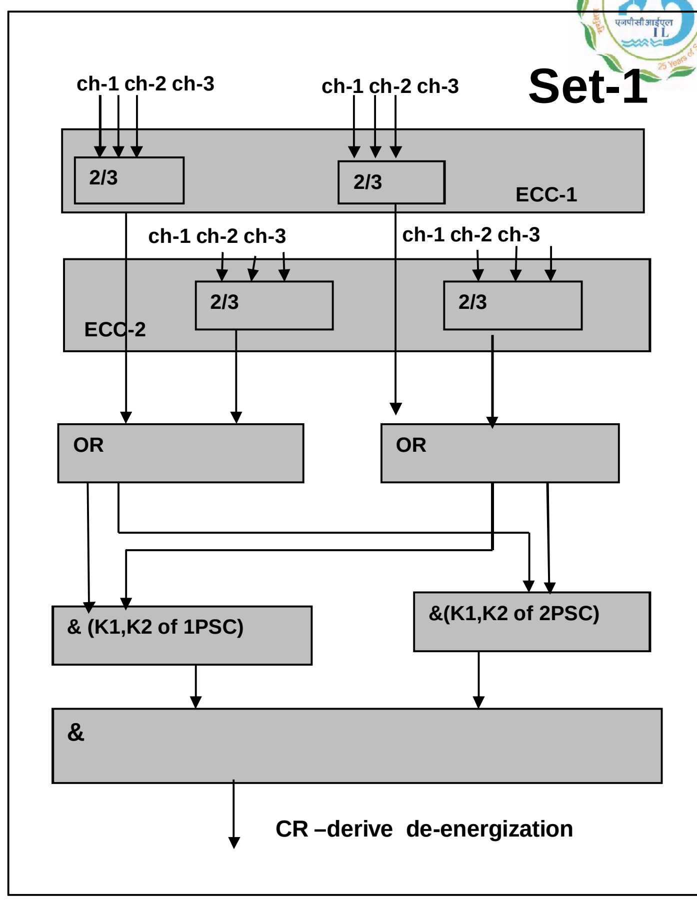
EP-PP ACTUATING PART

- Actuating part has two independent sets worked based on 1 out of 2 logic for generation of reactor protection signals.
- Each set receives protection signals from respective sets of initiating part.
- The main Constituents of EP actuating part are Emergency Command Generating (ECC) cabinets and Power Supply Cabinets (PSC)
- Under normal operation, 380V a.c supply to control rods is done vide K1 and K2 contractors of PSC6 cabinets.
- On receiving EP signal, it generates protection signals after 2/3 coincidence processing in ECC cabinets.
- On above signal, K1,K2 contractors of PSC get de-energised. This leads to cut off of main power supply to all 121 control rods which will fall under gravity for reactor trip.
- Facility to perform online testing including actuation of final contractors without dropping the control rods is available.

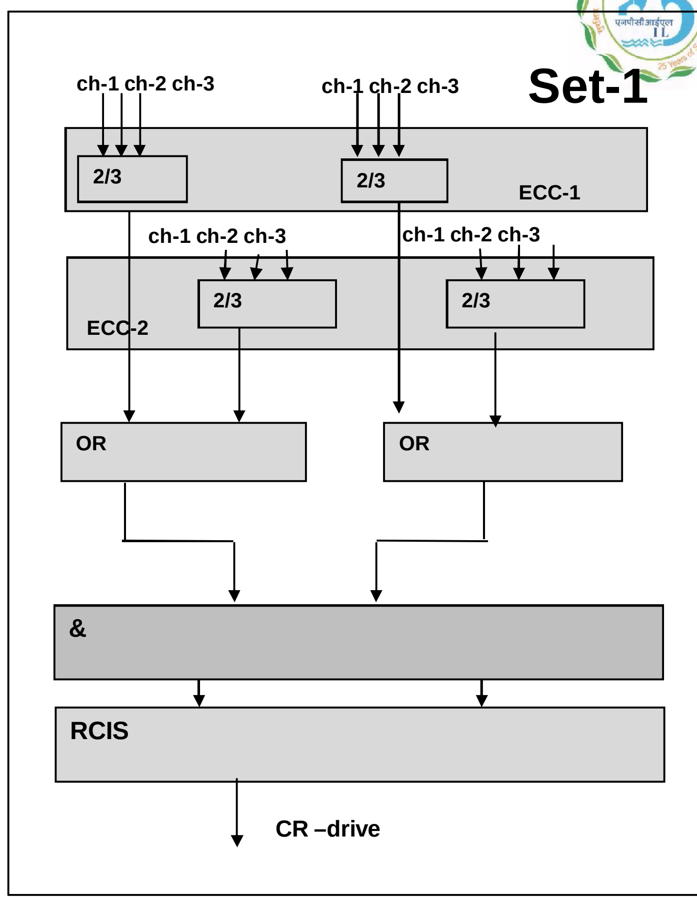
SAFETY LOGIC FOR EP- ACTUATING PART



EP-PP ACTUATING PART(Contd.)

- 2/3 voting logic processing for PP signals is done in same ECC cabinet as for EP.
- Output of ECC from both set are combined by AND & OR logic in multiplication cabinet of PP.
- Final Output for PP1, PP2 and APP are transmitted to RCIS for further action.

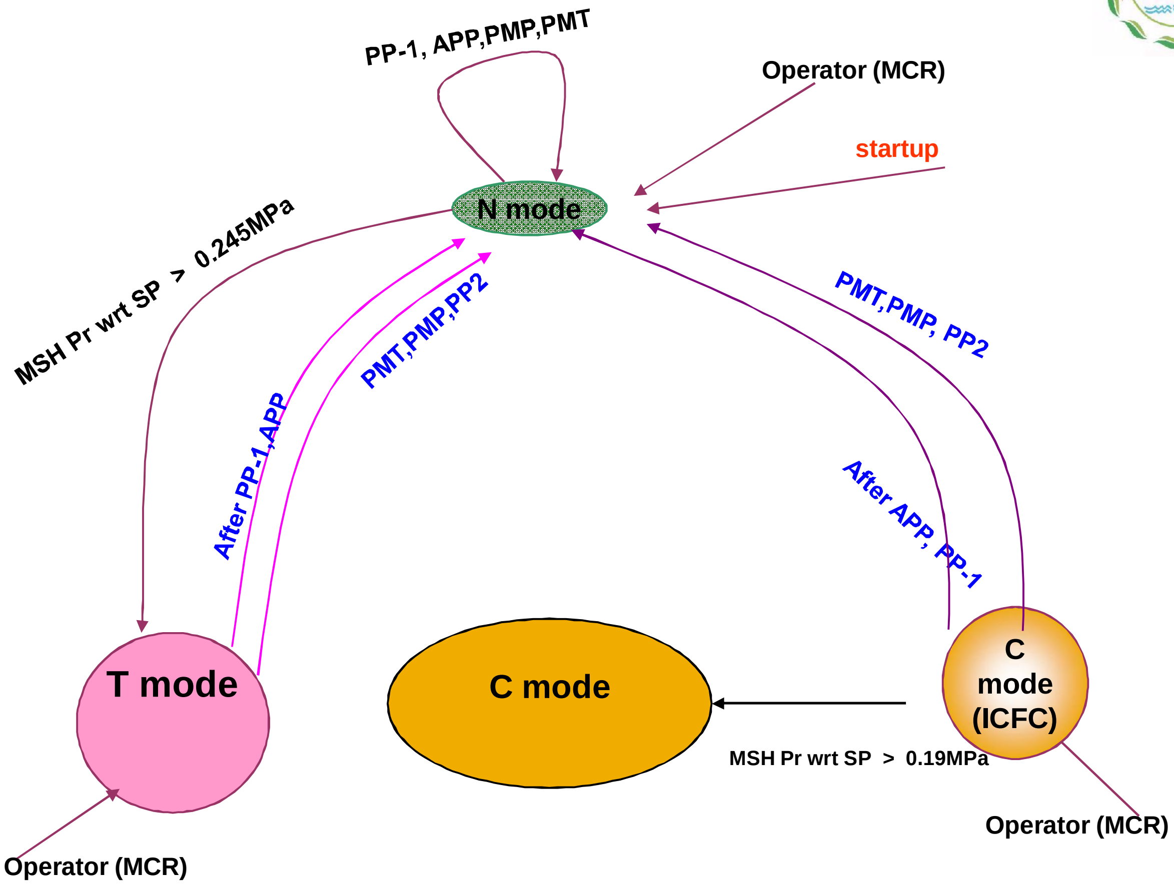
SAFETY LOGIC FOR PP- ACTUATING PART



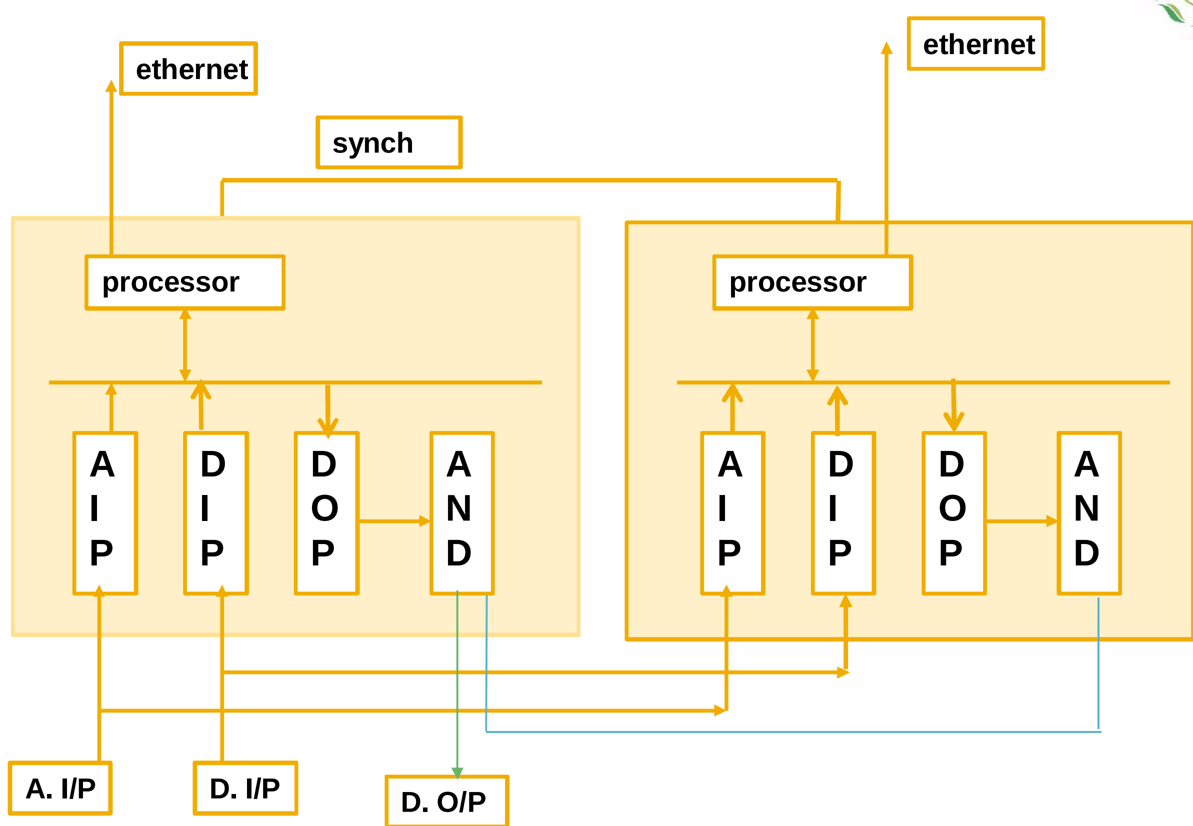
AUTOMATIC POWER CONTROLLER(APC)

- **Design Philosophy**:
  - Controls reactor during normal operation as well as during plant transient by maneuvering movement of Control Rods.
  - Works in three modes i.e. mode 'N', mode 'T' and mode 'C'.
  - In mode 'N', maintains neutron power within $\pm$ 1.5% of set value in the operating range of 3 – 100%.
  - In mode 'T', steam pressure of main steam header is maintained within $\pm$ 0.5 kg/cm2 in the range of 10 –100%.
  - In mode 'C', monitors the steam pressure while flux tilt control is being executed in-core flux control (ICFC) system.
  - Consists of two controllers working on hot standby principle.

MODES OF APC


PP-1, APP,PMP,PMT
Operator (MCR)
startup
N mode
MSH Pr wrt SP > 0.245MPa
After PP-1,APP
PMT,PMP,PP2
PMT,PMP, PP2
After APP, PP-1
T mode
C mode
C
mode
(ICFC)
MSH Pr wrt SP > 0.19MPa
Operator (MCR)
Operator (MCR)

STRUCTURAL DIAGRAM OF APC



SYSTEM ARCHITECTURE

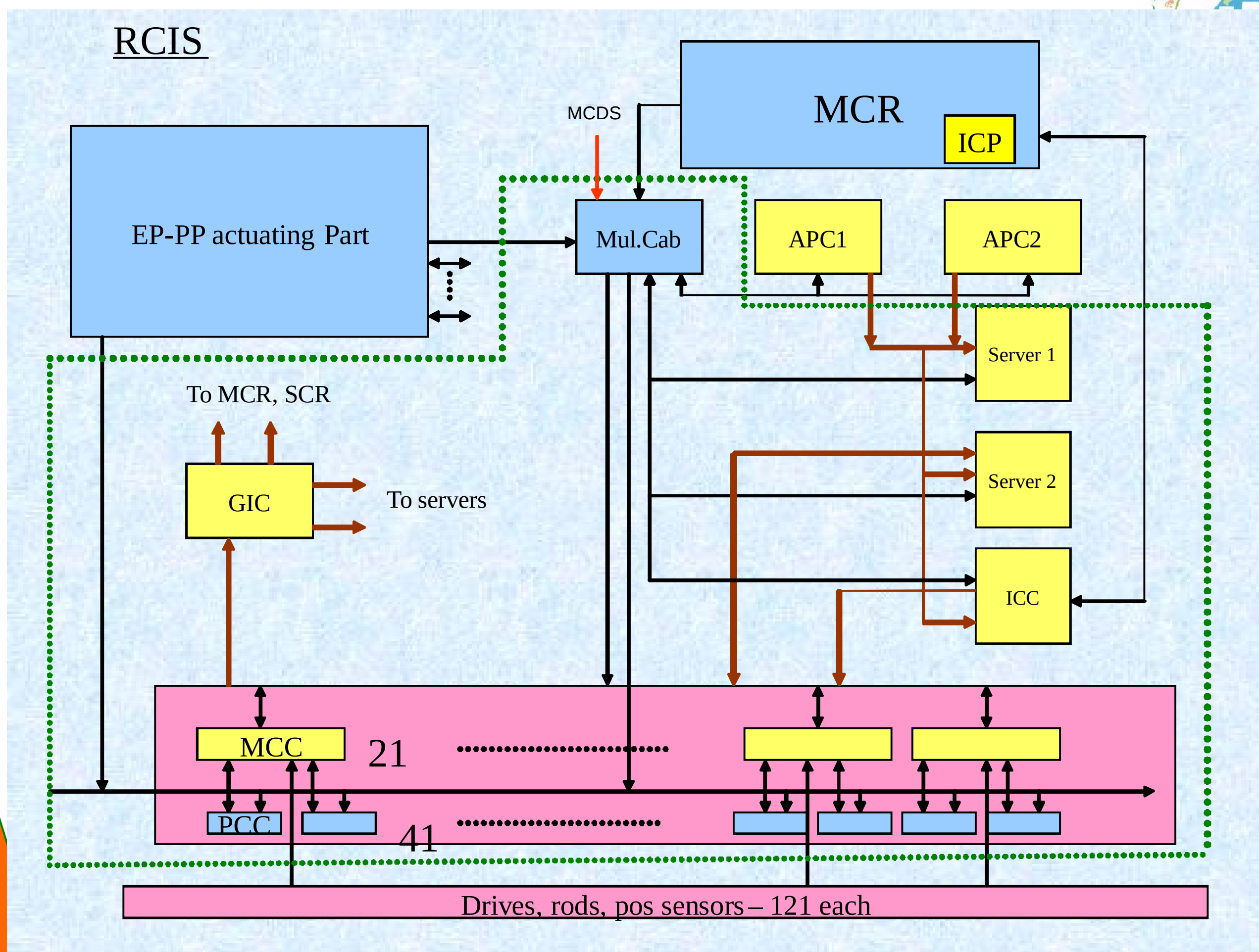
- **APC is consists of two micro-controller (MC1 , MC2)**
  - Each APC get independent sets of inputs
  - Each micro-controller
    - Has with its own bus, I/O cards
    - Gets same sets of I/P
    - Synchronized every cycle
    - Final O/P is generated by AND logic

ROD CONTROL AND INDICATION SYSTEM

▪ Design Philosophy

- Acts as the interface between control protection systems, operator and control rods.
- Control CR movement at constant speed of 20mm/sec and can hold CR at any position.
- At arrival of PP2 signal, it is inhibited to move CR- upwards.
- On set back (PP1) signal, it will move all CR groups downward one after another starting from the last group withdrawn in a strictly prescribed sequence, till PP-1 signal exists.
- On step Back (APP) signal, it will allow dropping one predefined group of CRs under gravity.
- Manual group and individual control of CRs.
- Performs CR movement as per priority checking of received signals (PP, APC, MCR).
- Generates CR Position signals in the form of 9 bit unique code for each position of CR.
- Comprehensive online diagnostic capabilities

SYSTEM ARCHITECTURE



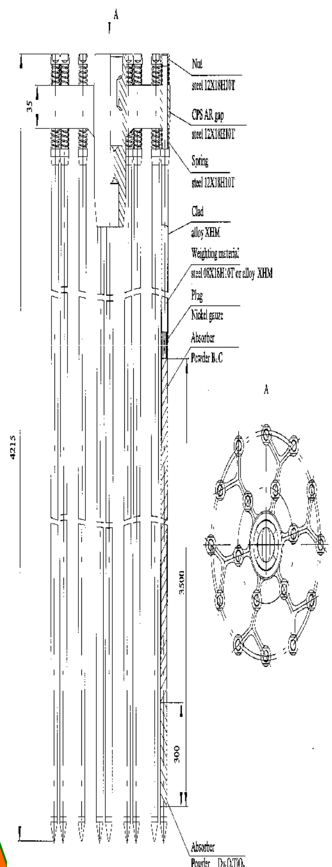
SYSTEM ARCHITECTURE

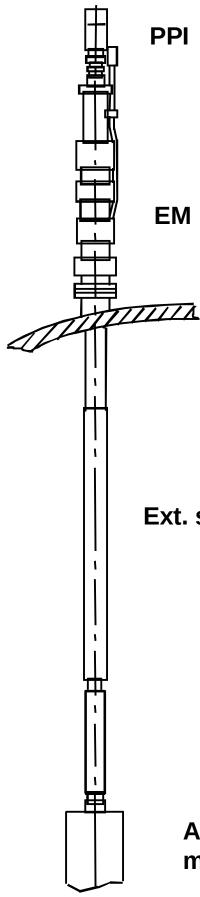
- **RCIS consists of following parts**
  - ➢Monitoring Control Cabinet (MCC) for generation of command for upward and downward movements of CR and monitoring of CR position.
  - ➢Power Control Cabinet (PCC) uses thyristor based power circuits for moving CR upwards or downwards at the working speed by forming current cyclogram for energization/ de-energization of electromagnet of CR-drive.
  - ➢Group Indication Cabinet (GIC) for indication of CR position in MCR
  - ➢Individual Choice Cabinet (ICC) to implement the function of individual control of CRs form MCR .
  - ➢Two redundant Servers for acquisition and processing of the data from EP-PP actuation part/APC/RCIS systems.

