

Produkter och system för framtidens dynamiska eldistributionssystem



Lars Hjort / 李家良

This was me 1974
这就是我 (1974年)





HM Power



- Founded in 2000
- Owned by Lars Hjort and Bertil Moritz with more than 25 years of experience as executives in ABB

HM Power Network Group of Companies

- Business Mission

“The business idea is to identify and understand problems in the electric power distribution industry, and then find attractive solutions to these”



HM Power Network Group of Companies

- Our areas of offers - Products and Solutions

Smart Ring



MV breaker cubicles



Monitoring & fault detecting



Self-healing network



Offshore Wind Power



Renewable Energy



EV Charging



Complete system



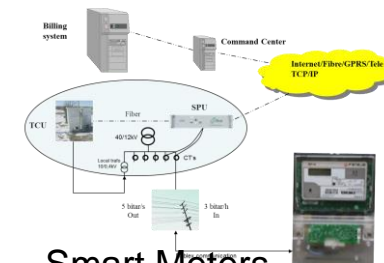
Secondary S/S



Example, underground S/S



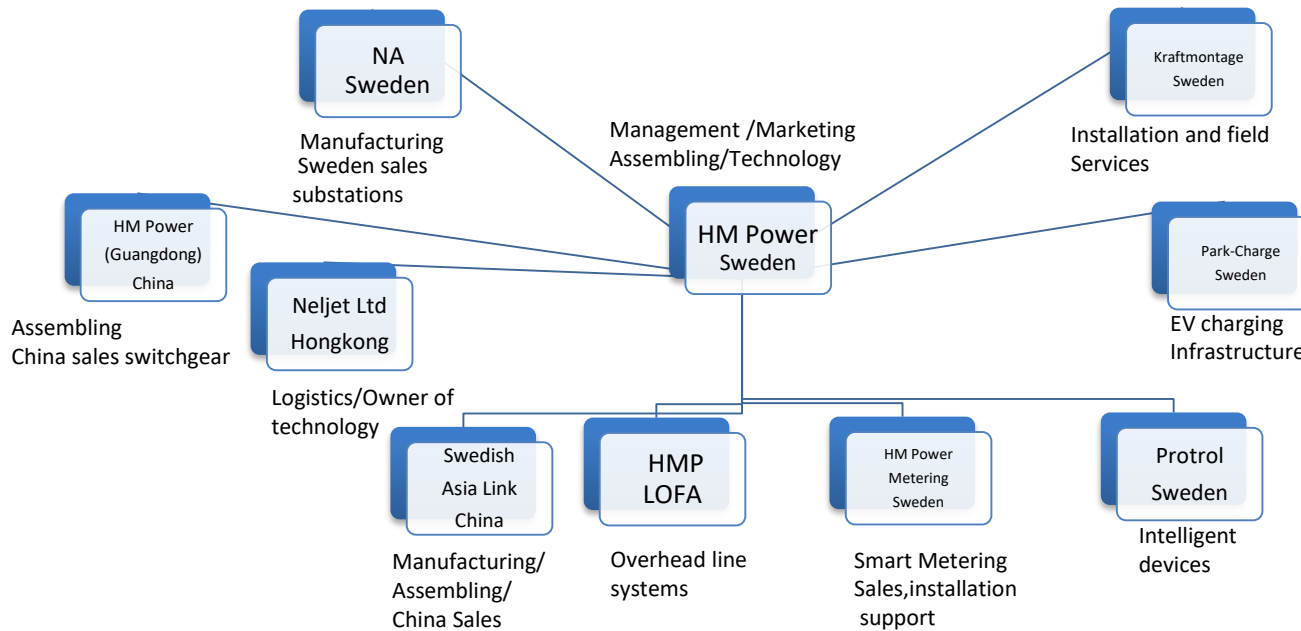
Automatic Meter Reading



Smart Meters



HM Power Network Group of Companies





**Development of Distribution Network
Technology**
配电网技术的发展

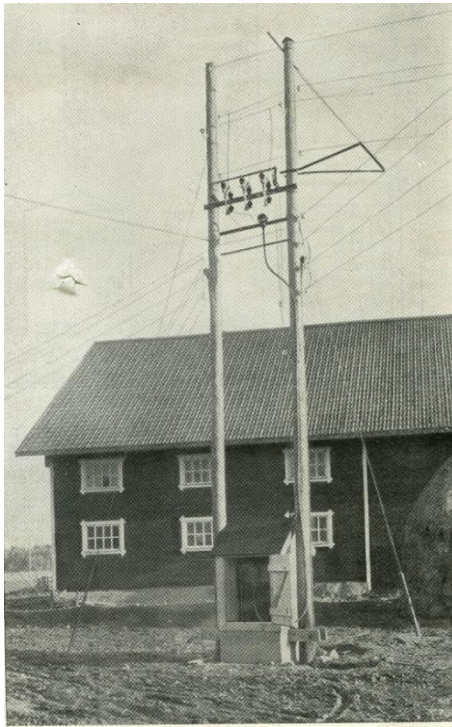


Fig. 4. Kapslad transformator med skydd av trä samt fränkskiljare

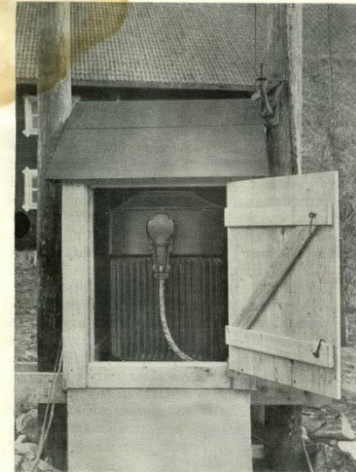


Fig. 5. Högsäpningkabelns anslutning på transformator enligt fig. 4.

på stolparna och går genom en fränkskiljare, typ ASY med smältskydd, ned till transformatorn. Fig. 5 visar den delade kabeländmuffen på transformatorns högsäpningssida. Anordningen på lågsäpningssidan utgöres av ett huvudsmältskydd, typ KS 60, samt tre kapslade smältskydd av typ GS 25, från vilka de utgående ledningarna äro dragna i form av jordkabler, (se fig. 6).

Det läsbara handtaget för högsäpningfränkskiljaren synes längst upp till höger på fig. 5.

Den kapslade transformatorn kan även med fördel användas för transportabla utrustningar.

formator mycket väl kan utbytas, utan att kapslingsanordningen behöver förnyas eller ändras. Så snart den nya transformatorns lock och genomföringar ha samma dimensioner som den gamla, kan kapslingsshuven utan vidare sättas fast på den nya transformatorn.

Sin största användning finner den kapslade transformatorn, vilket redan förut framhållits, såsom ersättning för stolptransformatorn. Den kan emellertid användas överallt där en vanlig standardtransformator förut varit lämplig, men härvid tillkommer den fördelen, att den på grund av sitt skyddade utförande får uppställas utan några extra skyddsanordningar i form av järnräck eller gallerväggar. Anläggningar finnas utförda vid mindre sågar, kvarnar och liknande industrier. I det förstnämnda fallet har transformatorn placerats c:a 50 m från husväggen och lågsäpningssledningen har dragits i form av jordkabel in till sågen, där en gjutjärnskapslad instrumentering kunnat monteras direkt på väggen.

I de fall, då transformatorn monteras inom-

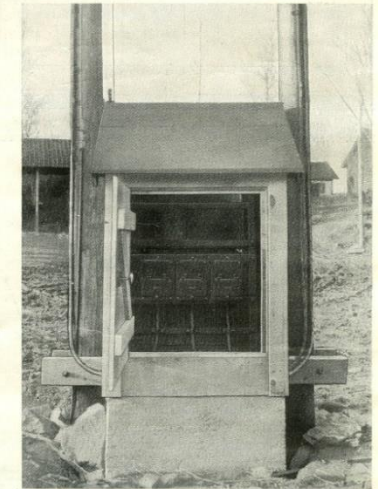


Fig. 6. Lågsäpningssinstrumentering för transformator enligt fig. 4.

hus, gälla fortfarande bestämmelserna angående brandfritt utförande av väggar och tak. Närmare upplysningar angående den kapslade transformatorn lämnas av Aseas samtliga filialkontor.

ASEA:s TIDNING

ÄVEN ORGAN FÖR ELEKTRISKA
KLUBBEN, VÄSTERÅS, OCH ASEA:s
TJÄNSTEMANNAFÖRENINGAR



UTKOMMER VARJE MÅNAD
PRENUMERATION HOS REDAK-
TIONEN - PRIS KR. 5:— PR ÅR

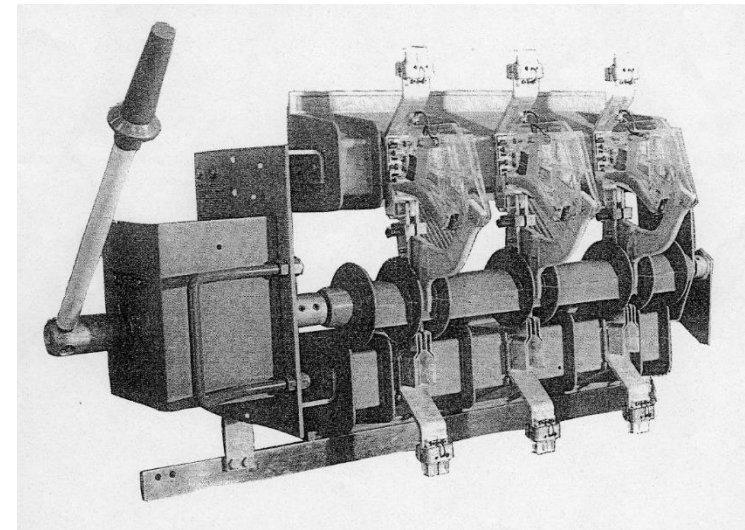
ÅRGÅNG 23
1931

Ansvarig utgivare: J. S. EDSTRÖM, Redaktion: H. SVENSSON & S. NORBERG
All korrespondens adresseras till Asea, Reklambyrån, Västerås.
Tillstånd till återgivande av artiklar och utdrag ur Aseas Tidning lämnas endast under förutsättning att denna tidnings namn tydligt angives.

