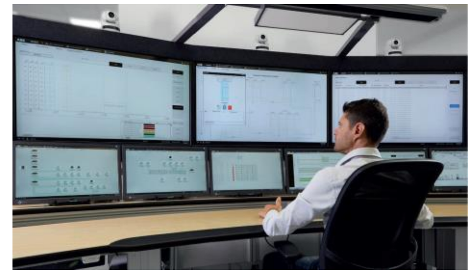
- S – Supervisory
- C – Control
- A – And (Analytics)
- D – Data
- A – Acquisition

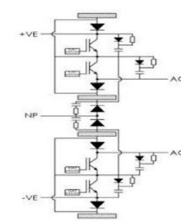
- SCADA
  - Supervisory Control and Data Acquisition
- EMS
  - Energy Management System
- DCS
  - Distributed Control System
- PMCS
  - Power Management Control System

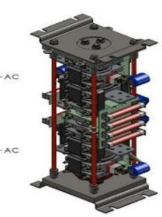
S - SUPERVISORY

- One central point of information gathering.
- Display information or data gathering
- Master control of certain systems
  - Some elements are self controlled and only supply information
  - Some elements are control only
  - Some elements are bi-directional and supply information

    but can also be controlled





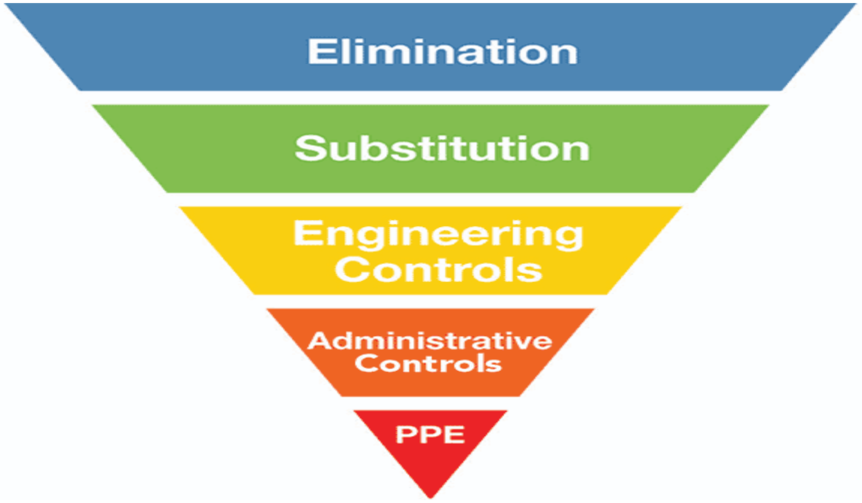


C - CONTROL

- Master control of certain systems
  - Some elements are self controlled and only supply information
  - Some elements are control only
  - Some elements are bi-directional and supply information but can also be controlled

- Control can be mastered by:
  - HMI – Human Machine Interface
  - PLC – Programable Logic Controller
  - IED – Intelligent Electronic Device

