

Practice in PMU Development for Smart Substation

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Outline

■ PMU Application in Wide Area Protection

■ PMU Development for Smart Substation

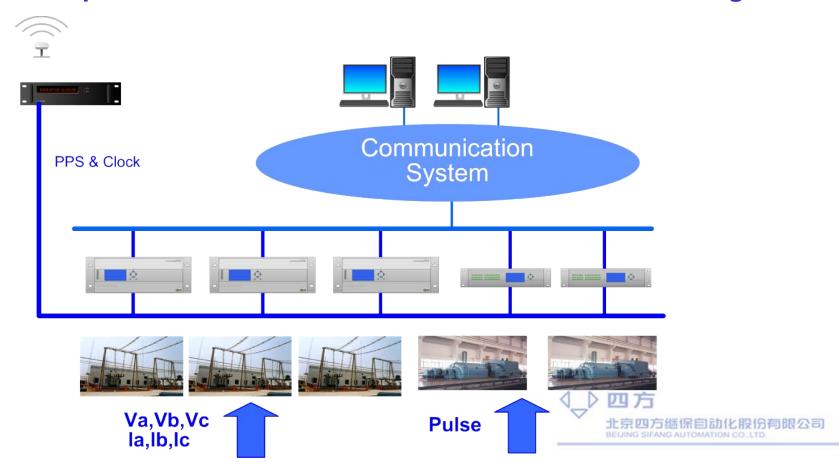
Future Application under Smart Substation



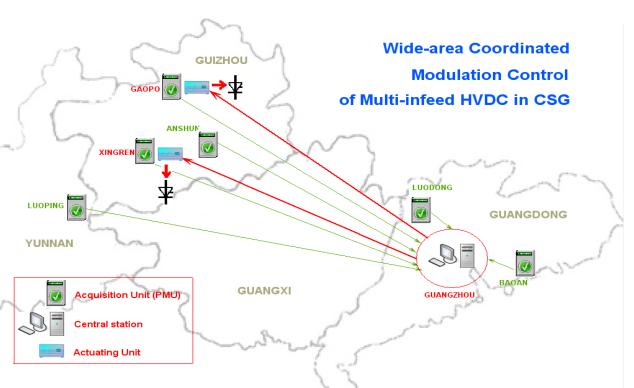
Current Status of PMU Deployment in China

For monitoring use

- Have covered all 500kV and above substation
- Will be deployed in 220kV level with large scale
- Required installation for wind farm connected to main grid



Wide area damping control system in CSG



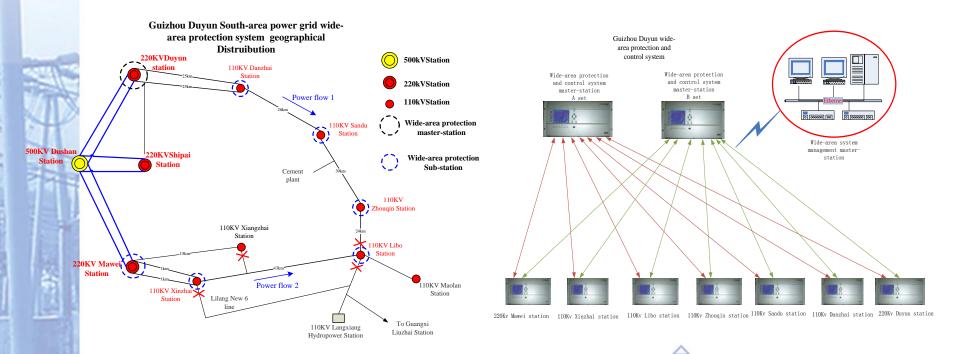


- Closed loop operation of HVDC modulation damping control
- RTDS test completed for wide area PSS control



