ANALYSIS OF ARCHITECTURAL SOLUTIONS FOR AUTOMATED RELAY PROTECTION OF SUBSTATIONS AND SUBSTATIONS USING SERVER TECHNOLOGIES

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A distributed RPA system is a system in which the RPA functions are performed by the terminal devices of the system - terminals. The implementation of such capabilities leads to the complication of information links between devices. These connections are typically made through individual interface elements. Such a network provides for the exchange of signals at speeds corresponding to the rate of emergency electromagnetic processes in the electric power system in the local network, but this approach reduces reliability. Circuits of output relays acting on electromagnets of circuit breaker opening, breaker circuits, busbar protection are proposed to be carried out by traditional wired cable connections.

An alternative principle of building a relay protection system is building a centralized system. First of all, it is advisable to consider a centralized system of measurements of relay protection and automation. When building a centralized relay protection and automation system, two solutions are offered: the first is the use of digital current transformers; the second is the use of RPA field measuring terminals. When building a centralized system in its architecture, a common element appears in series in the channel for inputting analog signals - a distributor of digital signals, the failure of which is critical for the entire relay protection system of the protected object. Increasing its reliability by tripling can significantly reduce the efficiency of the transition to centralized input of signals to the relay protection system.

For one server, the probability of failure is P, and the probability of a false positive is Z. Since the server controls all protections, if the server fails, any damage on the line will lead to protection failure, and the probability of such an event is (1-(1-X) 4). Accordingly, the probability of protection failure Y=P*(1--(1-X) 4). Linear part Y≈4*P*X, respectively Y~4*P. For three servers, different scenarios of the voting system are possible, consider two scenarios: "1 of 3" (when the switch will be turned off if at least one server issues a shutdown command) and "2 of 3" (when the switch will be turned off when any two servers at the same time will issue a shutdown command).

Probabilities	Consistent scheme	Parallel scheme	Server		
			«1 of 1»	«1 of 3»	«2 of 3»
Protection failure	$P+P^2+P^3$	4*P	4*P	$4*P^3$	$12*P^2-8P^3$
False actuation	$4Z-6Z^2+4Z^3-Z^4$	$4Z-6Z^2+4Z^3-Z^4$	Z	$3Z-3Z^2+Z^3$	$3*Z^2+Z^3$

Thus, the central server of relay protection and automation has unique properties, such as the absence of station and process buses. Except In addition, a multi-server system will have a larger (compared to a set of terminals) reliability both in terms of failures and false positives will allow automatically detect a damaged server, allow you to replace and configure servers without stopping protection.