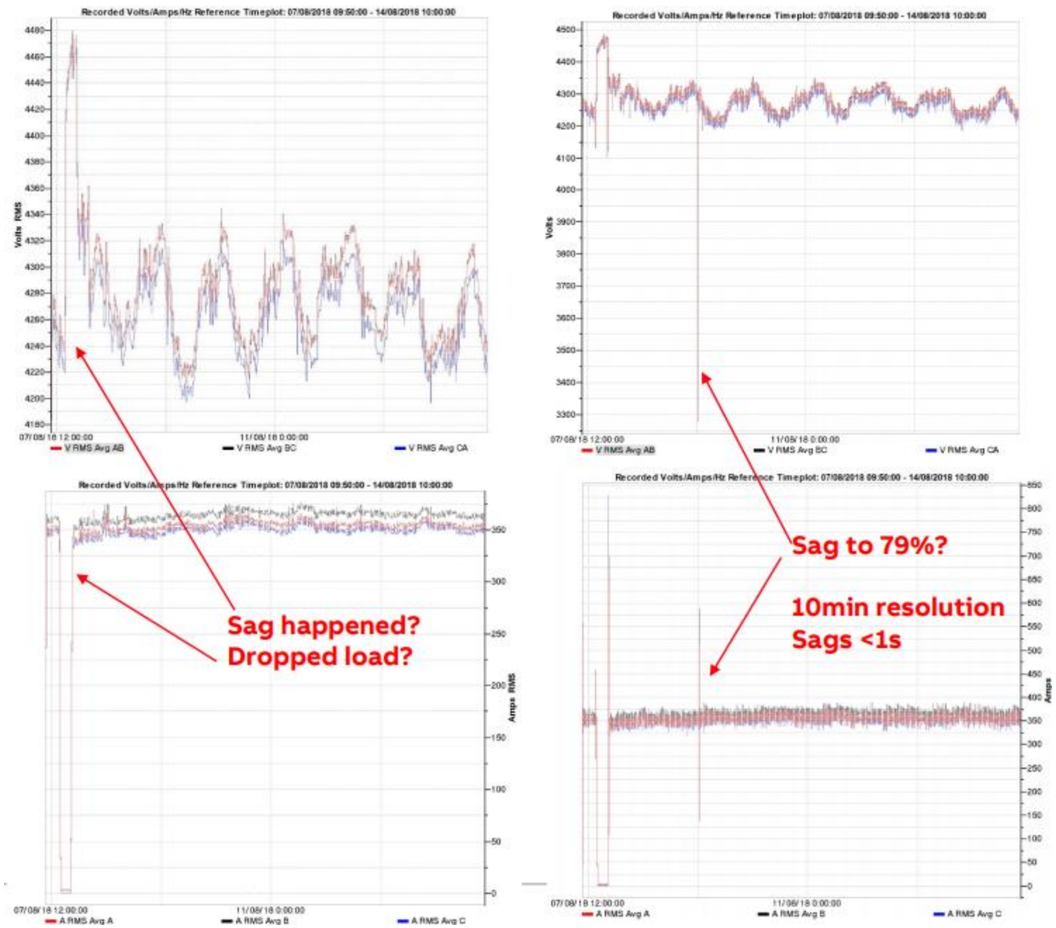
Control needs to engineered throughout the system to ensure levels of hierarchy are adhered to



A – AND (ANALYTICAL)

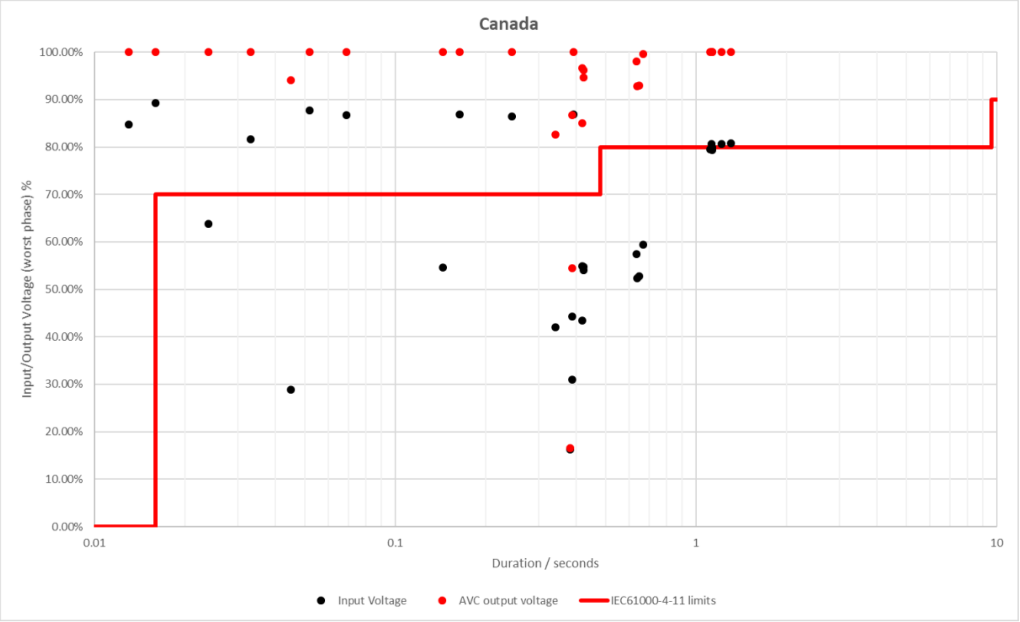
- Data is stored in a historian
- Data is presented via HMI
- Data can be captured in file forms (Excel)
- Data presentation can be manipulated to focus in on selected points
- Data can be compared to other data points

