



Centre for Development of Advanced Computing

An Autonomous Scientific Society of the

Department of Electronics & Information Technology

Ministry of Communications & Information Technology
Government of India

Power Electronics

Power is precious, if you need to use it efficiently, you need Power Electronics

- Dr. Z V Lakaparampil -

Power Electronics Technology

Multi-disciplinary nature

Optimally **Convert, Control & Condition** electric power to suit load requirements



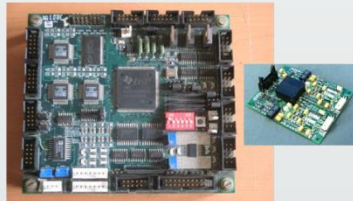
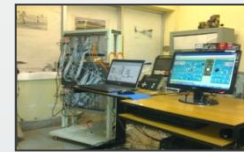
Technology for Renewable Energy



Full Spectrum Simulator



400Hz Inverter



Real time controller



PQ & UPS Technology

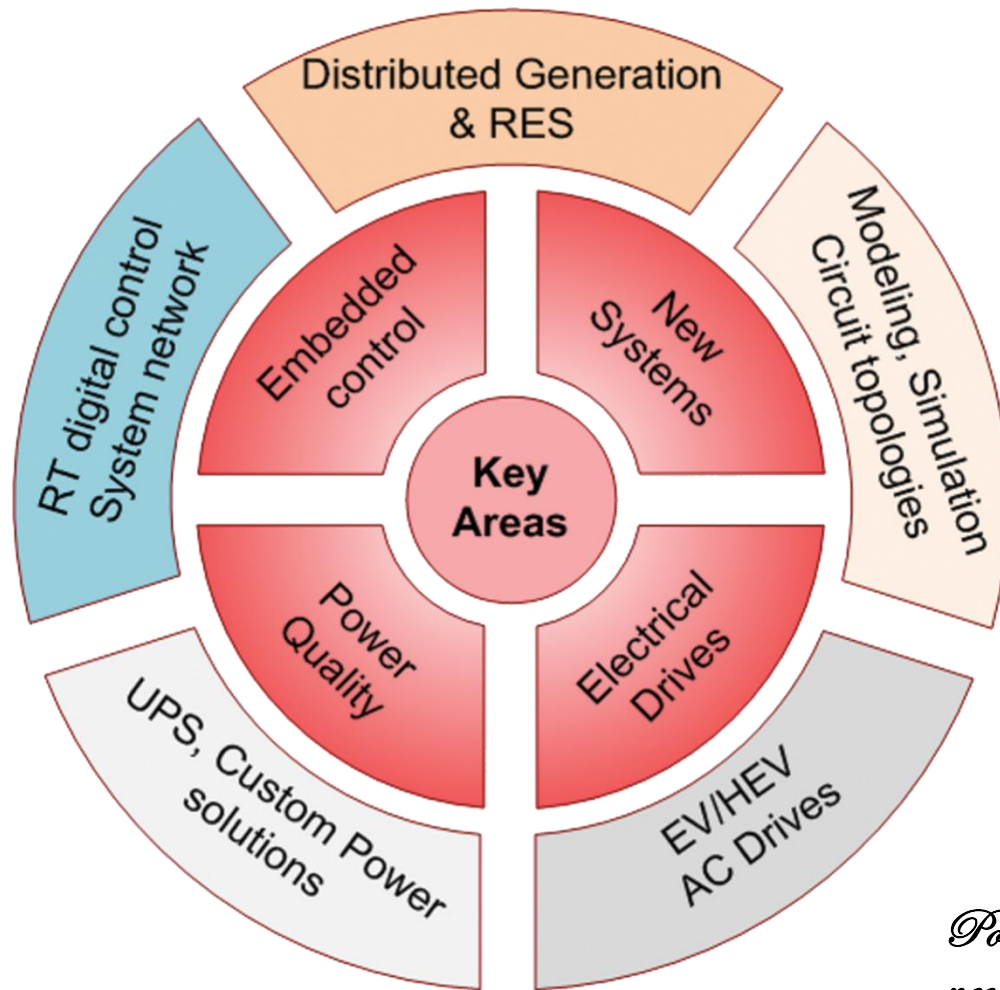


Technologies & Power Electronics Products

Share of electrical energy controlled through Power electronics, 40% in 2010 to 80% in 2030

