

DC SYSTEMS AND POWER ELECTRONICS B4 HVDC SYSTEMS AND THEIR APPLICATIONS PS1 10459

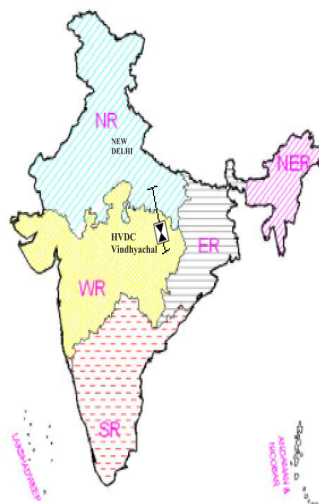
Refurbishment of India's Oldest HVDC Link, 500 MW Vindhyachal HVDC back-to-back system - Refurbishment Concept Planning and Strategies

Anurag SAPRA, Nileshwer, Ankit DHAGAT, Rajat BHANDARI, Karikalan M

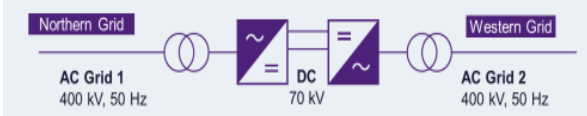
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Motivation

- Extend useful life of India's oldest HVDC Link (commissioned in 1989 interconnecting northern and western regional grids).
- Replace ageing Valve Hall equipment viz. Thyristor Valves, Valve Cooling System, DC Measuring System with state-of-the-art technology.
- Replace obsolete HVDC Control & Protection system with advanced Digital Control System, while retaining existing field equipment & cables.
- Implement new control features to support changed AC networks.
- Open Competition resulting in best price discovery for Owner, and First Refurbishment of HVDC system in India by a non-OEM.



Schematic Overview of one Block of Vindhyachal Back-to-Back HVDC Station (2x250 MW)

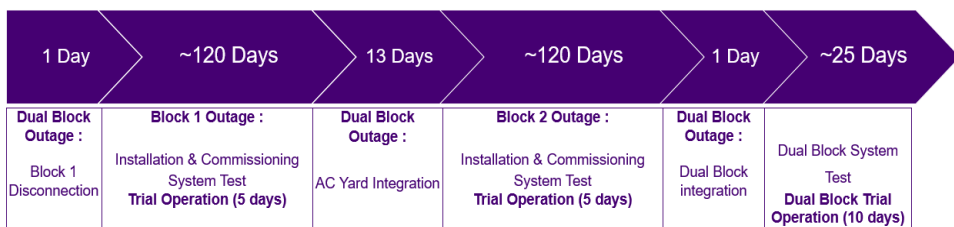


Refurbishment Approach

- Refurbishing one block (250 MW) with another block (250 MW) in operation.
- Short dual block outages for disconnection and integration.
- Multiple site visits during tender phase and design & engineering phase.
- Interface clarifications for existing devices & subsystems.
- Early involvement of Owner (on-site) during detailed design phase.
- Imparting training during execution to Owner's O&M personnel.



Refurbishment Planning



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Major Challenges and Mitigation

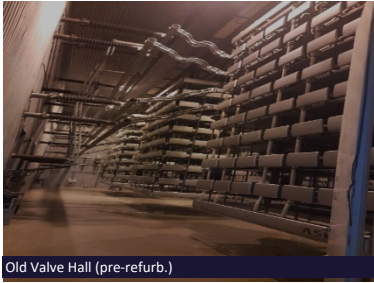


Building / Infrastructure related constraints

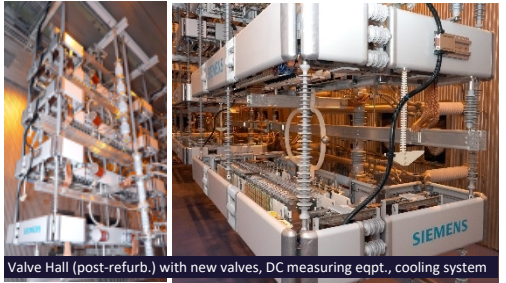
-  Insufficient width of Valve Hall entrance door.
-  Special tilting device used to move in the new module.
-  Existing load point arrangement not suitable for new valve towers.
-  Special steel adapter frame used to match the loading interfaces.



