Iplon SCADA & Power control in Utility Scale power plants

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Agenda

- **Power control in utility plants**
  - **50 MWp Panchpatti plant (TATA Solar)**
- **Facts about the plant**
- **SCADA**
  - **Plant network architecture**
  - **SLDC connectivity**
  - **Need for plant power control**
- **Live demo**

Reference

Customer	Location	Capacity (MW)
Welspun Energy Ltd.	Gujarat	5.0
(Now TATA)	Madhya Pradesh	151.0
	Maharashtra	20.0
	Karnataka 1	17.0
	Karnataka 2 (16 + 34)	50.0
	Karnataka 3	50.0
	Punjab 1	12.0
	Punjab 2	24.0
	Rajasthan	5.0
	Tamil Nadu 1 (50 + 50 + 50 + 100)	250.0
	Andhra Pradesh (70 + 30)	100.0
	Bihar (25 + 15)	40.0
	Repowering of Sites	60.0
ACME Cleantech	Uttarakhand (25 + 25)	50.0
Solutions Pvt ltd	Telangana (45 + 30)	75.0
Larsen & Toubro	Kiran/Gujarat	20.0
	RREC/Rajasthan	1.0
Jakson Solar	Ahmedabad	7.5
Avaada	Karnataka (3*30)	90.0
	Kanpur, UP	5.0
	Badhla, Rajasthan	100.0
	Karnataka (3*50)	150.0
	Karnataka (3*50) (on Execution)	150.0
	Maharashtra (on Execution)	100.0
	Haryana (2*50) (on Execution)	100.0
	Uttarpradesh (on Execution)	50.0
Amplus	Karnataka (34)+15 upcoming	49.0
KCP Solar	Jaggayapet	1.15
Smart Roof Solar Solutions	Punjab	1.0

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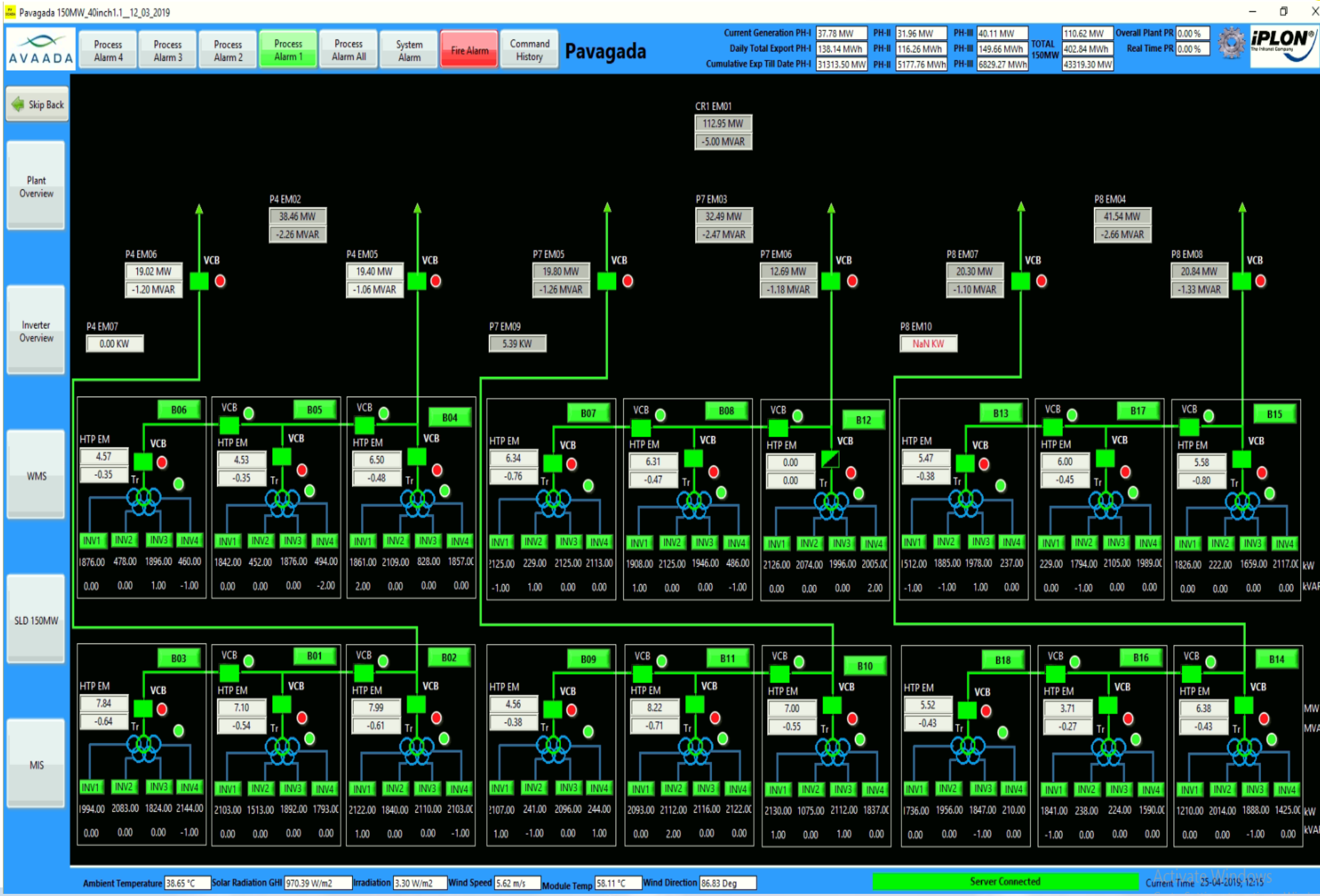
INTRODUCTION TO SCADA