Power Electronics

convert,
control &
condition
ELECTRIC POWER



growing

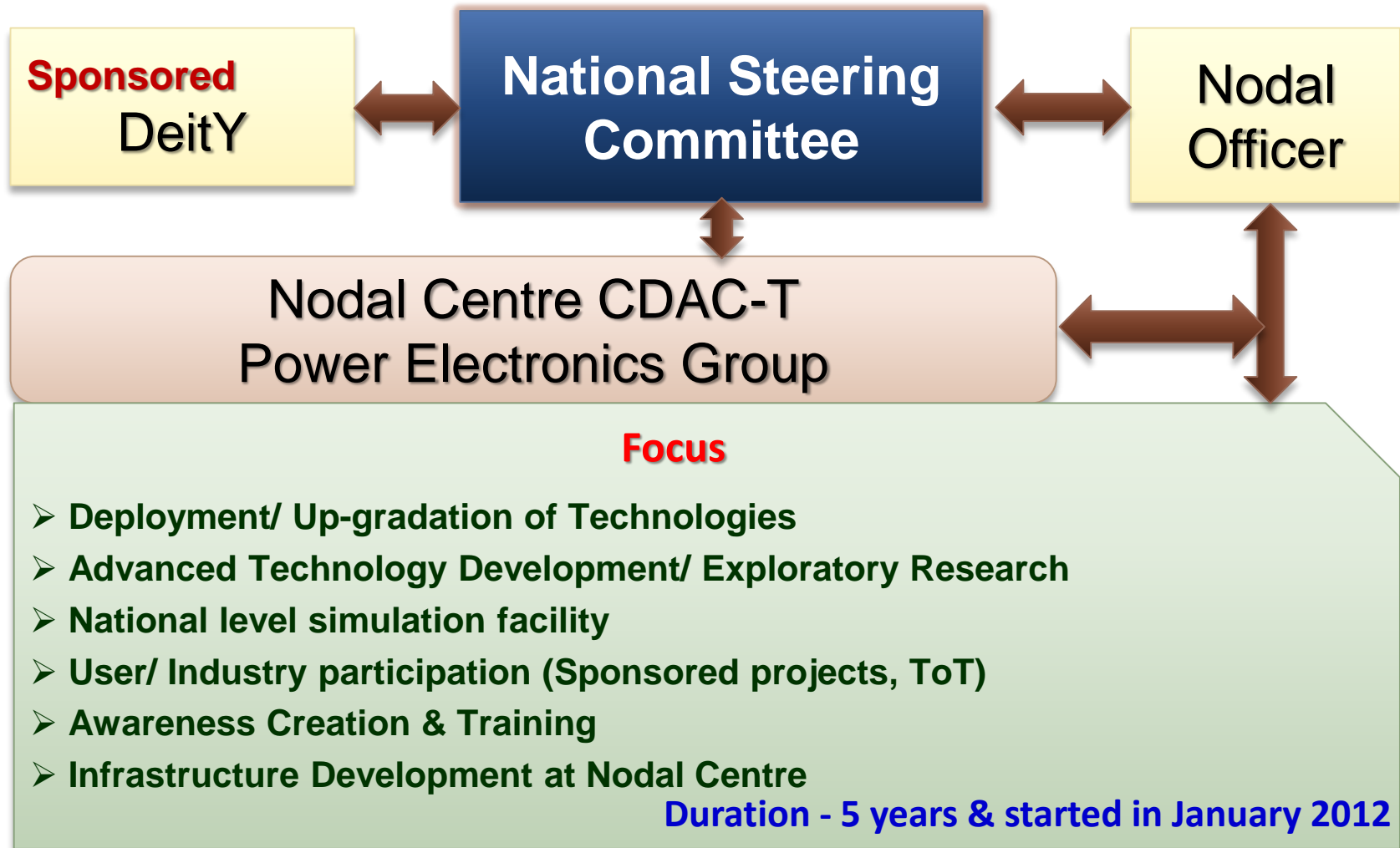
Power is precious, if you need to use it efficiently, you need Power Electronics

Multidisciplinary

Nodal Centre for

National Mission on Power Electronics Technology

<http://www.nampet.in/>



www.cdac.in

Sub-projects

- | | |
|----------|--|
| A | Deployment, Upgradation and Product Development (5) |
| B | Advanced technology Development projects (5) |
| C | Exploratory Research projects (8) |

1. Simulation Centre for Power Electronics & Power System at IITB

Simulation Lab setup & Training

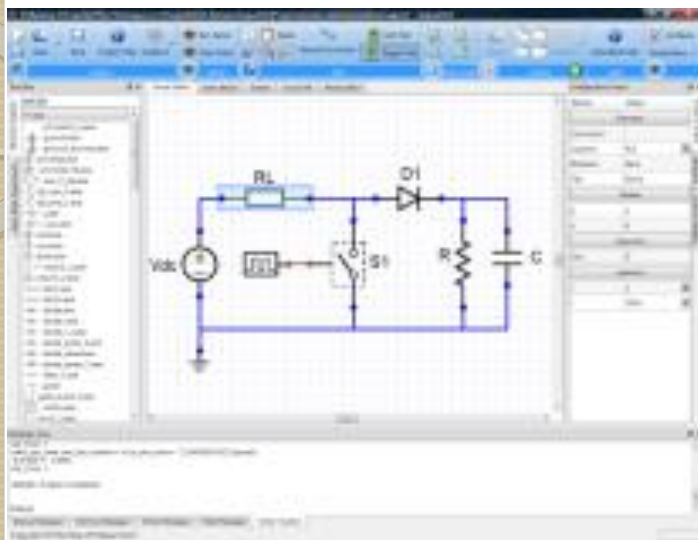
Course materials for conducting workshops



- Course calendar
- 500 participants
- Offline and real time simulation
- Custom simulation



2. Upgraded Full Spectrum Simulator



Component Elements

**Electrical, Digital,
General, General
mechanical**

Library Elements

**Power Electronics,
Power Systems,
Electronic Circuits
etc.**

Hardware:

2Rack with 24
Processors
working in
Parallel
(3CPU/PCB)

Computation:

20nodes/PCB for
passive element
circuits.

