Aditya Cements Works Ltd.(A Unit Of Grasim Cement Ltd.)
Adityapuram, Chittorgarh, Rajasthan- India

(92MW Generation Capacity)

Power Management Project

Type of Plant
Cement Plant

Location
Chittorgarh,
Rajasthan, India

Turbine Size
STG-1 25MW BHEL
STG-2 26MW HTC
STG-3 26MW HTC
STG-4 16.5MW ALSTOM

Woodward Supplied
- DSLC-II
- MSLC-II
- ATLAS-II
- HT Linknet Modules
- HMI/ SCADA
- ATLAS-II Software
- CAN-FO Converters

UltraTech Cement Limited is the cement flagship company of the Aditya Birla Group. A USD 5.9 billion building solutions powerhouse, UltraTech is the largest manufacturer of grey cement, ready mix concrete (RMC) and white cement in India. It is the third largest cement producer in the world, excluding China. UltraTech is the only cement company globally (outside of China) to have 100+ MTPA of cement manufacturing capacity in a single country. The Company's business operations span UAE, Bahrain, Sri Lanka and India.

UltraTech has a consolidated capacity of 116.8 million tonnes per annum (MTPA) of grey cement. UltraTech has 22 integrated manufacturing units, 27 grinding units, one clinkerisation unit and 7 bulk packaging terminals. UltraTech has a network of over one lakh channel partners across the country and has a market reach of more than 80% across India. In the white cement segment, UltraTech goes to market under the brand name of Birla White. It has one white cement unit and one wall care putty unit, with a current capacity of 1.5 MTPA. UltraTech has over 130 ready mix concrete (RMC) plants in 50 cities across India. It also has a slew of speciality concretes that meet specific needs of discerning customers. Our Building Products business is an innovation hub that offers an array of scientifically engineered products to cater to new-age constructions. UltraTech pioneered the UltraTech Building Solutions (UBS) concept to provide individual home builders with a one-stop-shop solution for building their homes. Today, UBS is the largest single brand retail chain with over 2500 stores across India.

UltraTech is a founding member of Global Cement and Concrete Association (GCCA). It is a signatory to the GCCA Climate Ambition 2050, a sectoral aspiration to deliver carbon neutral concrete by 2050. UltraTech has adopted new age tools like Science Based Target Initiative (SBTi), Internal Carbon Price and Energy Productivity (#EP100) as part of its efforts to accelerate adoption of low carbon technologies and processes across its value chain and thus reduce carbon footprint over the life cycle. UltraTech is the first company in India and the second company in Asia to issue dollar-based sustainability linked bonds. As part of its CSR, UltraTech reaches out to nearly 2.1 million beneficiaries in over 500 villages across India covering areas of education, healthcare, sustainable livelihoods, community infrastructure and social causes.

ADITYA CEMENT WORKS, CHITTORGARH, RAJASTHAN

Aditya Cement Works is one of the cement plant of Grasim Industries. It was built in 1995 in Shambupura, Chittorgarh, Rajasthan. The plant capacity is about 1.50 million TPA. The plant is equipped with state-of-the-art equipment and are certified with ISO 9001 for quality systems, and ISO 14001 for environment management systems.

Aditya Cement Works has three power plants (WHRS, TPP-1 & TPP-2&3) at different locations.

TPP-1 has one STGs (STG-1 = 15MW Generator driven by BHEL Steam Turbine)

TPP-2&3 has two STGs (STG-2 = 26MW Generator driven by HTC Steam Turbine, STG-3 = 26MW Generator driven by HTC Steam Turbine,)

WHRS (Waste Heat Recovery Steam) has one STG. STG4 = 16MW Generator driven by HTC Steam Turbine.

Woodward's Supplied Hardware for Power Management System.

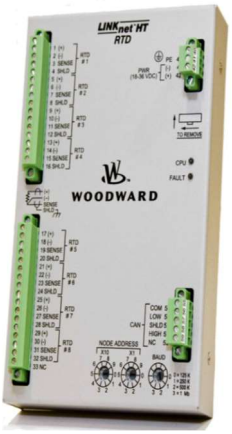
DSLC-2 – Digital Synchronizer and Load Control

MSLC-2 – Master Synchronizer and Load Control

ATLS-II –Open Hardware for Custom Breaker Combination Logic

HT Link net – Input / Output Modules connected with ATLAS-II at CAN Bus Communication.