- Data is key to Analytics
- Data is key to modeling



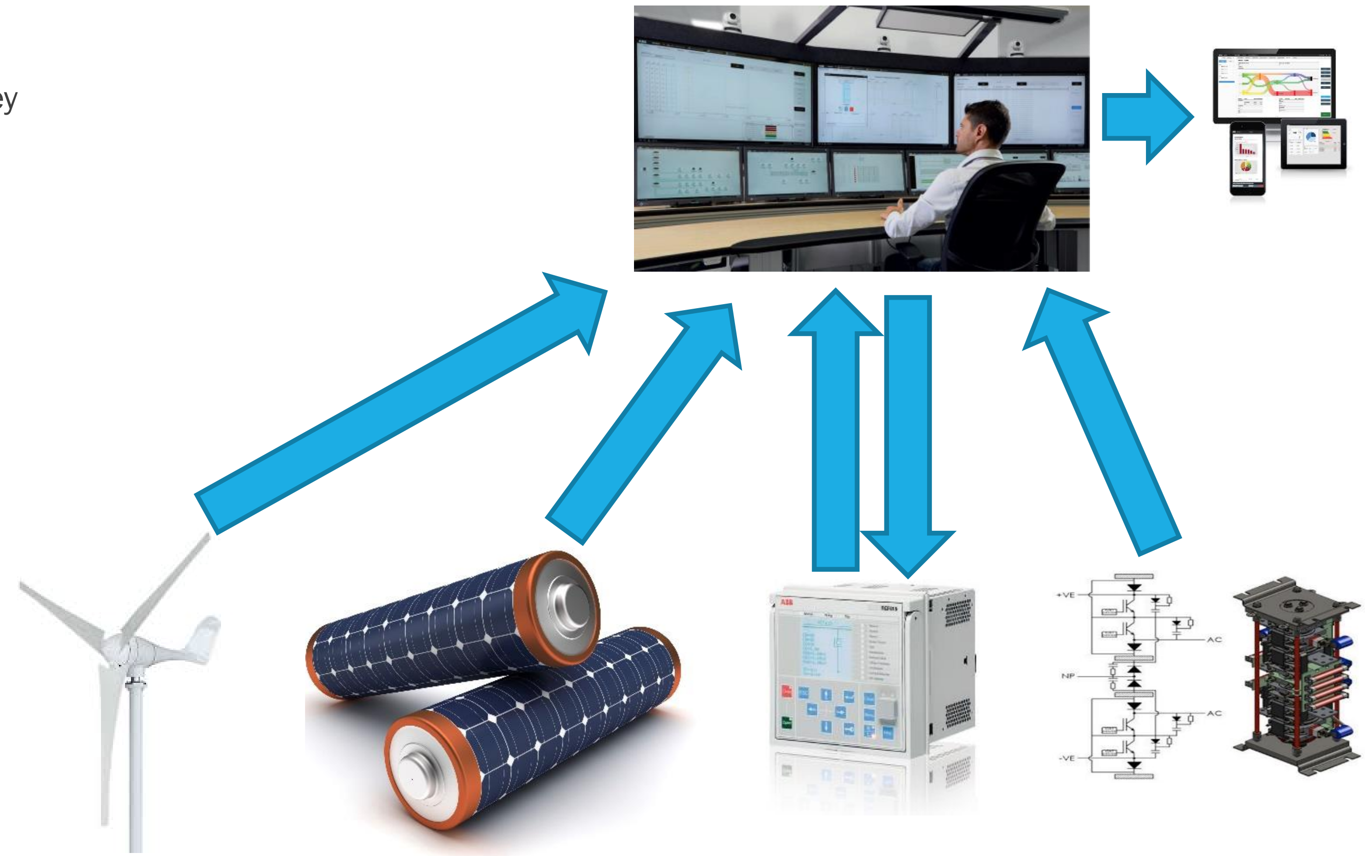
D - DATA

- Historians are used for storage of data
- Trends or graphs are used to show data
- Data has three important items:
  - Resolution
  - Availability
  - Data points
- Data is the backbone of Analytics and Modeling



A - ACQUISITION

- Communications is key
  - Modbus TCP/IP
  - IEC61850
  - Profibus / Profinet
  - DNP
  - Ethernet IP
  - Wireless
  - Internet

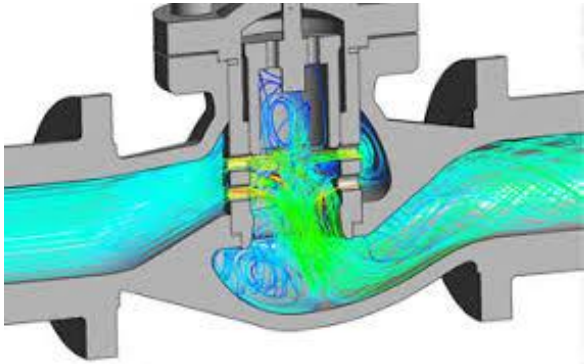


M – MODELING

- Computer Modeling
  - Before it happens let's see what is going to happen
  - Accuracy is dependent on engineers input into the computer model
  - Computer creates the model based on given calculations and outputs the answers
  - Engineering experience is key

