

Operational use of grounding switches within an HVDC converter station

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Paper is the summary of 3 utilities work in the past 6 years trying to work in a better & smarter path

- Developing a work practice using isolation grounding methods which is standard across different utilities to help workers in the field

HVDC operations has specific challenges to overcome

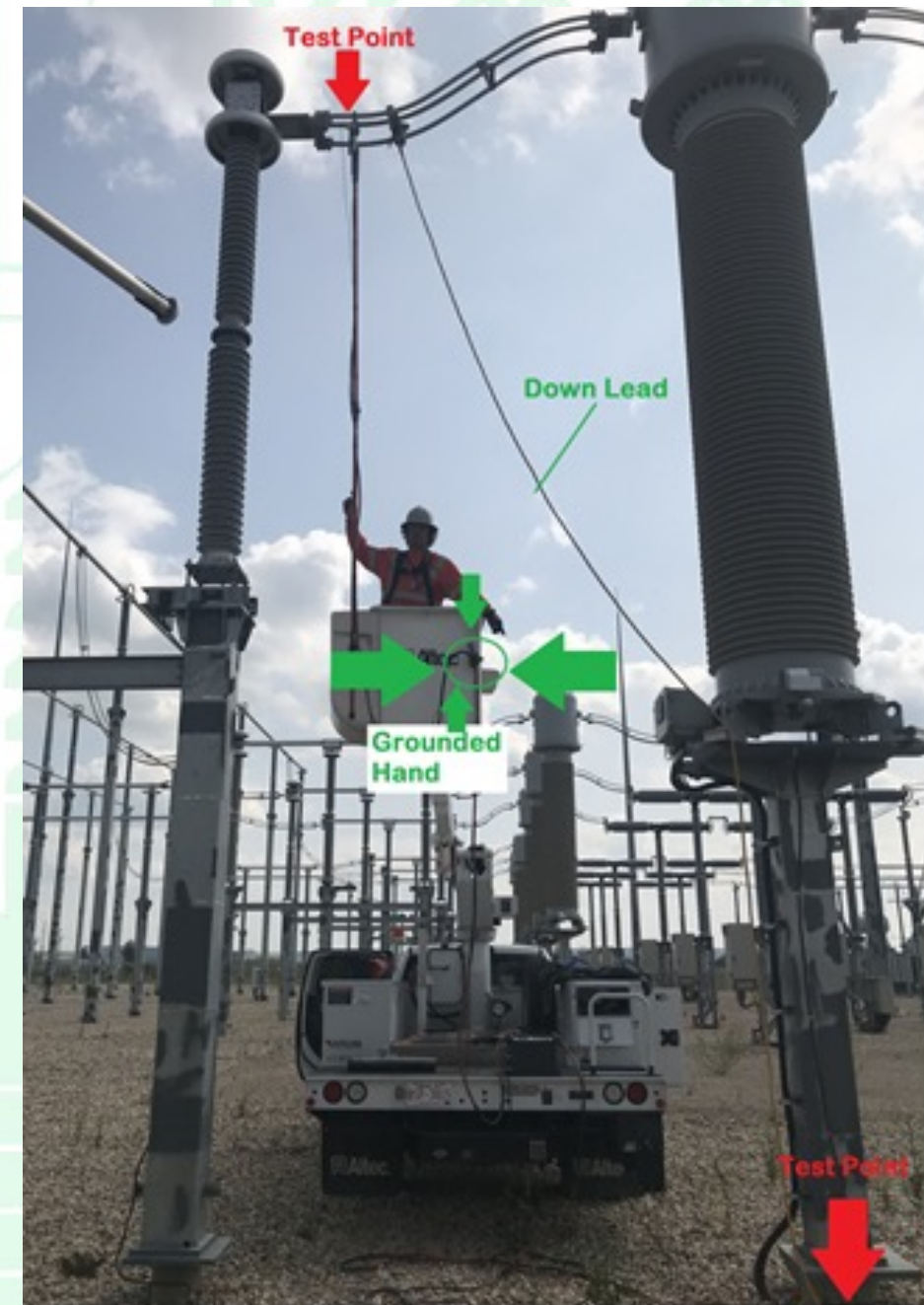
- Automated, interlocked stations with large clearances
- Substation bus ~ 24" or 8m from ground
- Ground chains 2/0 @ 42-46ft
- only for station staff, not line operations



Safety of workers

Making work easier for persons and keeping them safe is paramount. Advantages include

