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Title of Abstract:

**IMPROVED DIRECTIONAL COMPARISON PROTECTION FOR LINES,
TRANSFORMERS AND BUSES**

Author(s), Company(s)

Roberto Cimadevilla - ZIV

Speaker, Company (if known)

Abstract (not to exceed 300 words)

The unit-type protection normally used to protect lines, busses and transformers is the current differential. This protection generally includes a percentage characteristic whose settings are not always easy to calculate as they depend on several factors as CTs measurement errors, CTs current saturation value, CTs saturation level, type of restraint used by the characteristic, etc. These settings always compromise the security and the dependability. A very high slope maintains the security during external faults however it can limit the dependability during internal faults. This paper describes a directional comparison protection, with practically no settings, offering a great security and dependability, maintaining good sensibility for internal very resistive faults with high load flow, even in outfeed conditions, and at the same time being stable during CT saturation. This protection can be used as stand-alone or together with a current differential, supplementing the lack of security or dependability that the latter could have. The algorithms used for each protected element (line, bus or transformer) are analyzed and described in detail. Also, they are tested with an RTDS, simulating internal and external faults in very unfavourable conditions.

Name: Oscar Bolado
Company: ZIV USA Inc.

Phone: 847-299-6580