Version nr.:	1.0
Date of approval:	11.08.2023
Approved:	08.2023 ERS

Requirements for Protection and Control Systems for Landsnet's Customers

Introduction

This document outlines the requirements for Landsnet's customers regarding control and protection equipment. The aim is to ensure that faults in the customers' systems have as insignificant impact on the transmission system as possible.

For this purpose, Landsnet specifies the same requirements, regarding control and protection, to its customers as Landsnet does to the transmission system.

The Grid System

The Icelandic transmission grid consist of a 220 kV main grid in the South-West and North-East part of the country, a 132 kV ring connection surrounding the island that connects the two 220 kV networks and 132-, 66- and 33 kV that make up the regional transmission network.

The Icelandic Grid is a directly grounded system and Landsnet's protection philosophy is arranged accordingly. All customers must be connetcted to the transmission system via transfomer with a directly grounded star-point on the transmission grid side.

System Requirements to Customers

Validity:
These principles apply to new stations as well as refurbishing and extensions of existing stations.

Requirements for protection:
Using these principles, it is possible to fulfill the protection requirements set by Landsnet. Tripping a faulty component shall have as little effect on the operation of the transmission system as possible. Fault-clearing shall impose no risk to humans, property or system components.

The protection- and control systems shall be designed so that the risk of unwanted operation is minimized.

1. All short-circuits and winding faults shall be detected by at least two independent protection systems.
2. One of the two protection systems must fulfill requirements on minimum fault-clearing time of 100 ms and selectivity.
3. Under normal circumstances all short-circuits shall be cleared selectively. The following faults might cause unselective tripping:
    a. A fault in the protection system, both redundant and non-redundant.
    b. A fault in the circuit breaker.
    c. A fault between circuit breaker and current transformer.
    d. A broken conductor fault.
4. The protection system shall, under normal circumstances, isolate a faulty component from the rest of the power system.
5. All components in the 220 kV, 132 kV and 66 kV shall have a non-directional earth fault protection with RXIDG-characteristic ($t = 5{,}8 - 1{,}35 * ln\frac{I}{k*I>}$).
6. The protection system shall not trip during transient, dynamic, or abnormal stationary conditions caused by: fault clearing, switching, islanding, energizing, load shedding or loss of production units.
7. The protection of system components on voltage levels below 66 kV shall be selective against the protections in the main transmission system.
8. The current transformers used for protection purposes shall be of class 5P and must be designed not to reach CT-saturation under any circumstances based on the respective short-circuit power in the system.
9. The control and protection for the HV switchgear shall be done in a secure way following common practices i.e., regarding interlocks, trip logic etc.

Control and Protection

Transformers 30MVA or larger must be controlled via single pole control equipment.

A summary document showing the main functions of Control and Protection can be found in the appendix. The table is not finite but is meant to show the main philosophy. Each case shall be evaluated individually.

When connecting a new Customer to the Grid, some electrical connection for control, interlock and signaling might be required.

Landsnet will provide further information on control and protection upon request.

Appendix

The following table describes the control and protection functions for different voltage levels. When redundant control and protection is required, cases are indicated with 1&2.

		IEC Code	Ansi code	Line bay terminal			Transformer bay terminal			Customer bay terminal		Bus-tie terminal		Bus bar			Capacitor bank bay terminal		Reactor bay terminal	
				220 kV	132 kV	66 kV	220&# kV	132&# kV	66&# kV	220 kV	132 & 66 kV	220 kV	132 kV	220 kV	132 kV	66 kV GIS	220 kV	132&66 kV	220 kV	132 & 66 kV
Protection	Under Impedance Protection	Z<	21	1&2	1	1	1&2	**	**	**	**									
	Power Swing Blocking		68	1&2	1		1&2	1												
	Switch Onto Fault (SOFT)			1&2	1	1	1&2	1	1			1&2	1							
	Permissive Under-reaching Transfer Trip (PUTT)			1&2	1	*														
	Unbalance Protection	U2>	47	1&2	1	1											1&2	1	1&2	1
	Breaker Failure Protection (BFP) note#1	I> BF	50BF											1&2	1	1				
	Busbar Differential Protection (BBP)	Id>	87BB									1	1	1	1	1				
	Differential Protection (Diff)	Id>	87	1&2	1	1	1&2	1	1											
	Earth Fault (EF)	Io>	50N & 51N	1&2	1	1	1&2	1	1	1&2	1						1&2	1	1&2	1
	Overcurrent	I>> & I>	50 & 51				1&2	1	1	1&2	1	1&2	1				1&2	1	1&2	1
	Thermal Overload Protection	Ith>	49F	*	*	*														
	Overpower Protection [directional]	P>	32	1&2	1	1	1&2	1	1											
	Overvoltage	U>	59	*	*	*	1&2	1	1	1&2	1						1&2	1	1&2	1
	Undervoltage	U<	27	*	*	*	1&2	1	1								1&2	1	1&2	1
	Under Frequency protection	f<	81U	1&2	1	1				1&2	1									
	Pole Slip & Out of Step Protectio		78	1&2	1															
	Mechanical Protection						1&2	1	1										***	***
	Pole Discrepancy		52PD	1&2	1	1														
	Time-Domain Protection			*	*															
Control	Interlock			1&2	1	1	1&2	1	1	1&2	1	1&2	1				1&2	1	1&2	1
	Autorecloser (AR)	0 -> 1	79	1&2	1	*														
	Loss of Voltage (LOV)	U<	27	1&2	1	1	1&2	1	1	1&2	1	1&2	1				1&2	1	1&2	1
	Synchro-check		25	1&2	1	1	1&2	1	1	1&2	1	1&2	1							
	Trip-transfer			1&2	1	1	1&2	1	1			*+	*+							
	Point on Wave (POW)						1&2	**	**	1&2	**						1&2	1	*	*
	Automatic Voltage Regulator (AVR)						1&2	1	1										***	***
	Smart-Grid Controller													*	*	*				
Monitor	Distance to Fault	FLOC	21FL	1&2	1	1														
	Disturbance Recorder			1&2	1	1	1&2	1	1	1&2	1	1&2	1	1&2	1	1	1&2	1	1&2	1
	CB Supervision			1&2	1	1	1&2	1	1	1&2	1	1&2	1				1&2	1	1&2	1
	Event Recorder			1&2	1	1	1&2	1	1	1&2	1	1&2	1	1&2	1	1	1&2	1	1&2	1
	Trip Circuit Supervision			1&2	1	1	1&2	1	1	1&2	1	1&2	1				1&2	1	1&2	1
	Fuse Failure			1&2	1	1	**	**	**	**	**									
	Power Quality Meter									*	*									
	Oil Temp						1	1	1										***	***
	Winding Temp						1	1	1										1	1
	Online Oil Gas Monitoring						1	1	1										*	*
	Online Gas Monitoring for GIS			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Traveling Wave Fault Location System (TWS)			*	*	*														
	Phasor Measurement Unit (PMU)			1	1	*	1	1	*	1	1&*	1	1							

Label:

1 - System Main 1

2 - System Main 2

1&2 - Redunant with Main 1 and Main 2 systems

* Optional - depends on the project&application

** If transformer is ≥ 30 MVA

*** If oil insulated reactor

*+ If transfer bus

note #1: BFP for each bay is processed in the busbar protection