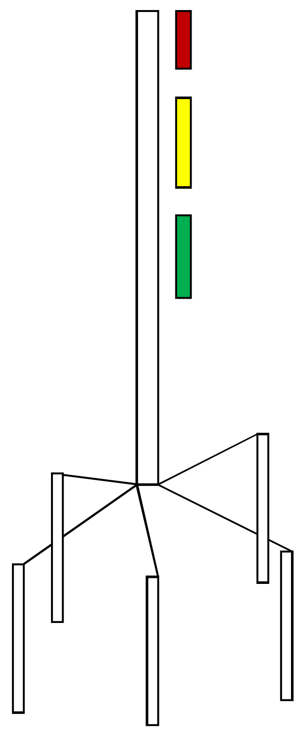
FINAL CONTROL ELEMENT

- The reactor control and protection system consists of 121 CR ($B_4C + Dy_2O_3$) distributed into 10 groups.
- CRs are used for start up, power control, excessive reactivity compensation & reactor shut down.
- To control the reactor power, CR groups 8th to 10th are used.
- On EP signal, all the CR groups are dropped under gravity to shut Down the reactor.
- Each CR consists of 18 absorbing elements, gripping cap & individual suspension springs. The CR cap has a receptacle for bayonet engagement with CR-drive extension shaft.
- Extension shaft is coupled with displacement unit, which in turn interacts with 3 electromagnet called pulling magnet, latching magnet & fixing magnet, respectively.
- Displacement of extension shaft is performed by successive actuation of electromagnets by current cyclogram, movable latch of displacement unit should move the extension shaft and the fixing latch should hold it between displacements.

CR DRIVE MECHANISM







CONCLUSION

- Some of the challenges are unique to C&I of Nuclear Industry to ensure safety with high degree of reliable and efficient operation of Power Plant
- RCPS contributes significantly by controlling reactor power during normal operation and tripping reactor at hour of need.
- Software are extensively used safety related system like APC and RCIS. In future, it may possible to use computer based system even for protection systems of Nuclear industry.

Thank You

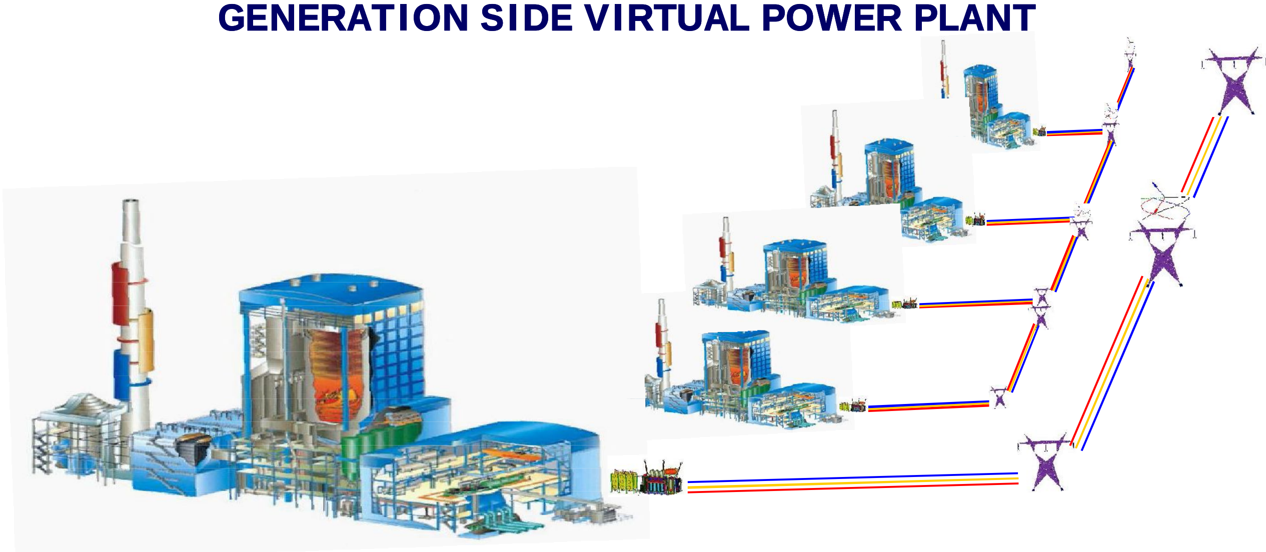
EDIFYING THE SMART FUTURE OF POWER UTILITIES BY ANALYSING THE BENEFITS OF GENERATION SIDE VIRTUAL POWER PLANT

Saroj Chelluri, DGM (PE-Elect) NTPC Ltd, Amit Kulsheshtra DGM (PE-Mech) and Prasenjit Pal, DGM & STA to Director (Tech), NTPC Ltd

EDIFYING THE SMART FUTURE OF POWER UTILITIES

BY

ANALYSING THE BENEFITS OF GENERATION SIDE VIRTUAL POWER PLANT

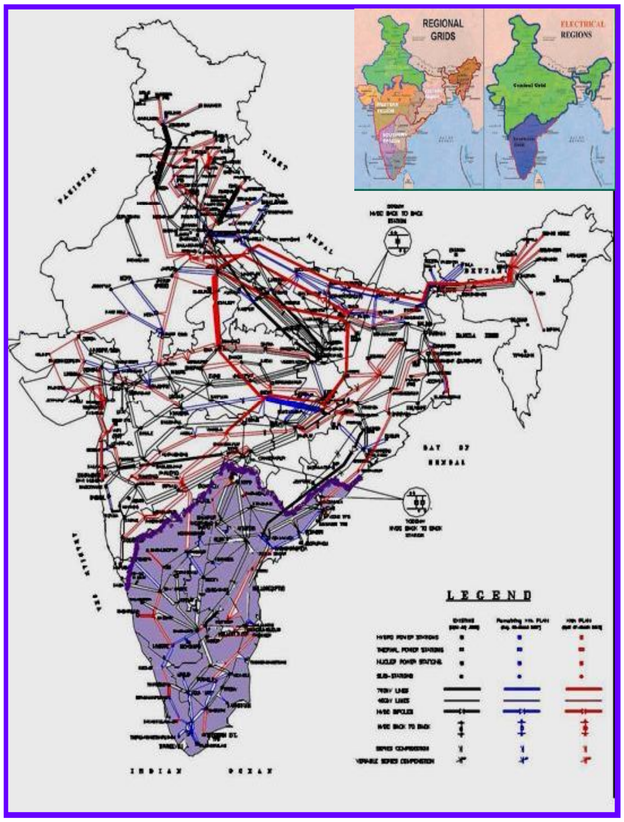


ISA(D) POWAT-INDIA 2012, New Delhi January 13th -14th, 2012

PREVIEW

- Introduction
- Indian Power Grid And Scenario
- The Game Changer
- The Concept of Generator side Virtual Power Plant (VPP)
- Standards For Integration And Data Connectivity For A Virtual Power Plant
- Evaluation Of The VPP Concept
- Conclusion

INDIAN POWER GRID



- Indian Grid is one of the largest transmission network carrying 1,50,000 MW of Power.
- 2700 Circuit km of 765 KV Lines
- 90,000 Circuit km of 400 KV lines
- 1,23,000 Circuit km of 220 KV lines

The whole grid was originally divided into five regional grids namely the North, West, East, Northeast and South. As of now four of these are operating in the synchronous mode since August 2006 it is called the “New Grid” The Southern Regional grid is presently connected to the new grid through several High Voltage Direct Current (HVDC) asynchronous ties and a AC lines in radial mode

INDIAN POWER SCENARIO

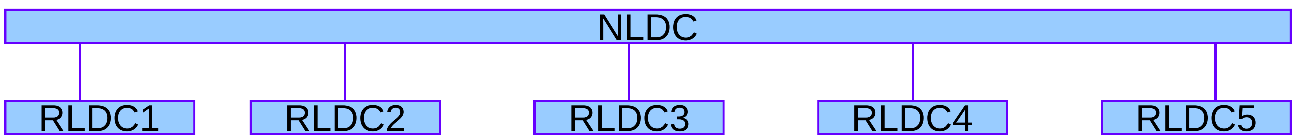
REGION WISE INSTALLED CAPACITY IN MW

REGION	THERMAL	HYDRO	NUCLEAR	TOTAL
NORTHEN	30816.75	14922.75	1620	47359.50
WESTERN	41986.79	7447.50	1840	51274.29
SOUTHERN	26622.57	11338	1320	39280.60
EASTERN	21390	3882	0	25272.25
N-EASTERN	989.74	1158	0	2147.74
TOTAL R.E.S.				20162.24

TOTAL INSTALLED CAPACITY 185496.62 MW

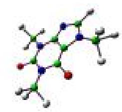
As on 09/01/2012 reference www.cea.nic.in

INDIAN POWER GRID



- National Load Despatch Centre (NLDC) is the apex body responsible for ensuring integrated operation of National Power system.
- Regional Load Despatch Centres (RLDC) as per the Electricity Act 2003 has been designed as the apex bodies in their concerned region for secure, economic and efficient operation of the grid.
- Regional Framework as provided by the Indian Electricity Grid code (IEGC) notified by Central Electricity Regulatory Commission (CERC) lays down rules, guidelines and grid standards

THE GAME CHANGER



Whether We Call It an Evolution Or Revolution, The Future Of The Power Business Will Be Dependent On The Quality Of The Interface Built Between The Power Generator, The Transmission Grid System And The Market

The Creation Of This Interface Means The Integration Of Millions Of Intelligent Endpoints And An Exponential Increase In Data That Must Be Communicated, Managed, And Acted Upon In Real Time

VIRTUAL POWER PLANT FOR A GENERATION UTILITY

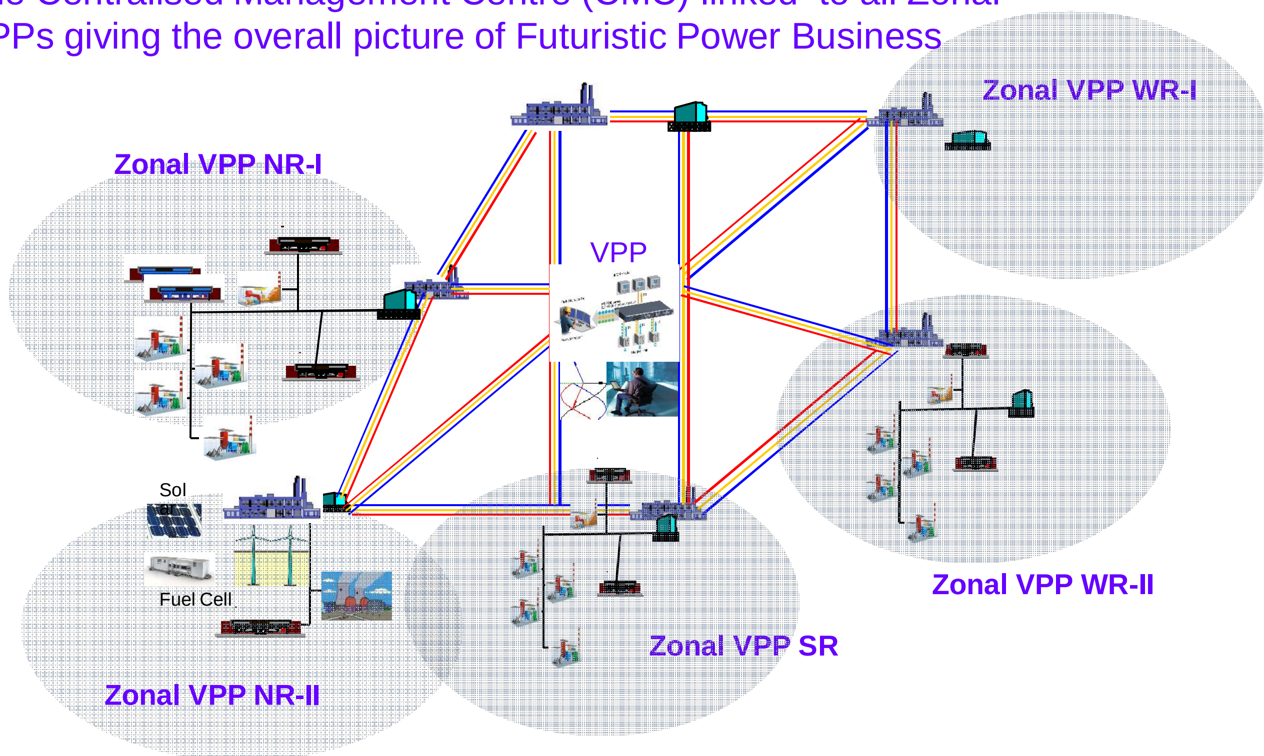
- Smart Grid Strategic Group (SG3) Prepared The IEC Smart Grid Standardisation Road Map In June 2010
- The roadmap conceptualizes the Virtual Power Plant concept in SAMRT Grid
- A Virtual Power Plant (VPP) In This Context Is Defined As A Collection Of Decentralised Generation Units That Can Be Monitored And Controlled By A Super Coordinating Energy Management System
- The Concept Of VPP Has Been Mainly Created For Distribution Side In The Smart Grid Concept.
- A Generic Concept Of Creating The Virtual Power Plant (VPP) For The Generation Side And Edifying The Benefits For A Power Generator Utility From Such A Model Is Studied

GENERATION SIDE VIRTUAL POWER PLANT (VPP)

- The Concept Visualised In This Paper Has Considered The Geographical Spread Of Power Utility Generation Stations And Created Geographical Zone Wise Virtual Power Plants (VPP)
- Region Wise Generation Side VPP Has Been Considered Coinciding With The RDC Concept Of The Indian Grid As:
  - North I & II
  - South
  - East I & II
  - West I & II
  - Central VPP

VIRTUAL POWER PLANT (VPP) FOR A GENERATION UTILITY

The Centralised Management Centre (CMC) linked to all Zonal VPPs giving the overall picture of Futuristic Power Business