FEBRUARI
Nr 2

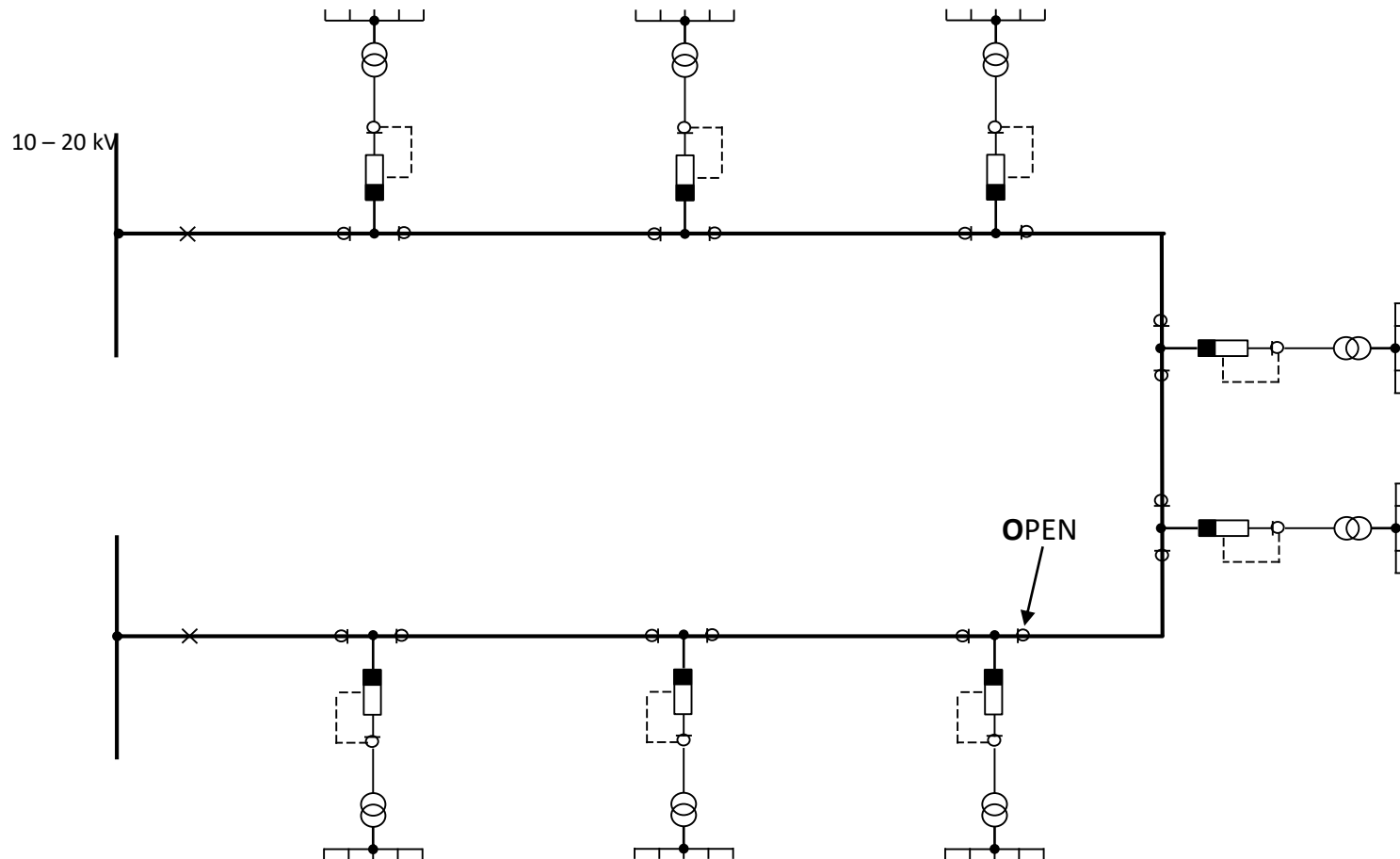
Historisk vy

- Första lastfrånskiljarna utvecklades av AEG Saxenwerk under 1960-talet.
- Gjorde det möjligt att bygga öppna slingor, en princip som spreds över hela världen.
- Kompakta ställverk med fast isolering på slutet av 1970-talet.
- Kompakta SF6 gas isolerade ställverk på 1980-talet.
- Lastfrånskiljare och säkringslastfrånskiljare har alltid inneburit en kompromiss jämfört med effektbrytare.



NGC, konstruerad och producerad av ASEA i Ludvika på 1970-talet

In 1974 ies a typical MV cable network looked like this – and often still do so
 1974年的典型中压电网如下图，现在还是经常这样布置



1960-1970 ies - Open loop systems

60~70年代 — 开环系统

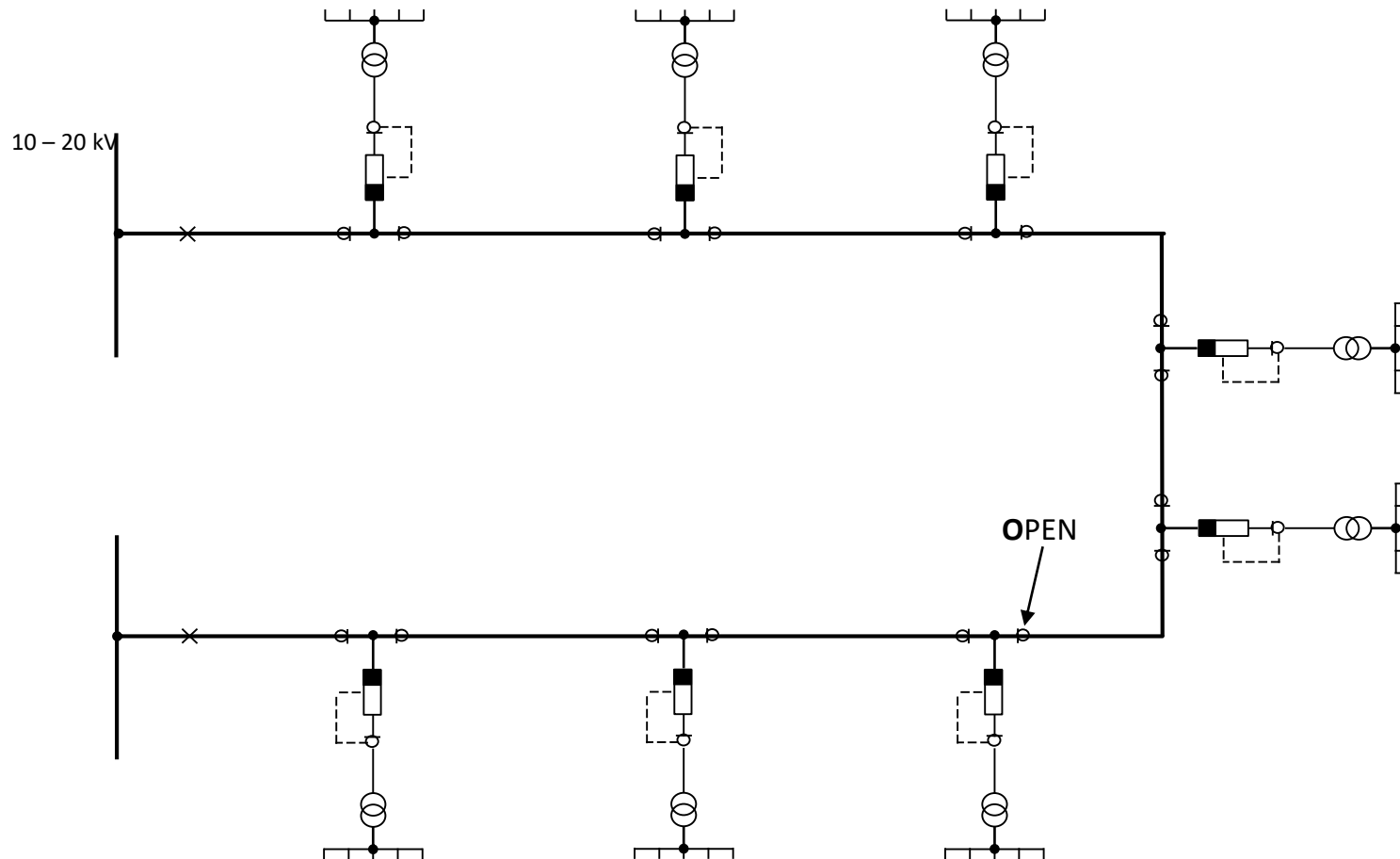
- ◆ A technical revolution of its time
当时的技术革命
- ◆ Made it possible to restore the network in reasonable time (reasonable of that time)
能够在合理时间内恢复网络（当时的合理时间）
- ◆ Load switches was much cheaper than circuit breakers
负荷开关比断路器便宜很多
- ◆ Circuit breakers was bulky, expensive and needed a lot of maintenance
断路器体积庞大，价格昂贵，需要大量的维护
- ◆ Made it possible to use factory built secondary substations
能够使用预制二次变电站
- ◆ The method was spread world wide
该方法全球广泛应用
- ◆ Time for restorage: 1 - 5 hours
恢复供电时间：1 - 5小时







In 1974 ies a typical MV cable network looked like this – and often still do so
 1974年的典型中压电网如下图，现在还是经常这样布置





**What happens in Europe and elsewhere?
欧洲和其他地方是什么情况?**

High reliability - the society requires continuous supply 高供电可靠性 — 社会需要持续电力供应

Drivers for change for Electric Utilities
电力公司改变的驱动因素



All communication is totally dependent on continuous supply from the grid.
所有通信都完全依赖于电网的持续供电

Local micro production
分布式电源



Some summer days 35% of the total electricity production comes from solar panels in Germany
德国在夏天时有35%的总发电量是由太阳能板供应



Power peaks 电力峰值

One Tesla car needs 130kW for quick charging
一辆特斯拉汽车需要130kW用于快速充电



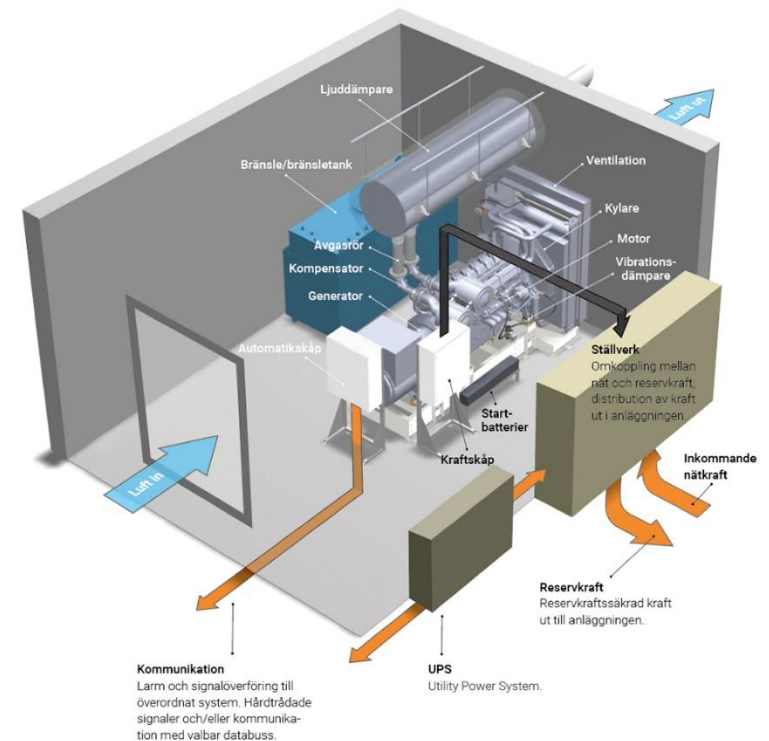
ELLEVO

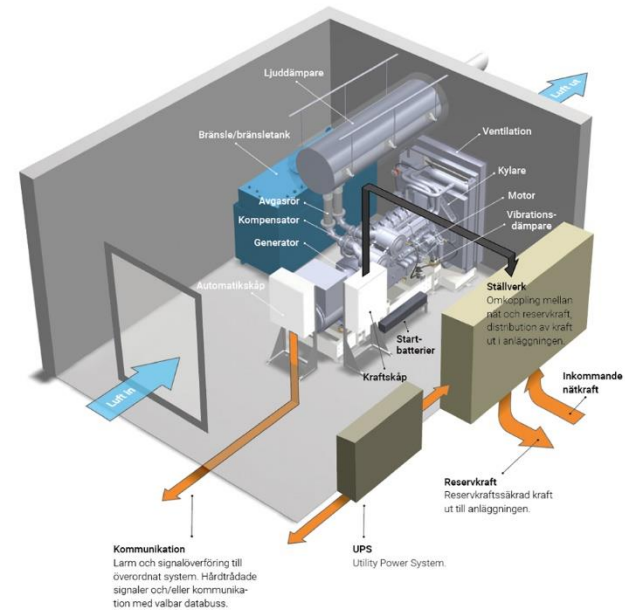
**SVENSKA
KRAFTNÄT**

VATTENFALL

Effektmarknad:

- Du får betalt för att inte konsumera vissa tider
- Du får betalt för att producera lokalt vissa tider

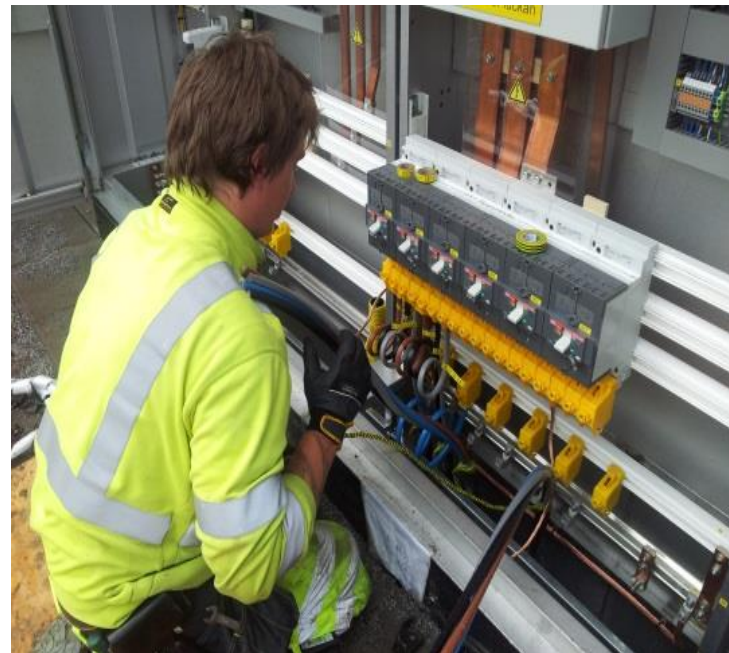




Svenska Kraftnät - stödtjänster:

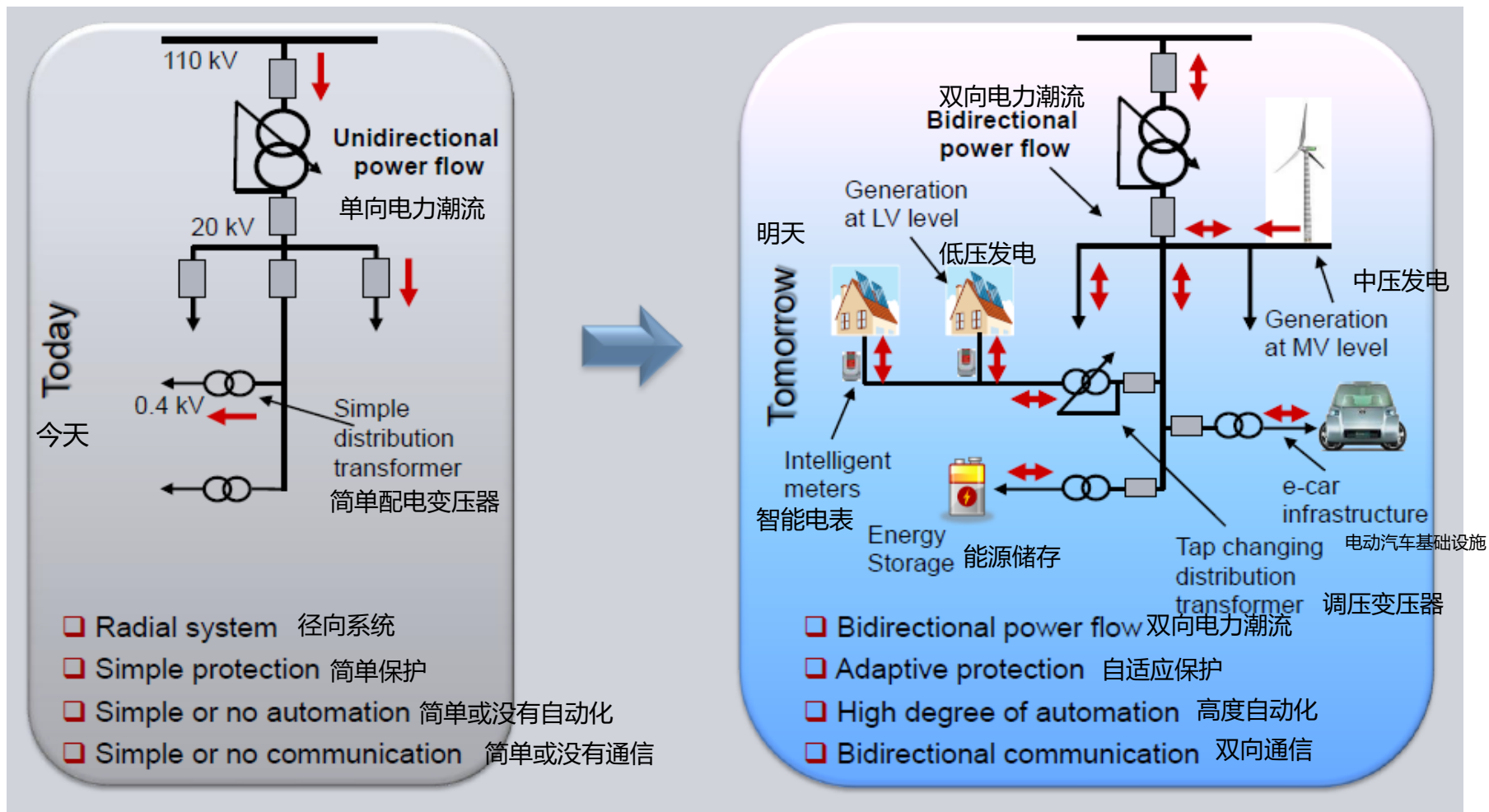
”För att stabilisera nätet köper vi varje år in olika reserver av el för stora värden. Är du intresserad av att tjäna pengar på att stötta kraftsystemet?”





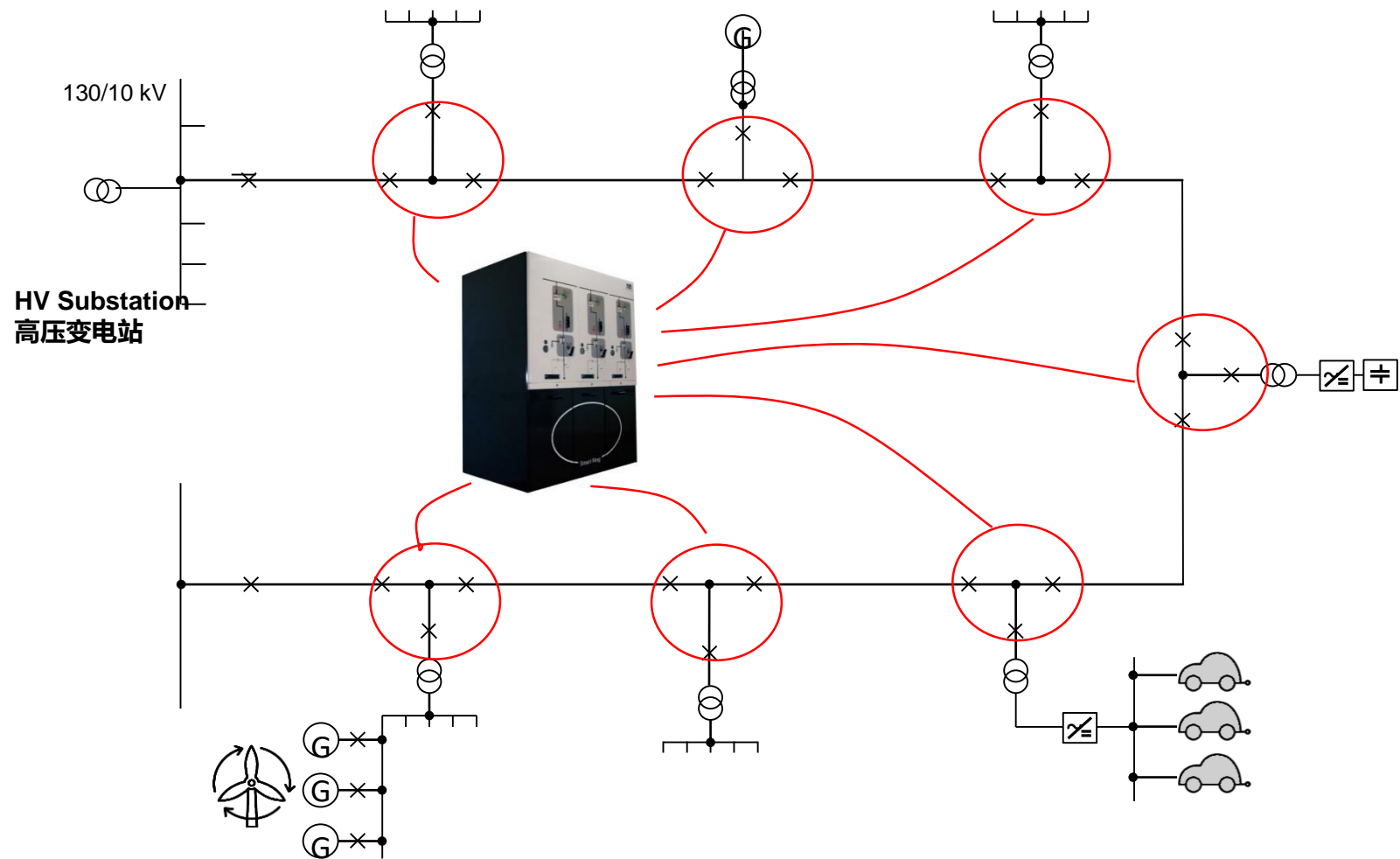
Effektbehov 1,6 – 2,5 MW per anläggning.

From static to dynamic networks 从静态到动态电网



Smart Ring circuit breaker for dynamic networks

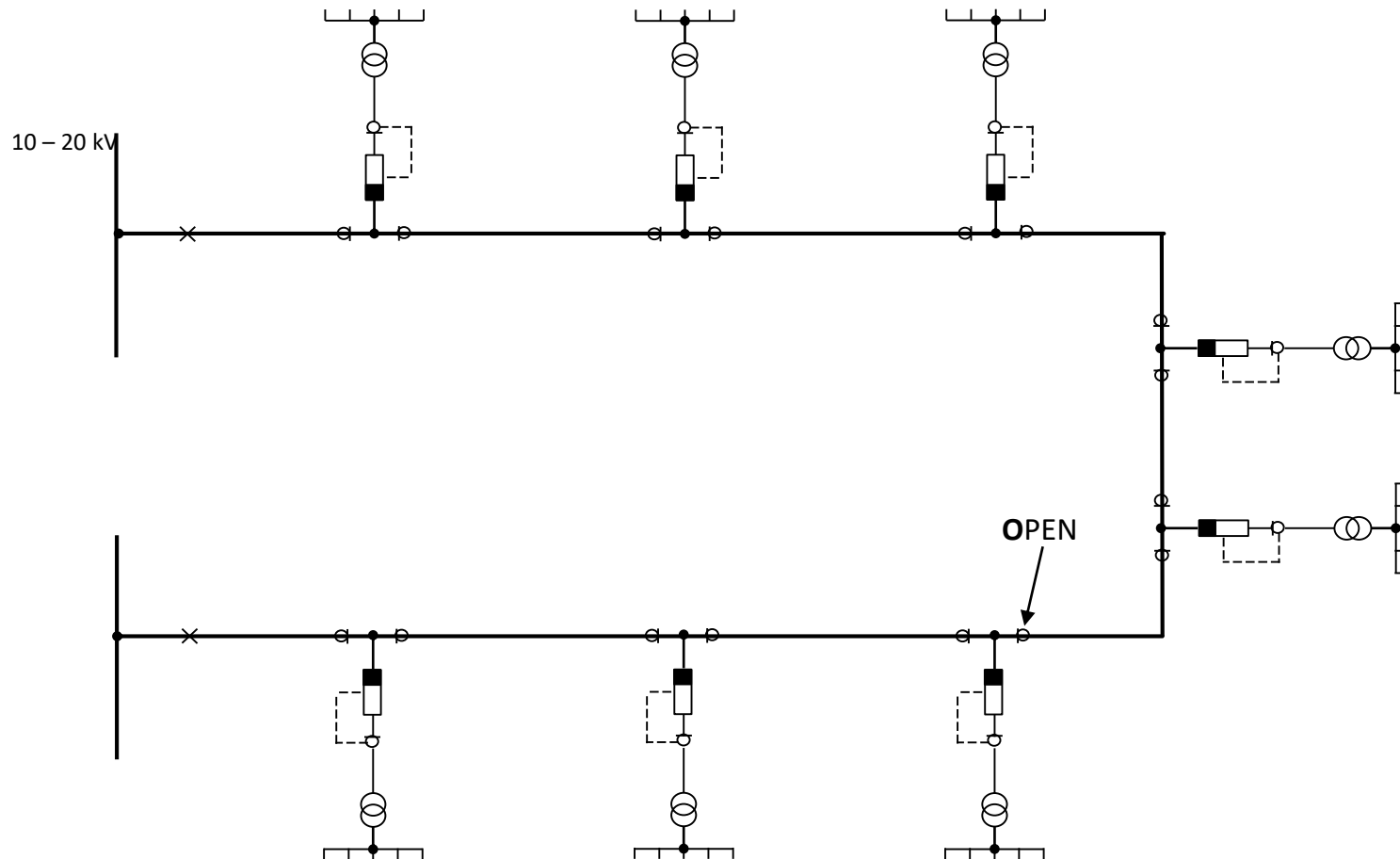
Smart Ring 断路器开关柜用于动态电网



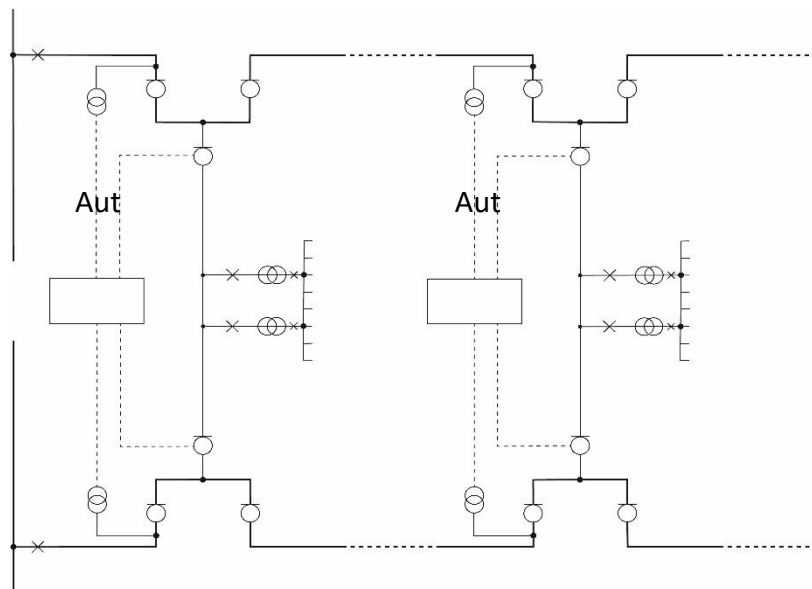


Different distribution solution
不同的配电解决方案

In 1974 ies a typical MV cable network looked like this – and often still do so
 1974年的典型中压电网如下图，现在还是经常这样布置