- SCADA build in the LabVIEW Software code.
- SCADA files are run in the Windows.
- LabVIEW– Laboratory Virtual Instrument Engineering Workbench
- Graphical programming language that allows for instrument control, data acquisition, and pre/post processing of acquired data


Pavagada 150MW_40inch1.1__12_03_2019
AVAADA
Process Alarm 4
Process Alarm 3
Process Alarm 2
Process Alarm 1
Process Alarm All
System Alarm
Fire Alarm
Command History
Pavagada
Current Generation PH-I 37.78 MW PH-II 31.96 MW PH-III 40.11 MW
Daily Total Export PH-I 138.14 MWh PH-II 116.26 MWh PH-III 149.66 MWh
Cumulative Exp Till Date PH-I 31313.50 MW PH-II 5177.76 MWh PH-III 6829.27 MWh
TOTAL 150MW 110.62 MW 402.84 MWh 43319.30 MW
Overall Plant PR 0.00 %
Real Time PR 0.00 %
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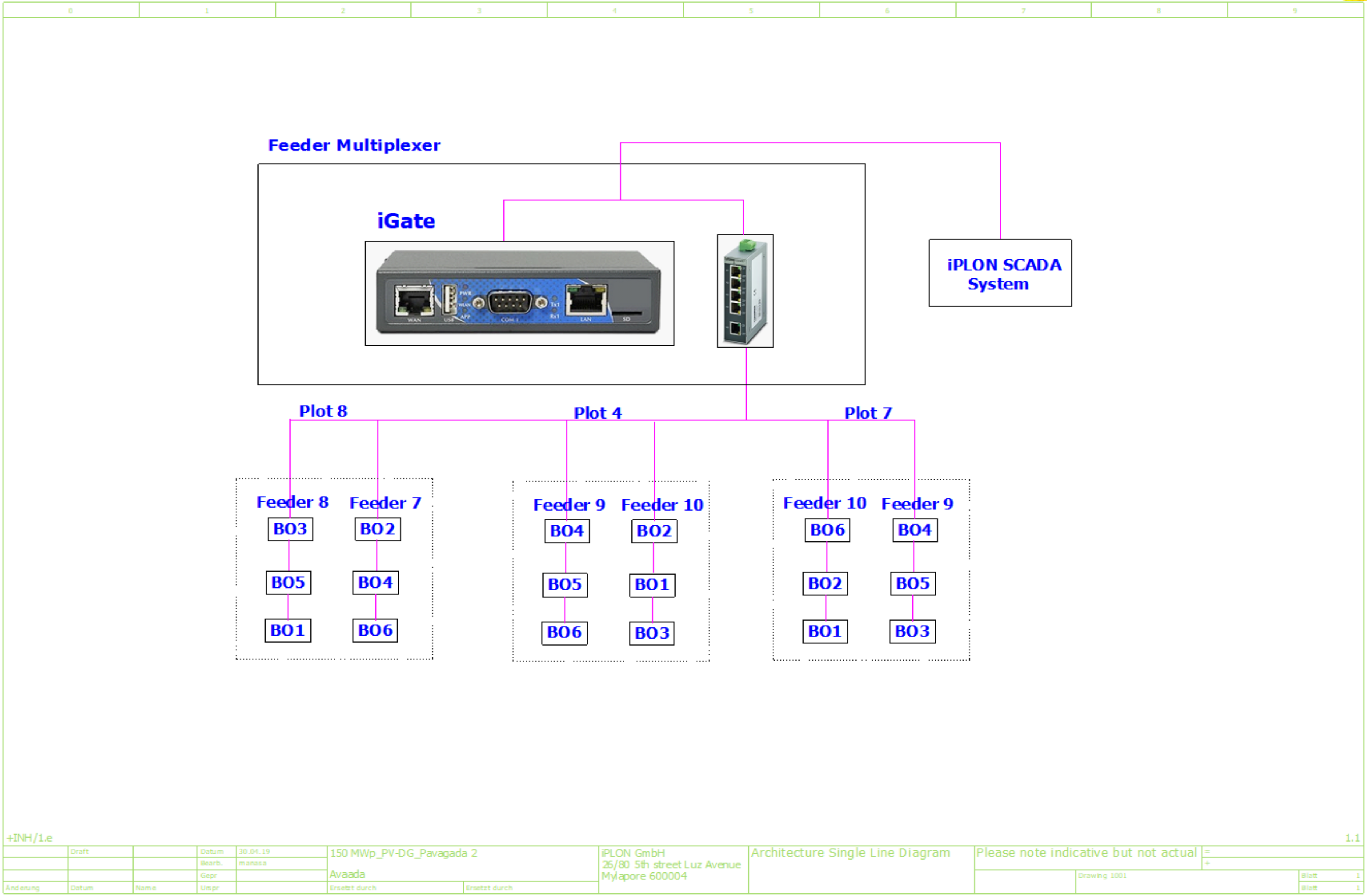
Skip Back
Plant Overview
Inverter Overview
WMS
SLD 150MW
MIS
CR1 EM01
112.95 MW
-5.00 MVAR
P4 EM02 38.46 MW -2.26 MVAR
P7 EM03 32.49 MW -2.47 MVAR
P8 EM04 41.54 MW -2.66 MVAR
P4 EM06 19.02 MW -1.20 MVAR
P4 EM05 19.40 MW -1.06 MVAR
P7 EM05 19.80 MW -1.26 MVAR
P7 EM06 12.69 MW -1.18 MVAR
P8 EM07 20.30 MW -1.10 MVAR
P8 EM08 20.84 MW -1.33 MVAR
P4 EM07 0.00 KW
P7 EM09 5.39 KW
P8 EM10 NaN KW
VCB
HTP EM
Tr
B06
B05
B04
B07
B08
B12
B13
B17
B15
B03
B01
B02
B09
B11
B10
B18
B16
B14
INV1 INV2 INV3 INV4
kW
kVAR
MW
MVAR
Ambient Temperature 38.65 °C
Solar Radiation GHI 970.39 W/m2
Irradiation 3.30 W/m2
Wind Speed 5.62 m/s
Module Temp 58.11 °C
Wind Direction 86.83 Deg
Server Connected
Current Time 25-04-2019; 12:15