- Data Modeling (Analytics)
  - After it happens let's see what happened
  - Accuracy is dependent on the data acquired and used in the computer model
  - Computer often puts the data into trends and graphs and is up to human understanding as to what happened.
  - Engineering experience is key

- Computer Modeling examples
  - Bim/revit (mechanical)
  - Etap / SKM (electrical)
  - CoFlow (reservoir)



THANKYOU FOR YOUR TIME

Contact:
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Calgary Alberta Canada

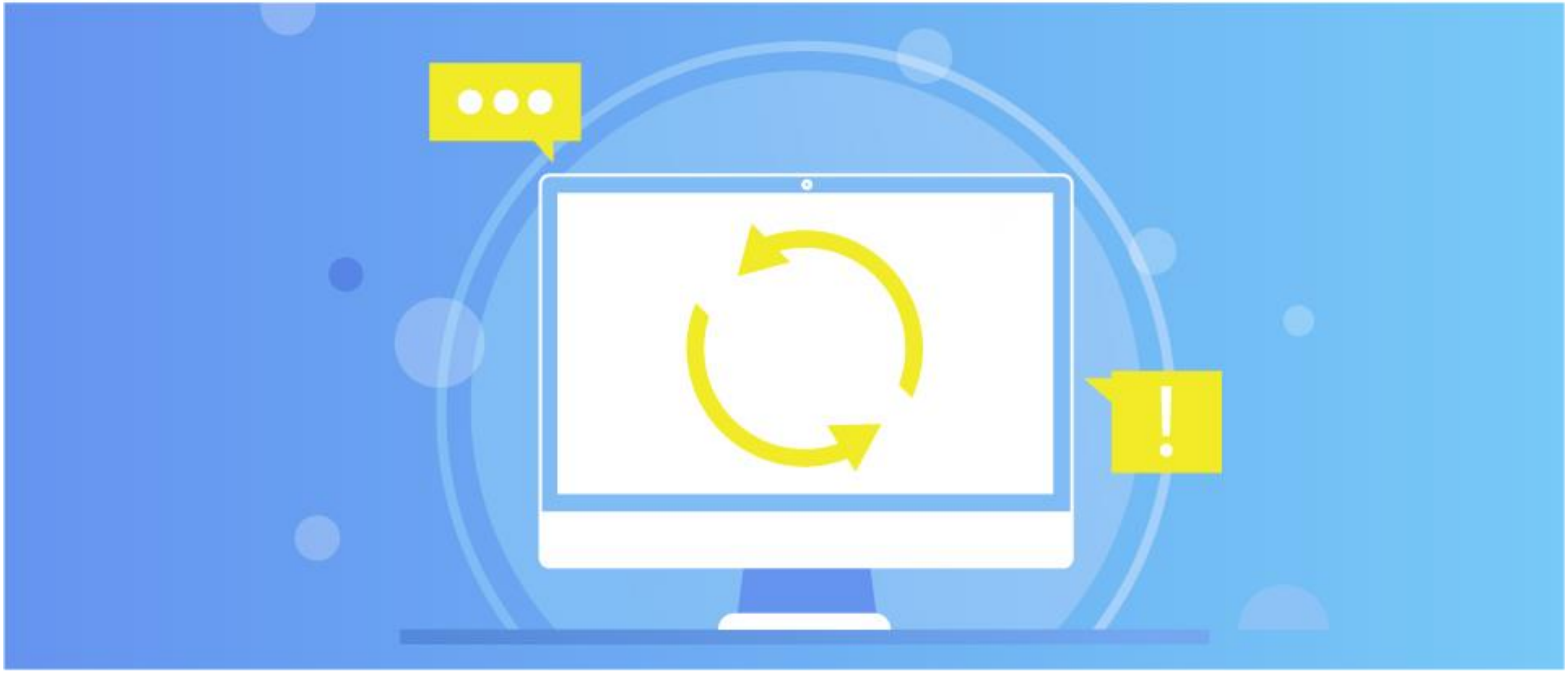
Discussion

Wrap up and next steps

- Workshop 3 topics
  - Economic Modeling
  - Sharing of experiences in commissioning and testing of new technologies or configurations
  - Process efficiencies within our existing framework

- **Please send your energy storage questions to:**
  - Email: energystorage@aeso.ca

Contact the AESO



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- ***Website:*** *www.aeso.ca*
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Thank you