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Q1.01: What are the expected benefits of using digital substation concepts and how to meet these benefits during industrial application?

Utilities as well as industries around the world have been installing digital substations over the last decade. The required products and technologies have become more common now ; IEC 61850 Process Bus protection and control devices for all typical applications, including busbar protection, are available in the market now. They cater for flexible architectures for the digital substation solutions, making it possible to adapt to different user preferences.

Standardisation of the solution is essential to capture the benefits offered by digital substations, just like other PAC solutions. Many utilities performed pilot projects to gain a deep understand of the technology and adapt the solution to maximise the benefits. A case from Australia, with participation from multiple manufacturers is highlighted on the slide. The pilot project was followed by a successful rollout to four additional substations.

One of the benefits of digital substation arise from the flexible architecture. In standard PAC systems, scheme redundancy is primarily about device redundancy ; Main 1 and Main 2 protections with independent CT and VT cores is typical of transmission protection. However, a break in the cabling from the CT or VT to the main protections results in protection depletion. By adopting a redundant communication network between the bay and process level devices, it is possible to enhance the availability of the PAC system in a digital substation.

Benefits associated with civil works, particularly cable trenches and cabling, is well known in the industry. Replacing copper with fibre-based communication network simplifies and speeds up the installation activity.

Layout of devices in the control room cabinets can also bring significant benefits. The picture on Slide #3 shows a possible arrangement for main protections (Main 1 for example) for a small substation, all in one control cabinet. The cabinet has main protections for three feeders and one incomer transformer, a control device and disturbance recorder for sampled values.

Benefits may also include reduced engineering drawings ; these may be optimised taking advantage of the reduction in cabling and terminations required at process and bay levels.