Design



Feeder Multiplexer
iGate
iPLON SCADA System
Plot 8
Plot 4
Plot 7
Feeder 8
BO3
BO5
BO1
Feeder 7
BO2
BO4
BO6
Feeder 9
BO4
BO5
BO6
Feeder 10
BO2
BO1
BO3
Feeder 10
BO6
BO2
BO1
Feeder 9
BO4
BO5
BO3
+INH/1.e
1.1
Draft
Datum
30.04.19
Bearb.
manasa
Gepr
Änderung
Datum
Name
Urspr
150 MWp_PV-DG_Pavagada 2
Avaada
Ersetzt durch
Ersetzt durch
iPLON GmbH
26/80 5th street Luz Avenue
Mylapore 600004
Architecture Single Line Diagram
Please note indicative but not actual
=
+
Drawing 1001
Blatt 1
Blatt 1

192.168.38.82/powercontrol/

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Inverter Power Control

PAC 48.8624 QAC -5.70295 PF -0.993

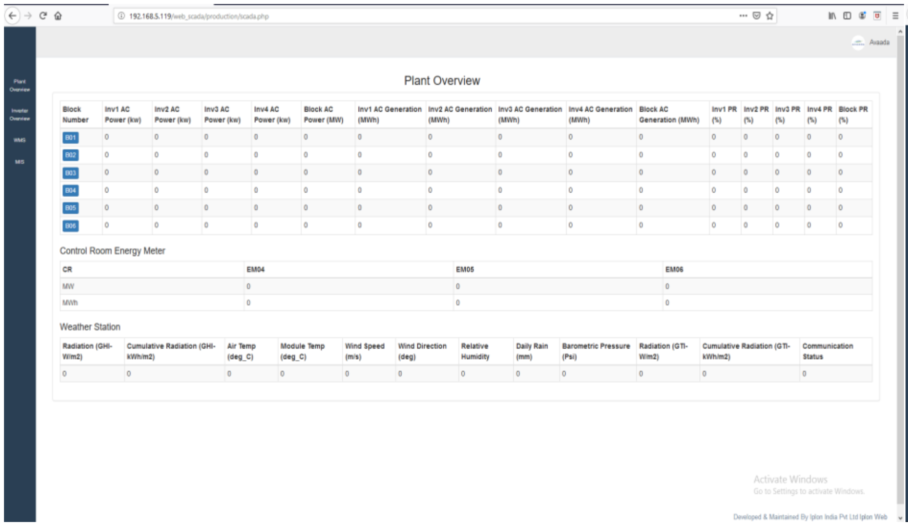
Active Power (%) 200 Go! Reset!

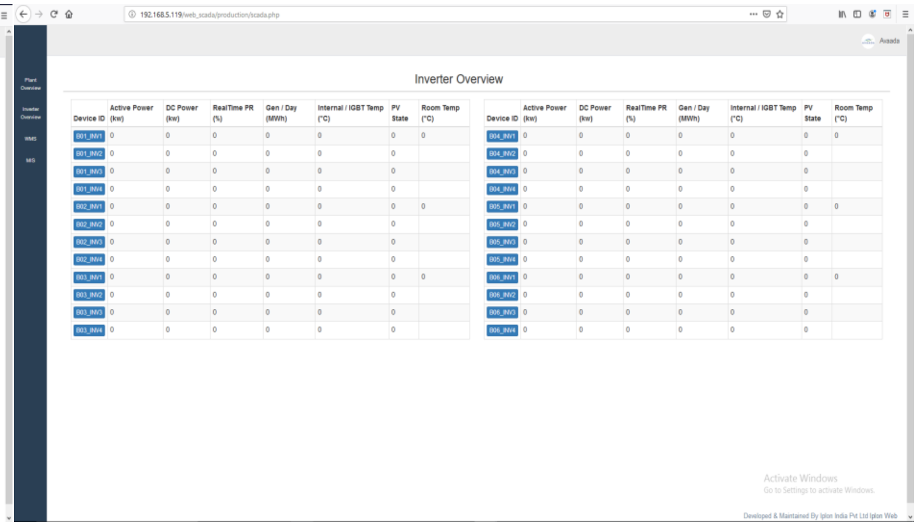
Reactive Power Ref Select QAC Reset!