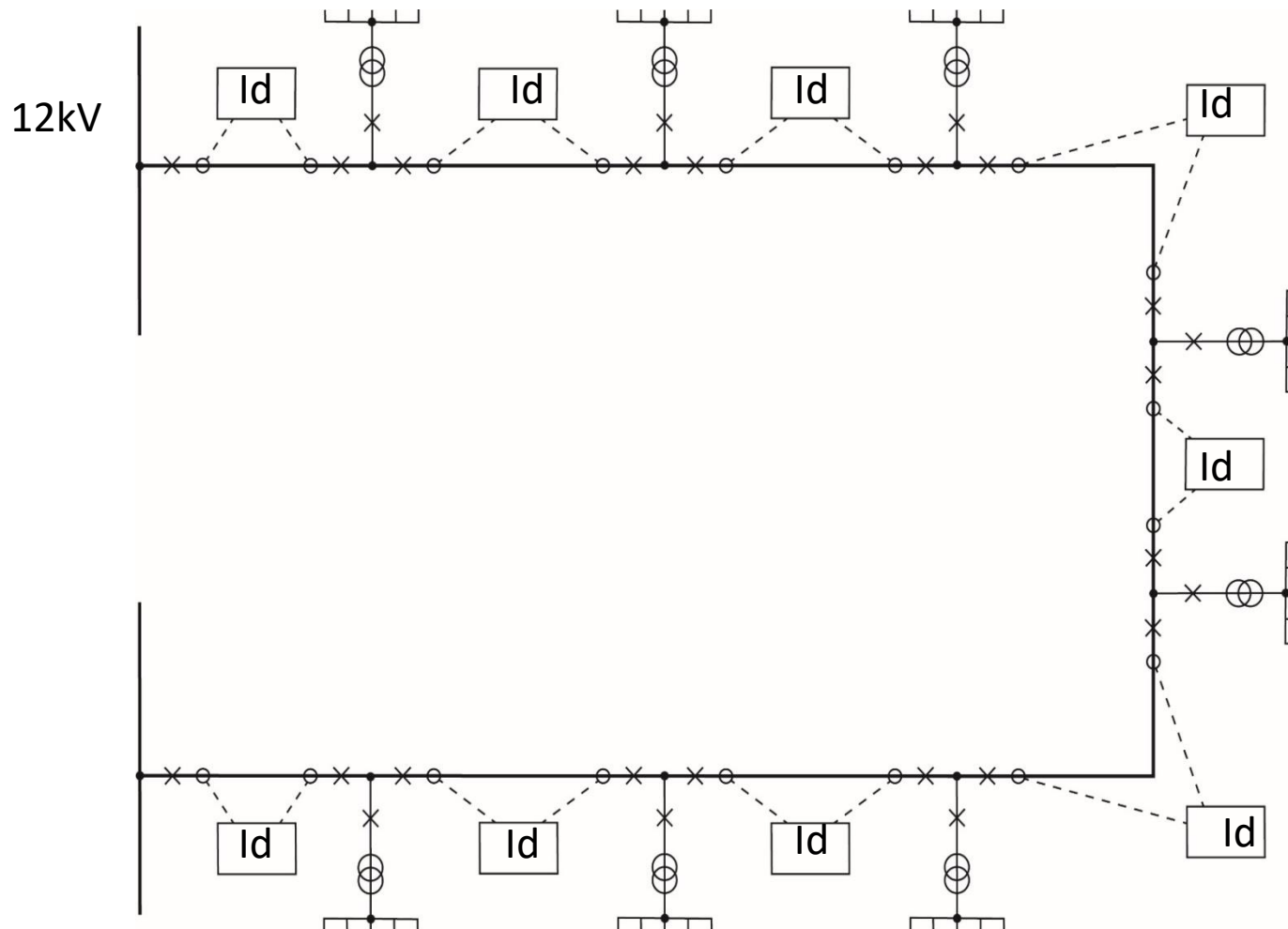


Double cable system of the 1960ies 20世纪60年代的双电缆系统



- ◆ Reduce outage time to 25 – 30 seconds
停电时间缩短至25~30秒
- ◆ All clients are effected
所有客户都受到影响
- ◆ Very costly compared to alternatives of today
与今天的替代方案相比非常昂贵
- ◆ No or very simple communication needed
无需或需要非常简单的通信

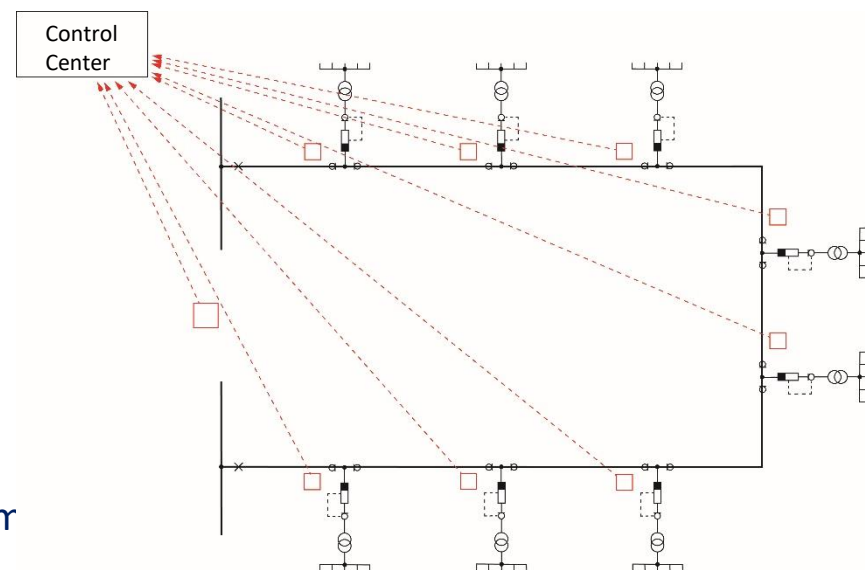
Closed loop systems 闭环系统



Closed loop systems 闭环系统

- Circuit breaker switchgear of that time were bulky, very expensive and required a lot of maintenance.
那个时期的断路器开关体积庞大，非常昂贵，并且需要大量维护。
- Require solid or low resistance neutral point - the earth fault currents are not allowed to be too small – can cause malfunction of the differential protection.
需要直接接地或低电阻中性点接地 —— 接地故障电流不能太小 —— 可能会导致差动保护发生故障
- Isolation of faulty cable without any outage at all.
完全不需停电就可隔离故障电缆
- Availability figures for Singapore, Hong Kong, London are the best in the world - Customer minutes lost per year is typically 4-5 minutes.
新加坡，香港，伦敦的供电可靠性数据是全世界最好的 - 每年客户的失电时间通常为4-5分钟。
- These systems did have and some still have no or very simple communication to the Operation Center.
这些系统在以前甚至是现在对操作中心是没有通信或非常简单的通信。

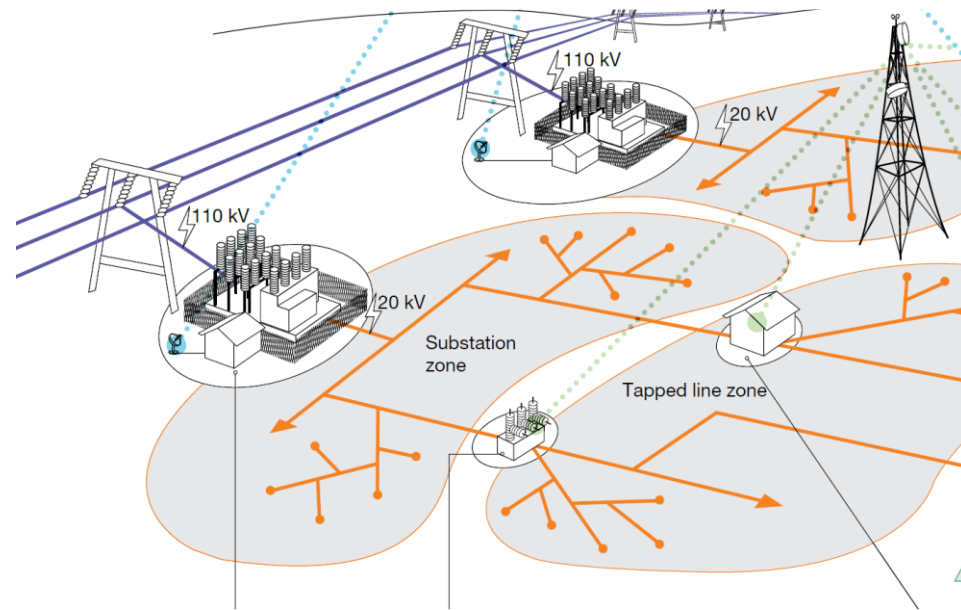
Different distribution solutions 不同的配电解决方案



- ◆ Big suppliers normally go for centralized system
大型供应商通常会采用集中式系统。
- ◆ One reason is probably because they organize responsibility for Self-healing systems or Distribution Automation to the Business Unit for Network Control Systems.
原因之一可能是因为他们把自愈系统或配电自动化的责任归到电网控制系统的业务部门。
- ◆ It is normally very difficult to establish good cooperations between different Business Units in big companies.
在大公司的不同业务部门之间常很难建立良好的合作关系。

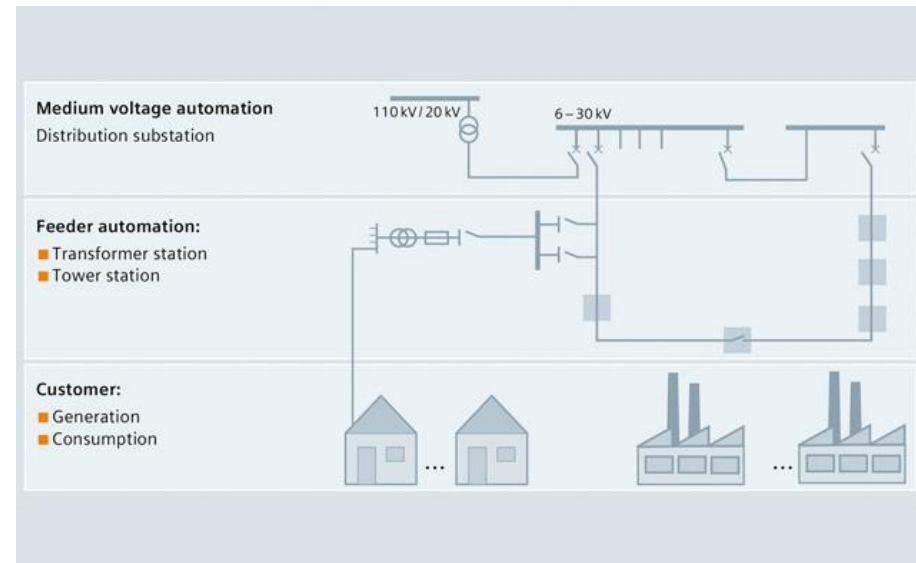
Different distribution solutions 不同的配电解决方案