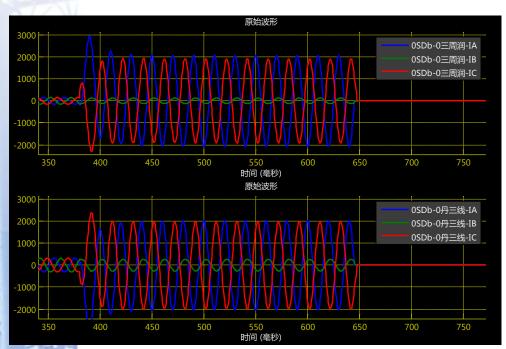
Guizhou Duyun Wide Area Protection System

- ■Duplicated Master Station, located at 220kV Duyun substation
- ■Sub Control Stations at two 220kV and five 110kV substations



北京四方继保自动化股份有限公司

RTDS Test for Guizhou Duyun WAP System



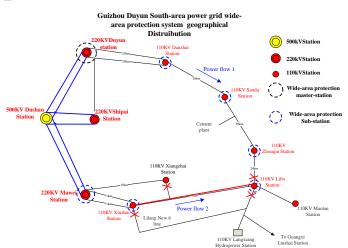


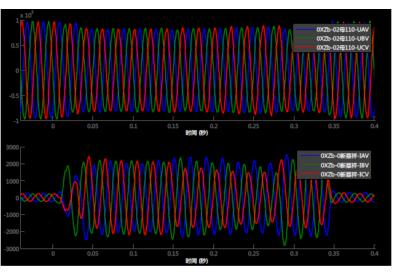
■Backup protection function

- ■For line ground fault and circuit breaker failure case, by conventional Zone 2 relays, the delay for fault clearance is usually 0.5~1.0s.
- ■For above same fault, WAP quickly detects the breaker failure, and after 0.2s confirmation delay, trips neighbor breakers.