Special Tilting Device to move the new Valve Module through narrow corridor & entrance gate







Old Valve Hall (pre-refurb.)



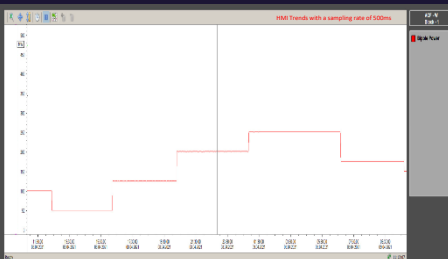
Valve Hall (post-refurb.) with new valves, DC measuring eqpt., cooling system



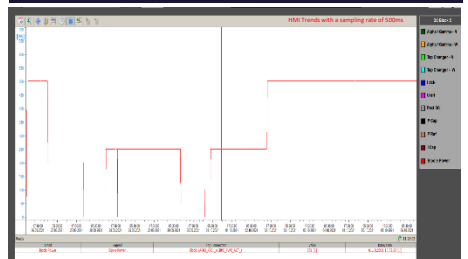
Control & Protection System related constraints

-  Retaining the existing field cables, while laying new cables inside the control room.
-  New cable interface cubicles were installed. Existing cable routes inside control room were re-used for new cables.
-  To keep one HVDC block & common systems running, while other HVDC block was in refurbishment phase.
-  Detailed planning with Owner in advance, for pre-outage, post-outage and during outage activities.

Block-1 in operation post refurbishment with Block-2 yet to be



Bipole in operation post refurbishment



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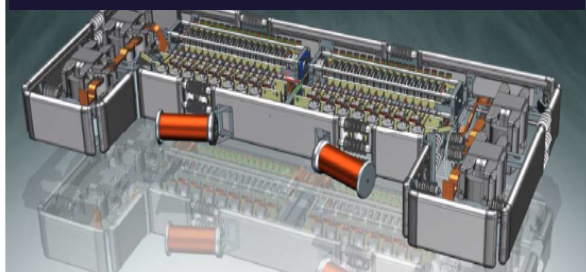
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Major Improvements after Refurbishment

▪ Valve Hall

Ergonomically designed, maintenance friendly C-type thyristor valve module



Old electrically triggered thyristors replaced with latest light triggered thyristors

Powerful 6-inch Light Triggered Thyristor

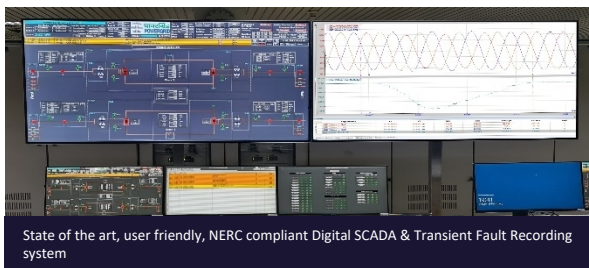


Higher blocking voltage & lower losses

▪ Control Room



Old Mimic Panel based system (pre-refurb.)



State of the art, user friendly, NERC compliant Digital SCADA & Transient Fault Recording system

▪ Valve Cooling System

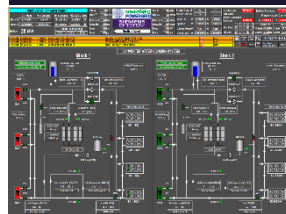
Spray type outdoor coolers (pre-refurb.)



Easy to maintain Dry type coolers (post-refurb.)







Operation & monitoring from control room







Conclusion

Refurbishment project has significantly different set of challenges compared to Greenfield HVDC project, e.g.

-  Minimise system or subsystem outages.
-  Complex interfaces to match vintage subsystems.
-  Limited information about existing subsystems.
-  Logistic constraints imposed by existing infrastructure.

For success of a refurbishment project the strategy must consider several actions, e.g.

-  Detailed planning of tasks during outage & pre- and post-stages.
-  Innovations / creative solution to handle interfaces.
-  Close cooperation with the Owner, site assessments.
-  Adaption of standard concept / solution.