DSLC-2 / MSLC-2



HT LINKNET

ATLAS-II

Woodward's Power Management System - The Control of Choice

Woodward performed detailed site surveys and studies to analyze the existing situations while consulting Aditya Cement Works on the necessary technical requirements. Follow-up meetings were conducted to ensure that project milestones were met on time.

Woodward's Power management controllers including DSLC-II & MSLC-II along with ATLAS-II were chosen for Aditya Cement works for controlling Power of 96MW generation capacity Plant as it met all of ADITYA CEMENT WORKS's performance and reliability requirements as well as it allowed Generator Breaker Auto Synchronizing of all the 4 no.'s of Turbines and run them in Load Sharing, Fixed Load, Import/Export Mode as well as took care of Load Shedding also.

This type of integrated Power Management system simplified Turbine loading and its Operation and reduced the overall system's complexity. Also it saved the Plant from unnecessary Blackouts during Grid Islanding Operation.

Since reliability was key to the long-term success as observed from UTCL-Rajashree, Awarpur & Tadipatri, UTCL chose the Woodward's Power Management controller's field proven hardware platform. The ATLAS-II platform with HT Linknets modules on Woodward's customized GAP software allowed engineers to validate different breaker combinations, Load shedding logic conditions frequency based & priority-based changes before putting the software program into actual operation.

System Description & Application Challenges

In Aditya Cement Works there are four different locations and four cabinets are supplied at different locations.

Cabinet-1 at WHRS (800W x 800D x 2000H): One DSLC-2, Two HT Link-net Modules and one SPMD supplied.

Cabinet-2 at LC2 (1000W x 800D x 2000H): Two MSLC-2, Atlas-II along with Four HT Link-net Modules.

Cabinet-3 at LC-0 & LC1 (1000W x 800D x 2000H): Three MSLC-2, four HT Link-net Modules.

Cabinet-4 at TPP-2 & 3 (1600W x 800D x 2000H): Three MSLC-2, Three DSLC-2 for STG-1, 2 & 3, One SPMD for Bus Coupler, Three HT Link-net Modules. One HMI server.

Woodward Controllers were installed at each location depending on the number of Synchronizing & shedding breakers.

Distance between Cabinet-1 & Cabinet-2 is 0.7 KM.

Distance between Cabinet-3 & Cabinet-2 is 0.8 KM.

Distance between Cabinet-4 & Cabinet-2 is 0.8 KM.

All four Cabinets connected using Multimode FO Communication. CAN to FO Communication used for ATLAS-II communication with HT Linknets at different Cabinets. Ethernet to FO Communication used for DSLC-2 & MSLC-2 Network-A & Network-B communication between different cables at different locations.

Woodward Supplied Load Management System: Woodward supplied 5 no. of cabinets located at each location communicating over Fiber Optic media which was around 4.6 km in total with 2 no. of HMI's at different locations. This includes Load Sharing signals, Load Shedding signals and Breaker combination signals of 35 paths of Plant SLD having more than 50 breakers. Atlas-II along with HT Linknet modules took care of breaker combination & Load Shedding part and DSLC-II / MSLC-II system for Generator Breaker Auto synchronizing & Load Sharing part.

Load Sharing System – For Load Sharing System Woodward supplied Four DSLC-2s at each STGs. Seven MSLC-2 supplied for Bus Coupler Synchronization. One MSLC-2 supplied for Grid Breaker Synchronization and Import/Export Control. Two SPMDs supplied for Bus Coupler Synchronization. For breaker combination Atlas-2 & Linknet supplied. There are 53 breakers in Plant whose feedback comes to Atlas-2 and Linknet at different locations. Breaker Combination GAP logic is made and to run this software ATLAS-2 with two AIO Combo Module and 13 HT Linknet used. On Basis of Feedbacks of All breakers in plant the final Breaker combination output generated which are given to desired DSLC-2 & MSLC-2 as per their requirement.

Given below are control for LMS used in Aditya Cement Works.