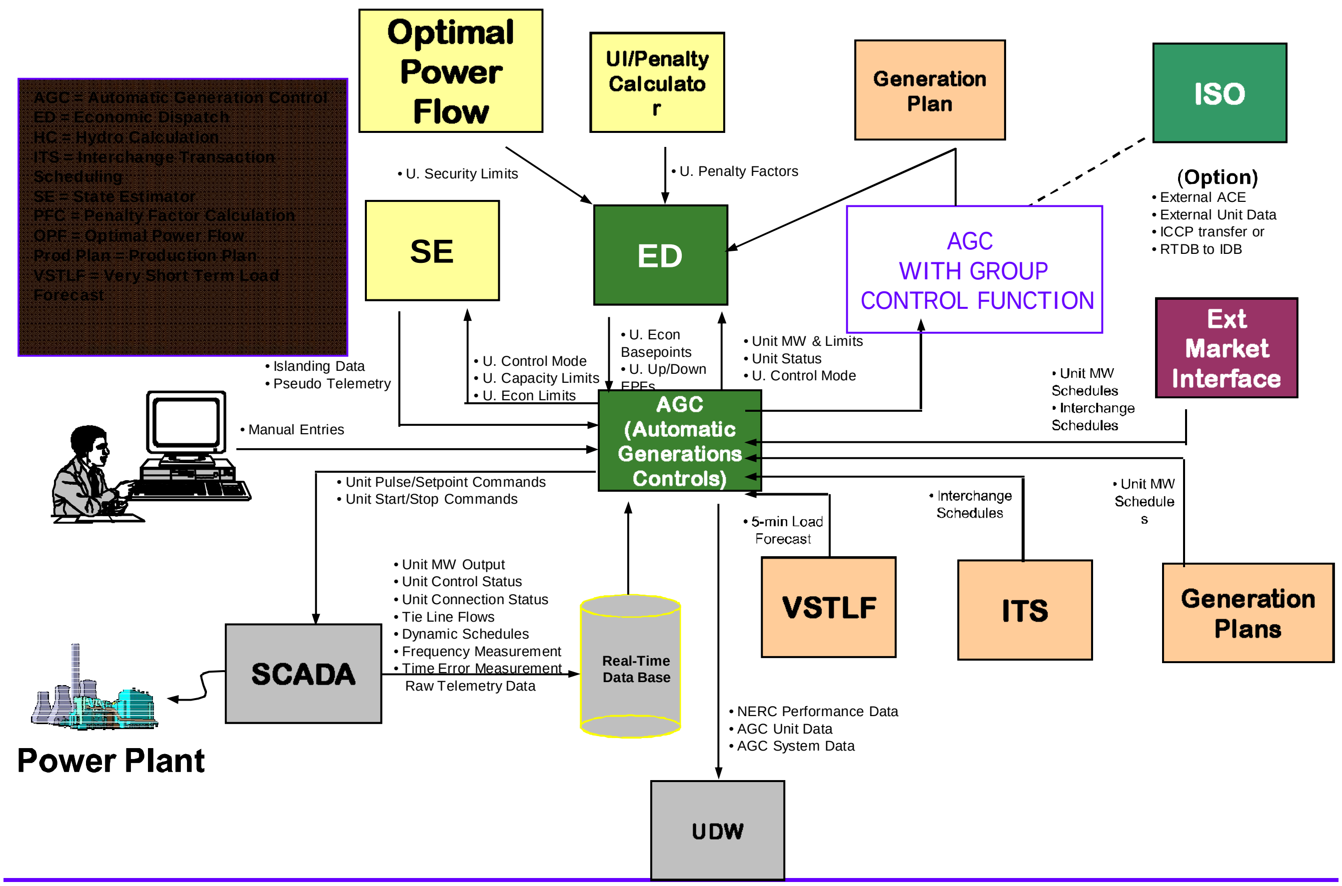


FUNCTIONS FOR GENERATION SIDE VPP

Major functions for which the Generation side VPP shall be Modelled and Designed are:

- Minimization of cost to customer and maximizing revenue to generator by internal optimization of operation
- Generation Scheduling and Dispatch
- Transaction Evaluations
- Demand response and Short Term Load Forecasting
- Asset management
- Emissions Dash Board
- Capability, Availability and Status of Evacuation Lines
- Fuel Status and Monitoring
- Portfolio management

GENERATION SIDE VPP OVERVIEW



AUTOMATIC GENERATION CONTROLS (AGC) ZONE VPP

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- In case of Zone VPP **the Concept of AGC needs to be extended to the group controls**. As in each zone the number of generators shall be more than one, a coordinated group control needs to be designed
- AGC also needs to provide Group control capability to control a group of generating units by sending a single control command for Zone VPP Generation control Concept. Both raise/lower pulse and set point group controls are required to be provided.
- The configuration of generator grouping shall be defined in the database

Automatic Generation Controls (AGC) For a Zone VPP

- Each generating unit provides an Individual/Group status signal to AGC in addition to the Local/Remote status.
- In a given group configuration, only the generators that have their status set to remote and Group will be controlled as a group.
- The units that are in remote and individual will be controlled individually.
- In addition, a Local/Remote status signal for the entire group may be defined so the plant personnel can switch the control of the group of generators from AGC to the local computer at the plant

Demand response (DR) and Short Term Load Forecasting (STLF)

- Short Time Load Forecast (STLF) and DR helps reduce operating costs through better scheduling of unit start up and shut down, as well as a lower spinning reserves. This provides the opportunity to run the units at higher load
- The Smart Grid facilitates on-line data availability that will suit the Neural Network technology and an accurate forecast can be achieved using the adaptive pattern recognition technology of neural networks
- The Zone VPP can import externally generated load forecast from the Grid for display and use in developing the load forecast
- Using this advanced technology, the Network Manager STLF can provide an indispensable tool for electric utilities during the shift from cost-based pricing to market based pricing.

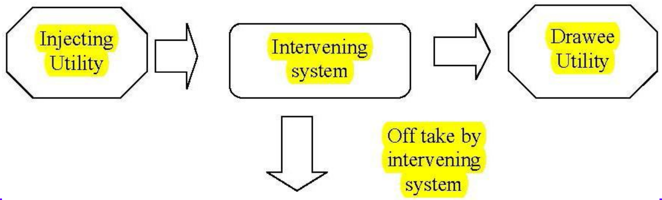
Fuel Status Monitoring & Emissions Dash Board

- Fuel Data At Other Plants And Zones Can Also Trigger Suggestive Generation Schedules From A Particular Zone /Unit Generator To Meet The Unit Commitment
- The parameters on the dash board shall be Fuel Data such as Coal Parameters, Calorific value, Stock availability for next day/ week/month and sourcing Data.
- Economic Despatch module in VPP shall enforces fuel and emission constraints through an interface with the Thermal Unit Commitment subsystem

Specific SOx (mg/Nm3)	
Specific NOx (mg/Nm3)	
Specific Mercury (µg/dscm)	
SPM (mg/Nm3)	
RSPM (µg/Nm3)	
Ash Utilization (%)	

REAL TIME STATUS OF EVACUATION LINES

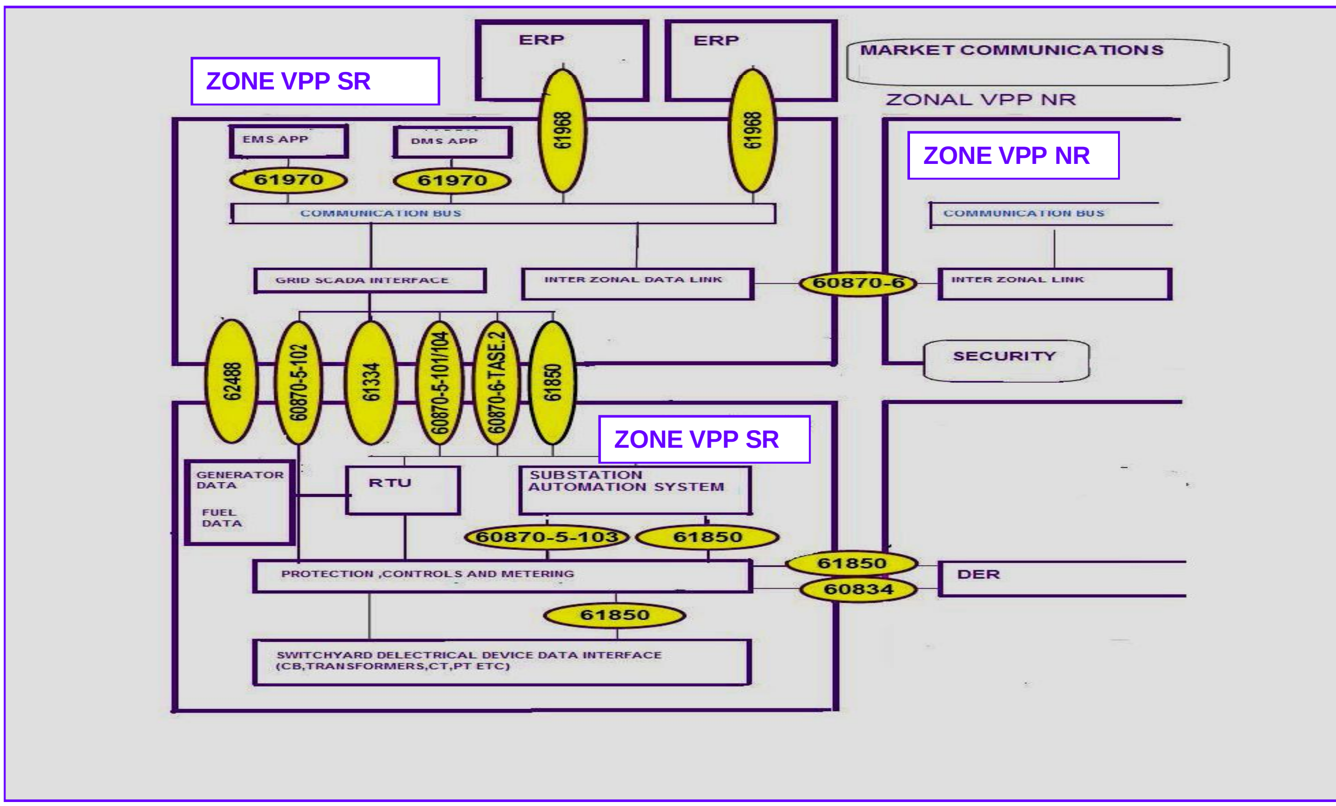
- On-Line Real Time Data Of Evacuation System And Availability Data Integrated Into The VPP Model Shall Provide The Required Leverage For Generation Rescheduling, Unscheduled Interchanges (UI) and Spinning Reserve
- As Of Now Long Time Access Contracts With States Are Tied, But In Near Future As More And Competition Is Generated, The Business Scenes May Change Leaving The Market In A *Free State* Where In The Prices Are Controlled By Demand And Supply
- Power Companies May Be Facing A Completely New Situation With More And More Deregulation Of The Energy Market, As Long-term Contracts May Get Replaced By Daily Competition



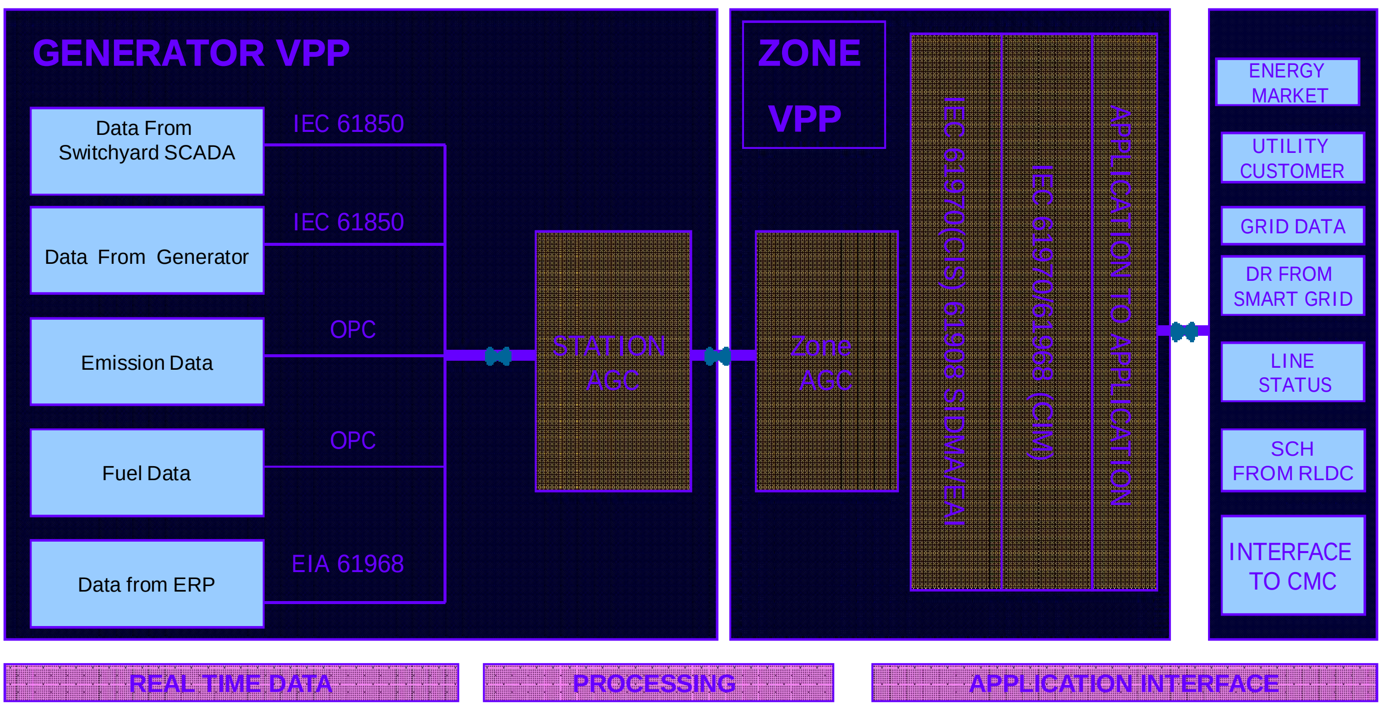
DATA INTERFACE MODEL OF GENERATION SIDE VPP

- The concept of VPP is based totally on a common semantic (data model), common syntax (protocol) and a common network concept.
- IEC 62357 Reference architecture addresses the communication requirements of the application in the power utility domain
- IEC 61850 supports the direct data exchange of data between IED's thus enabling switching interlocks across feeders independently of the station control units
- IEC 61850-7-420 is perfectly suited for the IEC 62357 reference architecture and Zonal VPP concept for distributed energy resource logical nodes
- IEC 61970 for CIM defines the direct language and data modelling with the object of simplifying the exchange of data between Zone VPP and the Central Management stations and also with the external environment (Supply Grid/Market etc) to the VPP

