Energy Storage Industry Learnings Forum Workshop 4

I. Purpose of this workshop

The purpose of this session is to learn from the experiences and expertise of the ESILF members and guest speakers on their presented topics.

- Learning Exchange
- Topic Discussions
- Next Steps

II. Workshop agenda

Est. Time	Agenda Items	Presenter
9:00 – 9:15	Welcome & Introduction	Ata Rehman
9:15 – 9:45	Presentation 1: Battery Energy Storage – unlocking new revenue and stabilizing electric grids	Varun Chhibbar, Hitachi Energy
9:45 – 10:15	Discussion	Luis Garrido
10:15 – 10:45	Presentation 2: Stand-alone Energy Storage Economic Analysis in Alberta's Market	Juan Arteaga, University of Calgary
10:45 – 11:15	Discussion	Luis Garrido
11:15 – 11:30	Wrap up and next steps	Biju Gopi

III. Attendees

Company	Attendees
ABB (ASEA Brown Boveri)	Dan Gustafson
Alberta Energy	Michael Fulsom
Alberta Utilities Commission (AUC)	Olex Vasetsky
CanWEA	Evan Wilson
Chapman Ventures	Dan Chapman
Energy Storage Canada	Justin Rangooni
FortisAlberta	Kevin Noble
FortisAlberta	Neil Cumming

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Company	Attendees
Hitachi Energy	Omar Osorio
Hitachi Energy	Varun Chhibbar
Nutana Power	Graeme Harrison
Power Advisory	Travis Lusney
RMP Energy Storage	Robert Stewart
TERIC Power	Craig Barnes
University of Calgary	Juan Arteaga
WindRiver (TPG)	Kipp Horton
AESO	Ata Rehman
AESO	Biju Gopi
AESO	Claudia Moroianu
AESO	Jenny Wang
AESO	John Olsen
AESO	Kasey Abdallah
AESO	Leon Weinstein
AESO	Luis Garrido
AESO	Mahdi Hajian
AESO	Steve Waller

IV. Overall outcomes from the day

The workshop was designed for the AESO and ESILF members to learn from the experience and expertise of the guest speakers. Each speaker was allotted 30 minutes to provide information they believed would add value to the AESO in integrating energy storage in Alberta.

The meeting began with Luis Garrido welcoming all attending members and guest speakers. The first presentation was made by Varun Chhibbar from Hitachi Energy who presented on *Battery Energy Storage*. The second presentation was made by Juan Artega from the University of Calgary who presented on Stand-alone Energy Storage Economic Analysis in Alberta's Marker. Following each presentation, AESO and ESILF members were given an opportunity to discuss and ask questions of each presenter.

Workshop presentations can be found on the Energy Storage Industry Learnings Forum page of the AESO website.

V.Discussions

Below is a synopsis of the discussions following each presentation..

Battery Energy Storage – Presentation by Varun Chhibbar, Hitachi Energy

- Question from the AESO in reference to the presentation regarding who manages the state of charge for the Battery Energy Storage System (BESS), and whether there is a percentage of the operation that is always reserved for reliability; if so, what percent of the state of charge is reserved from the market operator usage?
    - Hitachi Energy representative responded that the operational control of the BESS in the presentation is with AGL Energy, which is the entity that is utilizing the services of the BESS in the market. If there is a need for the capacity that the BESS offers to be used in the regulated market, the regulated market will have priority.
- Request for elaboration from AUC representative in reference to the presentation's mention of a battery generating 9.2 Million USD market revenue.
    - Hitachi Energy representative responded that the market revenue is generated by participating in the energy market. It is focused on four services that it offers: voltage control, frequency control, inertia and system strength. AGL Energy, as the entity that is leasing the BESS from ElectroNet, is using the capacity of the BESS for competitive market services, resulting in $9.2 Million USD in market revenue.
- Question from the AESO regarding the synthetic inertia feature, and whether that feature is built in or obtained separately.
    - Hitachi Energy representative responded that the synthetic inertia feature is a software feature in the convertor. All inverters offered by Hitachi Energy are grid forming invertors, so in this case it is a software feature.
- Question from the AESO in reference to the System integrity Protection Scheme (SIPS) and whether or not the 100 milliseconds (ms) response time could be reduced.
    - Hitachi Energy representative responded that it could be done faster. The presentation describes the response time from when the RAS signal is achieved to when the BESS ramps up. The requirement to be met in the example was from the time of initiation to when the BESS output was at its max of 30mw; in this example, it had to be achieved within 250ms. The 100ms was set up so that 250ms response time could be achieved.
- Question from Chapman Ventures representative on whether inertia could only be provided by rotating machines, and whether synthetic inertia capabilities are applicable to a largely interconnected grid, or are they limited to instances of islanding on a system or micro-grid applications?
    - Hitachi Energy representative responded that synthetic inertia is not limited to micro-grids. The need for inertia is more prevalent when in a grid-connected system. The need of the inertia function should become more common as the penetration level of renewable energy sources become more common.
    - Chapman Ventures representative responded that during instances when certain responses are required, and are achievable by an inverter response, the question remains whether this would be equivalent to what would typically be achieved by rotating machine system inertia.
- Question from University of Calgary guest speaker about slide 27 of the presentation. How are regulated services monetized or compensated in the example presented in Australia?

