

# Why buy replica controls for your HVDC project?



The National  
HVDC Centre

## Introduction

“Replica panels” for any HVDC project are duplicates of the physical control system for that scheme. Although small compared to the capital cost of a large HVDC project, buying replica controls represents a significant investment, so why do it?

HVDC system owners across the world routinely purchase replicas of the control systems for their HVDC schemes. In a similar way to a flight deck simulator, replica HVDC controls offer the ability to simulate HVDC performance in real time under network scenarios and conditions that are not practical to set-up on the real transmission system.

Real-time simulation with replicas offers benefits prior to commissioning by exposing and correcting network integration and compliance issues before they cause costly project delays. Once an HVDC project is in service replicas allow for upgrades and performance against evolving network conditions to be proven off-line, provide opportunities for operator training and can facilitate fault investigation to allow a return to service; all to minimise potential down-time of HVDC installations.



Caithness-Moray HVDC Replica Panels



The National HVDC Centre

## Benefits of Replicas: Pre-Commissioning

Even before an HVDC link is commissioned, replicas have a role in de-risking project delivery.

Risk area	Replica Usage	Benefits
<b>Network integration and compliance</b>	Replicas can be used to identify and prove solutions for potential adverse control interactions with other active elements such as generators and adjacent HVDC converters on the same AC network.	<ul style="list-style-type: none"><li>• Potentially adverse controller interactions can be identified and addressed in advance.</li><li>• Reduces the risk of non-compliances with network codes emerging close to commissioning</li><li>• Reduce the risk of damage to the other parties equipment connected to the network.</li></ul>
<b>Commissioning delays</b>	Replicas can be used to establish and rehearse commissioning tests that will be acceptable to the wider system operator.	<ul style="list-style-type: none"><li>• Minimise risks and delays to the commissioning phase.</li></ul>
<b>Familiarity with performance of new HVDC assets</b>	Studying replica controls will give the asset owner a greater understanding and confidence in the technology prior to commissioning.	<ul style="list-style-type: none"><li>• Asset owner/operator understanding of the technology.</li></ul>

## Benefits of Replicas: In-House Maintenance

As a training tool that allows rehearsal of maintenance procedures and an ability to load upgrade and test control software, control replicas reduce reliance on the original equipment supplier and allow for a greater extent of in-house maintenance.

The asset owner has more flexibility to:

- Refine control settings;
- Respond quickly to system issues ;
- Optimise the scope and frequency of maintenance activities; and
- Introduce new high level controls to enter new potential markets (e.g. emergency fast frequency response).

E: [info@hvdccentre.com](mailto:info@hvdccentre.com)

W: [hvdccentre.com](http://hvdccentre.com)

T: +44(0)1236 687 246

A: 11 Auchindoun Way, Wardpark,  
Cumbernauld, G68 0FQ

## Benefits of Replicas: Post-Commissioning

Replicas offer benefit throughout the life of an HVDC scheme mostly to reduce asset downtime which in the case of commercial interconnectors or a 1000MW offshore wind generation link could equate to an exposure of €1m/day.



Control Room at The National HVDC Centre

Risk area	Replica Usage	Benefits
<b>Faults During Operation</b>	When a fault does occur, replicas can be used to diagnose the fault and prove solutions to speed up a return to service. Similarly pre-emptive replica studies can predict potential faults and test solutions.	<ul style="list-style-type: none"> <li>• Reduce unplanned outages</li> <li>• Pre-empt faults before they occur.</li> <li>• Increased speed of fault resolution.</li> </ul>
<b>Diagnosing Alarms</b>	Replicas can be used to demonstrate, train and diagnose alarms on the Owner's high-level control system.	<ul style="list-style-type: none"> <li>• Faster fault identification, potentially reducing downtime.</li> </ul>
<b>In-House Training</b>	Replicas can be used to train those involved at all stages of the project: <ul style="list-style-type: none"> <li>• Operators;</li> <li>• Maintenance personnel; and</li> <li>• Network planners.</li> </ul>	<ul style="list-style-type: none"> <li>• Develop technology expertise and knowledge.</li> <li>• In-house familiarity reduces reliance on equipment supplier and speeds up fault resolution.</li> </ul>
<b>Maintenance Outage</b>	Ability to train and rehearse annual maintenance.	<ul style="list-style-type: none"> <li>• Minimises HVDC asset downtime.</li> </ul>
<b>Scheme Updates/Upgrades</b>	Any proposed changes to the control hardware or software can be checked in a safe environment using the replicas.	<ul style="list-style-type: none"> <li>• Reduce the likelihood of mal-operation.</li> </ul>
<b>Network Interactions</b>	Networks are always changing. By having replicas the interactions between the scheme and the wider network can be checked as developments are planned.	<ul style="list-style-type: none"> <li>• Potentially detrimental controller interactions can be identified and resolved in advance.</li> <li>• Reduce unplanned outages.</li> <li>• Reduce the risk of damage to the equipment.</li> </ul>
<b>Long-term Model</b>	Replicas provide the asset owner with a long term reliable and accurate representation of their HVDC link; which is independent of the supplier.	<ul style="list-style-type: none"> <li>• Hardware replicas do not go out of date.</li> <li>• Offline models can be validated against the real controls.</li> </ul>

## Benefits of Replicas: Financial Benefit

Procuring replicas represents a significant financial investment; however the benefits and risk reduction achievable through the use of replica are also significant:

- With un-planned outages of HVDC links costing upwards of €1m/day; reducing the risk (and duration) of such outages represents a significant financial benefit;
- Reducing the duration of planned maintenance through training operational engineers will also realise similar benefits; and
- Bringing the maintenance of an HVDC link 'in-house' could represent savings of €1-5million p.a.

## Conclusion

Replicas represent a significant upfront investment but more than pay for themselves through reduced downtime of the HVDC scheme itself, de-risking of project delivery and greater in-house expertise and familiarity with the assets.

The National HVDC Centre can provide support in specifying and procuring replicas as well as long term hosting and real-time simulation support facilities.