- European supplier nr 1 欧洲供应商#1
 - Centralized system 集中式系统
 - Motorized load switch disconnectors 带电操的隔离负荷开关
 - Zone-indication with help of advanced protection relays
借助先进继保的地区故障检测
 - Test installation in Sweden failed –
had to add Protrol fault
indicators from HM Power
瑞典试验安装失败 –
不得不使用Protrol故障检测系统
 - Time to restore 5 – 30 min
恢复供电时间：5~30分钟



Different distribution solutions 不同的配电解决方案

- European supplier nr 2 欧洲供应商#2
 - Centralized system 集中式系统
 - Motorized load switch disconnectors 带电操的隔离负荷开关
 - Fault indicators 故障检测系统
 - Time to restore, today 15 – 30min.
现在恢复供电时间是15~30分钟。



Different distribution solutions 不同的配电解决方案

- European supplier nr 3 欧洲供应商#3
- - Very similar to supplier nr 2 非常类似于供应商#2

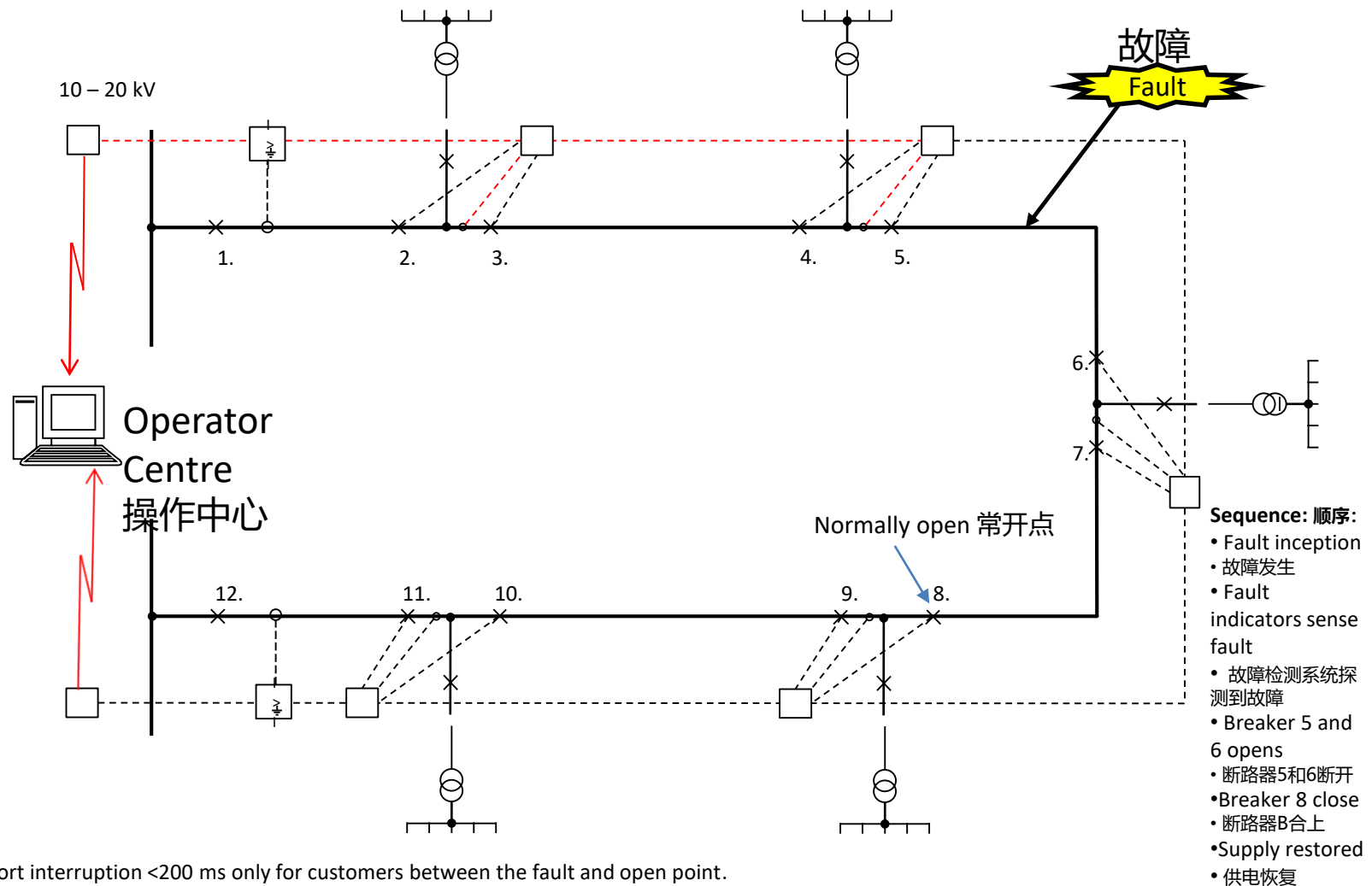




HM Power's integrated solution
HM的整合解决方案

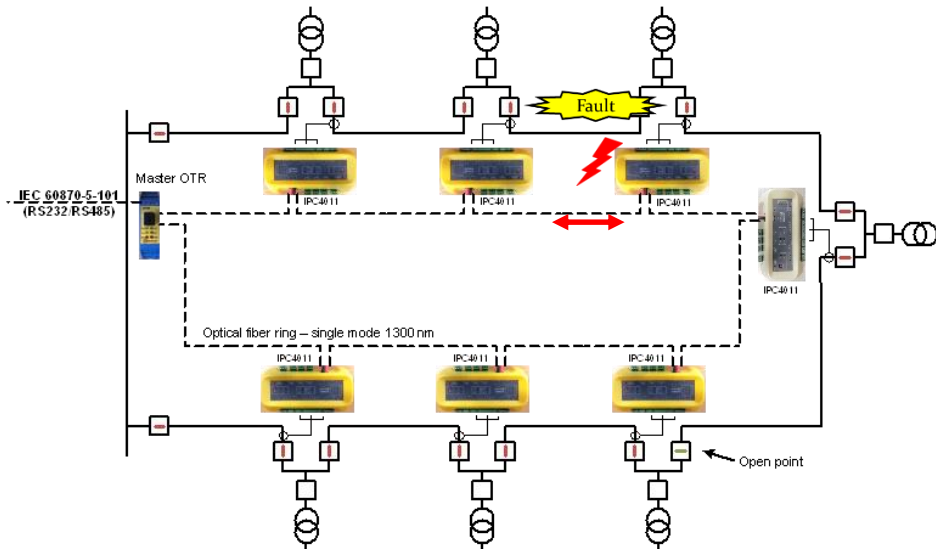
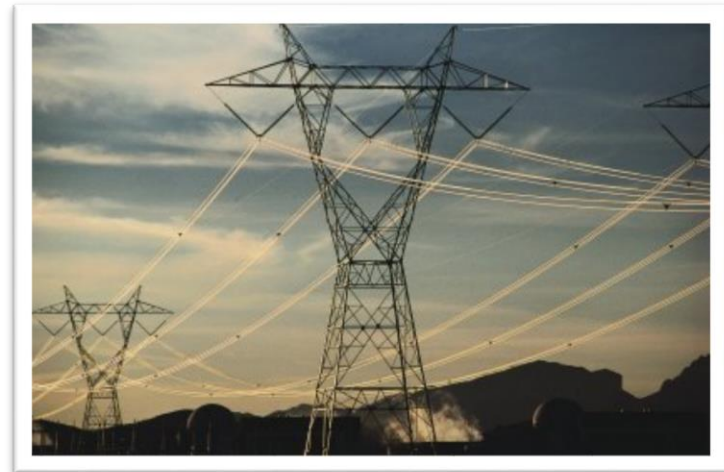
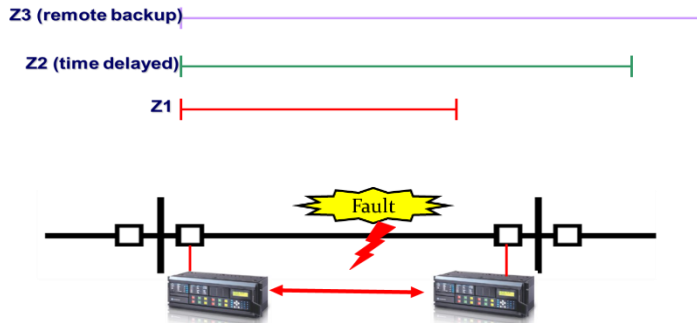
HM Power self-healing solution with circuit breakers –open loop system

HM Power开发的分布式智能自愈系统方案 – 开环回路系统



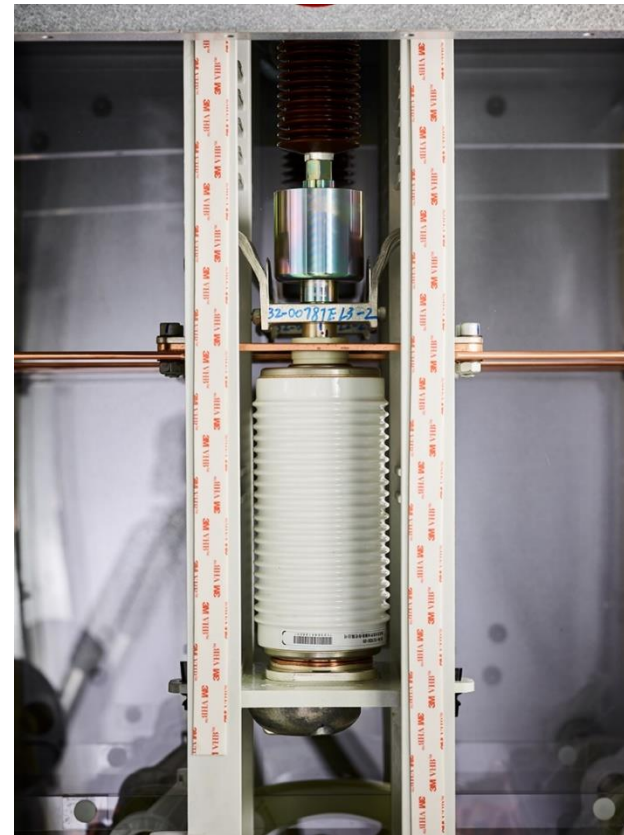
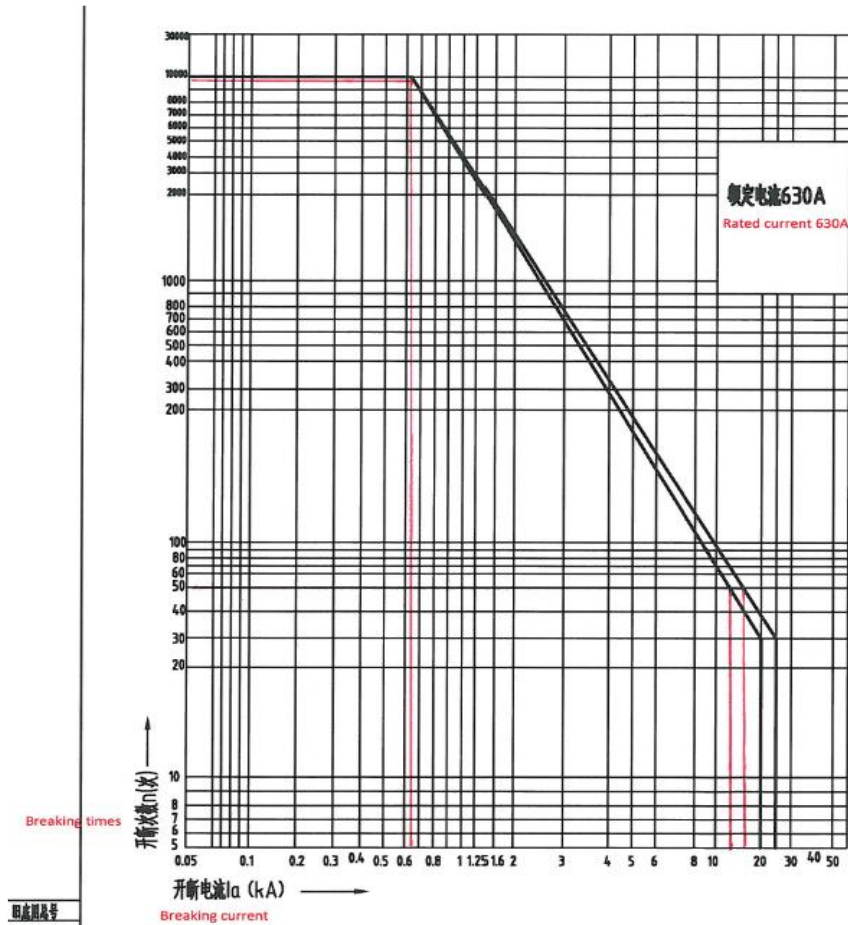
Short interruption <200 ms only for customers between the fault and open point.
短时中断 (< 200ms) , 只有故障点和常开点之间的客户受到影响。