- Hitachi Energy representative responded that it is similar to how regulated services are monetized in the Alberta market. The regulated system services are offered by ElectroNet, which is the wires owner in that area. The monetization isn't the only focus, because the energy storage systems bring value to the grid in terms of reducing outage time and the virtual inertia it provides the system reduces capacity constraints on the A/C interconnector.

- Question from Nutana representative regarding synthetic inertia, and if it is similar to fast frequency response (FFR) in that it is energy injection but doesn't mimic the response of a true synchronous machine. In other words, can it sustain an entire grid by itself absent synchronous machines?
  - Hitachi Energy representative responded that it is not the same as FFR. The difference between FFR and virtual inertia is that with FFR you must first measure the system frequency and then take action. With virtual inertia, the response is instantaneous.
  - Follow up question from Nutana representative on whether the inverter achieves its fast response by looking to a stored reference signal inside itself.
  - Hitachi Energy representative responded that yes, the inverter has its own internal frequency. If the frequencies between the system and internal converter frequencies are close, output from the inverter remains stable. If there is a positive rate of change of frequency on the grid, the response of the inverter is almost instantaneous.
  - Nutana representative responded that in a wide area network scenario with multiple inverters, each with their own independent reference signal, and if all were to react at once, the synchronicity of the reference signals is not guaranteed.
- Question from the AESO regarding value stacking and how it is not easily achievable when operating due to the configuration of the batteries. How are the batteries in your case study configured, and how can they participate in many different services to stack revenue?
  - Hitachi Energy representative responded that value stacking means your energy storage system is sized correctly. There needs to be a good understanding of what your energy storage system will and could be used for. Whether the services are being required simultaneously or if they are mutually exclusive has a significant impact on how Hitachi Energy sizes the battery. When it is known what the energy storage system will be used for, degradation studies can be done to determine the needed lifecycle of the system.

Presentation 2: Stand-alone energy storage economic analysis in Alberta's market – presentation by Juan Arteaga from the University of Calgary

- Questions from the AESO in reference to the presentation's optimization of transmission services:
  - Were market services excluded in favor of traditional transmission services?;
  - What is the risk scenario that you looked at?
  - Does the risk associated with the increase in price lead to a decrease in the probability of getting a contract?
  - Both transmission services were considered. The battery participates in the market while providing transmission services (congestion relief). . There is an inherent risk intrying to increase the probability of being contracted; however, the main risk that is being optimized is the risk of incurring losses (making less money by adding an additional service).
- Question from Nutana representative on whether there is an underlying assumption that the model has less than perfect foresight.

- University of Calgary representative responded yes, the model has been run with less than perfect foresight. However, for the purpose of the workshop, the model was kept simple to provide a better understanding of the profit.

- Question from the AESO regarding the congestion aspect of the model presented, and how it was modelled.
    - University of Calgary representative responded that a line rating was considered with a load profile. AB's aggregated load was used and normalized to 100MW. The scenario then depicts a load profile higher than 100MW, in which the battery would assist in accommodating the load.

VI. Wrap Up and Next Steps

The AESO will meet internally to review Energy Storage work for 2022 and how the ESILF could fit in the plan. Information about ESILF plan for 2022 will be provided in late January 2022.

Any further questions can be sent to the Energy Storage inbox at energystorage@aeso.ca.