1. Synchronization of Generator Breakers, Bus Couplers and Grid Breaker.
2. Base Load (Fix Load Control) while connected with GRID.
3. Force Base Load Control while Grid is not available, and any One STG needs to run at Fix Load and other remaining load is shared by other machines. For Base Load Control Mode Logic made in Atlas-2 to give Base Load DI for respected STG's DSLC-2 and out from Base Load Control , if STGs remains single due to tripping of other STGs which is running in Load Share in Control Mode.

4. Load Sharing Control Mode while Grid is not available. The Plant Load shared by the running machine proportionally.
5. Import Export Control at Grid Level.
6. Power Factor Control of individual STGs while running with Grid in Base Load control mode.
7. VAR Sharing while running without Grid. VAR shared by the STGs running in Load Share in Control Mode.
8. Constant Generator PF Control Mode while MSLC-2 at Grid is in Import/Export Control Mode.

Trials -

Grid Breaker Synchronization: - Smooth Synchronizing of Grid breaker with 3 no.'s of STG sets which were running in Load Sharing Control mode.

Load Sharing: - Island Operation when three no.'s of Turbines running in Load sharing mode sharing all the plant Load (Real & Reactive) in proportion to their rated capacity at 50Hz & rated Voltage.

Fixed Load: - This is the Base Load Mode which means fixing the load on Turbine when connected with Grid or any other STG as per the given Load set point.

Import/Export Control: - Controlling Import/Export power at Grid breaker as per the preset Set point. During Import/Export control, STG load floats to maintain the Import/Export Set point.

Load Shedding – Load shedding is a way to distribute demand for electrical power across multiple power sources. Load shedding is used to relieve stress on a primary energy source when demand for electricity is greater than the primary power source can supply. Load Shedding is required when any Power Source is shut down due to any reason or steam/fuel is not sufficient to run the Load or sudden increase the load above the capacity of power source.

In Aditya cement works there are total 28 breakers are Load breakers at two (LC-2 and LC0 & LC1) different locations which needs to be shed during the Load Shedding. There are total five (Four STGs and One Grid) Power Sources which are used as power source for Load Shedding Logic.

Load Shedding used is dynamic load base which calculate running load of STG, GRID as well as Load Breakers and generate breaker open command if any Source Load is tripped of Import increase beyond MD set-point.

Given below are Load Shedding which are used in the Aditya Cement Works.

1. **MD (Maximum Demand) Import Base** – In this load shedding logic maximum demand import set-point is given from HMI / GAP Logic. If import Load is increased beyond this set point, then Load Shed as per Priority selected. First Shedding Priority load shed first then wait for Delay-1 time. If still Import Load > MD Set-point, then shed next priority breaker.
2. **Island base Load Shedding** – If plant is running in Island (Without Grid) then if any Load Source Breaker trips then shed load which is equal to or greater than running load of Power Source Breaker.
3. **Frequency Base Load Shedding** – If plant is running in island Condition and there is problem in boiler due to which it could not supply sufficient steam to the turbine. In this case Frequency of Power Source is start decreasing. To save power source from under frequency trip, frequency Base Load shedding comes in picture and shed the load to save the blackout.

Taking all the STG sets in Load Sharing at the same time from different locations was a big task & Woodward system was able to fulfill that requirement. As the cement plant was in full operation during the implementation phase, only one STG was available to the commissioning team at a time. While working on one STG other STGs were providing power to the Plant. Careful studies and measures were undertaken to make sure all required I/O signals were identified and the commissioning would not pose any upset to the online critical units.

Project/System/Plant Result

Auto synchronizing at each of the STG breaker, Bus-couplers & Grid Breaker was done successfully.
During islanding actual Grid from plant at 10MW Export, Three STG sets come in Load Sharing and shares the plant Load in proportion to their Rated Capacity (MW) at 50Hz and Rated Voltage.
Even after commissioning plant got islanded from Grid at more 10MW Export condition & every time plant got saved from any tripping by Sharing the Plant Load through Woodward's Power Management System.