Transmission grid performance at distribution levels to reasonable cost.
 以合理的成本把输电网性能应用到配电网水平



Smart Ring - concept





- The circuit breakers covers future requirements during 40 years.
断路器满足未来40年的要求。

Fault detection technology with high performance 高性能的故障检测技术

Asymmetri fault detection method 相不对称故障检测方法

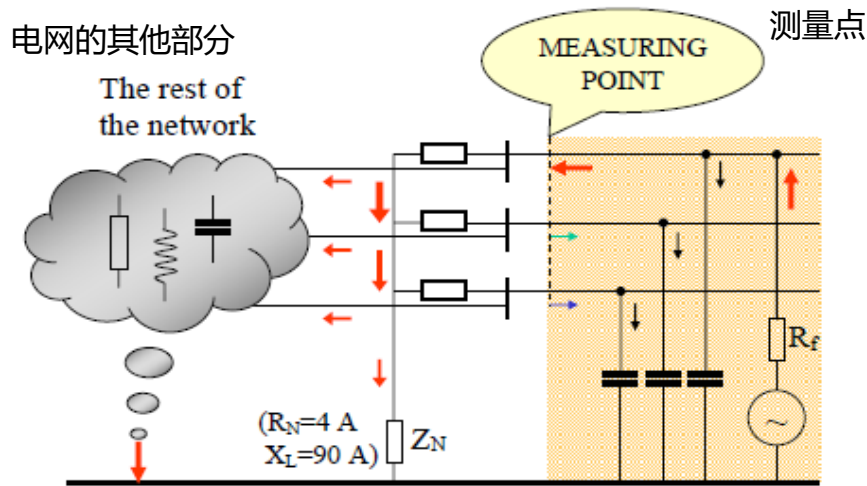


Manage to detect earth faults with 8000 ohms, 0,5 A. Also with floating neutral point.

既可检测8000欧姆，0.5A的接地故障，也可检测中性点不接地的接地故障。

High-precision Small Earth Fault Current Detection Device - Phase Asymmetry Algorithm

高精度小电流接地故障检测技术——相不对称算法

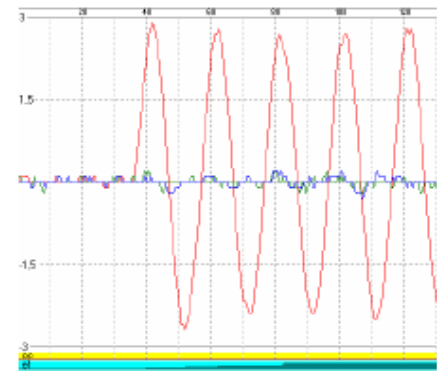


An earth fault will cause changes in the phase currents

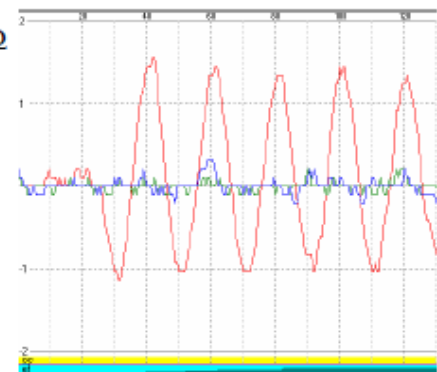
接地故障将导致相电流发生变化。

— I_A (faulty)
— I_B
— I_C

$R_f = 3 \text{ k}\Omega$



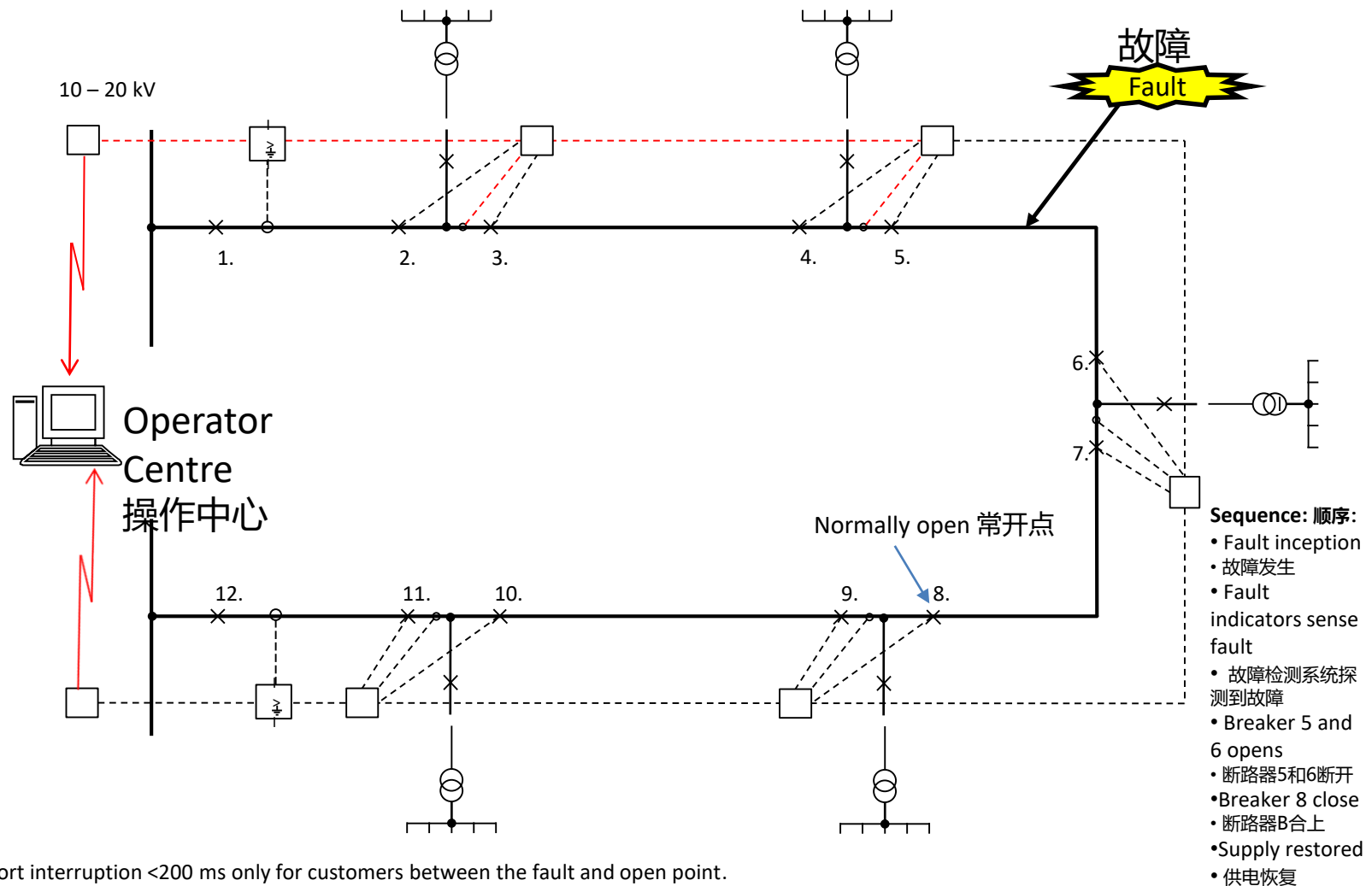
$R_f = 6.4 \text{ k}\Omega$



- With phase asymmetry technology to detect earth fault current
采用相不对称技术检测接地故障电流
- Accurately detect down to 0.5A single-phase earth fault current in the neutral point floating system
可精确检测出中性点不接地系统中，最小0.5A的单相接地电流。

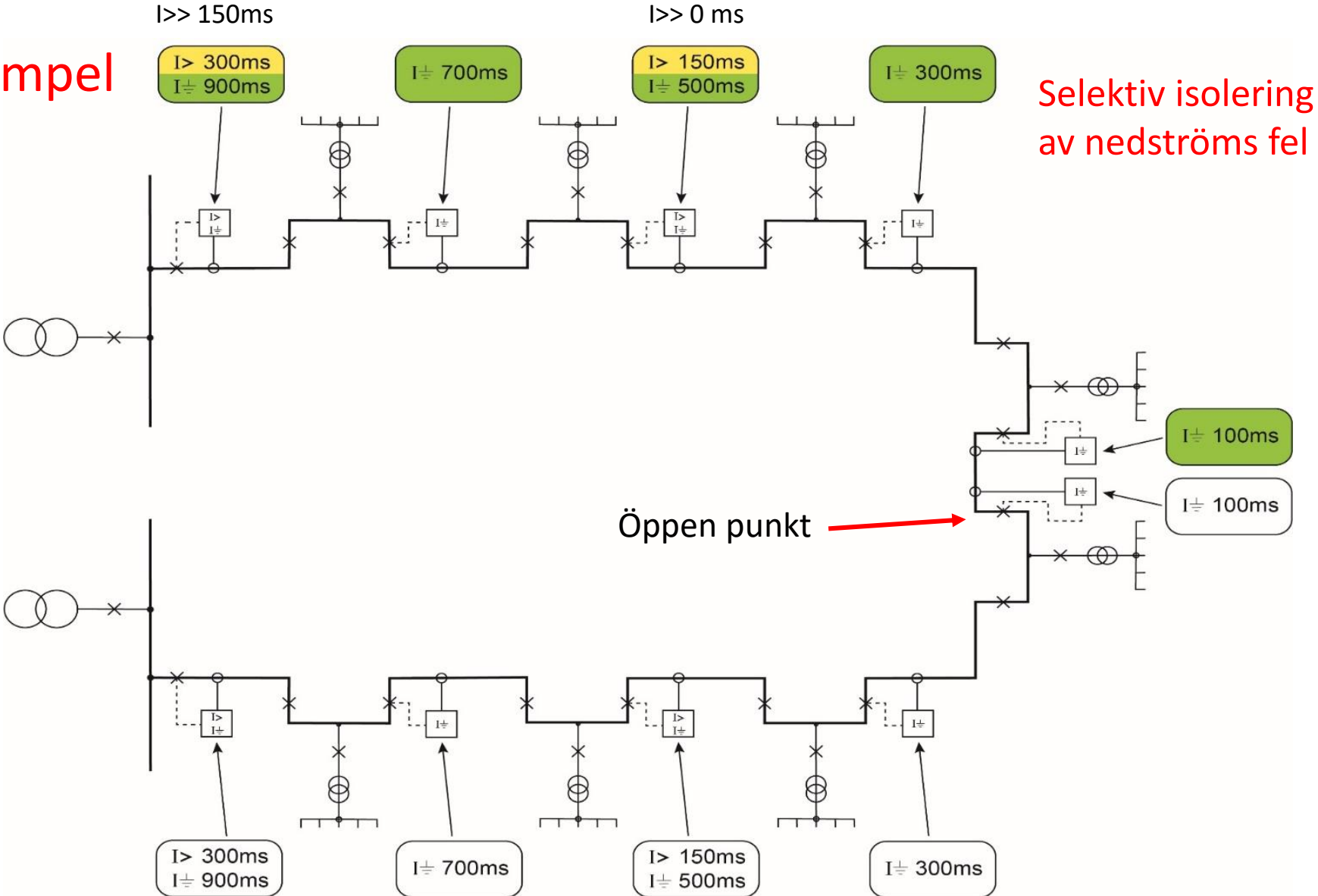
HM Power self-healing solution with circuit breakers –open loop system