Action Results and Data Recordings from Field Operation

3 phase short circuit fault





Fault Voltage

Fault Current

Action message output from master station

Action of wide area current differential protection

		Large Large Att.	実时告警监測窗口 ====================================
升罪变	周章安 三都安 荔波安 町间	拝尾安 劉策安 主站A 事件	主地 排列费
168	1110-01-17 IN 07-95 440	数据异常美国	本後 十公共権・不法 東内本ノ連維 (Antale)
	0012-09-17 20 15 12 500	数据异常古常	(法級 主始评性×子姓 種句表)
170	2012-09-17 09 14 18 400	教養者等を担	深深 井を子P 元以 中午春 午は 1-00m
171	8812-09-17 28 49:09 500	数据异常告罄	《来源 主话保护》(子は、相句家)
172	THE STAN SHEET	熱觀异常次向	連接 世紀末年 今後 東京家 英雄 アガルル
173	1012-08-18 10 05 21 320	电缆突变启动	(未練 主始保护: (水路) 三月相(水) (A 祖 首當 +1.05 6A 末編 -2.18 / 3 4B 首第 +05 4A 末端 +0.58 / 0 4B 首當 +20 8A 末端 -8 1A
174	TACE OF ME TO THE AND ADDRESS.	电视技术发展	(保護 主義条件)(機能 三周時度)(持度 200kg)
175	012-09-16 12 59:44 560	数据异常告罄	《承德·主法保护》·子林·荔枝集》
176	101.2 cm 11 52 bd 91 400	建程表表的 因	連接 予払用序が予め 韓原等へ特殊 (1910m)
177 2	2812-08-19 01:34:48.500	数据异常世营	(未規:甘始保护/平は、新審安)
178	DIE (0.12.01-00.00.10)	数据异常近面	(水源 王拉特F)(子证 明第3、张武 1970m)
179	2012-03-19 15 54 13 440	电流突升启动	(快煙 主站保护)(機器 新農運搬)(x 相 首結 f23)(nk 末端 -6 7a)(t 相 首編 f445 nk 末端 -0 1 k)(c 相 首編 f119 sk 末端 -0 9a)
180	100 0 0 15 15 64 15 441	电路块英省社	清視 主法選手の機能 複数 (数/) (2) 複数 (5.5) 手腕 (1.5) 20 4 4 5 5 5 5 5
1BL 2	8812-03-19 15 54:13 440	电经深变启动	(未練 主結保护) 微點,拜新任然 A. 相 首語 +150 2A. 未端 +150 0A. 3 相 首語 +225 0A. 未端 +201 6A. ② 相 首義 +50 5A. 未緒 +50 2A.
	2012-03-19 35 54 18 490	过载言事	· 沙漠 · 吹き歌音作 · 沙路 · 斯斯特米 · 市民 · 185 · 195 · 195
	1012-03-19 15 54:18 460	广域差动动作	年限 主演 理論 発起 新草神教 側面 20m2×26相 ABで調整/4x 相 11-057, 4x 12-968, 2x×5 相 11-066, 3x 11-1037, 5x×5 相 11-060, 7x 1x-540, 7x×5種 (近 16 25x)
184	1912-00-16-35-54-18-460	太汉郑明老 平	(环境·主张课): (河京·高沙东部英科技开关)
185	012-09-19 15 54:18 460	龙送剧副命令	《來禮 主站保护》对策 新意志新発体线开关》
186	2213-00-19 TE No. 10 100	广敦玄奘旗往	支持 支持 大阪 新春学界 (1) 1 1 1 1 1 1 1
167	012-08-19 15:54:18.560	过载自动	(未源: 厂城过载新灯-0955
188	2212-69-19-35-59-16-700	厂模畫制造图	字類 主英語序 銀幣 新華経路/胸部 2404.14 植 15-40.14 15-40.14 相 15-50.14 15-40.16 15-40.16 15-40.16 15-40.16 15-40.16
189 2	012-03-19 15 54:10 880	过载告警消失	《朱禄二广军过载就位》《姚贴、新越祥统》
190	1919-59-19 HE SHITE (1919)	20世紀 10世紀 10世紀 10世紀 10世紀 10世紀 10世紀 10世紀 1	- 清清 - 广风以至草材、(PMS) - 摩部科
191 2	2012-03-19 15 54:21 440	电额突变级回	〈朱.诚、主站保护·沙野、新荔样粥、持续、3D00sc
192	1912-63-19 15 54 EL WW	可將開表走自	字列 [[[]] [] [] [] [] [] [] []
193 2	(012-10-19 15 54 21 440	电流突变返回	(外操:主弦網P)/线路 序新II线/持续 Dittins/
194	1817 DR-10, 11 W-00 1791	单连来来进动	李清·李龙理的《数数·海兰创版》中,有"新"(1911年)中,宋朝(1911年)(1918年)(1918年)中,宋明(1919年)中,宋明(1918年)(1918年)
195	28127-03-20, 15, 40, 00, 160	过能告警	(朱陵: 广城过秦联切: 後國: 第三线: 南流: 1067-872-李培:
196	01 0-63-40 (F at 01 74)	電影音楽選手	- 美国 - 1 株式会体打 - 1 株式会体打 - 1 株式 - 1 年 - 1

IT Evolution in substation

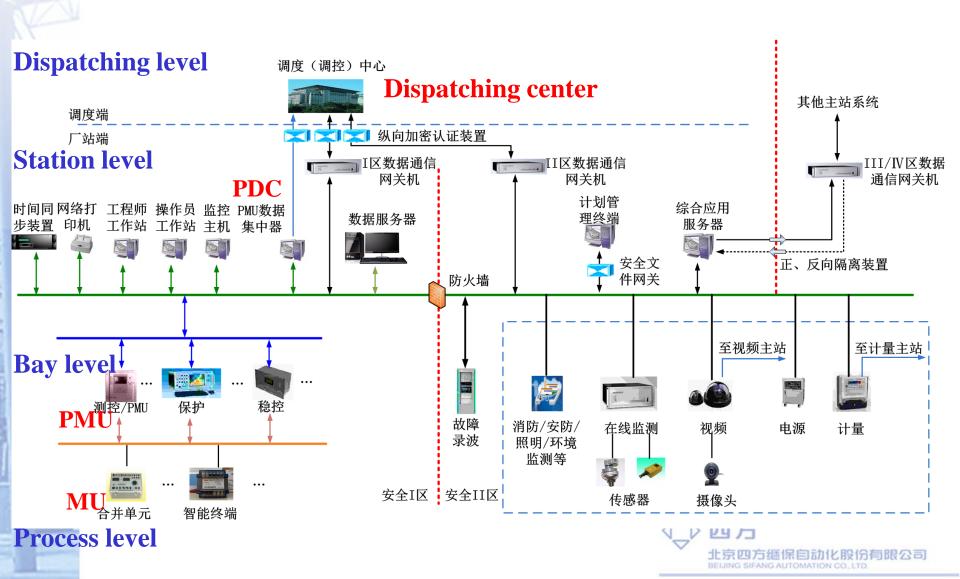
- In China today, all the devices in all 220kV and above substations are microprocessor based, all links between control room and relay room are optical fibers. While links between relay room and switch yard are mainly conventional cables.
- Next steps towards smart substation
 - Electronic CTs and PTs;
 - Optical tripping;
 - Adoption of IEC61850 specification.