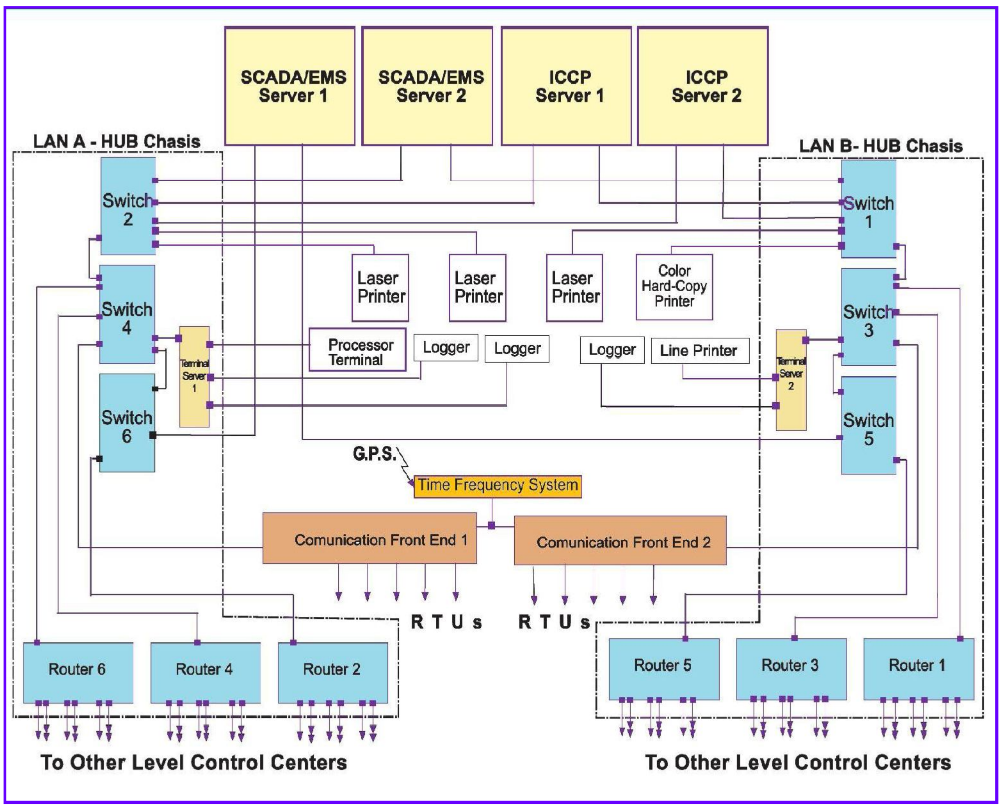
DATA INTERFACE MODEL For IEC 62357

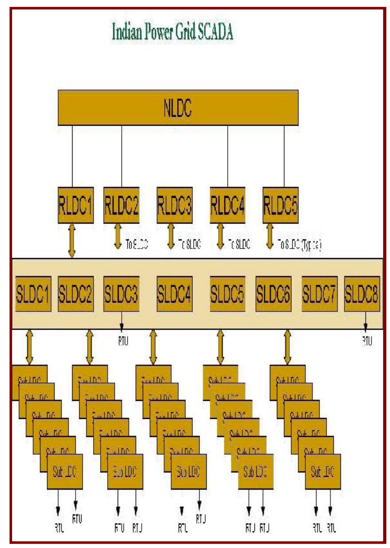


THE VIRTUAL POWER PLANT BASED ON REF ARCHITECTURE OF IEC 62537



INDIAN POWER GRID SCADA





EVALUATION OF THE VPP CONCEPT

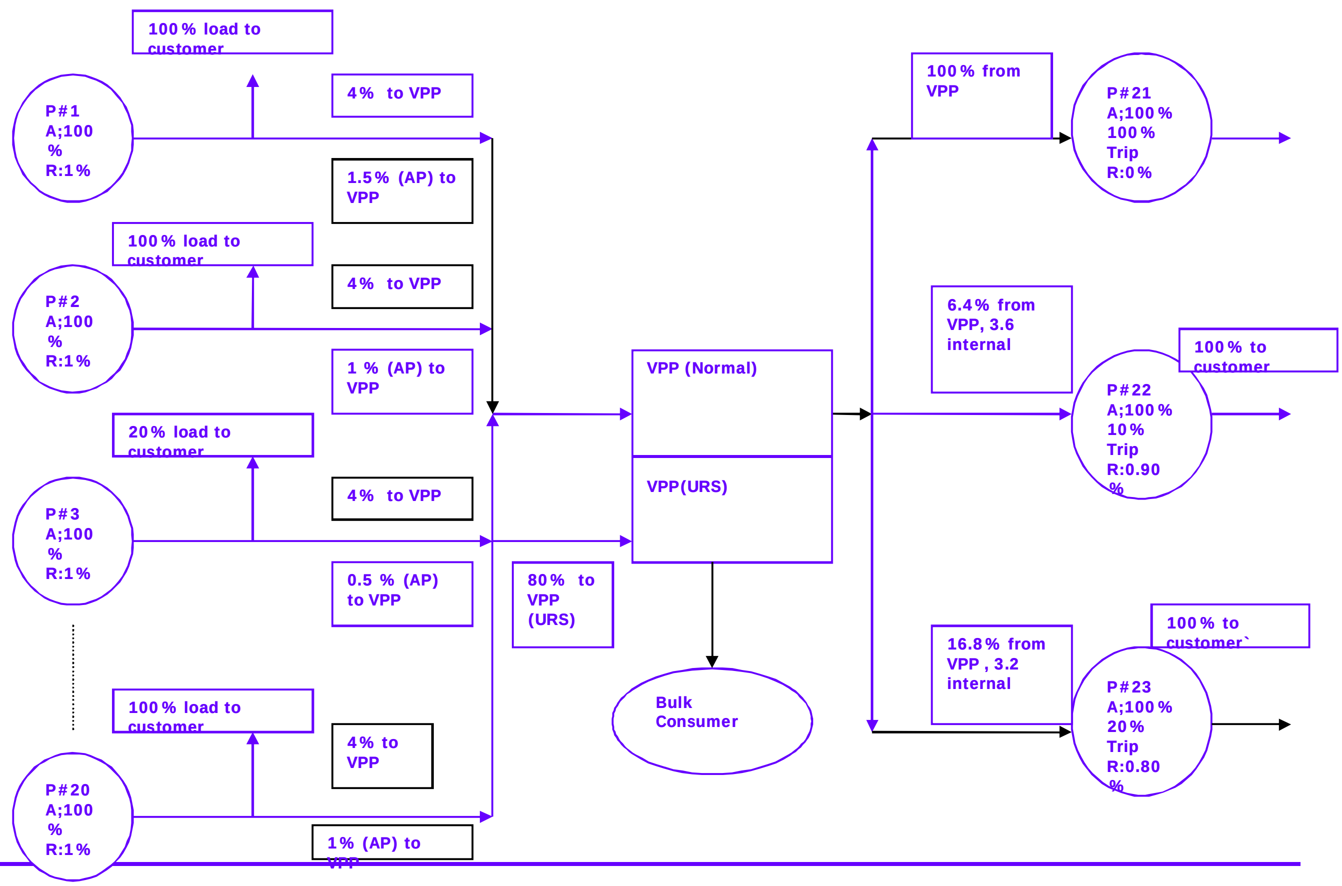
The Advantages Of Creating A Dynamic Generator Side VPP Are

- Real Time Visualization Of The Generation Status And Capability Along With Fuel, Emissions Status, And Available Evacuation Lines Capability And On Line Cost Of Generation
- Analytical Capability And Controllability Of The Model For Effective Portfolio Management And Asset Utilisation
- Two Way Communication With The Power Grid For Smart Power Generation Options
- The Ultimate Benefit Can Be Reaped With SMART GRID In Place And Data Connectivity Through Standard Protocols
- Application Model For The Generation Side VPP Need To Be Developed And Tested For A Prototype

The Transaction Evaluation (TE) function For VPP

- The Transaction Evaluation (TE) function in VPP concept needs to evaluate the economic results of possible energy transactions with interconnected utilities
- The Transaction Evaluation programs shall model for the cost and operational aspects of the Generators for including:
  - Piecewise linear or polynomial incremental heat rate curves for each of the unit.
  - Time-dependent start-up costs
  - Maintenance and de-ration of units at selected hours
  - Spinning and operating reserve
  - Fixed generation at selected hours
  - Fuels status
  - Emission Penalties (futuristic)
  - Fixed transactions

VPP Concept Diagram



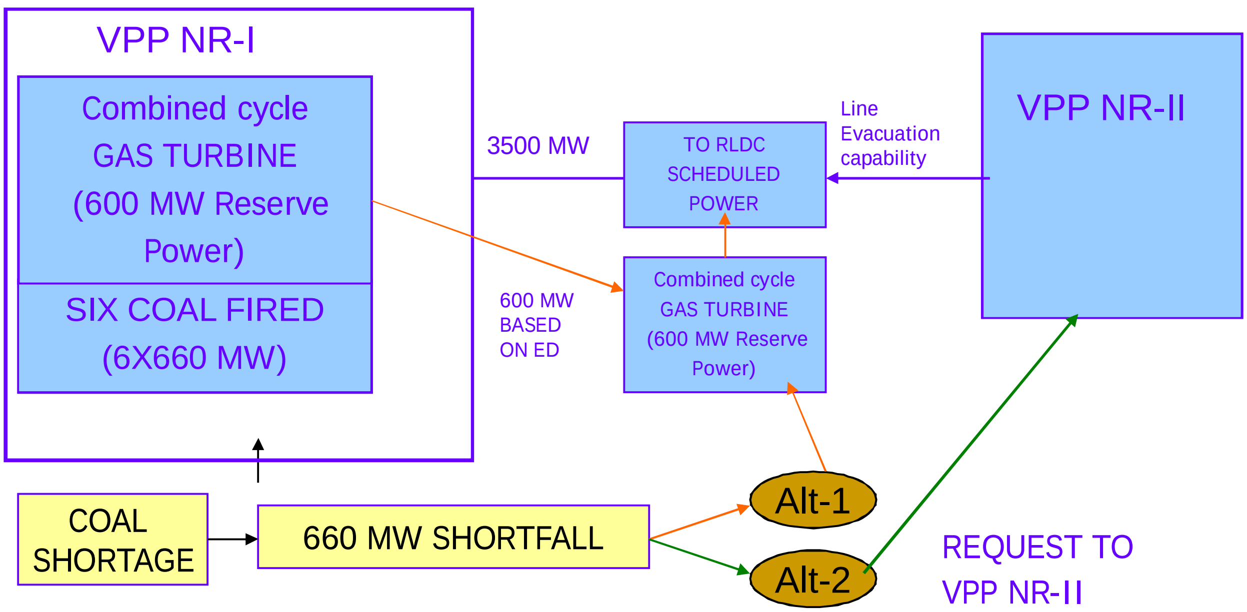
Calculation Methodology

- Selection of Receiving and Generating Stations Based on maximum earning potential
- Allocation of power to receiving Station from generating station through VPP
- Additional Revenue =

  $\{(COE)_{Rec} - (COE)_{gen}\}$ X Energy Supplied (kWh)
- Declaration of Station and VPP Capacities shall be made dynamic based on actual outages
- Plants with higher cost of generation need not be included in VPP

PORTFOLIO MANAGEMENT

Portfolio Management Module In VPP Shall Provide Additional Information On "Forecasting And Usage Planning" And "Monitoring And Control"



VPP AS A WIN- WIN SITUATION

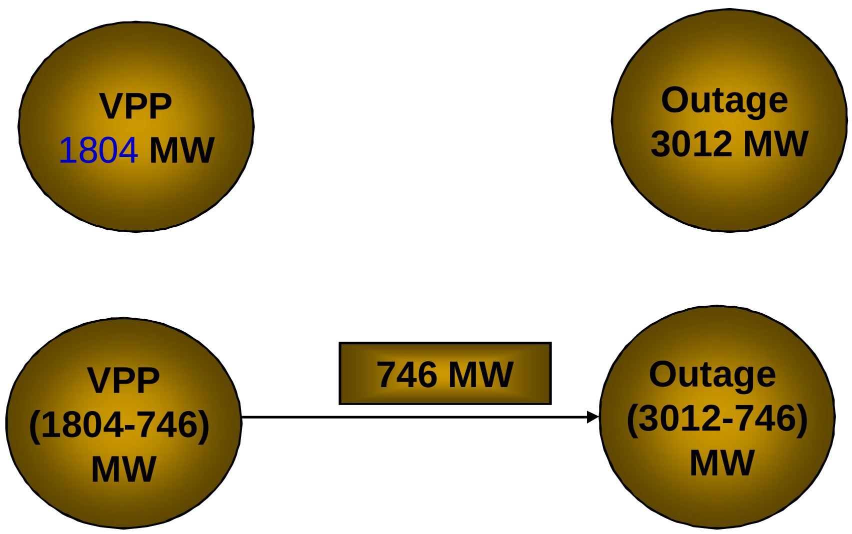
- The VPP concept can meet the contingencies of plant trip, forced unavailability or scheduled overhauls
- In such a situation the consumer's demand is met at the contracted fixed and variable cost
- The Generator is also benefitted as it can honour the contract and does not loose the fixed cost and the incentive
- There can also be benefits from higher efficiency and lower percentage of auxiliary power consumption due to plant operating at peak load

Conclusion

The Virtual Power Plant (VPP) Is The Power Plant Of The IT Mind - A Plant Locked In The Digital World That Can Shift The Traditional Generation To Smart-grid-enabled Parameters Making Generators Work **SMARTER** Rather Than **Harder**

Thank You

Glimpse of VPP working



Additional Income per hour – Rs. 5.5 lakh

Projected Average Annual Income– Rs. 476 Crore

PLANT	CAPACITY	AVBLTY	DC	SG	FC+ EC	OUTAGE	URS	CAP TO VPP	VPP POWER(AVL)	VPP POWER (SUPPLY)	INCOME
Singrauli	2000	1800	1735	1735	1.85552	200	0	81	0	Int	36990
RihandI	1000	1000	800	800	2.28607	0	0	45	45	Tal S K1	31026
RihandII	1000	1000	977	977	2.41851	0	0	45	45	Tal S K1	1086
Unchahar-I	420	420	360	360	3.05053	0	0	18.9	19	Tal S K1	17275
Unchahar-II	420	420	360	350	3.1852	0	0	18.9	19	KH -II	5372
Unchahar-III	210	210	180	180	3.53174	0	0	9.45	9	KH -II	4383
Tanda	440	440	482	432	3.87835	0	0	19.8	20	KH -II	0
Dadri -C-I	840	630	585	535	3.83555	210	0	28.35	0	0	0
Dadri-C-II	980	980	922	922	4.25399	0	0	44.1	44	0	0
Badarpur	735	495	448	448	4.01931	210	0	22.275	0	0	143
Anta	419	280	262	239	4.09619	139.33	23	35.6	36	KH -II	0
Auraiya	633	663	616	572	4.12731	0.36	46	75.835	76	0	0
Faridabad	432	432	404	404	4.19404	-0.414	0	19.44	20	0	23086
Dadri-G	830	830	800	750	3.83592	-0.22	50	87.35	87	KH -II	158828
Korba	2100	2100	1800	1800	1.42736	0	0	94.5	95	Tal S K1	0
Korba-II	500	0	0	0	2.49635	500	0	0	0	0	43506
Vindyachal-I	1250	1260	1180	1180	2.34079	0	0	56.7	57	Tal S K1	32917
Vindyachal-II	1000	1000	935	935	2.37658	0	0	45	45	Tal S K1	17889
VindyachalII	1000	1000	980	930	2.71053	0	0	45	45	Tal S K1	20461
Sipat-I	630	660	600	600	2.41914	0	0	29.7	30	Tal S K1	47534
Sipat-II	1000	1000	971	971	2.85176	0	0	45	45	Tal S K1	0
Kawas	656	328	627	502	4.14537	328.2	125	139.76	140	0	0
Gandhar	657	438	605	316	4.23332	219.39	289	308.71	309	0	0
Ramagundam	2100	1900	1810	1810	2.10843	200	0	85.5	0	0	10831
Ramagundam-I	500	500	482	482	2.6257	0	0	22.5	23	Tal S K1	0
Simhadri	1000	500	0	0	3.21354	500	0	22.5	0	0	0
Simhadri-II	500	500	475	475	4.50314	0	0	22.5	23	0	0
Kayamkulam	350	359.577	336	0	13.273	0	336	354.180965	354	0	0
Farakka	1600	1600	955	955	4.43365	0	0	72	72	0	0
Farakka-II	500	0	0	0	0	500	0	0	0	0	11790
Kahalgaon -I	840	840	710	710	3.7853	0	0	37.8	38	KH -II	0
Kahalgaon -II	1500	1000	700	720	4.10021	500	0	45	0	0	0
Talsupr-K1	1000	500	420	420	3.10807	500	0	22.5	0	0	88641
TalSupr-K2	2000	2000	1935	1935	3.11531	0	0	90	90	KH -II	0
Taltarn-Th	460	460	422	422	0	0	0	20.7	21	0	0
											551759

TOTAL INCOME FROM VPP	39.73	Crores per month
	476.72	Crores /year

REAL-TIME GENERATION DATA OF NTPC STATIONS 06/12/2011 16:25:59 Block= **66** Inst Freq central= **49.69** Hz South= **49.57** Hz

STATION	CAP	Avail	U1	U2	U3	U4	U5	U6	U7	U8	U9	U10	Total	LF	DC	SG	AG	AVG	AG/DC	AVGFREQ	UI	Price G/R/L
SINGRAULI	2000	1800	216	217	214	213	0	500	512				1872	104.03	1735	1735	1748	1746	100.66	49.69	403	172
RIHAND-I	1000	1000	364	508									872	87.17	800	800	802	804	100.49		403	136
RIHAND-II	1000	1000			527	521							1048	104.80	977	977	996	994	101.75		403	136
UNCHAHAR-I	420	420	202	190									391	93.20	360	360	361	362	100.58		403	224
UNCHAHAR-II	420	420			202	200							402	95.63	360	360	366	359	99.78		-403	223
UNCHAHAR-III	210	210					196						196	93.54	180	180	181	181	100.55		403	224
TANDA	440	440	118	109	115	115							457	103.97	402	402	407	407	101.21		403	274
NR	**5490**	**5290**											**5238**	**99.02**								
DADRI-C-I	840	630	210	215	0	211							636	100.91	585	585	588	588				
DADRI-C-II	980	980					491	490					980	100.05	922	922	931	928				
BADARPUR	705	495	93	96	93	0	211						493	99.55	448	448	447	449				
ANTA	419.33	280	79	0	80	91							250	75.77	262	239	248	247				
AURAIYA	663.36	663	101	103	103	101	99	101					607	91.56	618	572	598	597				
FARIDABAD	431.586	432	129	132	147								407	94.39	404	404	399	399				
DADRI-G	829.78	830	121	126	139	119	122	135					763	91.96	800	750	748	748				
NCR	**4869**	**4310**											**4136**	**95.96**								
KORBA	2100	2100	202	206	203	437	479	429					1956	93.15	1800	1800	1819	1825				
KORBA-II	500	0							0				0		0	0	0	0				
VINDHYACHAL-I	1260	1260	220	213	222	221	219	218					1313	104.23	1180	1180	1187	1177				
VINDHYACHAL-II	1000	1000							505	492			996	99.65	935	935	942	938	100.30		403	162
VINDHYACHAL-III	1000	1000									516	507	1023	102.26	980	980	984	984	100.36		403	162
SIPAT-I	660	660	642										642	97.24	600	600	610	607	101.17		403	-
SIPAT-II	1000	1000				518	525						1043	104.26	971	971	980	491	50.58		-403	101
KAWAS	656.2	328	97	96	110	0	0	0					302	92.17	627	502	296	572	91.16	49.68	403	202/759/894
GANDHAR	657.39	438	106	0	106	122							334	65.15	605	316	328	328	54.16		403	205/760/-
WR	**8833**	**7786**											**7609**	**97.73**								
RAMAGUNDAM	2100	1900	0	199	187	512	509	515					1921	101.13	1810	1810	1818	1816	100.32	49.59	403	161
RAMAGUNDAM-II	500	500							516				516	103.29	482	482	485	484	100.49		403	176
SIMHADRI	1000	500	498	1									500	99.93	0	0	466	466			403	265
SIMHADRI-II	500	500			512								512	102.48	475	475	0	0	00.00		-564	265
KAYAMKULAM	359.577	0	0	0	0								0		338	0	-3	-2	-00.66	49.58	-654	-/-/978
SR	**4460**	**3400**											**3454**	**101.59**								
FARAKKA	1600	1600	201	206	202	113	492						1213	75.84	955	955	1141	1119	117.17	49.67	403	315
FARAKKA-II	500	0						0					0		0	0	0	0			0	
KAHALGAON-I	840	840	198	199	202	198							796	94.78	710	710	726	718	101.13		403	312
KAHALGAON-II	1500	1000					0	362	371				733	73.30	700	700	688	696	99.43		-403	295
TALSUPR-K1	1000	500	0	465									465	93.01	420	420	429	432	102.77		403	273
TALSUPR-K2	2000	2000			495	507	513	492					2007	100.37	1935	1935	1904	1917	99.06		-403	273
TALTHRM-TH	460	460	64	64	62	62	112	113					477	103.60	422	422	427	427	101.18		403	93
ER	**7900**	**6400**											**5691**	**88.92**								
COAL (COM)	27035	24215											23472	96.93								

http://191.254.198.107/gdams/outage_drilldo...

REASON	400 KV Switch Yard Bus-3 CT Burst
TRIPPED AT	5/12/2011 6:27:13 PM
S/D PERIOD TILL NOW	0days 21Hrs 59Min
REVIVAL DT	
EXPECTED DT	

boa vinda willkommen
welkom
benvenuto ようこそ
bienvenue
välkommen
velkommen
bienvenido
welcome
witamy 热烈欢迎

SWAGAT

PHOENIX CONTACT
INNOVATION IN INTERFACE

Corporate Charts 2003

Heart of the Power Plant…..

Control System

Heart of the Control Cabinet…..

Power Supply

which pumps the required energy to the rest of the process components in the cabinet…….

Agenda

- Why Power Supplies....
- POWER for all Stake holders in a Power Plant
  - POWER for Consultants and Designers
  - POWER for System Integrators
  - POWER for End Customers
- Innovations for Evolving Challenges

Agenda

- Why – Power Supplies?

Why Power Supplies…

- Industrial control systems have utilized 120 V ac or 230 V ac.
- Electrician in the early 70’s & 80’s work entirely with switches, relays, photo controls and solenoids actuators)….at 120 V ac voltage levels.

What changed?

- The microprocessor….in the early eighties
- Replaced relay logic and reduced the size of most control systems by one-half to a third of their original size.

.

Why Power Supplies…

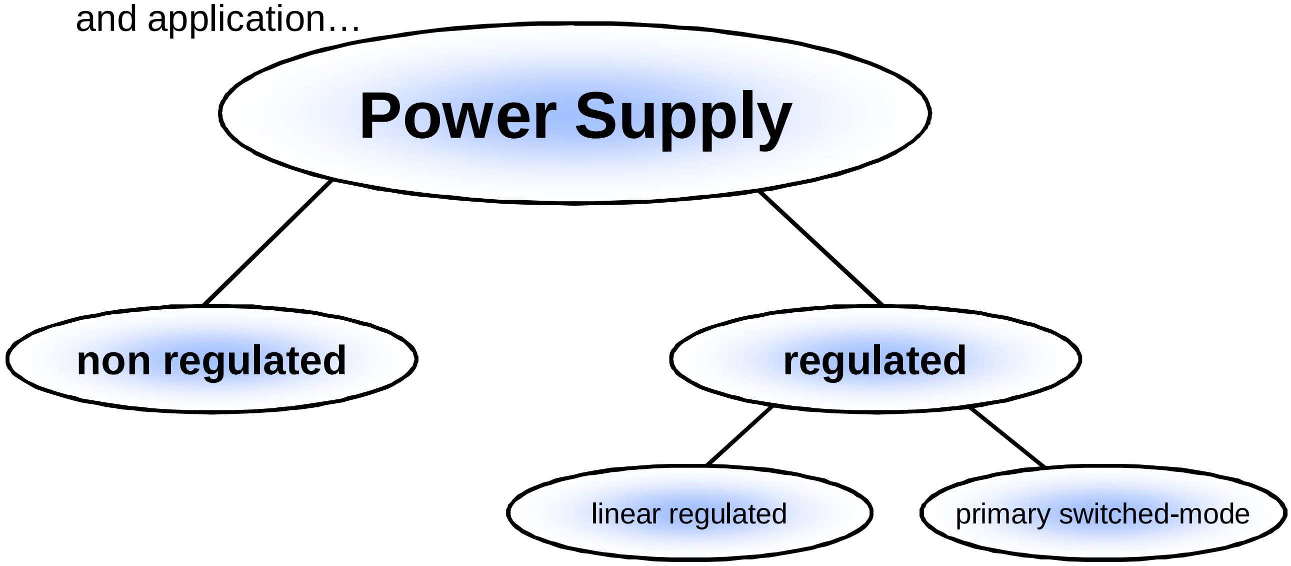
- Microprocessor came lower control voltages….. Industrial control systems now required 24 V dc or 5 V dc.
- mid-eighties…….explosion of PLCs (programmable logic controllers).
- PLCs incorporated microprocessors that required 24 V dc operating power

Regulated, primary switched

⇒

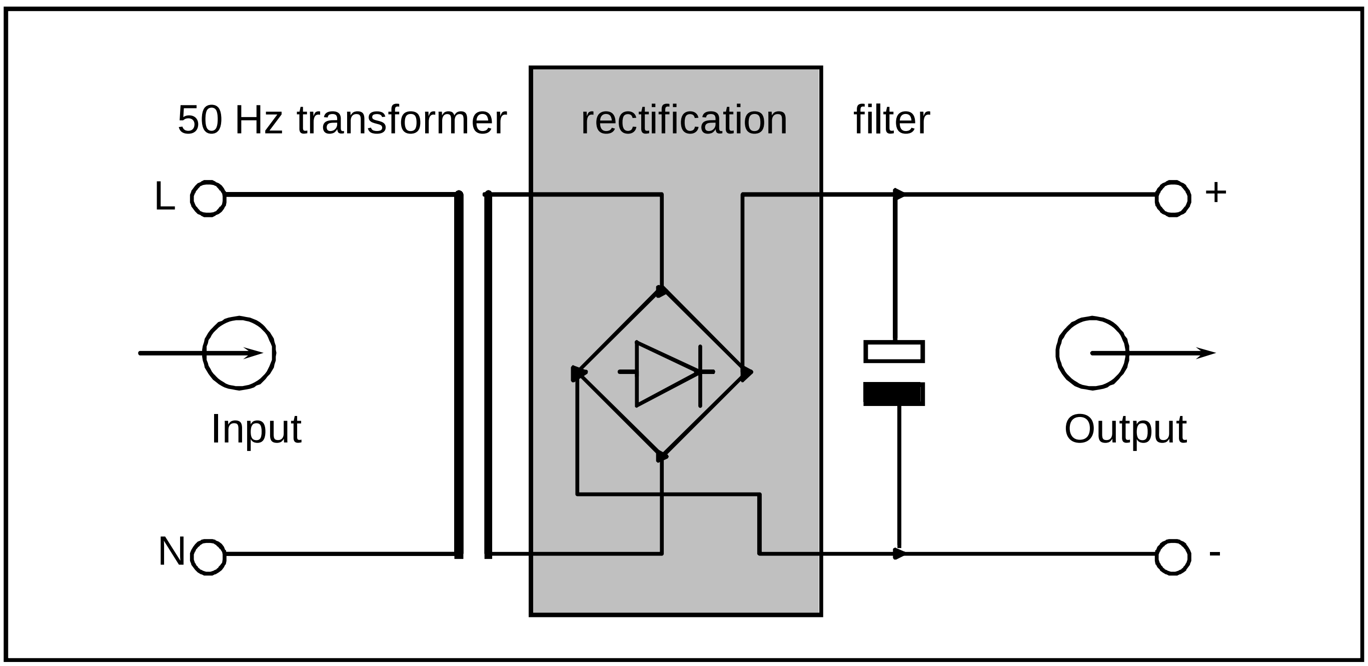
Power Supply Design and Application Area…

The electrical/electronic design of the power supply is critical to its performance and application…



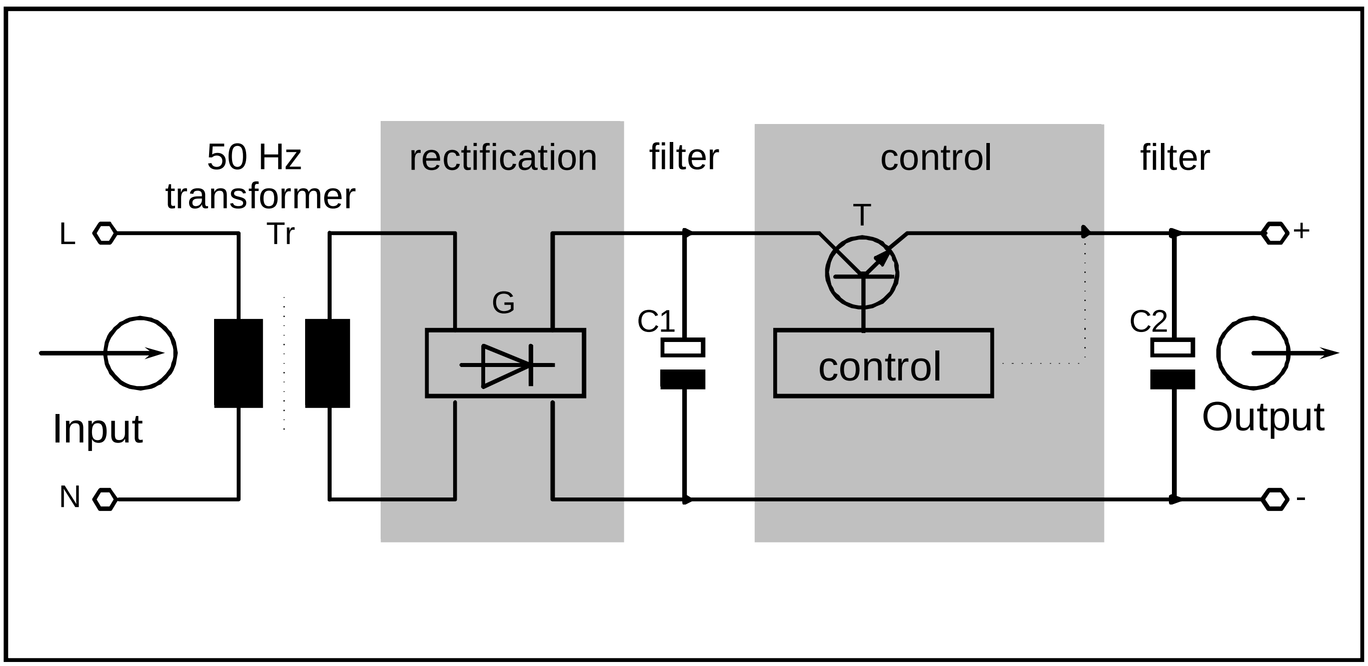
Power Supplies

Schematic Circuit Diagram of non-regulated Devices



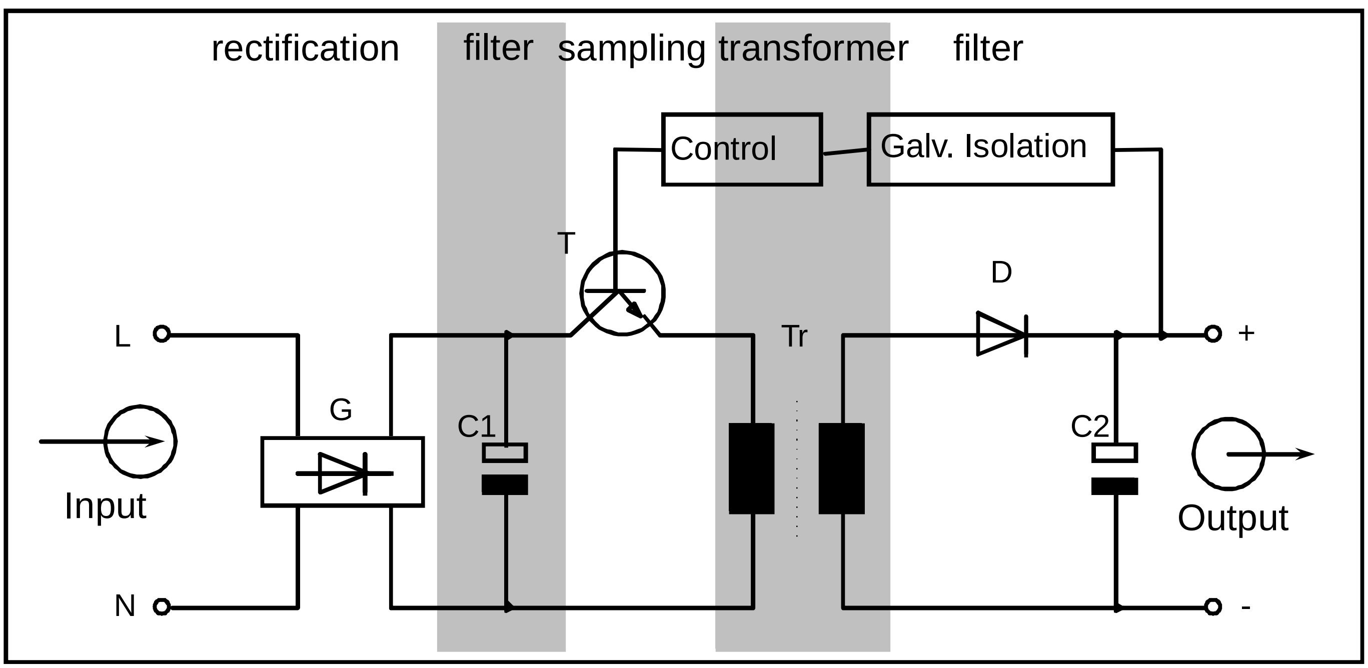
Power Supplies

Schematic Circuit Diagram of Controlled Devices

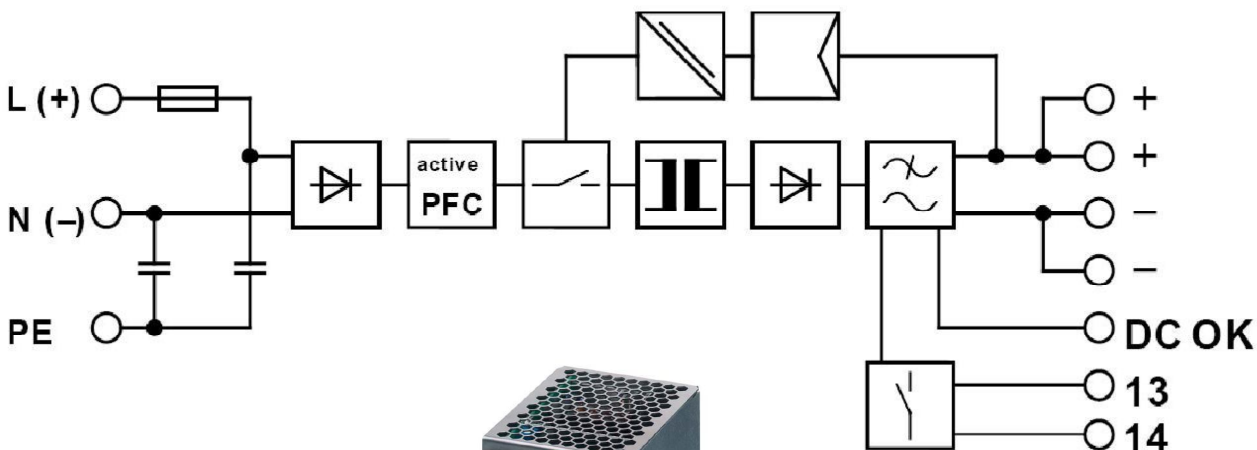


Power Supplies

Schematic Diagram of Primary Switched Devices



Typical QUINT diagram



Agenda

•Technology Advantages

Technology

ISA Delhi Section

Conversion Principle	:	Primary Swicth Mode Power Supply.
Output Technology	:	VI – Characteristic.

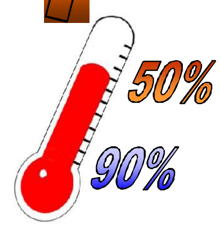
Industrial Grade Power Supply

MTBF > 500,000 Hr

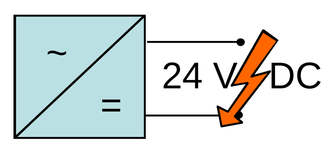
Advantage of Primary switch mode device

- Compact design
- Low Power Losses due to compact size of Transformer

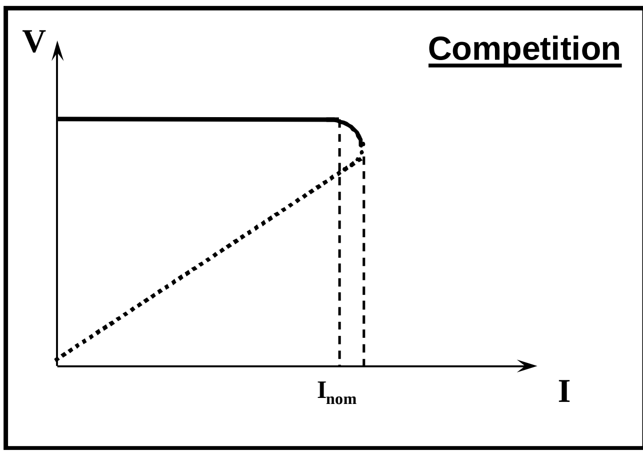
- high efficiency

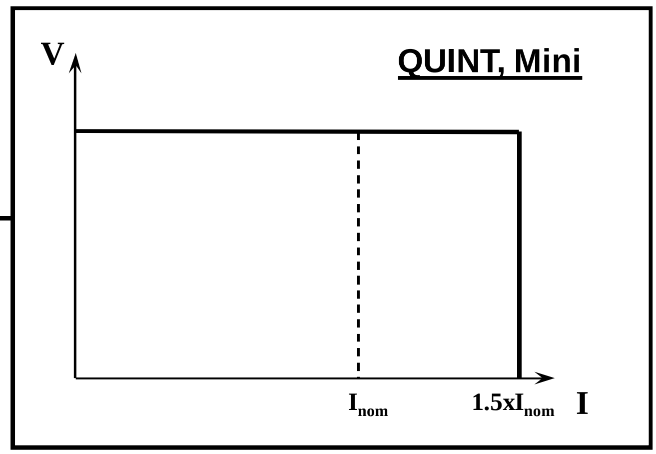


- Short-circuit-proof and idling-proof output



Output characteristics

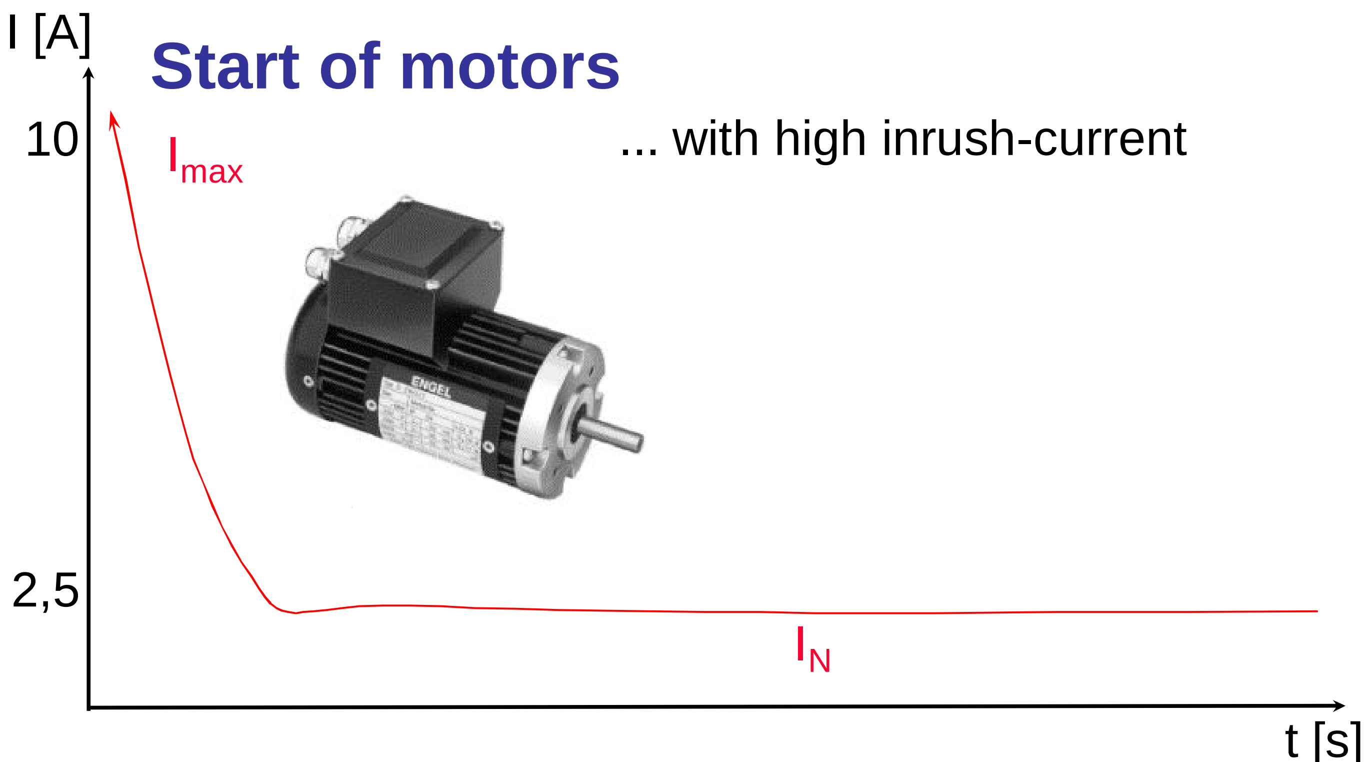




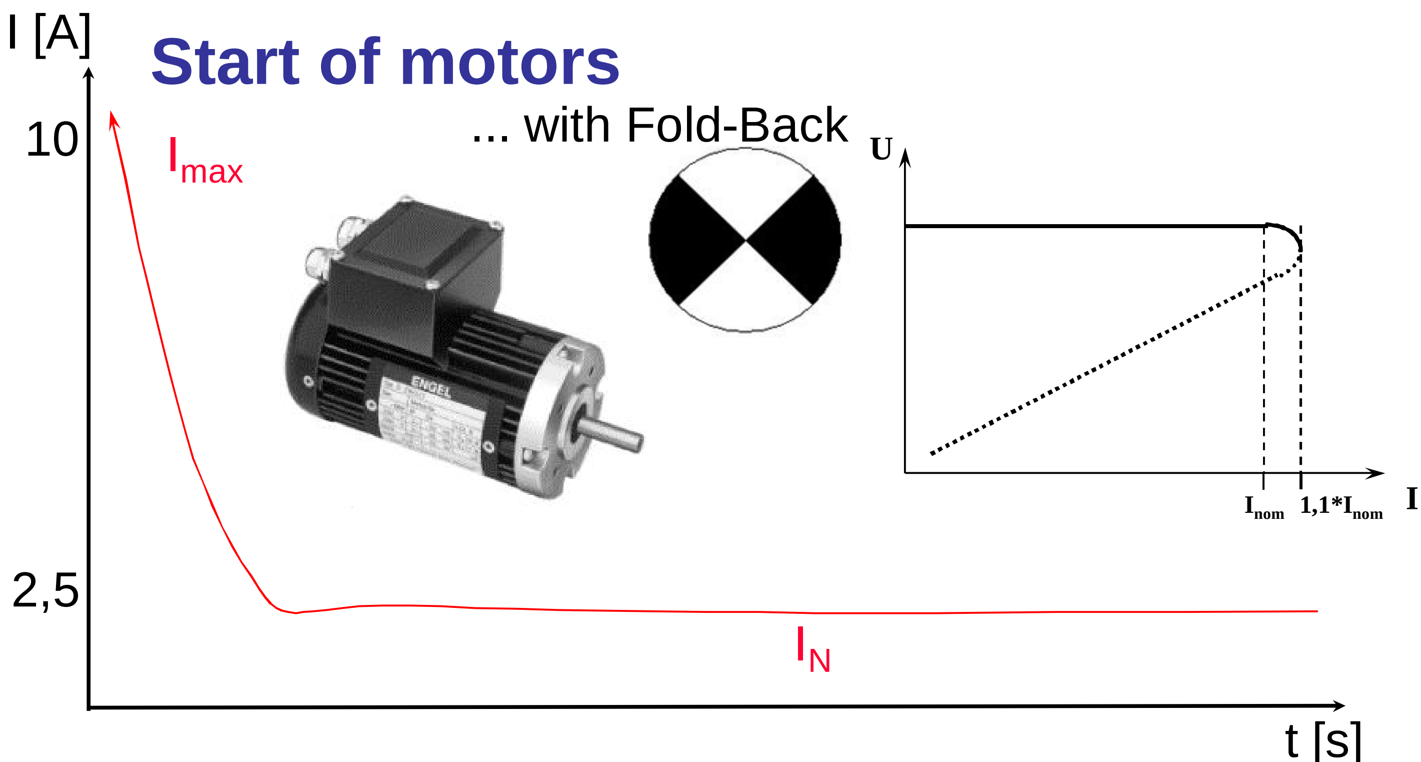
Fold-Back (hick-up):
The output is protected against overload by switching off power shortly, followed by an independent restart.

V-I characteristic:
The output is protected against overload by reducing the output voltage. The output current flows continuously.

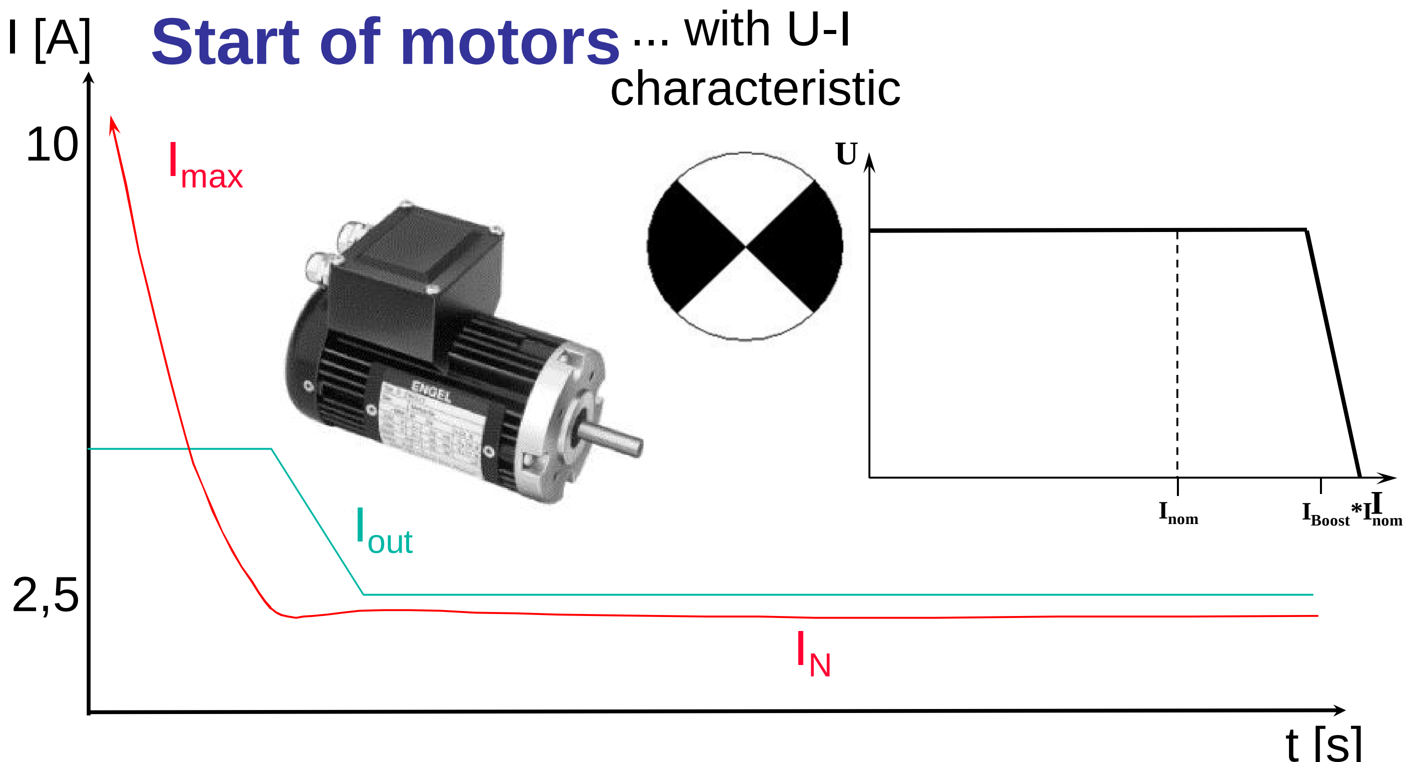
Advantage of UI characteristics on Fold-Back characteristics



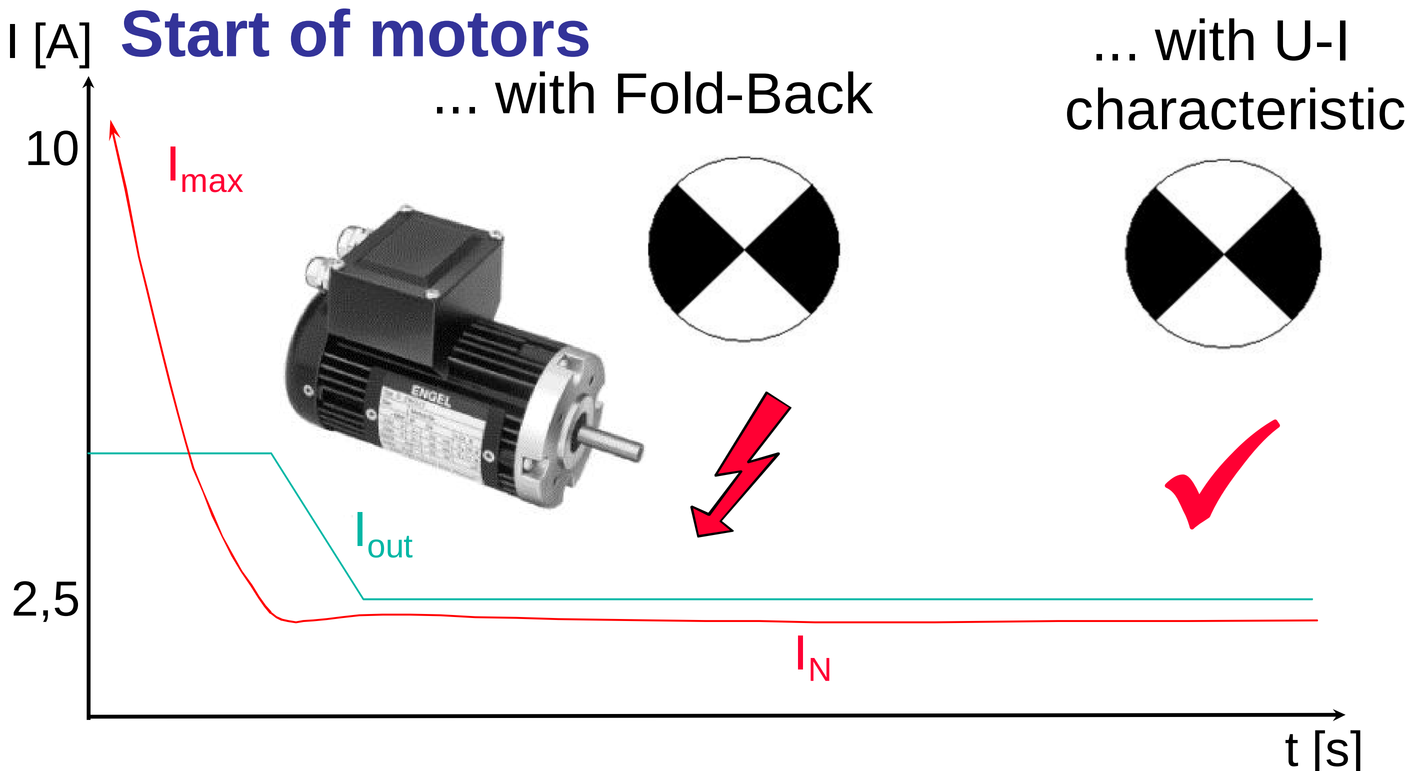
Advantage of UI characteristics on Fold-Back characteristics



Advantage of UI characteristics on Fold-Back characteristics

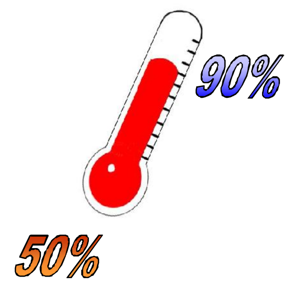


Advantage of UI characteristics on Fold-Back characteristics



Advantage of Industrial Grade

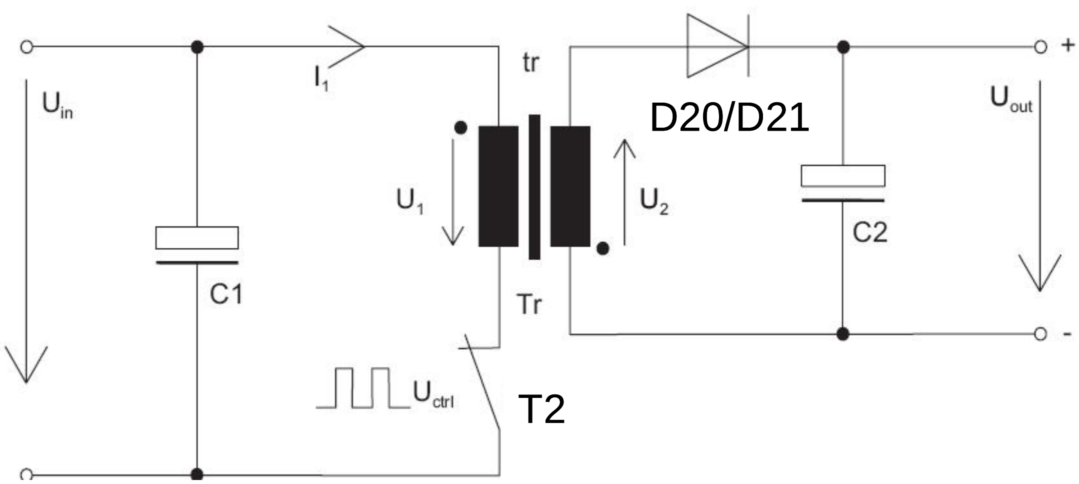
- **Wide Input Range**
- **International Approval**
- **Wide Operating Temperature Range**
- **Din Rail Mountable.**
- **Rugged**



Operation of Fly back converters and their advantages against other conventional converters

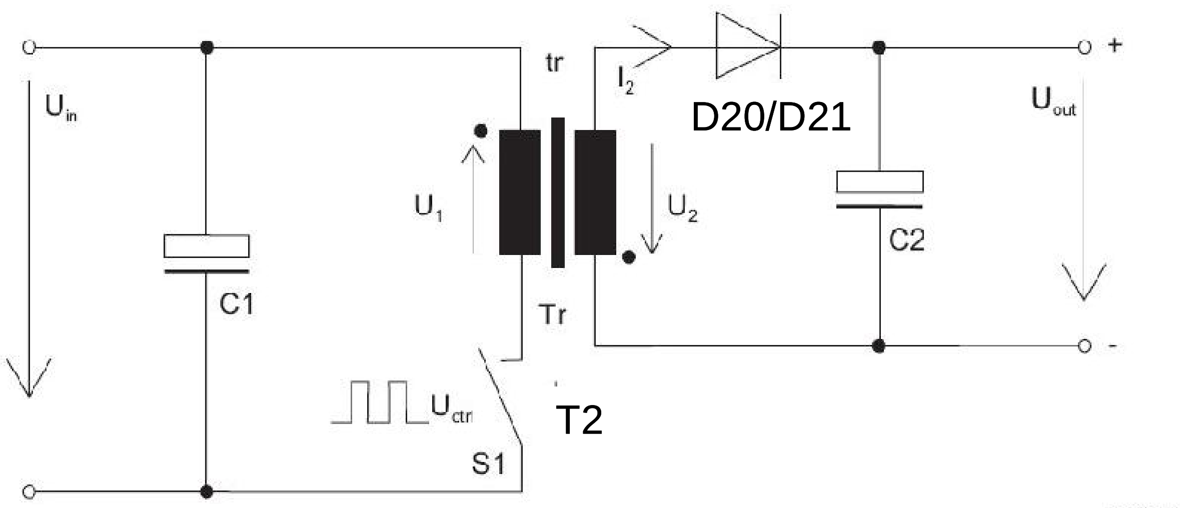
QUINT in operation

Flyback converter with T2 closed



QUINT in operation

Flyback converter with T2 opened



Advantage of Flyback converter

- Compact Size of Power Supplies.

- Low component resulting in simple but reliable and compact design.

-Lower Power Losses.

MTBF - Mean Time Between Failure

MTBF > 500,000 hr = 57 Yrs

- MTBF (Mean Time Between Failure)
  A measurement of Probability of Failure of any electronics Device.

- The basis for the MTBF calculation is the IEC 61709 (Siemens standard SN 29500).

- The PxC power supplies have an MTBF of more than 500.000h

- MTBF is evaluated for all electronics components being used in the device and lowest of these is considered the MTBF of resultant device.

Philosophy of Short-circuit proof property of the power supply device & buffering capacitor

Philosophy of Short-circuit proof property of the power supply device & buffering capacitor

- Power supply units with U/I characteristic are electronically protected against overload and short circuit.

- For a 24 V DC voltage, the maximum output current is typically 1.1 times the nominal current. In the event of an overload or a short circuit the output current of 1.1 times IN is still available while the output voltage is reduced.

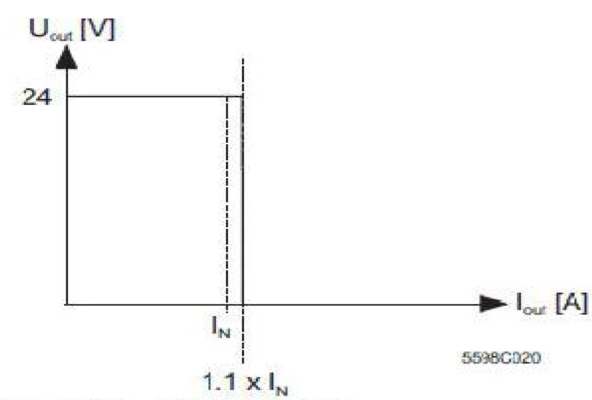


Figure 3-27 U/I characteristic

Agenda

- POWER for all Stake holders in a Power Plant
  - POWER for Consultants and Designers
  - POWER for System Integrators
  - POWER for End Customers

Specification Extract from a Power Consultant

DC Power Supplies

i. For 24 V DC power supply, Bidder shall furnish the separate parallel redundant 24 V DC system for DDCMIS & Microprocessor based control system in BTG package and for PLC package and microprocessor based system (with out OWS & printers) provided with BOP packages as per chapter 7.

ii. Parallel redundant 240 V AC to 24 V DC convertor with 50% sharing shall be provided for 24 V DC power supply in each cubicle separately as per requirements for PLC package and microprocessor based system (with OWS & printers) provided with BOP packages as per chapter 7.

AC to DC convertor shall be SMPS based and shall have wide range of AC/DC input voltage (85-264 V AC & 90-350 VDC). It shall have the necessary diagnostic functions like indications for DC OK, automatic overload monitoring etc. The MTBF for the power supplies shall not be less than 500,000 hours (in Accordance with (IEC – 1709) with operating temp. from – 25deg. C to 70 deg. C.

Specification Extract from a Power Consultant

- DC Power Supplies

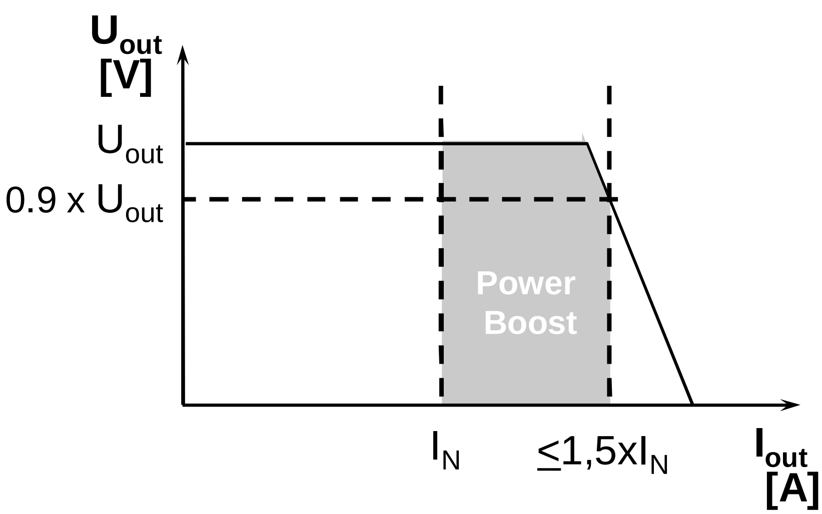
  - Parallel redundant 240 V AC to 24 V DC converter with 50% sharing shall be provided for 24 V DC Power Supply in each cubical separately as per requirements for PLC package and microprocessor based system

  AC to DC Converter shall be SMPS based and shall have wide range of AC/DC input voltage (85-264 V AC & 90-350 V DC). It shall have necessary diagnostics functions like indications for DC OK, automatic overload monitoring etc. MTBF for the Power Supplies shall not be less than 500,000 hours(IEC-1709) with operating temperature from -25deg.C to 70deg.C

POWER for Consultants and Designers

- STATIC Power Reserve
- Maximum Reliability throughout the entire system by Redundant Operation
- World wide Input
- Prevention Function Monitoring for the End User

STATIC RESERVE

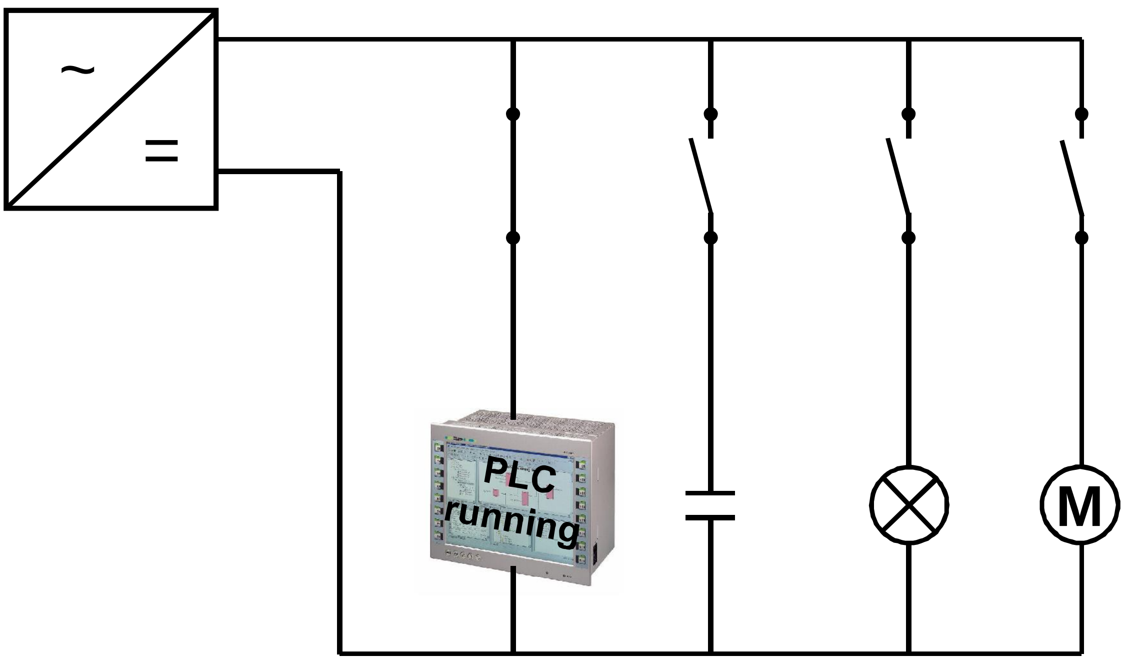


- → Static power reserve
- → Up to 1.5 times the nominal current
- → Continous up to 40°C
- → Ca.10 min at 60°C

Static Power Reserve

- Help the designer to plan for Extra Power availability
- Ensures Reliable starting of the heavy loads

STATIC POWER RESERVE
Reliable starting of heavy loads



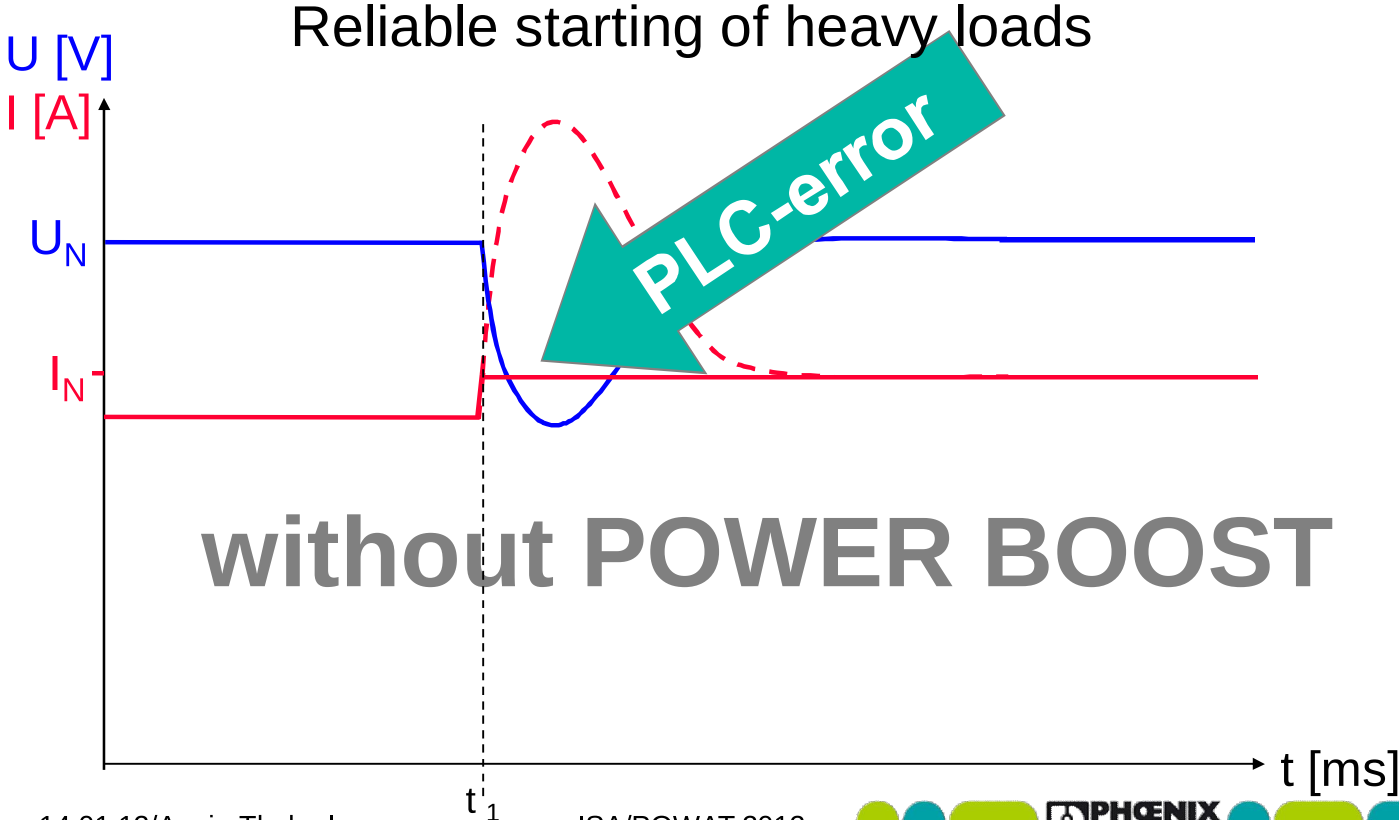
→ loads are working in parallel

→ loads with high inrush currents are starting

→ The voltage at the PLC should not drop!

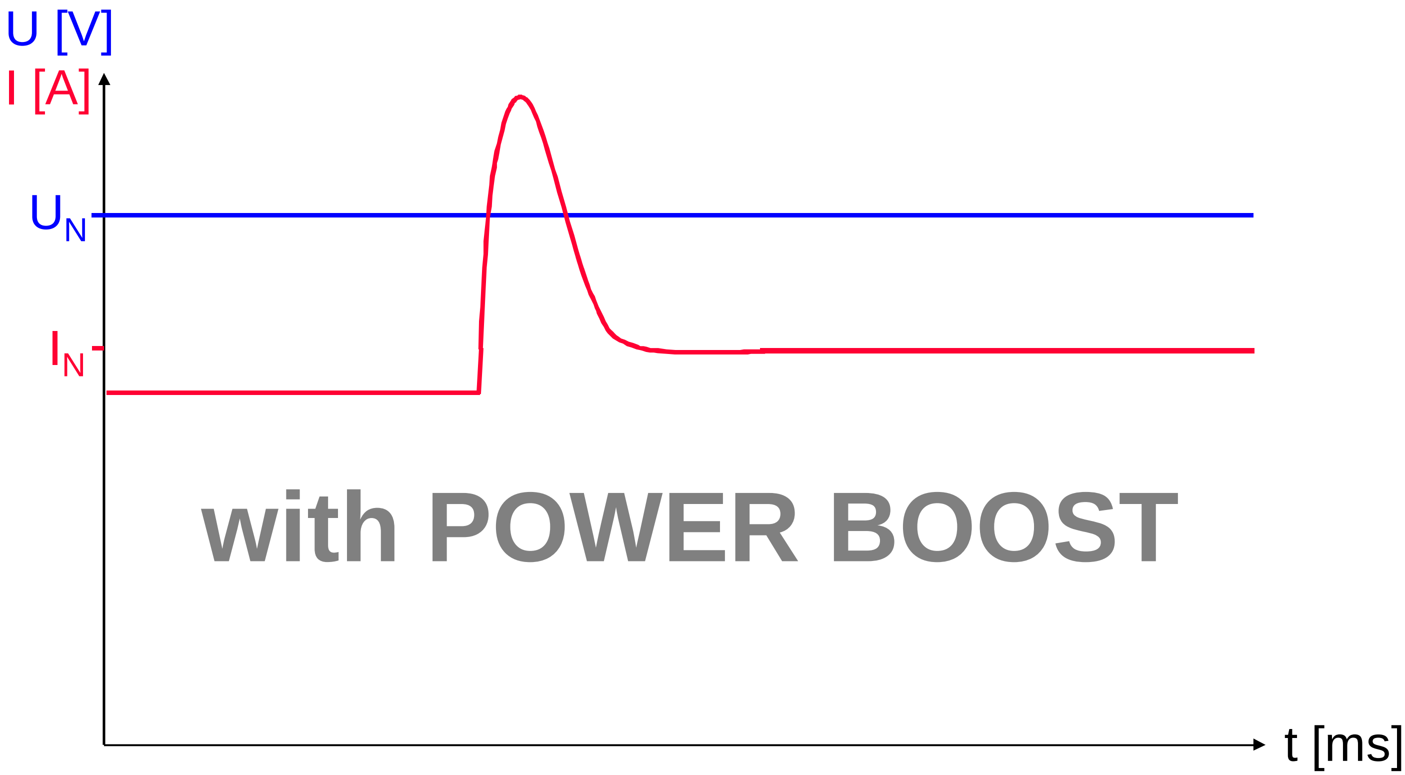
STATIC POWER RESERVE POWER

Reliable starting of heavy loads



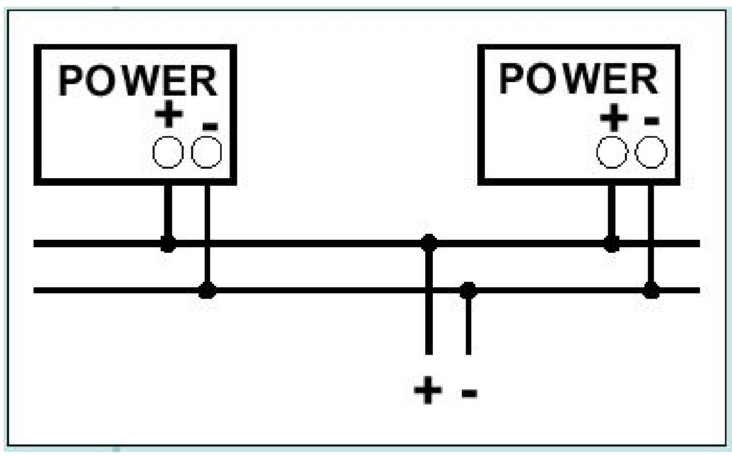
STATIC POWER RESERVE

Reliable starting of heavy loads



Power Reliability

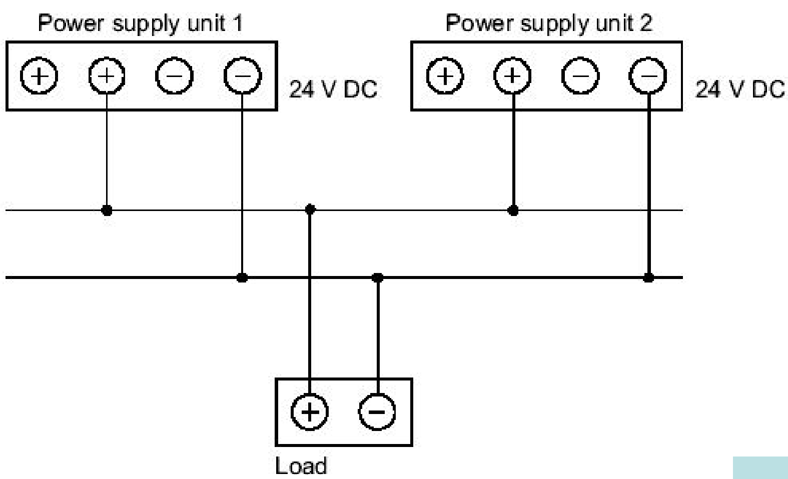
Parallel connection



All equal devices can be connected in parallel in order

- to increase power (2x10A = 20A)
- to achieve redundancy (2x10A = 10A)

Power Reliability
Parallel connection



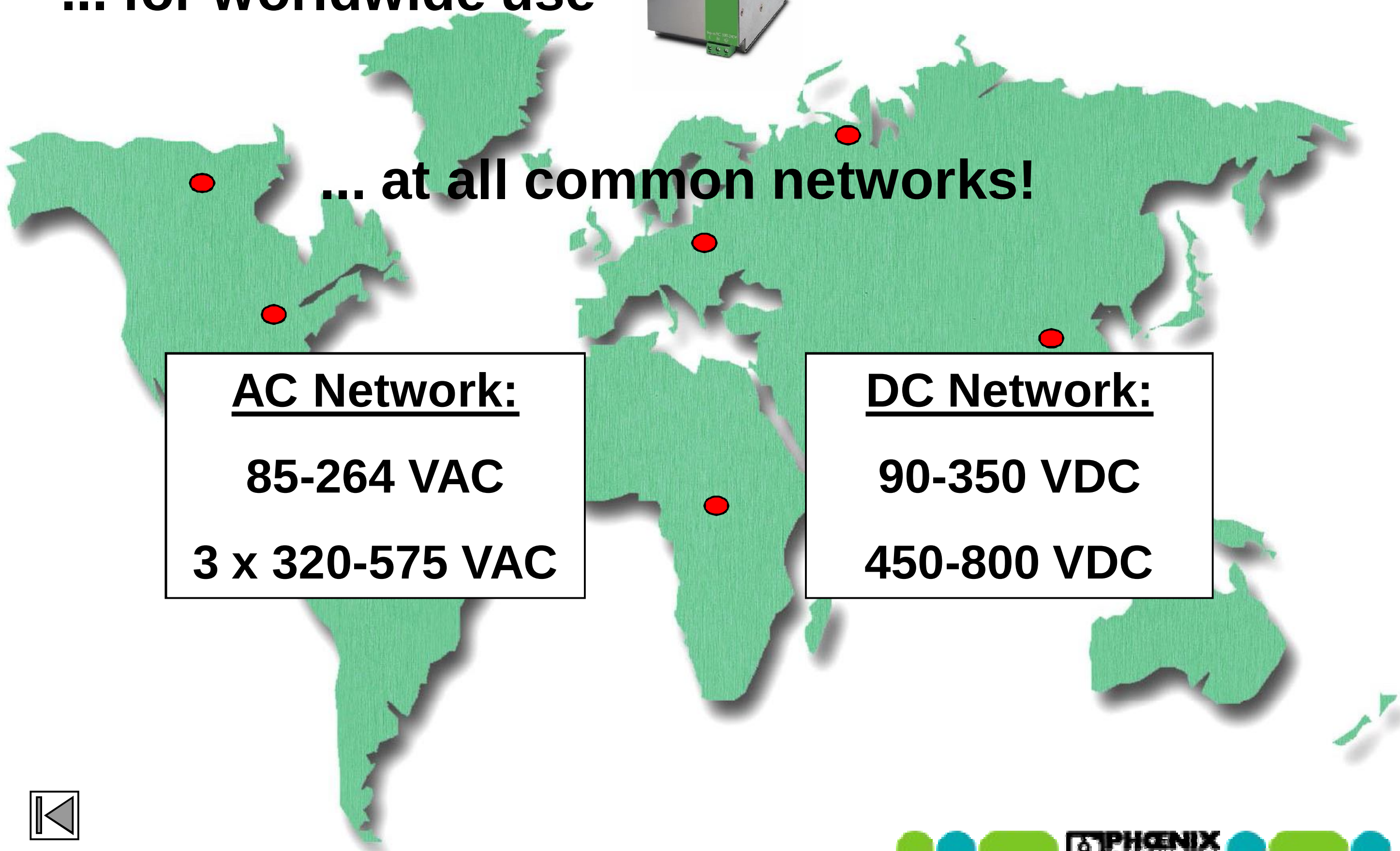
All cable connections must have...
- the same length
- the same cross section

Voltage balancing is required (<50 mV)!

POWER

... for worldwide use

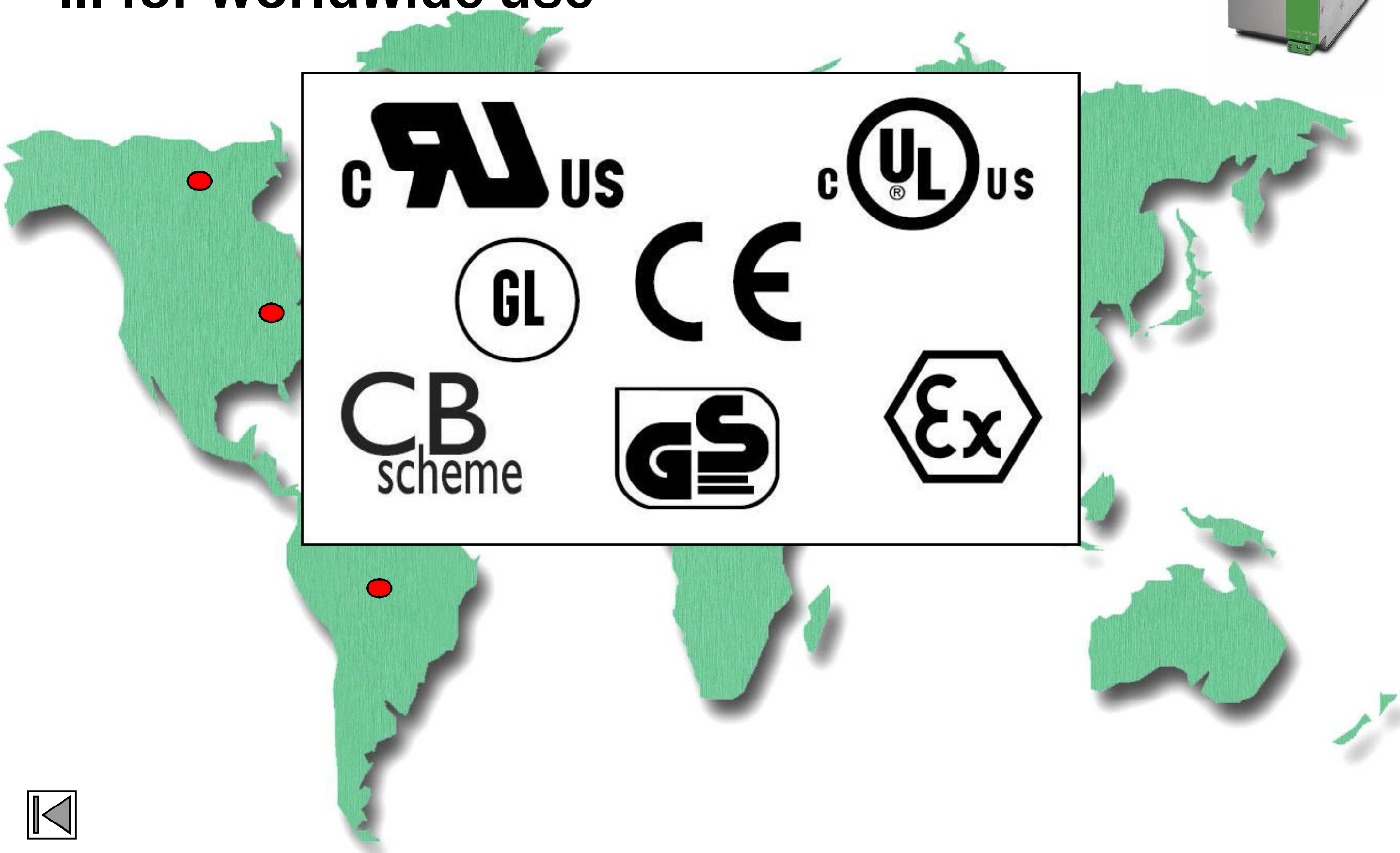
... at all common networks!



AC Network:
85-264 VAC
3 x 320-575 VAC

DC Network:
90-350 VDC
450-800 VDC

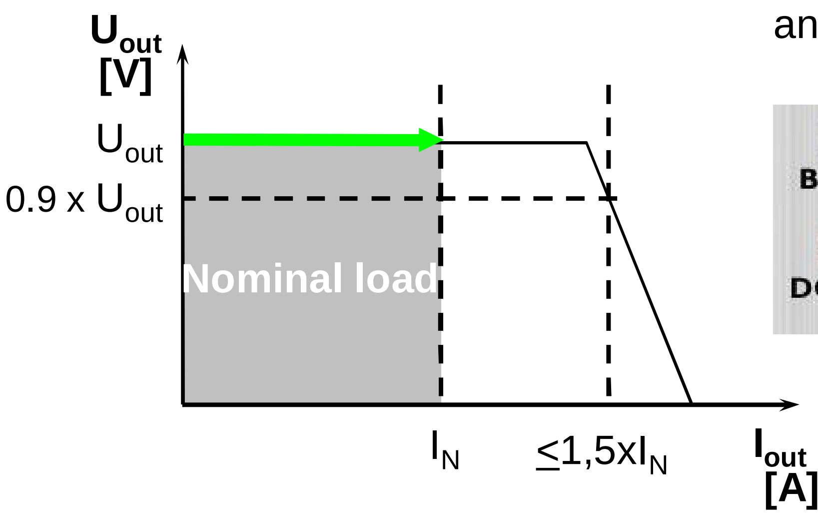
POWER
... for worldwide use



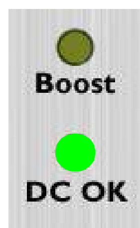
POWER for END USERS

Preventive Function Monitoring – The early Warning Solution

Preventive function monitoring



Monitoring the output voltage and current

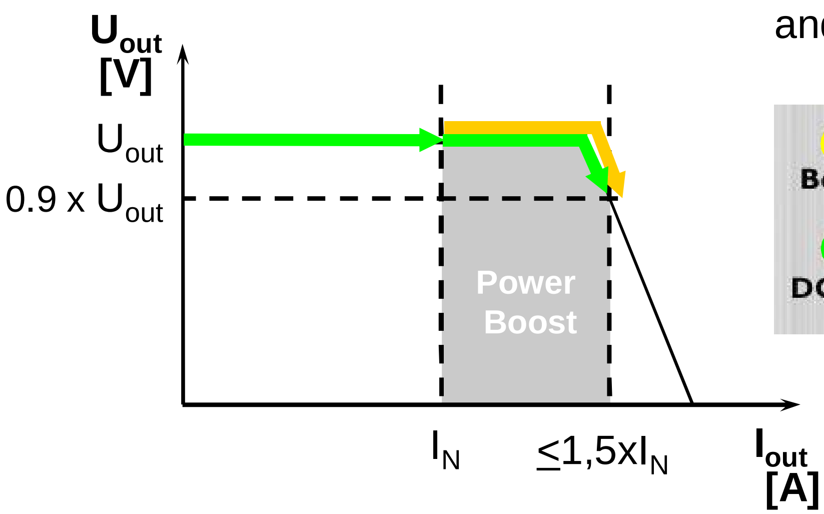


$I_{OUT} < I_N$

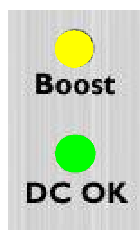
$U_{OUT} > 0.9\ U_N$

→ Power Supply is working with nominal values

Preventive function monitoring



Monitoring the output voltage and current



$I_{OUT} > I_N$

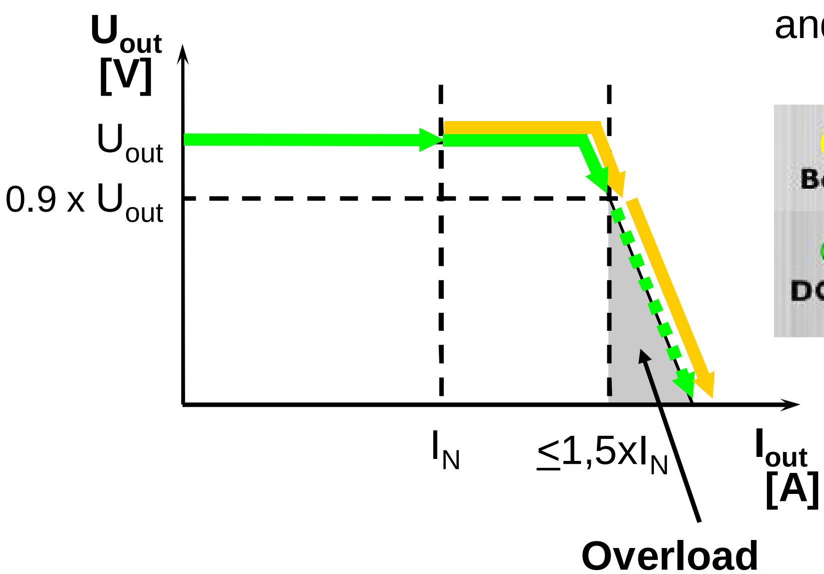
$U_{OUT} > 0.9\ U_N$

→ Detects critical situations before a problem occurs

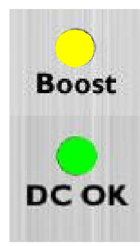
→ output current > nominal output current

→ output voltage remains constant

Preventive function monitoring



Monitoring the output voltage and current

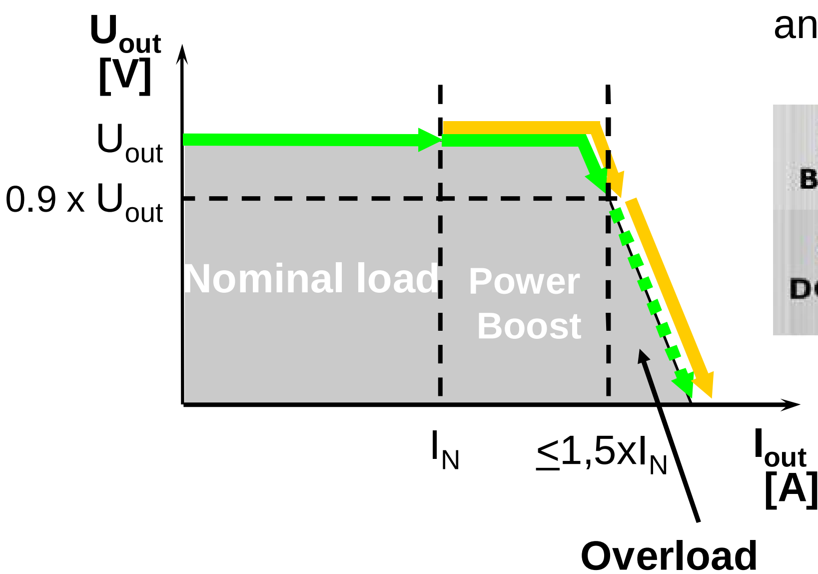


$I_{OUT} > I_N$

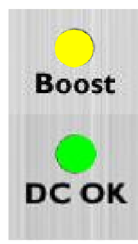
$U_{OUT} < 0.9\ U_N$

→ Output voltage < 90% of the adjusted output voltage

Preventive function monitoring



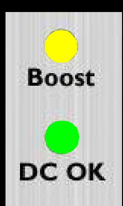
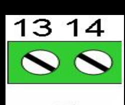
Monitoring the output voltage and current



$I_{OUT} > I_N$

$U_{OUT} < 0.9\ U_N$

Advanced preventive function monitoring

Signaling	Nominal range	Power Boost	Overload
  			
Meaning	$I < I_N$	$I > I_N$	$U < 0.9*U_N$