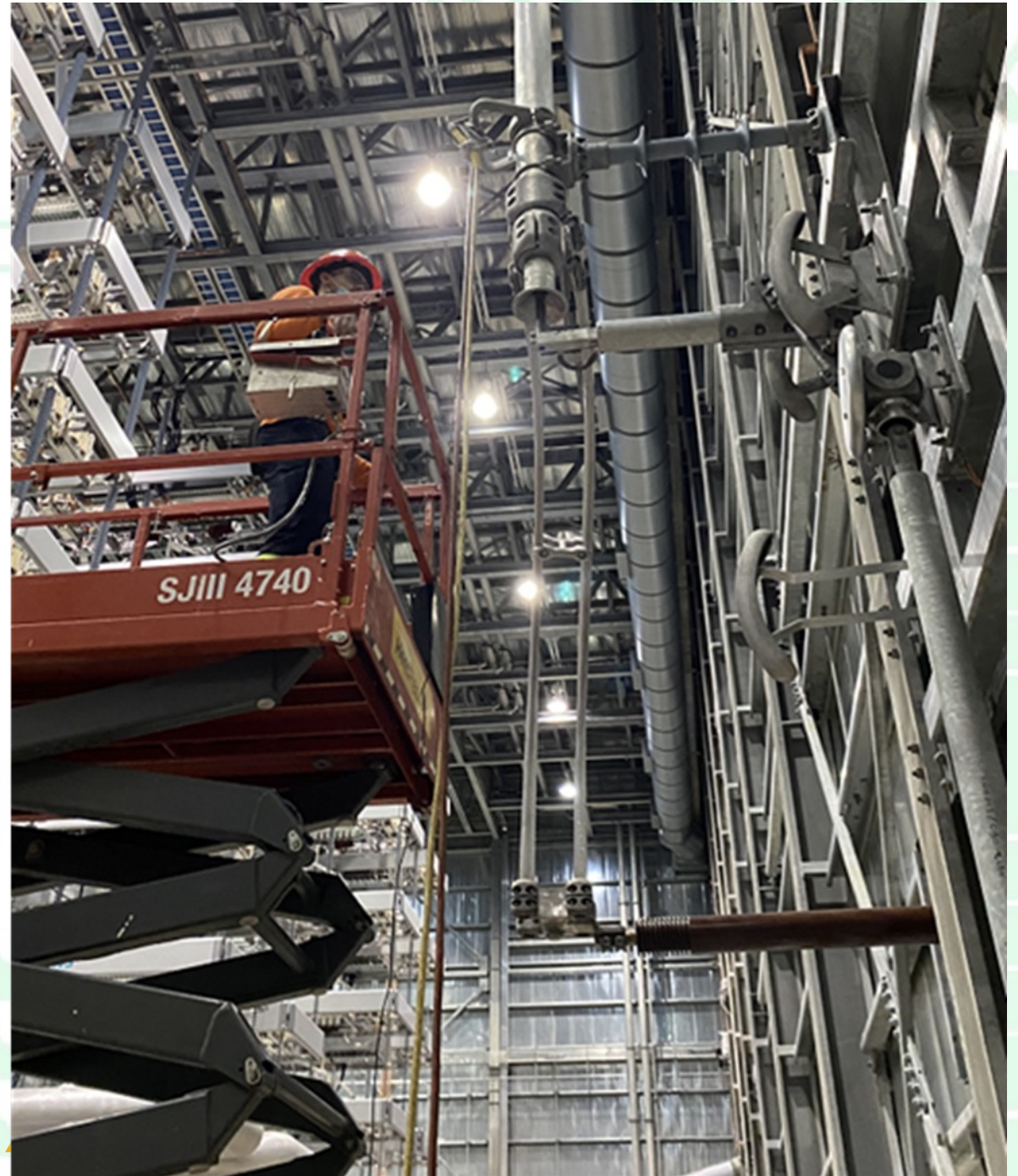
- Dealing with heavy grounds, reaching out of a lift or bucket
- Reduces hazards like line induction when attaching grounds near the worker
- Accidental energization to a work area
 - Less induced current during
 - No whipping action
- Human error
 - Reduced chance of equipment damage, grounds are permanently attached
 - Works together with inter-lock systems, reducing the amount of procedural error.



Cost-benefit – operational downtime vs maintenance

Operational downtime is key

- Requires quick turnaround for smaller faults to return for bulk power transfer
- Compliance to Forced & Scheduled availability targets
- Testing requirements for these considered to minimize operational loss
 - outdoor testing every 3 – 3.5 years
 - indoor testing every 5.5 years



Site & weather conditions

Some converter stations have routinely 6-7ft of snow throughout winter months

- Hard to maintain work area in winter
- Using switches, decreases operational costs to maintain work area in planned outages
- Decrease the equipment effort and response time during forced outages

Wind prevents persons to work aerially routinely for one utility



working indoors with some unintended consequences

Valve hall conductors:

- In cases where temporary grounds are routinely applied directly to conductors within a valve hall bird caging becomes imminent.
- Bird caging then leads to corona and rapid deterioration of surrounding insulators.

Valve hall equipment:

- bus bars and equipment terminations often become scratched, gouged and/or dented over time as grounds are applied and removed which leaves these locations
- susceptible to corona if not properly tended too.



Complex interlocking decreases operational risk within the stations

- All ground switches in DC yard are motorized ground switches – have the ability to be locked out and disabled like other MOD.
- Sequences within the HVDC control to isolate and ground station are used by operations, commissioned in FAT & site testing
 - automatically isolates and grounds installation
- Found that most employees were grounding initially with temporary portable grounds near closed switches



Standards & Initial Testing

No maintenance standard for ground switches at this time

- CAN / ULC S801 allows use of a grounding switch
- ASTM standards note testing and inspection for temporary portable grounds only

Testing between utilities has a common approach to verify results between each other

- Ongoing Inspection testing / maintenance strategy to be developed with results
- Further work on interpreting results based on site conditions and 3 different switch manufacturers
- Similar process for decoupling and isolation of motor circuits are common throughout for safe isolation

Overall – 300 to 500% better than temporary grounding