Sampling at
50usecs

HiL interface:

48DI, 48DO,
12AI, 48AO

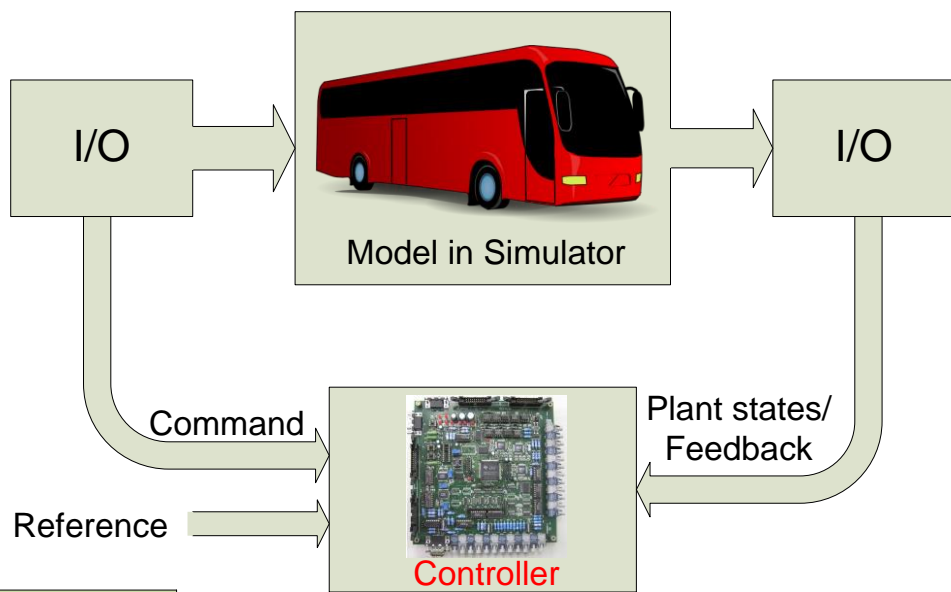
User interface:

USB connectivity
with standard PC

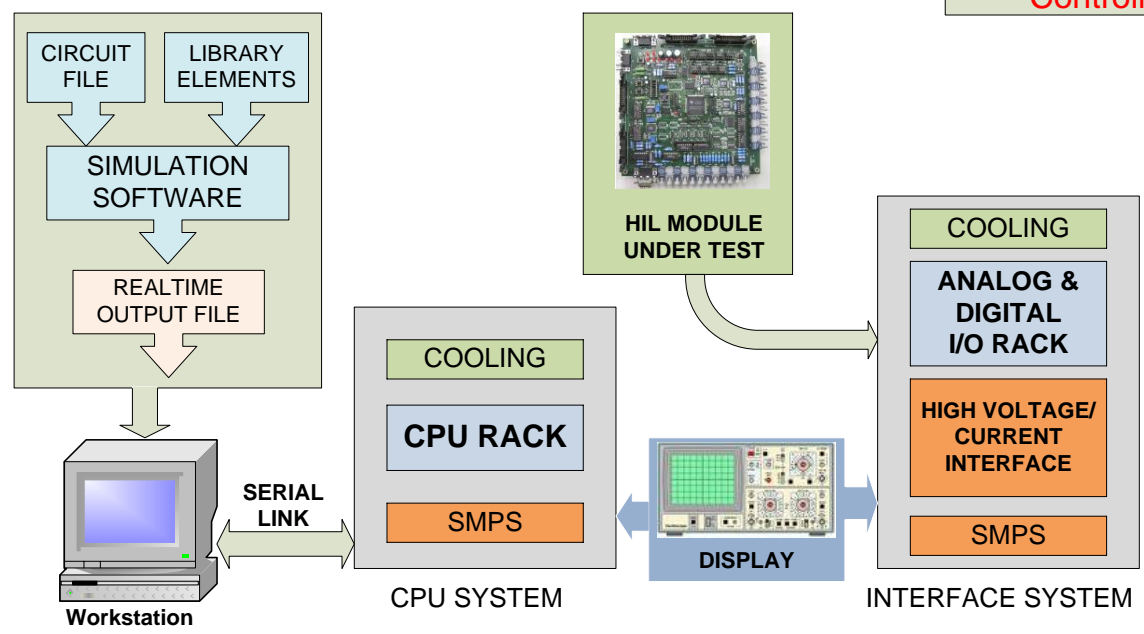


2. Upgraded Full Spectrum Simulator

Deployment Up-gradation & Product development

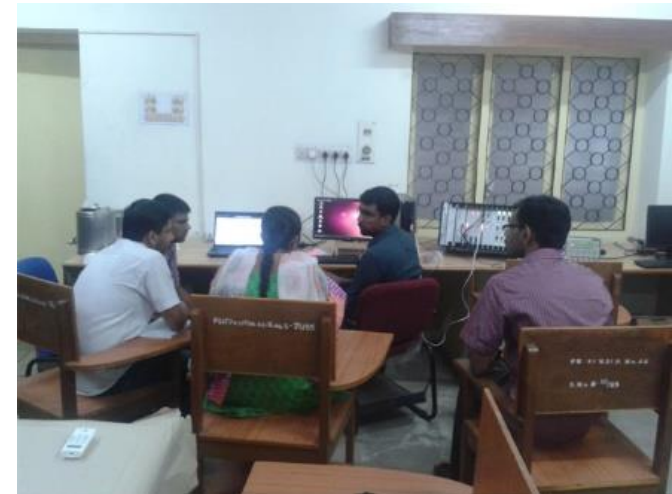


HiL test



3. Development and Deployment of FSS miniature models in Educational Institutes

Real time Simulation in educational Institutes



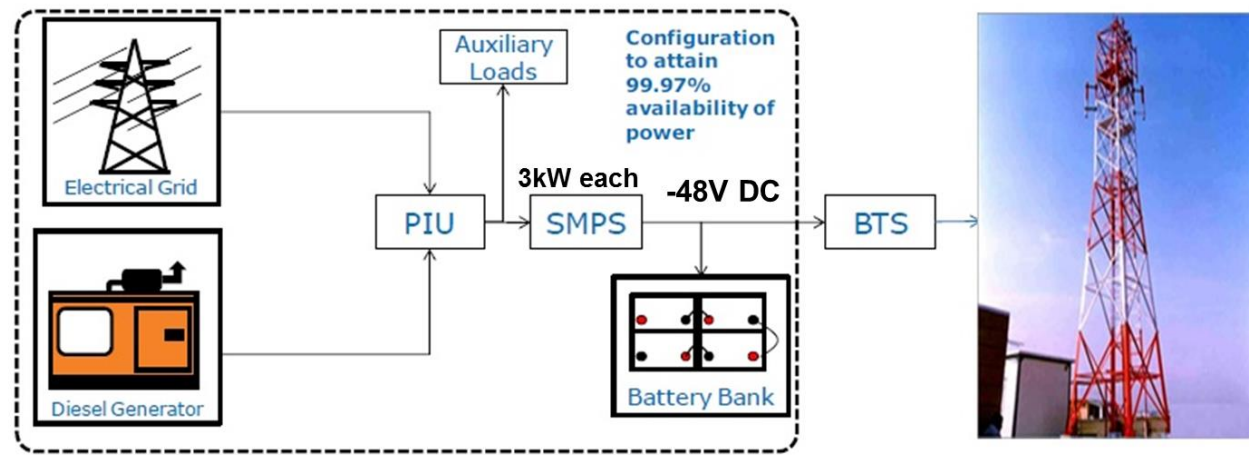
- 9 no. of 32 bit FP DSPs operating at 150mflops in one processor rack
- Linux based workstation- simulation configuration & user interface
- PC interface through USB
- 12 Analog Inputs & 12 Analog Outputs
- 12 DI & 12 DO Real time PWM digital input capability for HiL

4. Development of a Futuristic Indigenous Power Conversion Technology for Grid Connected Solar Photovoltaic Power Plants

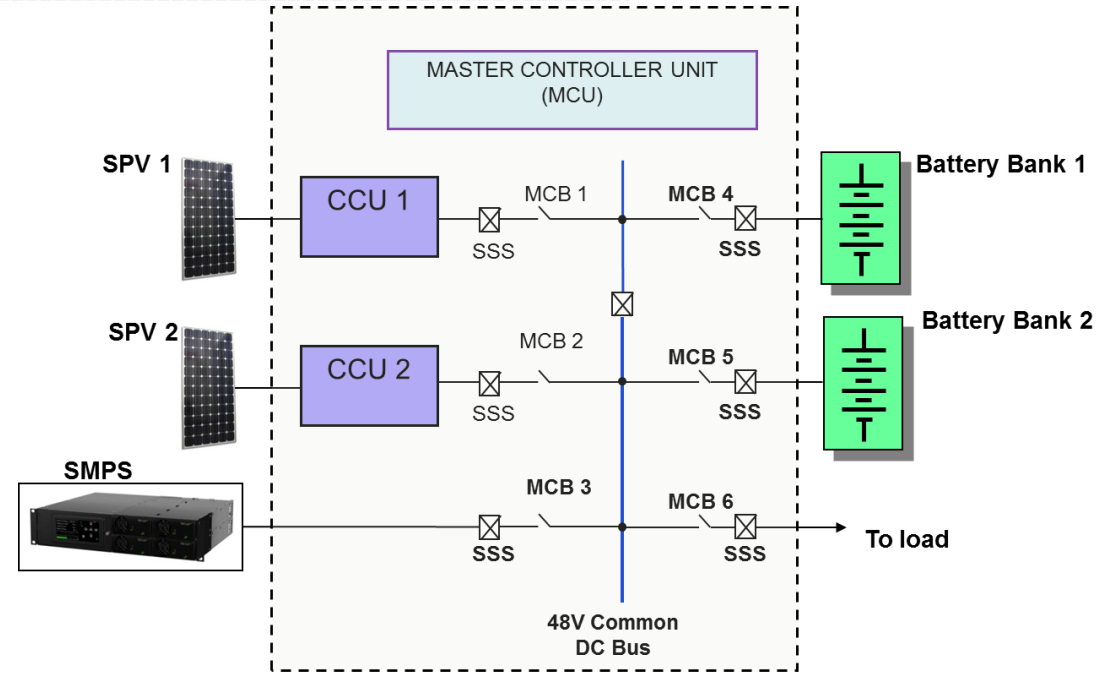


- ✚ Power converters with Modules(IPM)/IGBT
- ✚ Digital control DSP-FPGA
- ✚ MPPT
- ✚ Power export at Unity Power Factor
- ✚ I_{THD} as per IEEE 519 recommendations
- ✚ Protections IEEE 929-2000(IEEE Practice for Utility Interface of SPV)