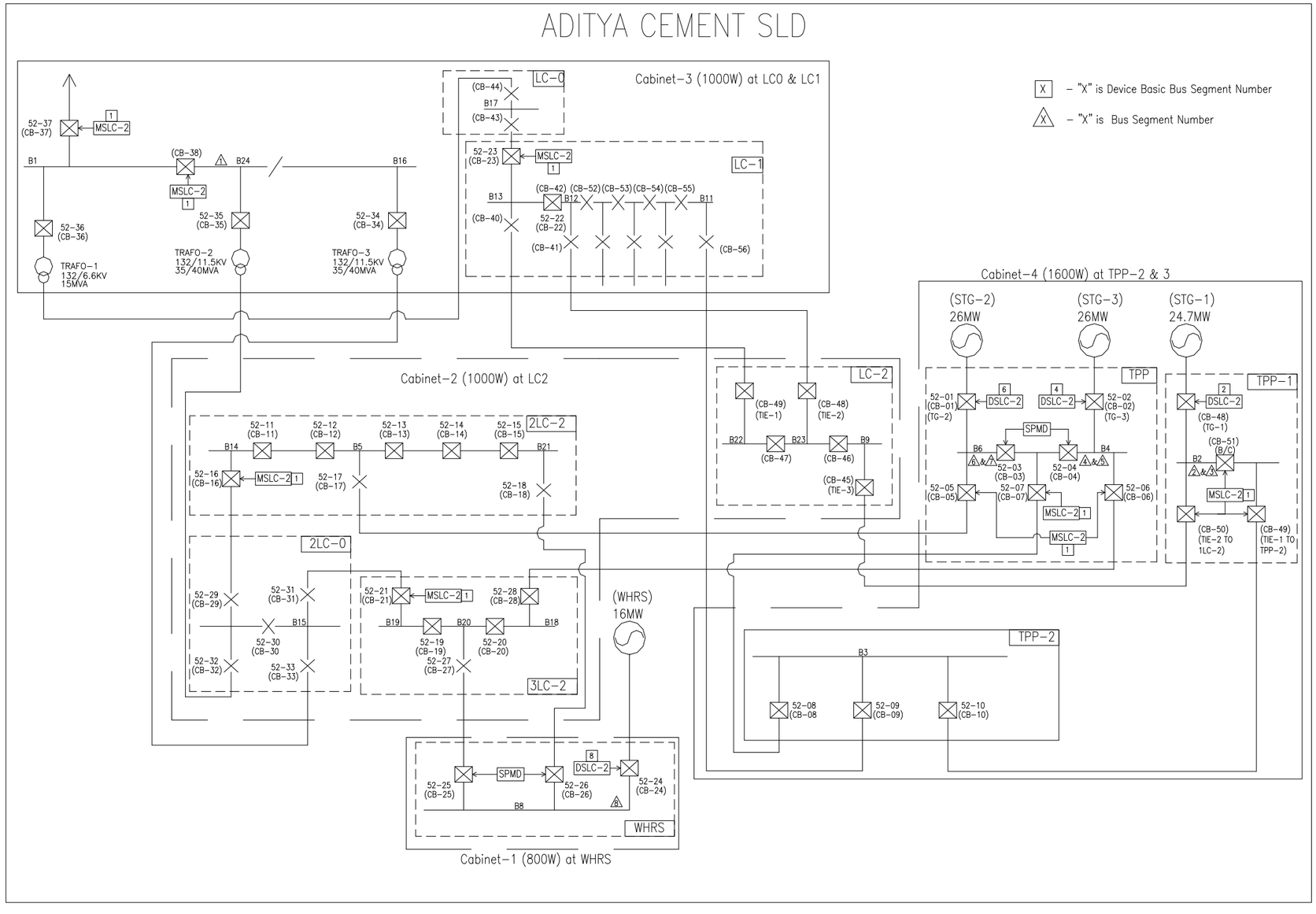
The new Power Management System was able to handle Import/Export when tied to utility and Load Sharing when system is in island mode. These experiences confirm PMS as a total solution provider for Power Generation and are capable of providing quality and reliable support to our client.

Aditya Cement Works was satisfied with the overall system & its commissioning.