HM Power开发的分布式智能自愈系统方案 – 开环回路系统



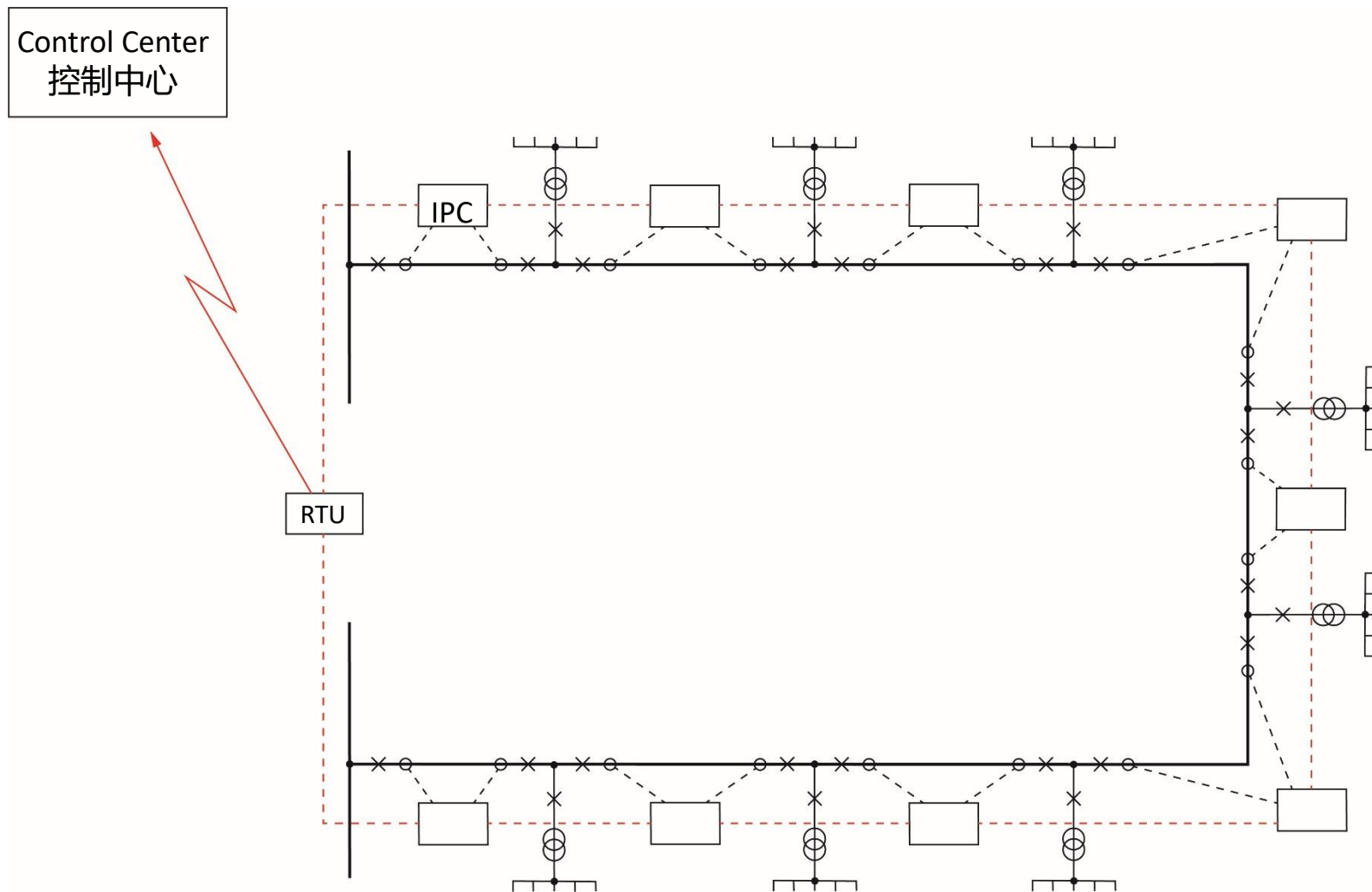
Short interruption <200 ms only for customers between the fault and open point.
短时中断 (< 200ms) , 只有故障点和常开点之间的客户受到影响。

Exempel



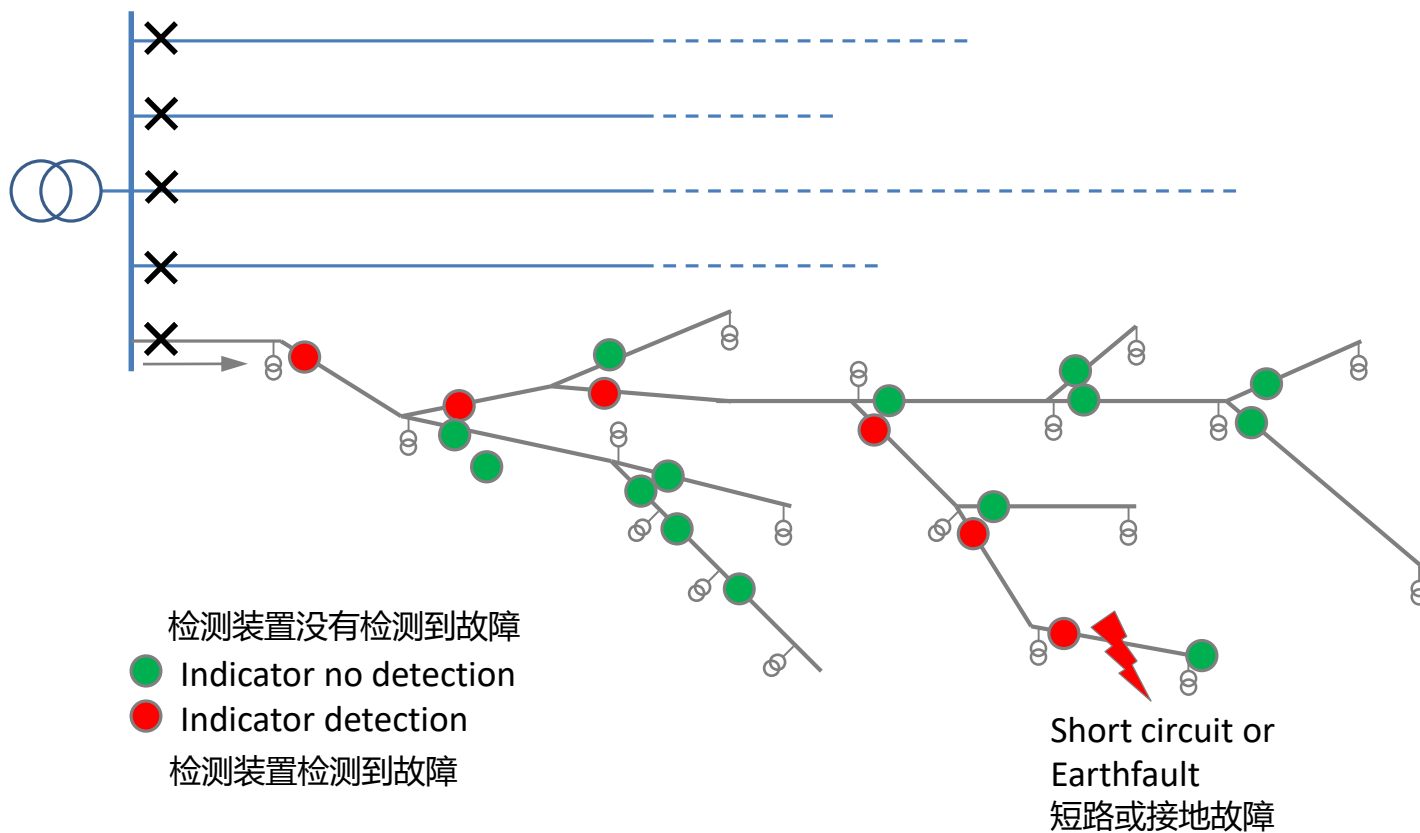
Selektiv isolering
av nedströms fel

Modern closed loop system 现代闭环系统



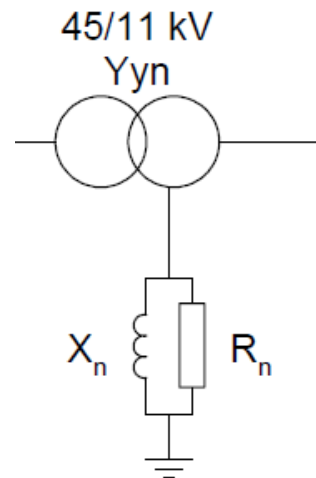
Over head lines - earth fault line identified and localized

高精度小电流接地检测——接地故障选线、选段





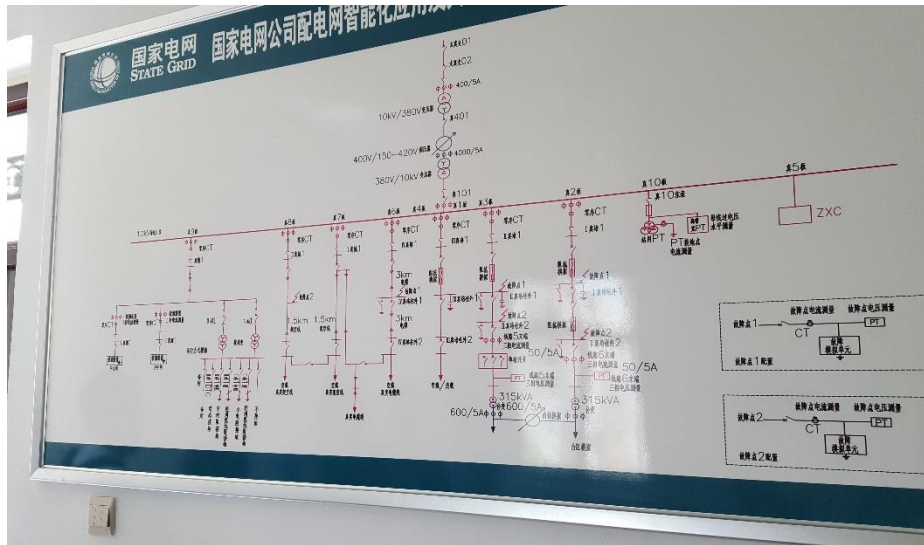
- We have developed a fault indicator that manage to indicate earth faults 8000 ohms, 0,5A. Also managing floating neutral points.
我们开发了一种接地故障检测技术，可检测8000欧姆高阻接地，0.5A的接地故障电流，可检测中性点不接地的接地故障。



- When possible we recommend to use high resistance earthed neutral point with Petersen coil.
如果可能，我们建议用消弧线圈高电阻中性点接地。

Test av Protrol felindikator för höghögliga jordfel med Petersen jordad eller flytande nollpunkt.

Testplats: State China Grid Distribution Smart Application and Key Equipment Jointed Laboratory in Luohe.

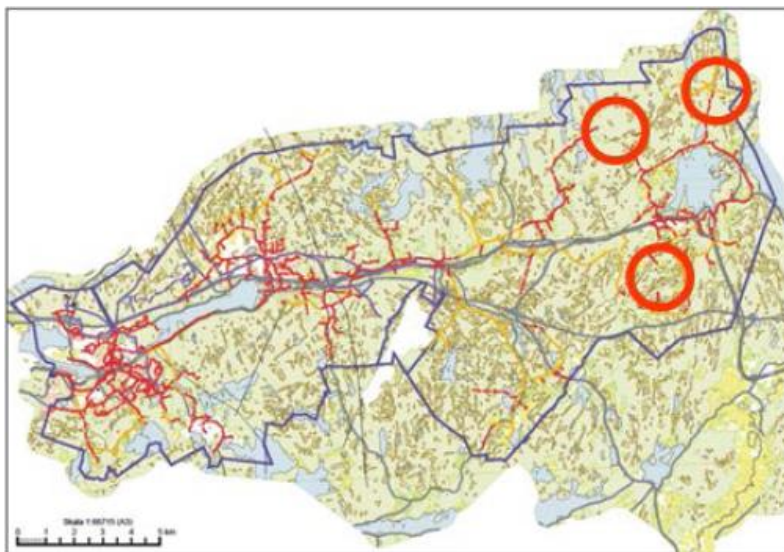




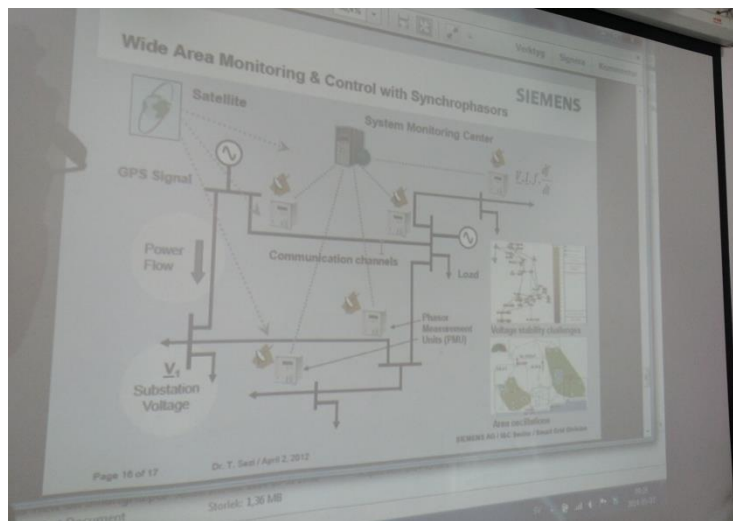
HM Power Applications
赫兹曼电力方案应用案例

Decentralized Self-healing Distribution Automation System Application

分布式智能自愈配电自动化系统应用



- Close to Gothenburg, complete self-healing loop with 8 secondary substations installed in 2014. HM Power provided switchgears integrated with fault indicators. The secondary substations commissioning as complete function.
2014年在哥德堡安装了含8个二次变电站的完整自愈网络。