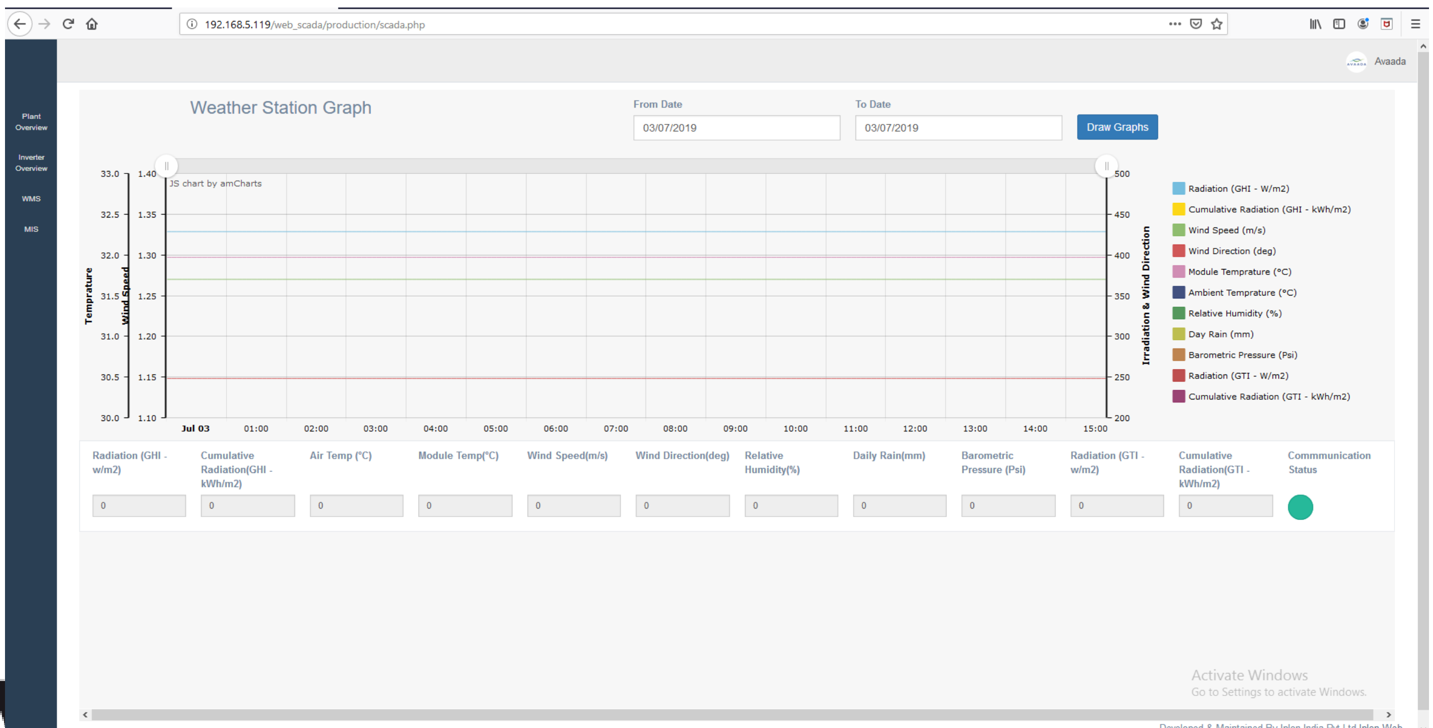
Reactive Power Select - kVAr 0 Go! Reset!

Inverter	Active Power Limit(%)	Reactive Power Select (2-kVAR,4-cos phi)	Reactive Power Refernce	Active Power(kW)	Reative Power(kVAr)	PF(-)	IGBT Temp(°C)
B01_INV1	20000	NaN	NaN	988.633	620	1	97
B01_INV2	20000	NaN	NaN	944.7	3	1	99
B01_INV3	20000	NaN	NaN	993.425	635	1	99.75
B01_INV4	20000	NaN	NaN	1013.1	-14.25	1	99.75
B02_INV1	20000	4	9900	997.6	50.5	0.996667	104.333
B02_INV2	20000	4	9980	991.333	42.1	1	98
B02_INV3	20000	4	9980	1010.87	17.8667	1	101.667
B02_INV4	20000	4	9980	1007.8	64.2333	1	99
B03_INV1	20000	NaN	NaN	1026.13	-0.05	1	97.75
B03_INV2	20000	NaN	NaN	1025.57	-0.5	1	100.667
B04_INV1	20000	2	0	997.8	0.4	1	103.667
B04_INV2	20000	2	0	994.567	0.633333	1	100.667
B04_INV3	20000	2	0	998.767	0.2	1	99
B04_INV4	20000	2	0	987.433	-0.766667	1	98
B05_INV1	20000	NaN	NaN	952	0.475	1	97.25
B05_INV2	20000	NaN	NaN	970.225	-0.15	1	96.25
B05_INV3	20000	NaN	NaN	998.625	-0.625	1	98.25
B05_INV4	20000	NaN	NaN	992.425	0.9	1	101.5
B06_INV1	20000	NaN	NaN	1003.7	62.475	1	99.5
B06_INV2	20000	NaN	NaN	994.45	63.75	1	98
B06_INV3	20000	NaN	NaN	985.325	62.125	1	104
B06_INV4	20000	NaN	NaN	987.775	60.95	1	97.25
B07_INV1	20000	NaN	NaN	990.375	-1	1	100
B07_INV2	20000	NaN	NaN	983.2	-0.35	1	97.5
B07_INV3	20000	NaN	NaN	985.175	0.625	1	99.5