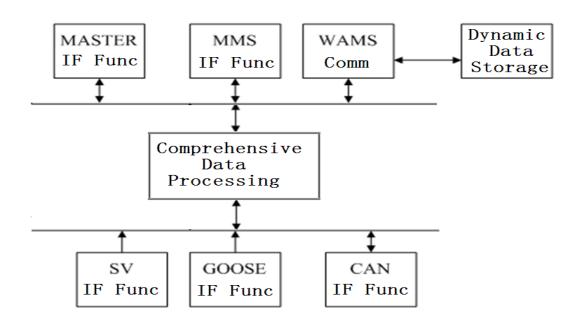


Infrastructure of integrated supervision and control system of smart substation



Development of Digitalized PMU

PMU interface definition





PMU test platform

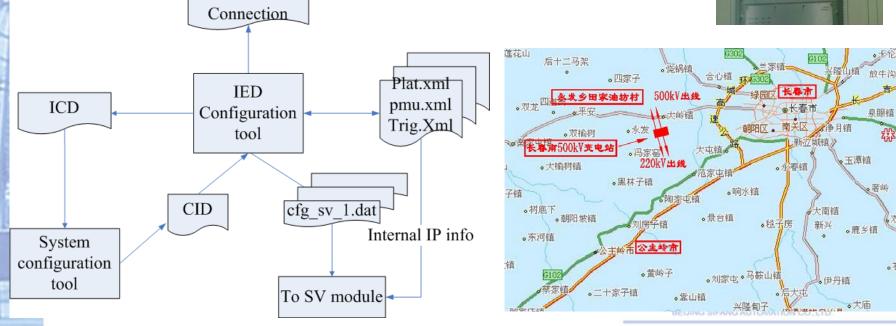


Application in Changchun South 500kV smart substation

- ■Phasor calculation and real-time communication to dispatching center
- ■Under IEC61850, equipment modeling, receiving and processing of SV/GOOSE message, MMS service for sharing data with supervisory devices and other IEDs

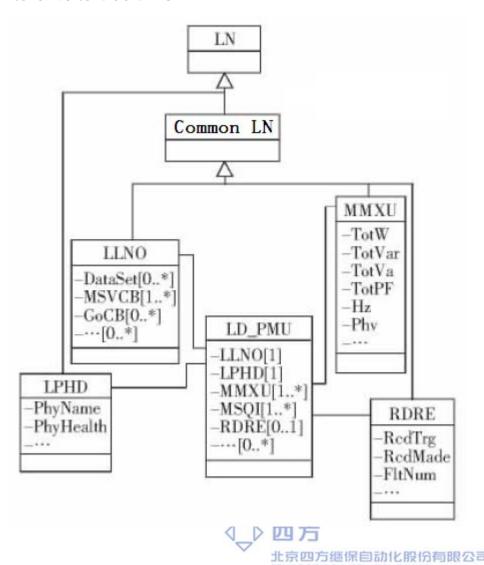
Virtual I/O





Future work for PMU development under smart substation

- ■Standard PMU modeling and compatibility with IEC61850-90-5
- With improved reliability of MUs, switches, etc,
 PMU can be used for wide area protection under networklized smart substations





Any Question?

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