- Vattenfall Distribution made agreement with HM Power recently to install a complete self-healing loop in city area.
Vattenfall供电公司最近与赫兹曼达成协议，在市区安装一套自愈配电回路。

“Self-healing” reference case – Gothenburg distribution system

瑞典的实用方案 - 哥德堡配电系统



Fullskale-test i Härryda:

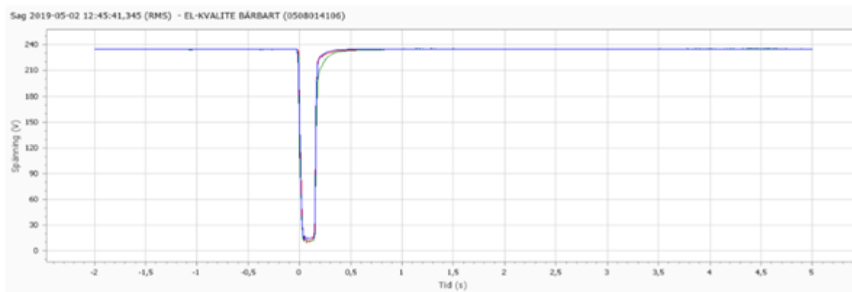
2.500 ohms motstånd valdes för att motsvara en tänkbar impedans i felstället.

Automatiken inställd på 0,5 sek för jordfel.

Reläskyddet i fördelningsstationen inställd på 1,5 sek.



Spänningsdipp hos kund





- **Norra Djurgårdsstaden a Smart grid project in Stockholm**
Norra Djurgårdsstaden—斯德哥尔摩的智能电网项目





Commissioning applications in China 中国已经运行部分案例

- Chancheng Jun Ling housing estate project 禅城隽岭小区项目
- Guangdong Nanhai Jun Hu Hao Ting project 广东南海君湖豪庭项目
- Guizhou Bijie city self-healing project 贵州毕节市城区自愈项目
- FAST(Five-hundred-meter Aperture Spherical Telescope) project
天眼FAST项目
- Anshun city Backbone network self-healing system 安顺市主干网自愈系统

Decentralized Self-healing Distribution Automation System Application

分布式智能自愈配电自动化系统应用



➤ In 2012, “Feeder Line Smart Automation Development Project in Guizhou Zunyi Utility, Southern Grid
2012年南方电网贵州遵义供电局“馈线智能化科技开发项目”

➤ 2014, 100% Reliable Power Supply Regional Self-healing (Optical Fiber Differential) technology development project in Guizhou Bijie
2014年南网贵州毕节供电局“100%供电可靠性区域自愈系统(光纤差动)科技开发项目”

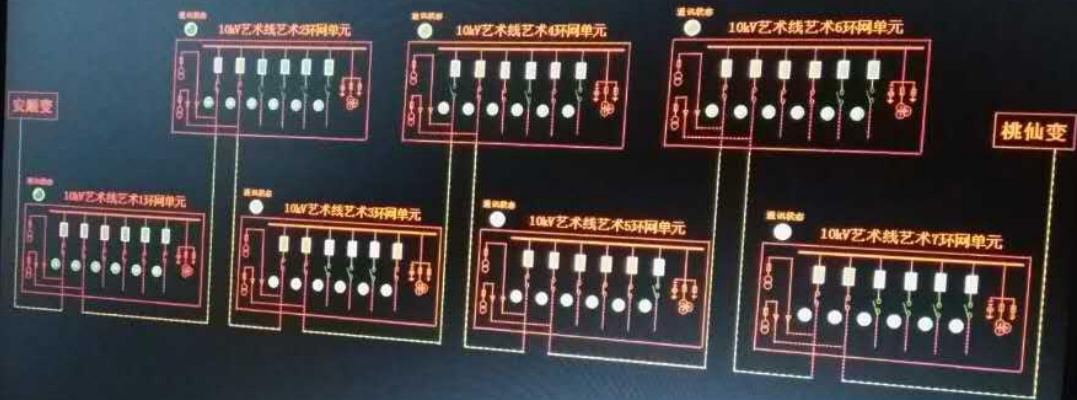


➤ 2015, “Zero Outage-Optical Fiber Differential Community Self-healing Project” in Foshan Utility, Southern Grid
2015年南网佛山供电局“零停电—光纤差动小区自愈项目” 大型社区配电项目应用。

Self-healing system in distribution network 配电网“零停电”智能分布式自愈系统应用案例



沈阳艺术线配网自动化后台



DELL

Self-healing system in distribution network 配电网“零停电”智能分布式自愈系统应用案例



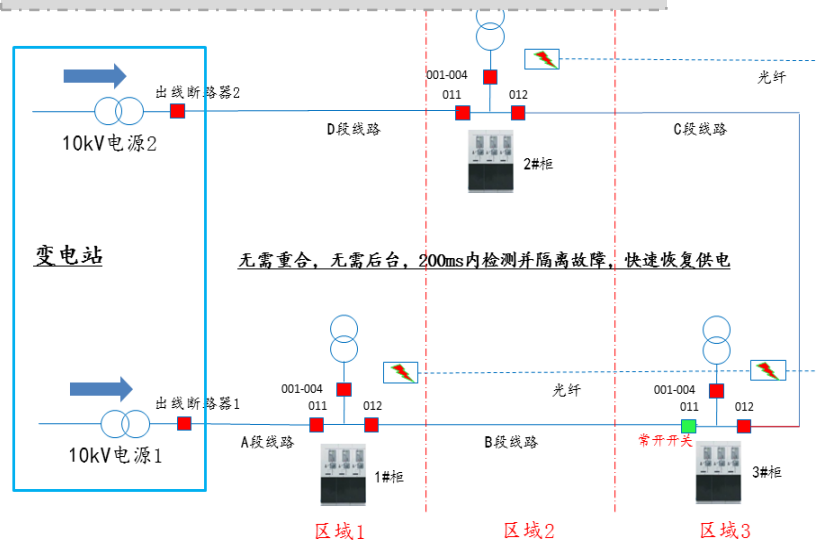
FAST(Five-hundred-meter Aperture Spherical Telescope) self-healing system project in 2016 2016年“FAST天眼”射电望远镜供电系统自愈项目



Self-healing system in distribution network 配电网“零停电”智能分布式自愈系统应用案例



FAST(Five-hundred-meter Aperture Spherical Telescope) self-healing system project in 2016 2016年“FAST天眼”射电望远镜供电系统自愈项目





Success in market 在市场取得成功

- ◆ Launched in Sweden in 2010;
2010年在瑞典推出;
- ◆ Launched in China in 2011;
2011年在中国推出;
- ◆ Market share in Sweden 35% today,
◆ 在瑞典占35%的市场份额。

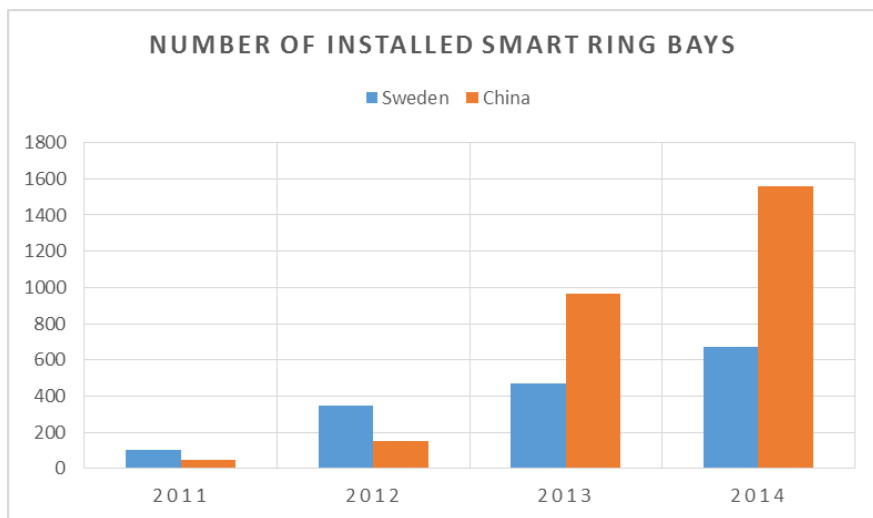


References 参考客户

6 years of excellent track record without any recalls, demonstrate that high level of quality has been achieved

6年来没有任何召回的优秀业绩记录，证明已达到高水准的质量。

Today 2023 – 28.000 bays in service



Europe

- Björklinge Energi Ekonomisk Förening
- Bodens Energi Nät AB
- Brittedals Elnät Ekonomisk Förening
- Elektra Nät AB
- Falu Energi & Vatten AB
- Hedemora Energi AB
- Hofors Elverk AB
- Härjeåns Nät AB
- Härnösand Elnät AB
- Kvänum Energi AB
- Lidköpings Elnät AB
- Ljusdal Energi AB
- Luleå Energi AB
- Mariestad-Töreboda Energi AB
- Mälarenergi Elnät AB
- Nossebro Energi
- Öljands Elektriska Distributionsförening
- Årviden Energi Elnät AB
- SE i Åsträngs Energi AB
- Sjögerstads Elektriska Distributionsförening
- Skellefteå Kraft
- Trollhättan Energi Elnät AB
- Varbergstogens Elkraft Ekonomiska Förening
- Vinninga Elektriska Förening
- VB Elnät AB
- Ålands Elandelslag
- Årsunda Kraft och Belysningsförening
- Österfärnebo EI
- Dala Elnät
- Dala Energi
- Katrineholm
- Kramfors
- LEVA i Lysekil
- Näkäns Energi AB
- Rejlers
- Tekniska Verken i Linköping
- Fortum
- Envikens Elnät
- Göteborg Energi AB
- Öresundskraft AB
- Halmstad Energi och Miljö Nät AB
- Balfour Beatty Rail AB
- Infratek Sverige AB
- Jönköping Energi Nät AB
- YIT Sverige AB
- Ale Elförening
- Falkenbergs Energi AB
- Eskilstuna Energi & Miljö Elnät

Sweden

- Sollentuna Energi AB
- Alingsås Energi Nät AB
- Varbergs Energi AB
- Nacka Energi AB
- Vetlanda Energi & Teknik AB
- ABB AB
- SIEMENS AB
- NCC Roads AB
- NEA VÅST AB
- Vattenfall Services Nordic Ab
- Elektro Skandia AB
- Skanska Sverige AB
- Linjemontage i Grästorp AB
- Svenska Kraftmontage

China

- AnDaCheng Electric Power Service Co. Ltd.
- AnNeng Electric Power Engineering Co. Ltd.
- BaiJia Electrical Engineering Installation Co. Ltd.
- BeiJiang Switchgear Co. Ltd.
- DuoBao Electric Power Engineering Co. Ltd.
- FeiYu Electric Appliance Installation Co. Ltd.
- Guizhou TianNeng Technology Co. Ltd.
- HaiHong Transformer Co. Ltd.
- HengHui Electric Power Engineering Co. Ltd.
- HongGuang Electric Power Engineering Co. Ltd.
- HongQuan Electric Power Engineering Co. Ltd.
- HuangDing Water & Electricity Install. Engineering Co.
- HuiCheng Power Electrical Installation Co. Ltd.
- JingNeng Electric Power Engineering Co. Ltd.
- JingSheng Electric Appliance Installation Co. Ltd.
- JingWang Power Electrical Installation Co. Ltd.
- KeYuan Electric Co. Ltd.
- KuanCheng Electric Co. Ltd.
- LiXing Electric Appliance Installation Co. Ltd.
- MinCheng Construction Engineering Co. Ltd.
- QiXing Electromechanical Installation Engineering Co.
- Omron Electric Power Engineering Co. Ltd
- + many more

Thank you!
谢谢!