Inverter	Active Power Limit(%)	Reactive Power Select (2-kVAR,4-cos phi)	Reactive Power Refernce	Active Power(Mw)	Reative Power(kVAr)	PF(-)	IGBT Temp(°C)
B07_INV4	20000	NaN	NaN	986.225	0.45	1	99.5
B08_INV1	20000	NaN	NaN	956.2	0.733333	1	98
B08_INV2	20000	NaN	NaN	997.633	0.6	1	95.25
B08_INV3	20000	NaN	NaN	1008.33	0.175	1	96.25
B08_INV4	20000	NaN	NaN	1000.63	-0.1	1	98.5
B09_INV1	19999	NaN	NaN	996.825	63.2	1	98
B09_INV2	20000	NaN	NaN	985.933	63.7833	1	97
B09_INV3	20000	NaN	NaN	1001.62	62.8667	1	99.3333
B09_INV4	20000	NaN	NaN	995.317	62.5167	1	100
B10_INV1	20000	NaN	NaN	1000.13	51.725	1	102.75
B10_INV2	20000	NaN	NaN	997.025	62.425	1	98.25
B10_INV3	20000	NaN	NaN	993.8	26.225	1	105.75
B10_INV4	20000	NaN	NaN	1005.18	63.6	1	101.167
B11_INV1	20000	NaN	NaN	1002.23	0.225	1	97.5
B11_INV2	20000	NaN	NaN	999.5	64.1	1	94.3333
B12_INV1	20000	NaN	NaN	983.475	62.65	1	94.25
B12_INV2	20000	NaN	NaN	1005.6	63.9333	1	100.667
B13_INV1	20000	NaN	NaN	1008.47	64.3333	1	100
B13_INV2	20000	NaN	NaN	982.933	0.433333	1	95
B13_INV3	20000	NaN	NaN	1011.18	46.625	1	99.25
B13_INV4	20000	NaN	NaN	1007.55	63.125	1	98
B14_INV1	20000	NaN	NaN	1014.23	42.5333	1	104
B14_INV2	20000	NaN	NaN	1022.3	21.2	1	104.667
B14_INV3	20000	NaN	NaN	1007.18	62.475	1	100
B14_INV4	20000	NaN	NaN	987.425	62.1667	1	101







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Case Study (TN 50 MW)

- **Savings using iPLON auto Power Control Solution**
- Real time data gathered from the 2 adjacent Solar Power Plants
- plants has frequent curtailment from the grid side
- "M" – 50 MW plant with iPLON control
- "T" & "I" – 50 MW plants with manual control

- **Savings using iPLON auto Power Control Solution**
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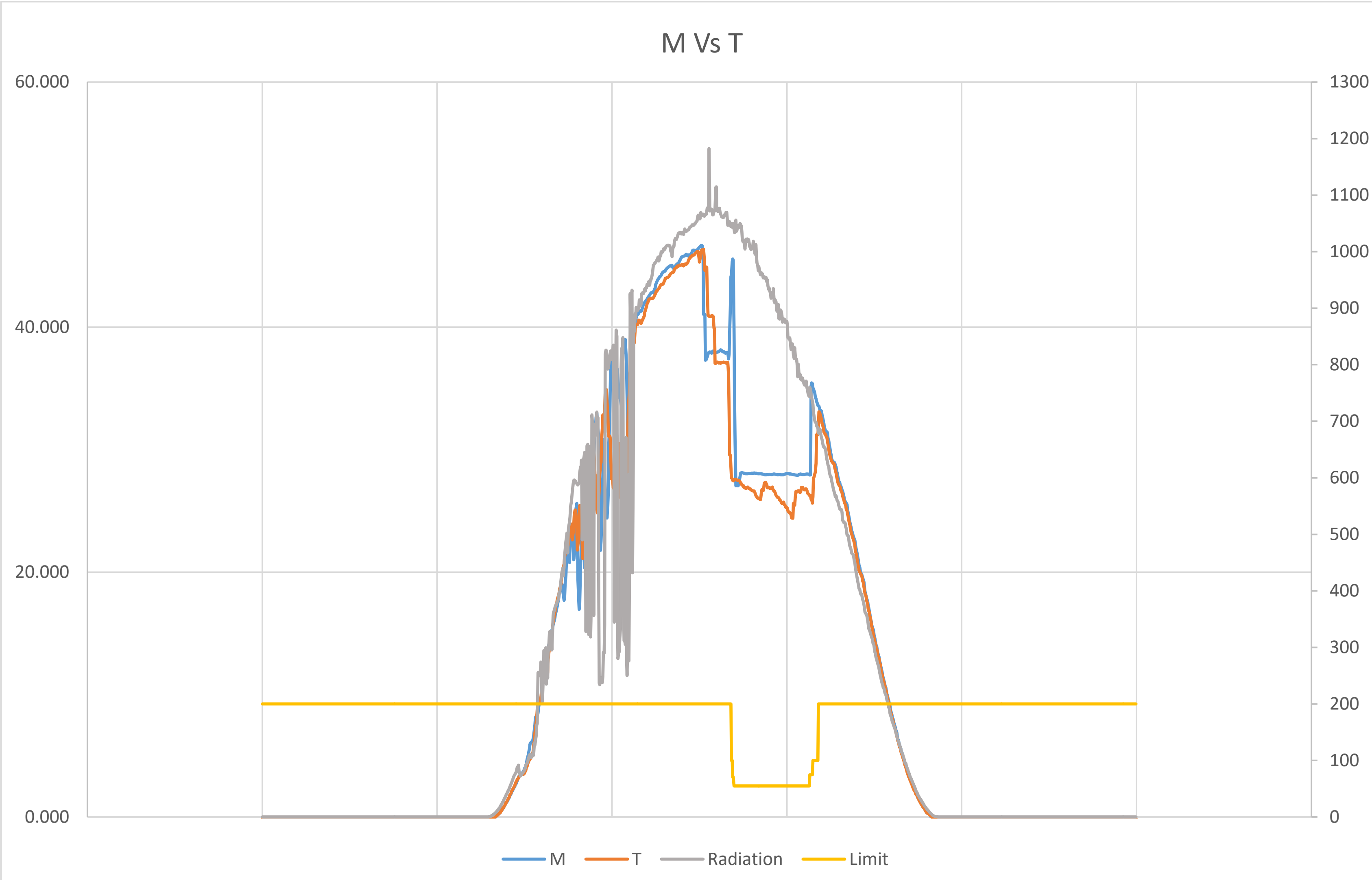
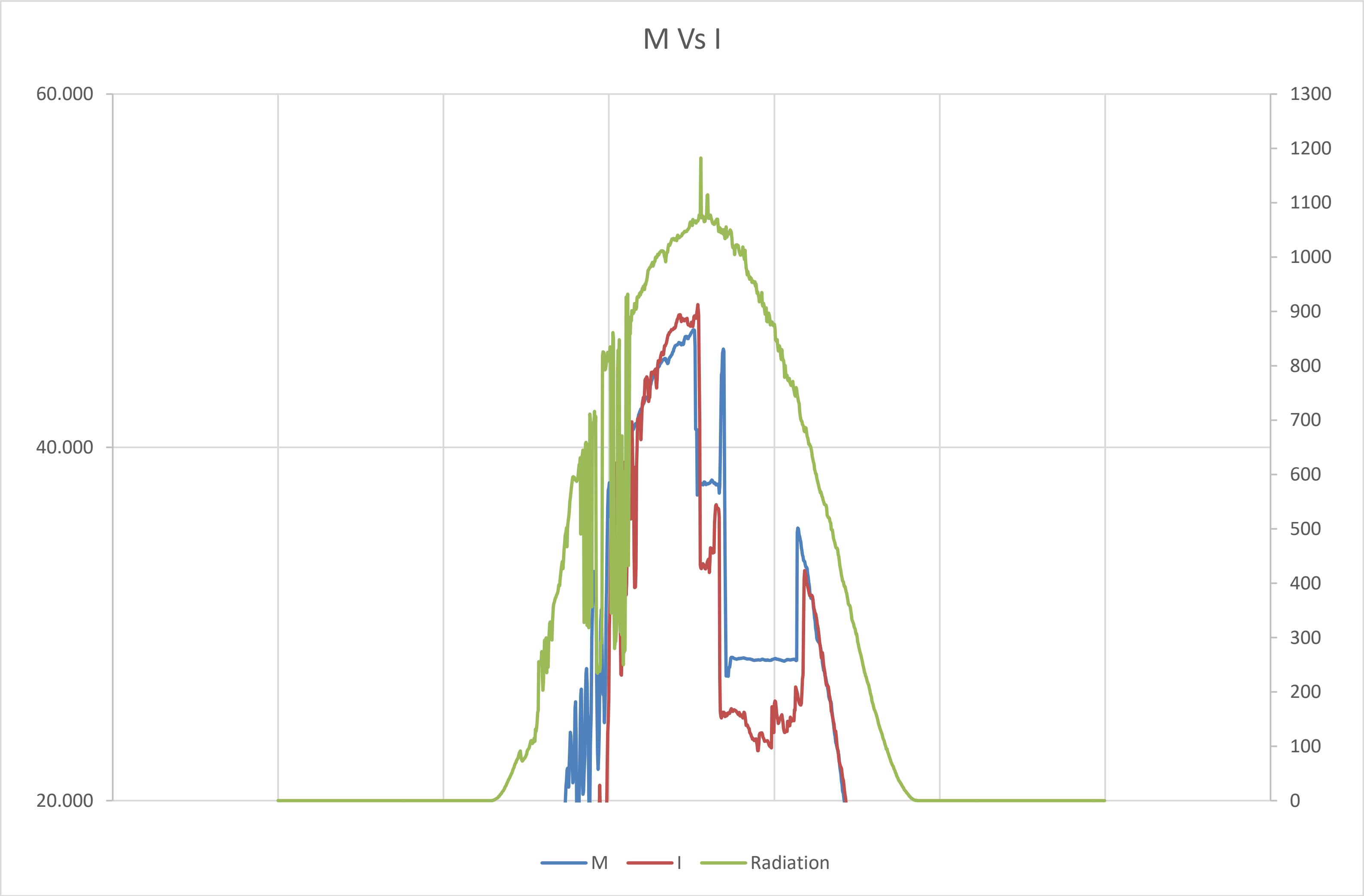
1) iPLON Power Control Vs Manual Control



Inverter switch ON delay



Inverter switch ON delay

Operator time					12		Inverter Wake up =						0:05:00													Inverter Signal	Inv Wake Up Time	Total Time to wake up
Inv #01	12																									0:00:12	0:05:00	0:05:12
Inv #02	12	12																								0:00:24	0:05:00	0:05:24
Inv #03	12	12	12																							0:00:36	0:05:00	0:05:36
Inv #04	12	12	12	12																						0:00:48	0:05:00	0:05:48
Inv #05	12	12	12	12	12																					0:01:00	0:05:00	0:06:00
Inv #06	12	12	12	12	12	12																				0:01:12	0:05:00	0:06:12
Inv #07	12	12	12	12	12	12	12																			0:01:24	0:05:00	0:06:24
Inv #08	12	12	12	12	12	12	12	12																		0:01:36	0:05:00	0:06:36
Inv #09	12	12	12	12	12	12	12	12	12																	0:01:48	0:05:00	0:06:48
Inv #10	12	12	12	12	12	12	12	12	12	12																0:02:00	0:05:00	0:07:00
Inv #11	12	12	12	12	12	12	12	12	12	12	12															0:02:12	0:05:00	0:07:12
Inv #12	12	12	12	12	12	12	12	12	12	12	12	12														0:02:24	0:05:00	0:07:24
Inv #13	12	12	12	12	12	12	12	12	12	12	12	12	12													0:02:36	0:05:00	0:07:36
Inv #14	12	12	12	12	12	12	12	12	12	12	12	12	12	12												0:02:48	0:05:00	0:07:48
Inv #15	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12											0:03:00	0:05:00	0:08:00
Inv #16	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12										0:03:12	0:05:00	0:08:12
Inv #17	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12									0:03:24	0:05:00	0:08:24
Inv #18	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12								0:03:36	0:05:00	0:08:36
Inv #19	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12							0:03:48	0:05:00	0:08:48
Inv #20	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12						0:04:00	0:05:00	0:09:00
Inv #21	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12					0:04:12	0:05:00	0:09:12
Inv #22	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12				0:04:24	0:05:00	0:09:24
Inv #23	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12			0:04:36	0:05:00	0:09:36
Inv #24	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12		0:04:48	0:05:00	0:09:48
Inv #25	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	0:05:00	0:05:00	0:10:00
																										Total Time		3:10:00

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Fig 9. iPLON Power Control Vs Manual Control for Plant 1

Inverter switch ON delay

PVS800 state machine

The PVS800 follows the state machine shown below.

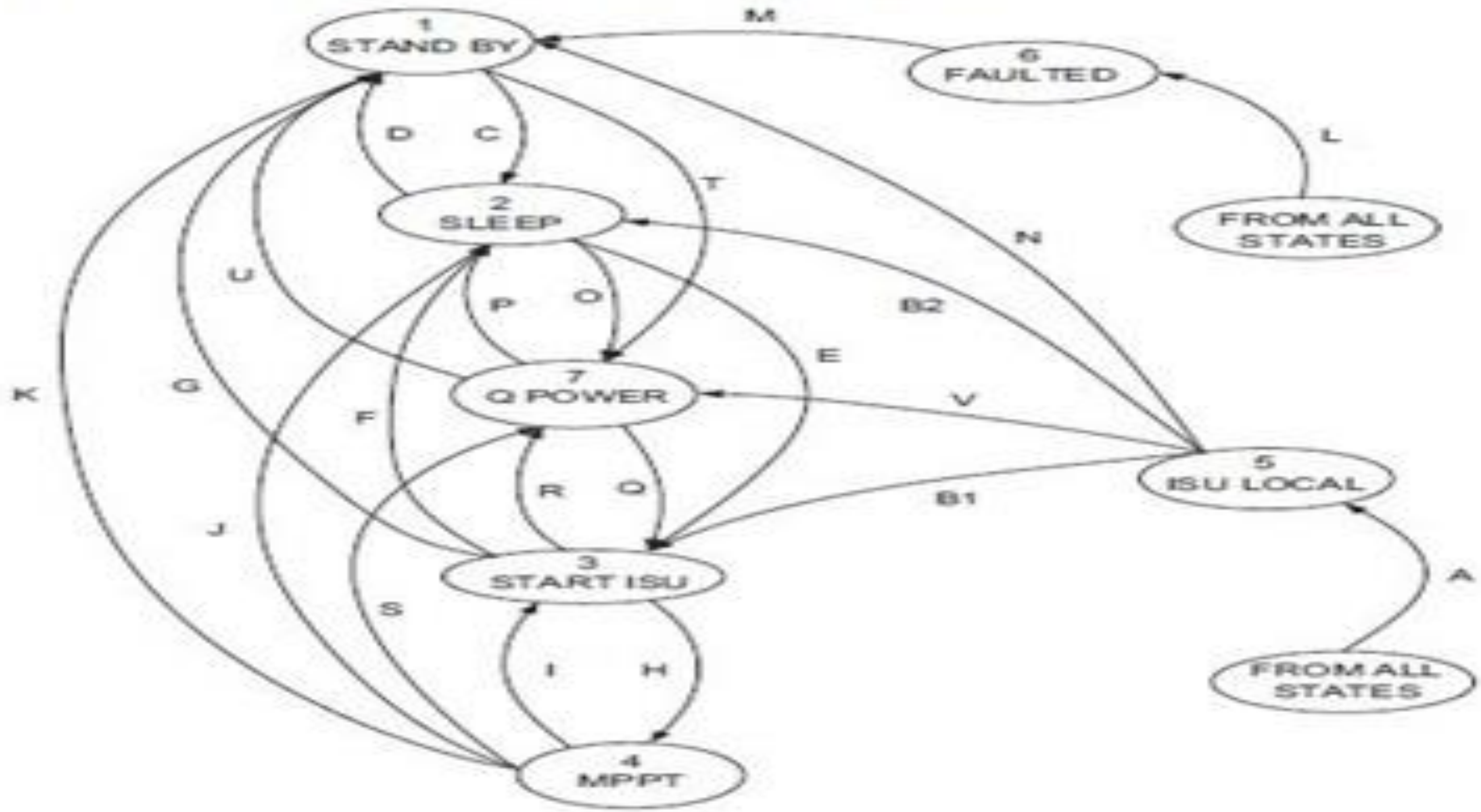

Fig 9. State Model for PVS800 Central Inverter

DC/AC Contactor ON / OFF cycle

- in STANDBY mode, the DC and AC contactors are open.
- every switch has it's own limited switching cycles the DC & AC contactor of the Inverter might have a manufacturer guarantee
- Cause inverter downtime finally

Comparison

S.NO	Task	Manual Operation	iPLON Power Control Solution
1	Generation loss	Yes	No
2	INV Down time	Yes	No
3	Operation time	1 hr 35 minutes	20 sec
4	ON OFF Delay time	Yes	No
5	Manual stress	Yes	No

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Thank You!

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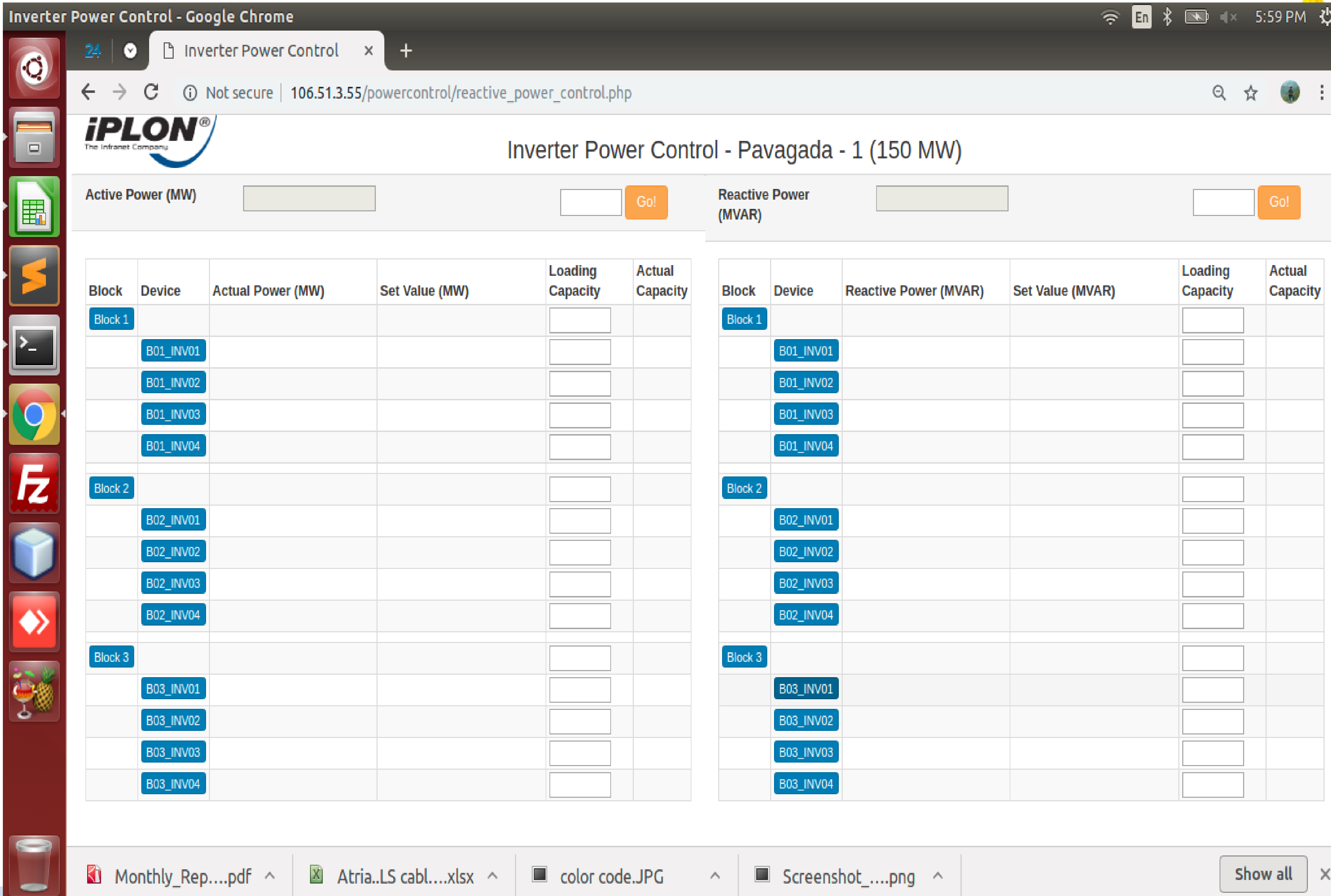
www.youtube.com/user/iPLONChannel



Block	Device	Actual Power (MW)	Set Value (MW)	Loading Capacity	Actual Capacity
Block 1					
	B01_INV01				
	B01_INV02				
	B01_INV03				
	B01_INV04				
Block 2					
	B02_INV01				
	B02_INV02				
	B02_INV03				
	B02_INV04				
Block 3					
	B03_INV01				
	B03_INV02				
	B03_INV03				
	B03_INV04				

Block	Device	Reactive Power (MVAR)	Set Value (MVAR)	Loading Capacity	Actual Capacity
Block 1					
	B01_INV01				
	B01_INV02				
	B01_INV03				
	B01_INV04				
Block 2					
	B02_INV01				
	B02_INV02				
	B02_INV03				
	B02_INV04				
Block 3					
	B03_INV01				
	B03_INV02				
	B03_INV03				
	B03_INV04				

Training and workshop

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