5. Development of Solar Charge Controller Unit for Telecom Application



www.cdac.in



1. Development of 10kV Power Supply with Solid State Crowbar protection



Power supply Assembly



Crowbar assembly

2. SOPC based Power Electronic Controller



Specifications

- ❑ **FPGA** :
Cyclone III
EP3C25E144C8N
- ❑ **On chip Memory:** 64
kBytes (Inside FPGA)
- ❑ **Flash memory :** 2MB
- ❑ **Digital I/Os :** 55 No.s
(3.3-V LVTT
(configurable for I2C
ADC/DAC, PWM
interfaces)
- ❑ **Host interface :** JTAG
- ❑ **Supply voltage:** 3.3 V

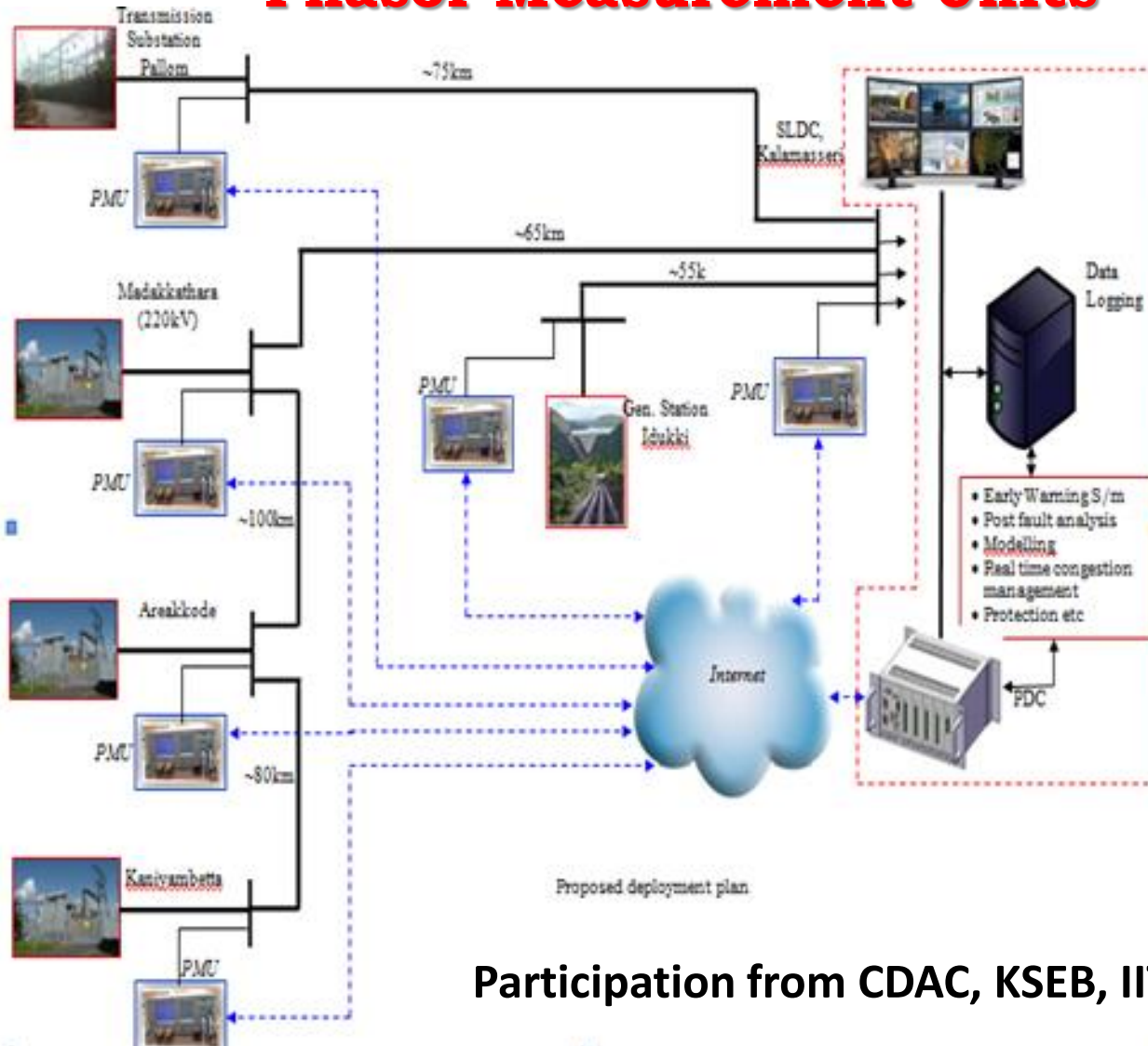
Technology for single
processor & multiprocessor