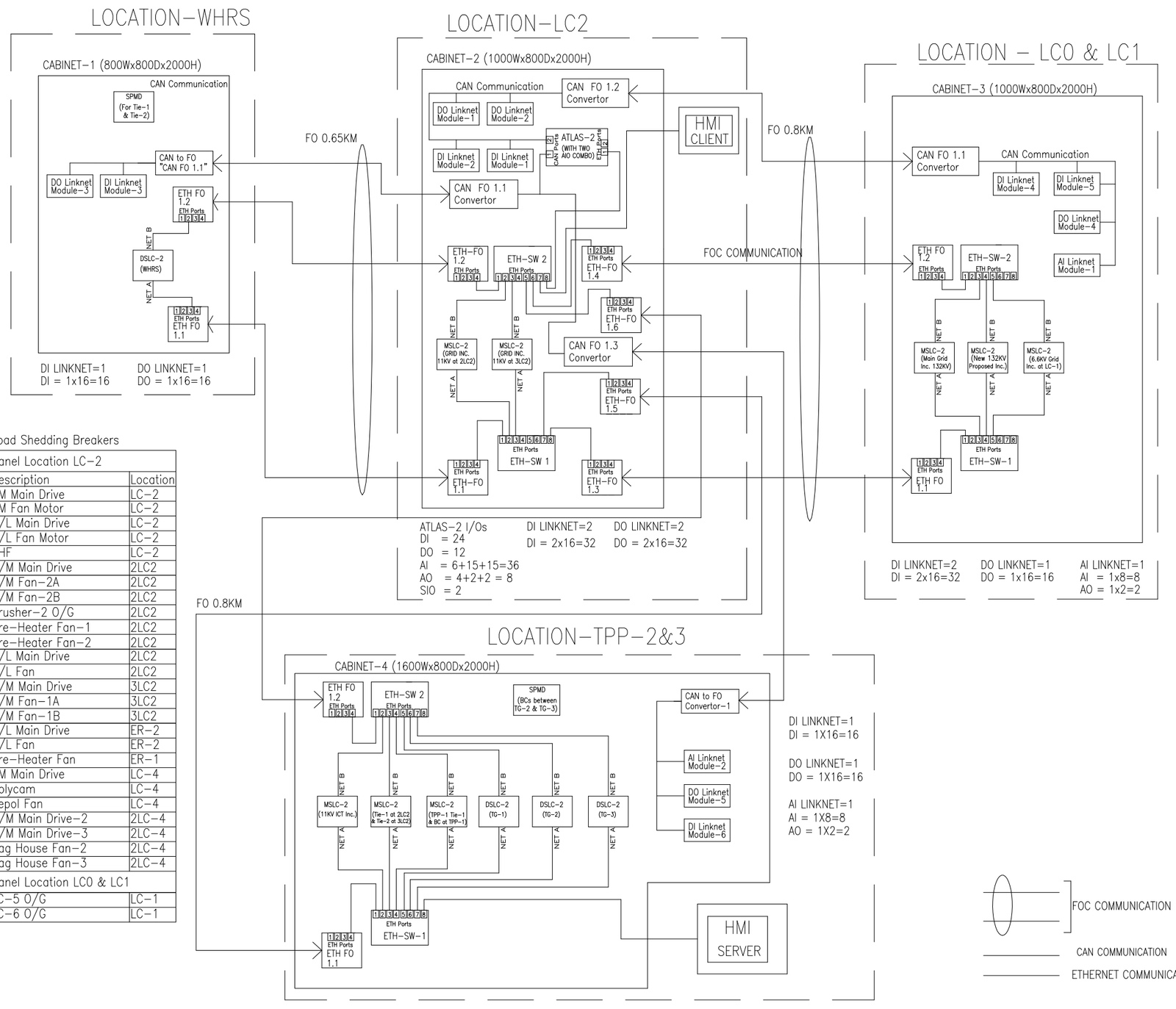
Woodward Equipment Installed

Woodward supplied the following controls for Power Management System:

- **DSLC-II, MSLC-II controls**
- **ATLAS-II & HT Linknet Modules**
- **Core ATLAS-II software program**
- **Four Cabinets (DSLC-2, MSLC-2 & ATLAS-II)**
- **Engineering workstation with HMI**
- **Wiring & installation assistance**
- **Factory Assistance Test**
- **Operator Training**