- **Application evaluation**
- Three applications evaluated
- Better performance than the
state-of-the-art DSP
- PE control in 1-2 micro-sec



SOPC Peripheral Interface Card

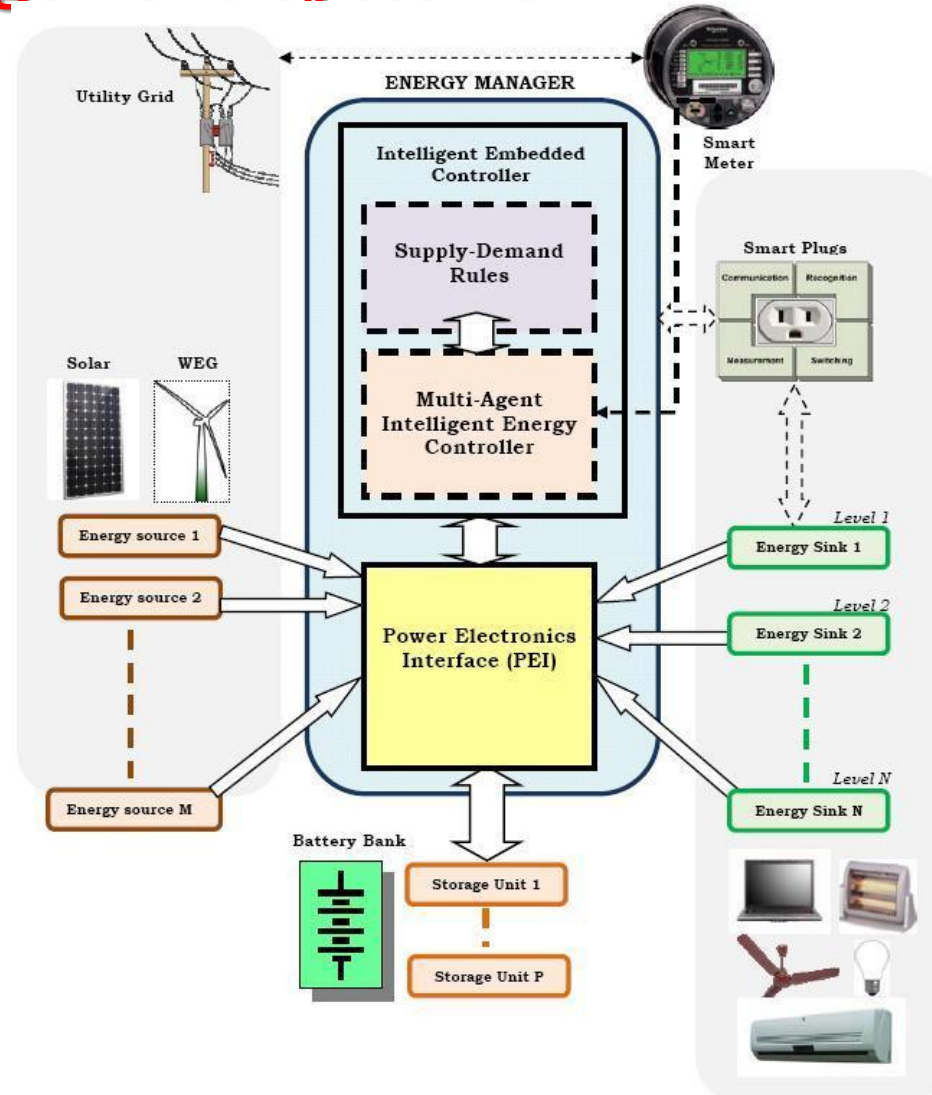
3. Wide Area Monitoring (WAM) Using Phasor Measurement Units



Participation from CDAC, KSEB, IIT-B & CPRI

4. Implementation of Net Zero Energy Building using Non-conventional Sources and Energy Management Systems

Participation from EMC

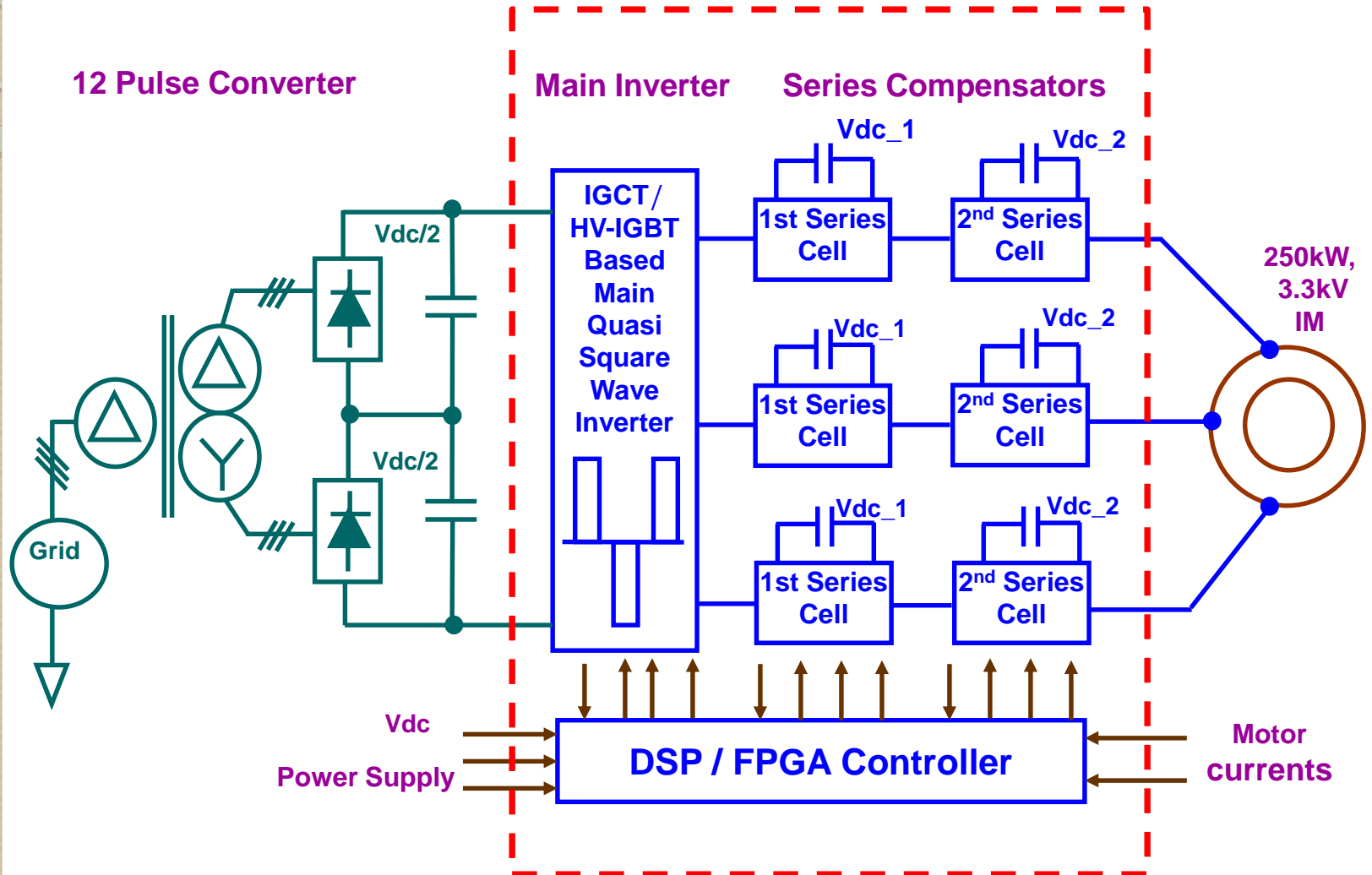


NITC

Advanced Technology development



5. Medium Voltage Drive with selective Natural Harmonic Elimination

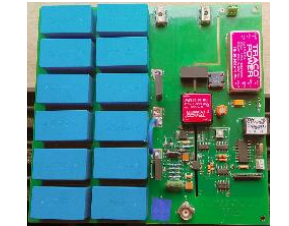
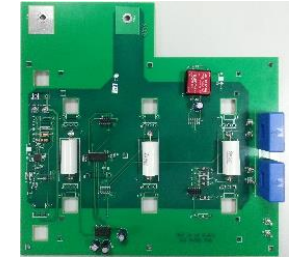
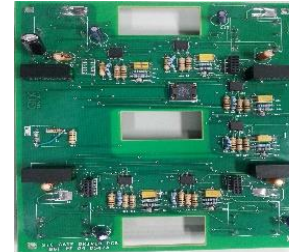
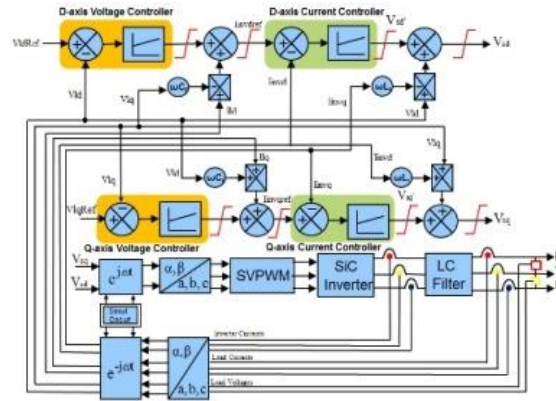


Advanced Technology development

NITC



1. Study of Dynamic and Static behavior of SiC devices and development of converter topology



Dynamic characteristics, device losses

Performance evaluation of SiC in chopper mode

Closed loop control of PMSM Solar Inverter

2. Investigations on GaN Devices for Power Electronic Switching Applications and Design and Development of a HF GaN Converter Topology by CDAC(T) and IIScB (EE Dept, DESE, CeNSE)

Develop GaN based switch

A circuit topology for GaN based SMPS

Application



NITC

Exploratory Research projects

3. Development of LVDC Architecture

4. Design, development and testing of 3-phase permanent magnet machines and their converters by IEST

5. Development of DC-DC converter and bi-directional converter for SPV application by NITT

6. Modeling Design and fabrication of Induction Motor for Propulsion Applications by IITP

7. Modular Multilevel Converters for Grid-connected Applications by IIT Bombay

8. Active gate driver design for SiC MOSFET based inverter for induction motor drive application by IIT Madras



NITC

Exploratory Research projects



NITC

**Infrastructure Resources at
Nodal Centre**



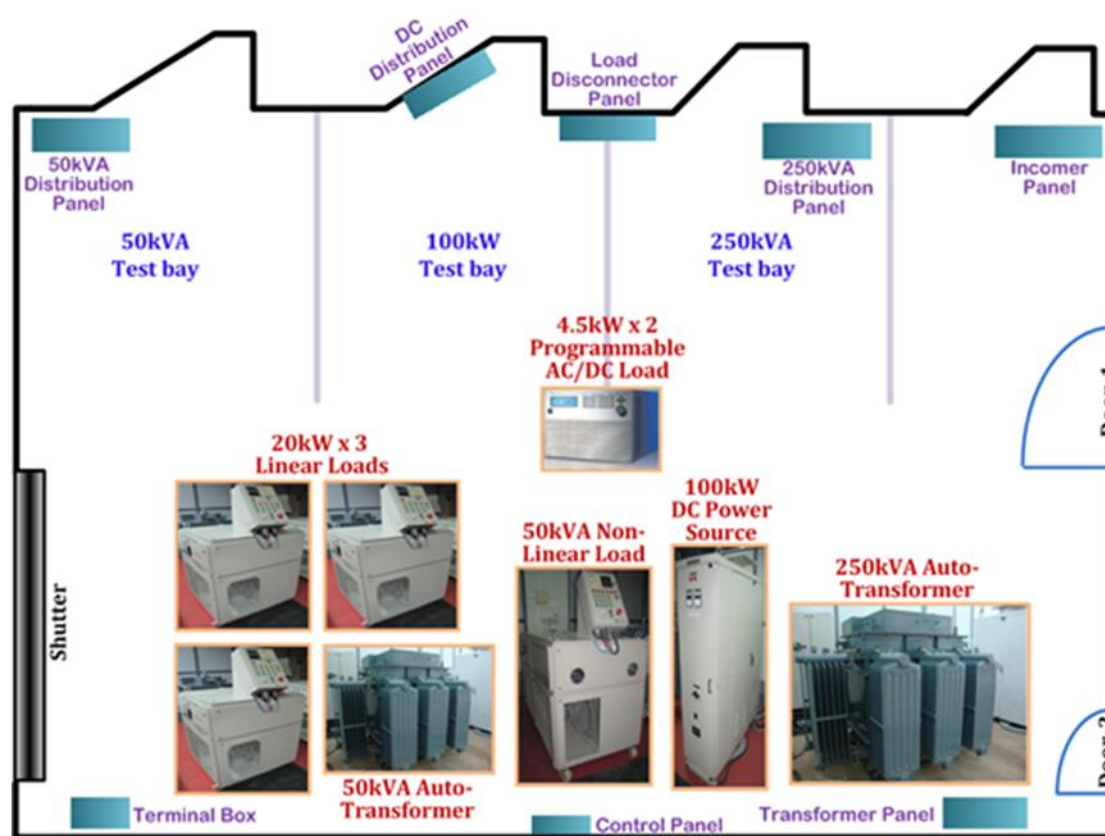
Power Conditioning Unit-Wind



25kW Solar Photovoltaic Arrays



Power Conditioning Unit- Solar



1. National Workshop on Power Electronics NWPE (2)
2. Short term courses (10)
3. International interaction /Awareness creation

Awareness Creation & Training

Five National Workshop on Power Electronics
Fifteen Short-term Courses
Three PE Curriculum Workshop



Power Electronic Data base (www.nampet.in)

Digital Library, Technology Trends, Journals and Publications,
Components Data base, SEQUEL club, Discussion forum, Crazy Idea portal etc.

Thank you























Achievements in phase -1

National Power Electronics Infrastructure



Nodal Centre	Low Power Lab: Simulation & CAD packages, DSP & FPGA Development platforms High Power Lab: Development & Test platforms
IITB	Power Electronics Drives & Permanent Magnet Machines
IISc	Self-Learning Environment
IITKgp	High Power Drives & PQ solutions
IITK	Power Systems, Applications In Power Electronics
IITD	CAD of Electric Machines
BESU	Machine Drives & Power Quality
NITT	Power Electronics/ Machine drives/ Controllers for RES & FACTS
BIT	Power Electronics
NITR	Variable Frequency Drives
RIT	Power Electronics
Anna U	Electrical Drives



				
Ashok Leyland	BARC	BHEL	Indian Railways	Indian Air Force
				
Emerson Network Power	Numeric Power Systems	Hykon Power Electronics	Amara Raja	HBL Power Systems
				
Keltron	Megatech Power Equipments	Veeral Controls	Power-one MicroSystem	
				
Electr- ohms	Keptech Power Controls	Kerala Automobiles	Techser Power Solutions	
				
NMRL	Industrial Controls & Drives	Hind Rectifiers	Electro-therm	