ADITYA CEMENT SLD
X – "X" is Device Basic Bus Segment Number
X – "X" is Bus Segment Number
Cabinet–3 (1000W) at LC0 & LC1
LC–0
LC–1
52–37 (CB–37)
MSLC–2
B1
(CB–38)
B24
B16
52–36 (CB–36)
52–35 (CB–35)
52–34 (CB–34)
TRAFO–1 132/6.6KV 15MVA
TRAFO–2 132/11.5KV 35/40MVA
TRAFO–3 132/11.5KV 35/40MVA
(CB–44)
B17
(CB–43)
52–23 (CB–23)
(CB–42)
(CB–52)
(CB–53)
(CB–54)
(CB–55)
B13
B12
B11
(CB–40)
52–22 (CB–22)
(CB–41)
(CB–56)
Cabinet–4 (1600W) at TPP–2 & 3
(STG–2) 26MW
(STG–3) 26MW
(STG–1) 24.7MW
TPP
TPP–1
52–01 (CB–01) (TG–2)
DSLC–2
52–02 (CB–02) (TG–3)
SPMD
B6
B4
52–03 (CB–03)
52–04 (CB–04)
52–05 (CB–05)
52–07 (CB–07)
52–06 (CB–06)
(CB–48) (TG–1)
(CB–51) (B/C)
B2
(CB–50) (TIE–2 TO 1LC–2)
(CB–49) (TIE–1 TO TPP–2)
Cabinet–2 (1000W) at LC2
LC–2
(CB–49) (TIE–1)
(CB–48) (TIE–2)
B22
B23
B9
(CB–47)
(CB–46)
(CB–45) (TIE–3)
2LC–2
52–11 (CB–11)
52–12 (CB–12)
52–13 (CB–13)
52–14 (CB–14)
52–15 (CB–15)
B14
B5
B21
52–16 (CB–16)
52–17 (CB–17)
52–18 (CB–18)
2LC–0
3LC–2
52–29 (CB–29)
52–31 (CB–31)
B15
52–30 (CB–30)
52–32 (CB–32)
52–33 (CB–33)
52–21 (CB–21)
52–28 (CB–28)
B19
B20
B18
52–19 (CB–19)
52–20 (CB–20)
52–27 (CB–27)
(WHRS) 16MW
TPP–2
B3
52–08 (CB–08)
52–09 (CB–09)
52–10 (CB–10)
52–25 (CB–25)
SPMD
DSLC–2
52–26 (CB–26)
52–24 (CB–24)
B8
WHRS
Cabinet–1 (800W) at WHRS

SYSTEM ARCHITECTURE for ADITYA CEMENT



Load Shedding Breakers

Sn.	Description	Location
	Panel Location LC–2	
1	RM Main Drive	LC–2
2	RM Fan Motor	LC–2
3	C/L Main Drive	LC–2
4	C/L Fan Motor	LC–2
5	PHF	LC–2
6	R/M Main Drive	2LC2
7	R/M Fan–2A	2LC2
8	R/M Fan–2B	2LC2
9	Crusher–2 O/G	2LC2
10	Pre–Heater Fan–1	2LC2
11	Pre–Heater Fan–2	2LC2
12	C/L Main Drive	2LC2
13	C/L Fan	2LC2
14	R/M Main Drive	3LC2
15	R/M Fan–1A	3LC2
16	R/M Fan–1B	3LC2
17	C/L Main Drive	ER–2
18	C/L Fan	ER–2
19	Pre–Heater Fan	ER–1
20	CM Main Drive	LC–4
21	Polycam	LC–4
22	Sepol Fan	LC–4
23	C/M Main Drive–2	2LC–4
24	C/M Main Drive–3	2LC–4
25	Bag House Fan–2	2LC–4
26	Bag House Fan–3	2LC–4
	Panel Location LC0 & LC1	
27	LC–5 O/G	LC–1
28	LC–6 O/G	LC–1

PO Box 1519, Fort Collins CO 80522-1519, USA
1000 East Drake Road, Fort Collins CO 80525, USA
Phone +1 (970) 482-5811 ◆ Fax +1 (970) 498-3058
Email and Website—www.woodward.com

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For more information contact: