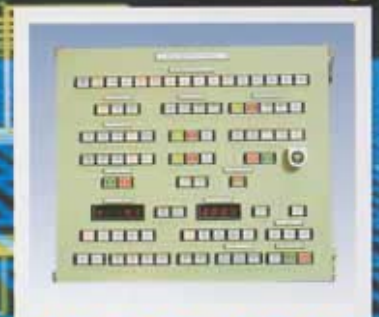


**DIGITAL
ELECTRO HYDRAULIC CONTROL
SYSTEM FOR STEAM TURBINE**

D-EHC



TOSHIBA
TOSHIBA CORPORATION

D-EHC

DIGITAL ELECTRO-HYDRAULIC CONTROL SYSTEM

The TOSHIBA's D-EHC is a control system developed especially for a power generation plant turbine, based on requirements learned through many years of experiences of power generation plants in all over the world. Toshiba, as a plant supplier and turbine manufacturer, has applied much knowledge of plant/ turbine operation and monitoring in the D-EHC system. For example, the turbine start-up operation is one of the important functions in D-EHC, and the start-up procedure, which is determined by our turbine designer from its lifetime consumption with turbine design data, enables optimum operation and longer equipment life. Besides, TOSHIBA's D-EHC incorporates TOSHIBA's most advanced technology from the electronic components to the total system, and it provides high-reliability and high performance.

Employed as hardware in the D-EHC cubicles is TOSHIBA's programmable controller, which has been developed exclusively for power generation plants. This hardware configuration enables the introduction of such innovative techniques as:

- accumulated technology for programmable controllers
- distributed controller for supervising
- man-machine interface with CRT
- standardized interface technique (interface with other computer systems)

It is assured that TOSHIBA provides high reliability in the D-EHC with a total quality control system from each component to system engineering.

FEATURES

MONITORING

Important process values essential for turbine are supervised on the D-EHC color graphic CRT.

- Thermal stress
- Start-up procedure display
- T.S.I. (turbine supervisory) instruments), etc.

CONTROLLABILITY

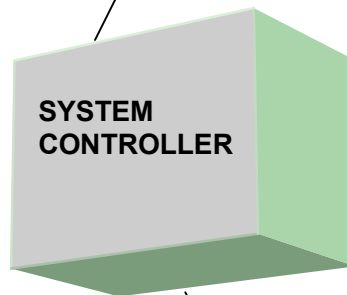
- Distributed architecture
 - monitoring, valve control, and I/Os.
- High control performance
 - variable gain control for speed, valve, frequency
 - Non-linear compensation for valve flow, etc.
- Safety control
 - Input signal diagnosis, safe voting algorithm
- Full automatic turbine start-up
- Auxiliary control (Option)
 - ALR, AFC, IPR, FLR
 - Auxiliary equipment control
- Possibility of advanced control (Option)
 - Expert system, multi-control, etc.

MAINTENABILITY

- Easy maintenance possible with software adjustment.
- Easy diagnosis function in operation.
 - CPU self-diagnosis
 - Signal check
 - Comparison check
 - Power failure detection
 - Interface check

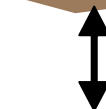
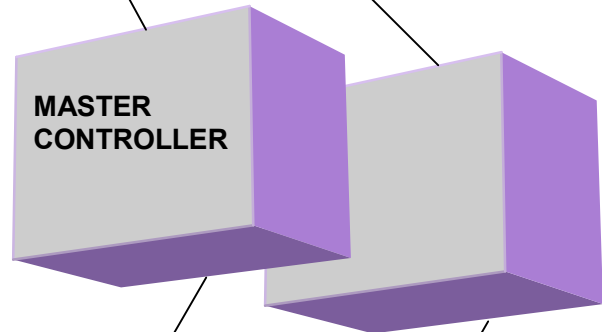
OPERATION

CRT operation is available for easy man-machine interface. Besides, a control panel with hard-wired push buttons for load inc./dec. and trip is prepared for back-up operation. This human-oriented interface provides for safe and easy operation.



RELIABILITY

- Apply distribution of functions for each controller.
- Duplicated controller, data buses, power supply.
- Apply highly reliable components
 - developed and qualified by TOSHIBA
 - proven in many plants



TURBINE VALVES

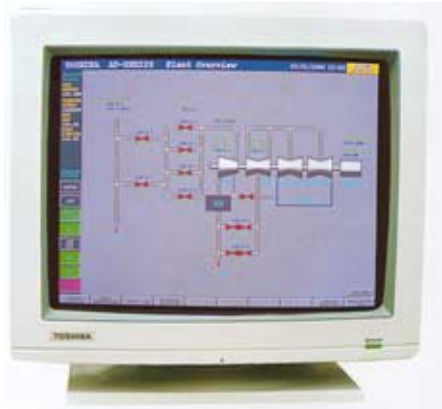
D-EHC SYSTEM OVERVIEW

MAN-MACHINE INTERFACE

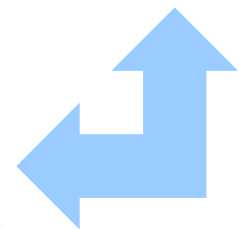
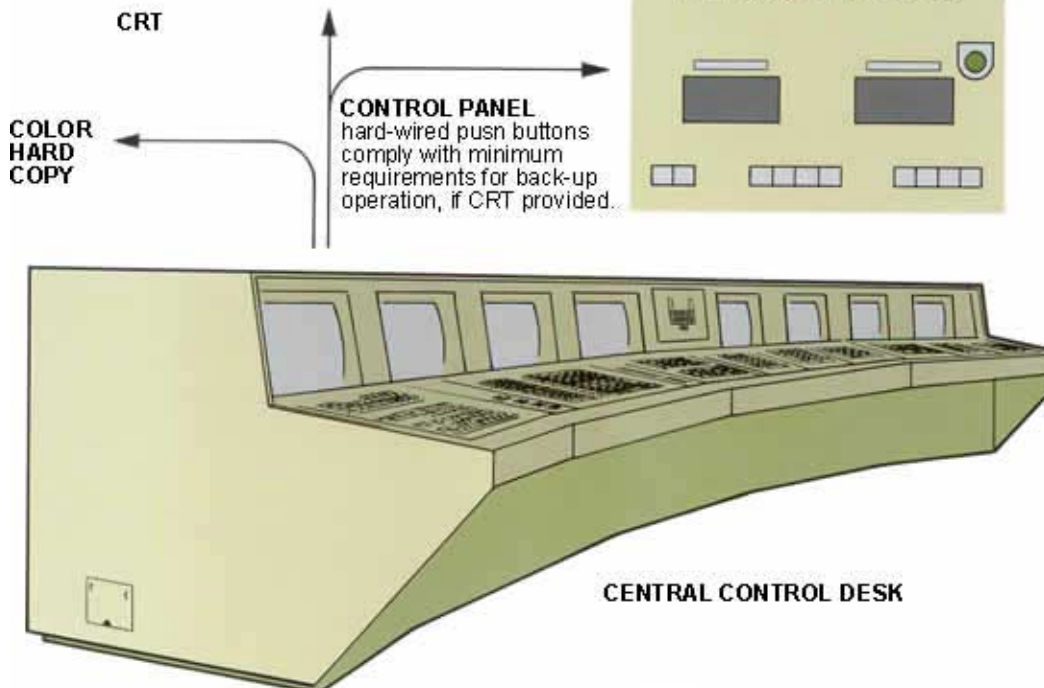
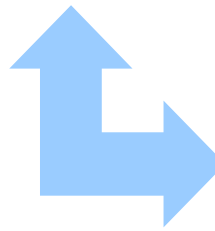
CRT and control panel insert are provided as a standard man-machine interface, for operation and monitoring. On the color graphic CRT, important information is integrated and CRT operation is available.

CONTROL

Microprocessor-based controllers, hard-wired control logic, and other PI/O circuits are installed in the D-EHC cubicles.



Interface with other computer system

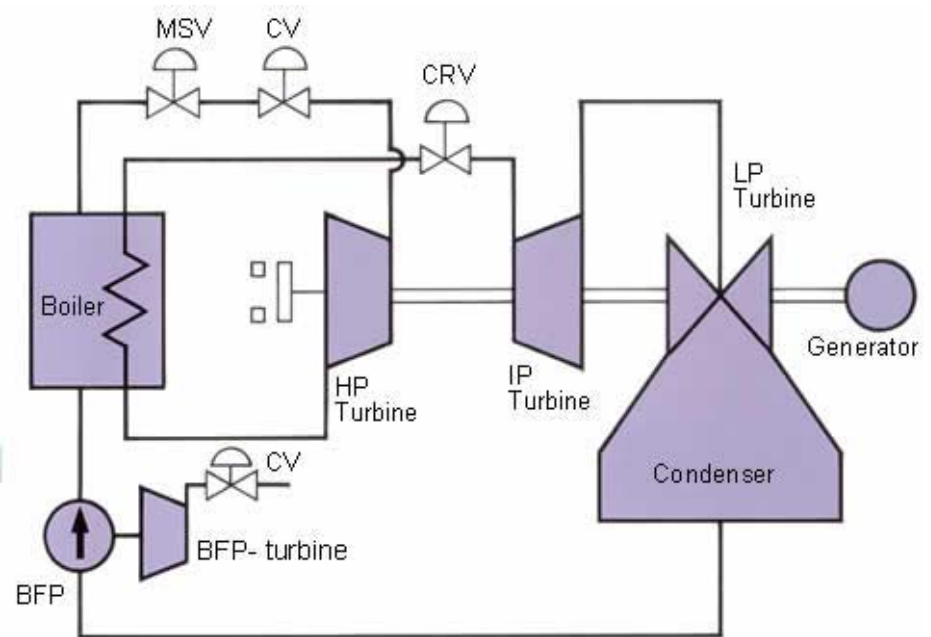


Connected with prefabricated cables



PLANT

Plant process values essential for turbine control and monitoring are input from the plant to DEHC. Control demand for turbine governing is output from the D-EHC.



EHC CUBICLES

MONITOR PANEL

Local alarm indication in details

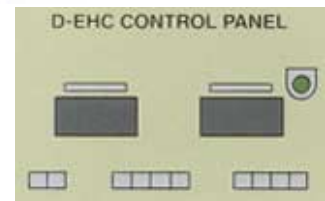
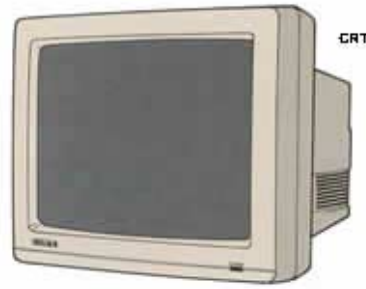


CONTROL FUNCTIONS

The D-EHC provides the standard functions that are essential for turbine control. Besides, various optional functions can be implemented in the D-EHC according to the client's requirement. If BFP-turbine exists, DEHC for the BFP-turbine can also be provided.

MAIN TURBINE D-EHC [Standard Functions]

- TURBINE SPEED CONTROL
- LOAD CONTROL
- LOAD LIMITING
- LINE SPEED MATCHING (LSM)
- FA/PA VALVE TRANSFER
- CV CHEST WARMING
- AUTOMATIC TURBINE START-UP
- THERMAL STRESS CALCULATION
- TURBINE TRIP
- TEST -TURBINE VALVES
- TURBINE OVERSPEED
- BACK-UP OVERSPEED GOVERNOR

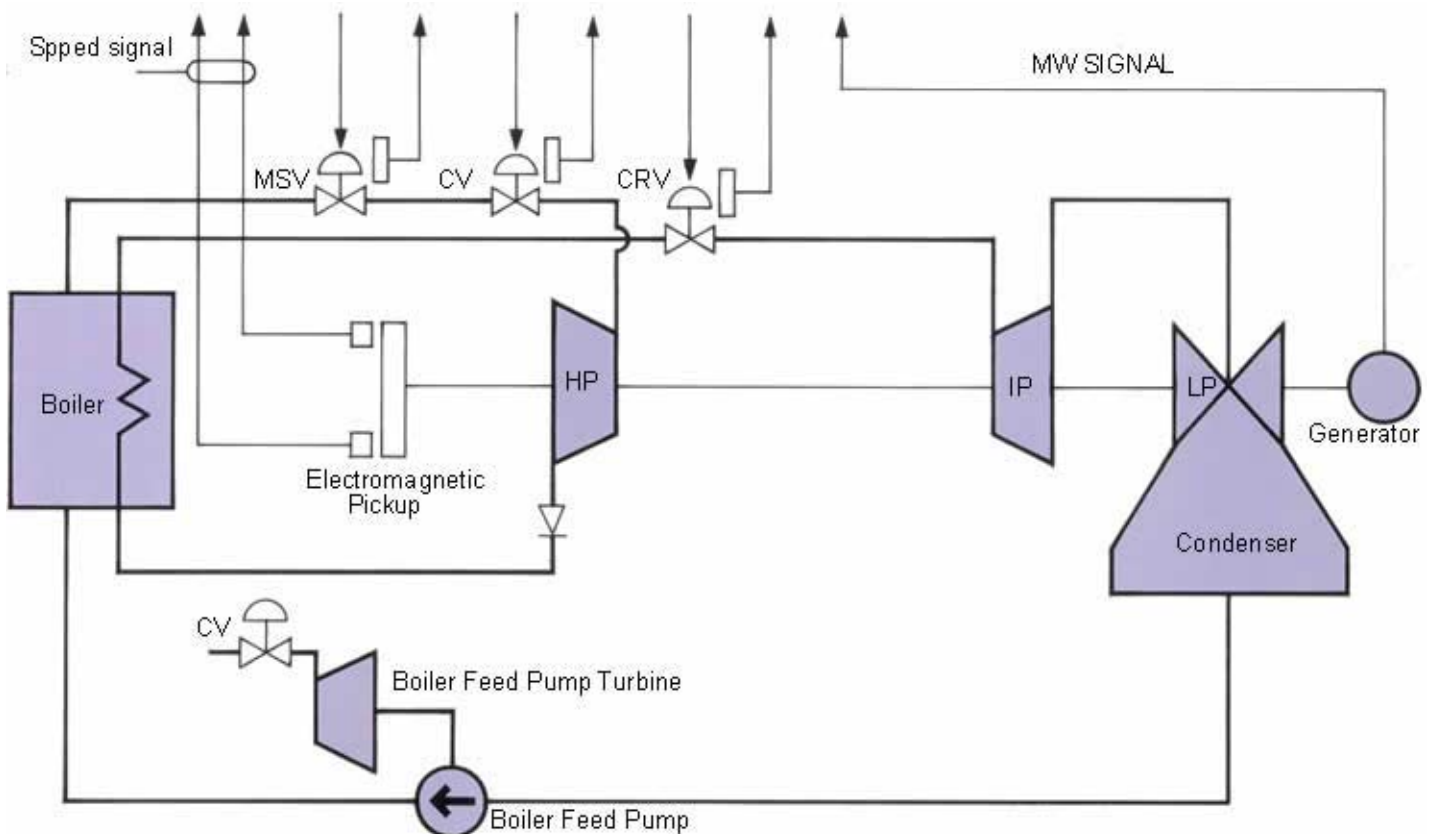


[Optional Functions]

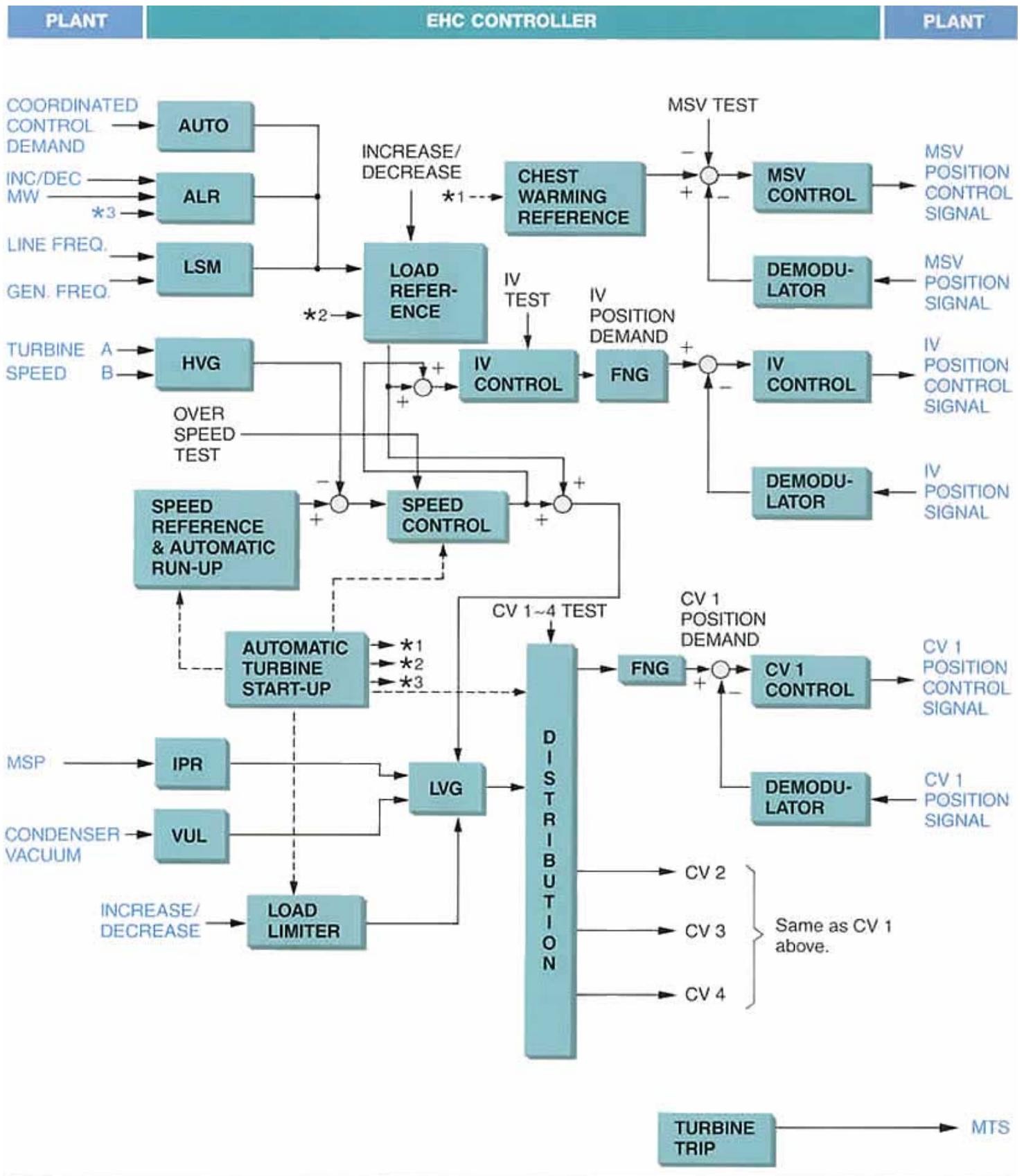
- INITIAL PRESSURE REGULATION (IPR)
- POWER LOAD UNBALANCE (PLU)
- EARLY VALVE ACTION (EVA)
- LOAD LIMIT/REFERENCE FOLLOWER (FLR)
- VACUUM UNLOADER (VUL)
- AUTOMATIC FREQUENCY CONTROL (AFC) (ISOCHRONOUS)
- AUTOMATIC LOAD REGULATOR (ALR)
- TURBINE BYPASS VALVE CONTROL

BFP-T D-EHC [Function]

- BFP-TURBINE SPEED CONTROL



CONTROL BLOCK DIAGRAM



<NOTE FOR ABBREVIATIONS>

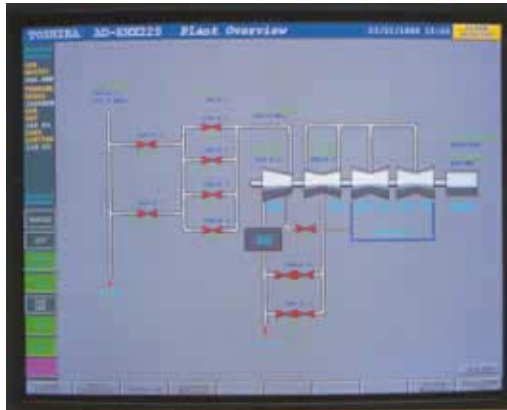
HVG: High Value Gate LVG: Low Value Gate FNG: Function Generator MTS: Master Trip Solenoid

MONITORING FUNCTIONS

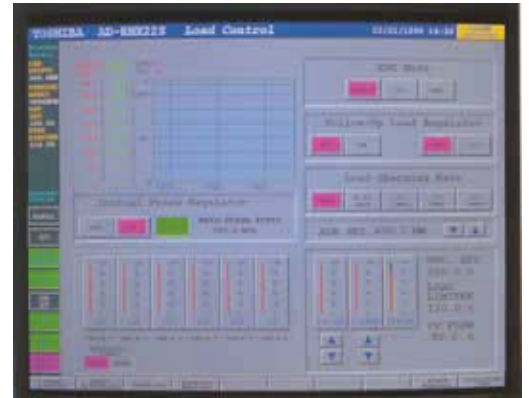
D-EHC CRT provides comprehensive information to the operator for turbine control and monitoring. Color hard copier of the D-EHC CRT is available as an option.

- Graphic (turbine system configuration)
- Message (alarm, operation guidance)
- Trend graph with operation progress
- Control block diagram
- Bar chart
- Turbine supervisory
- Status
- Diagnosis (fault location)

EXAMPLES



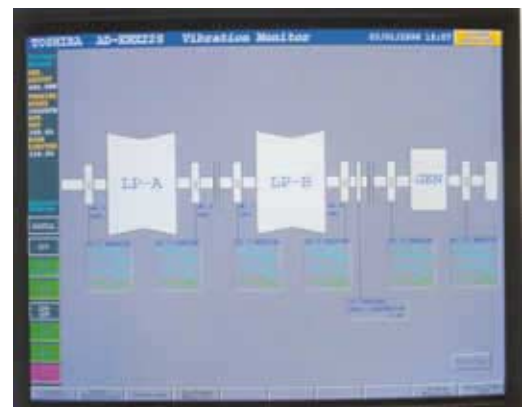
PLANT OVERVIEW



LOAD CONTROL



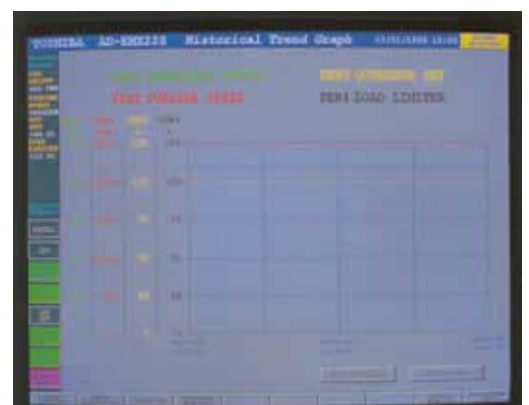
STATUS AND INSTRUCTION FOR TURBINE START-UP: TREND GRAPH ESSENTIAL FOR TURBINE START-UP OPERATION



VIBRATION MONITOR



FAULT LOCATION

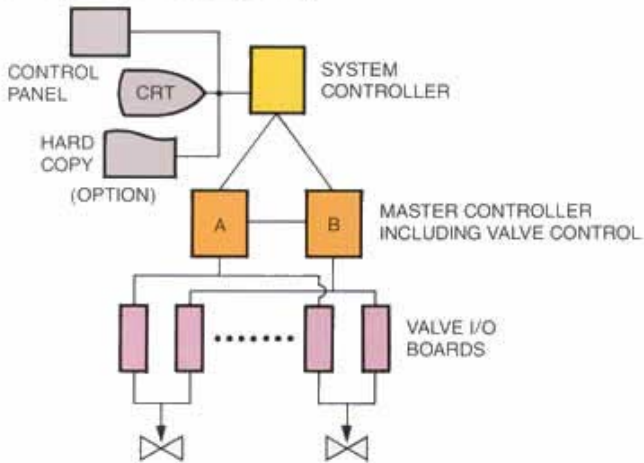


TURBINE SUPERVISORY

LINE UP AND APPLICATIONS (Configurations of Controllers)

FOR LARGE AND MEDIUM POWER

TYPE 1 (STANDARD)



<FEATURES>

- MAN-MACHINE INTERFACE WITH COLOR CRT
- DIGITAL VALVE CONTROL
- SOFTWARE ADJUSTMENT (AUTOMATIC CALIBRATION)
- DUPLICATED MASTER CONTROLLERS

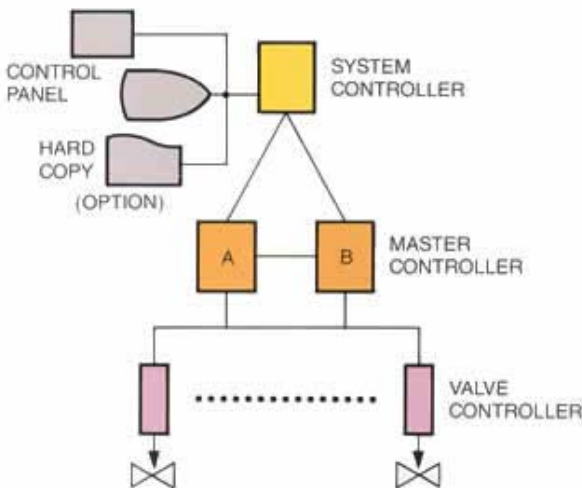
<INTERFACE>

- MULTI DATA TRANSMISSION
- PI/O

<OPTIONS>

- COLOR HARD COPY
- AUXILIARY EQUIPMENT CONTROL

TYPE 2



<FEATURES>

- MAN-MACHINE INTERFACE WITH COLOR CRT
- ANALOG VALVE CONTROL
- DUPLICATED MASTER CONTROLLER

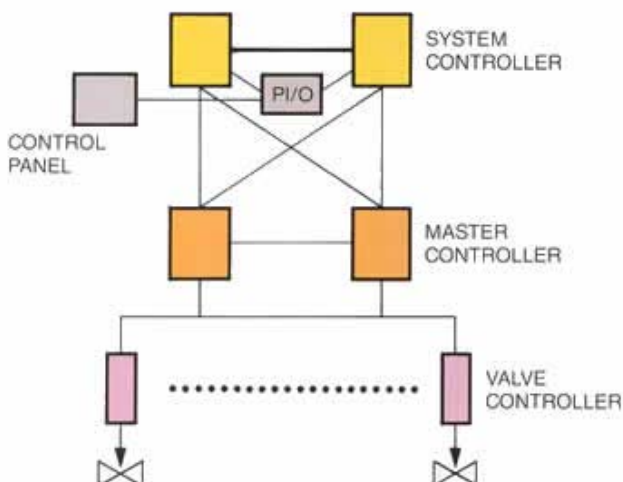
<INTERFACE>

- MULTI DATA TRANSMISSION
- PI/O

<OPTIONS>

- COLOR HARD COPY
- AUXILIARY EQUIPMENT CONTROL

TYPE 3



<FEATURES>

- ANALOG VALVE CONTROL
- DUPLICATED SYSTEM/MASTER CONTROLLER

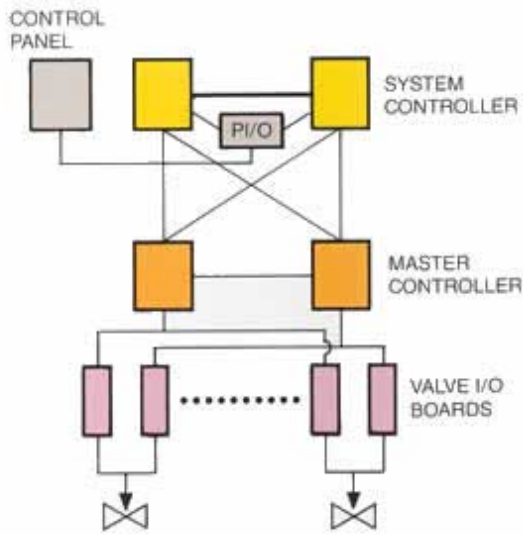
<INTERFACE>

- DATA TRANSMISSION
- PI/O

<OPTION>

- AUXILIARY EQUIPMENT CONTROL

TYPE 4



<FEATURES>

- DIGITAL VALVE CONTROL
- SOFTWARE ADJUSTMENT (AUTOMATIC CALIBRATION)
- DUPLICATED SYSTEM/MASTER CONTROLLER

<INTERFACE>

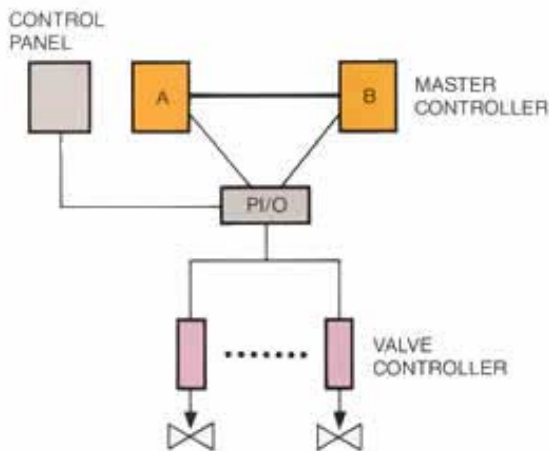
- DATA TRANSMISSION
- PI/O

<OPTION>

- AUXILIARY EQUIPMENT CONTROL

FOR MEDIUM AND SMALL POWER PLANT/ BFP-T

TYPE 1 (STANDARD)



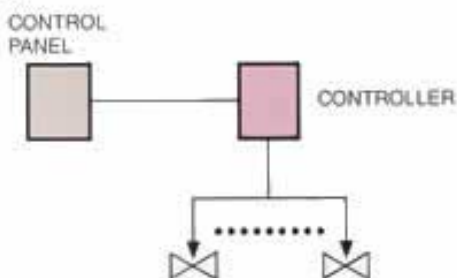
<FEATURES>

- ANALOG VALVE CONTROL
- DUPLICATED MASTER CONTROLLER

<INTERFACE>

- DATA TRANSMISSION
- PI/O

TYPE 2



<FEATURES>

- DIGITAL VALVE CONTROL
- COMPACT SYSTEM
- SOFTWARE ADJUSTMENT (AUTOMATIC CALIBRATION)

<INTERFACE>

- PI/O

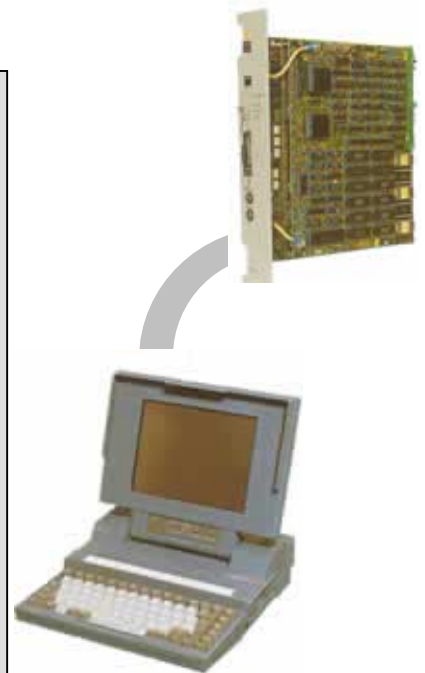
SUPPORT SERVICES

Maintenance/test tools

1. Logic loader
 - displays program block diagrams.
 - enables on-line set value adjustment through the display and keyboards.
2. Hard copy (option)
 - prepares copies of logic loader displays.
3. Plant simulator (option)
 - enables functional checks of the speed/load
 - control and valve position control in D-EHC cubicles.



SIMULATOR

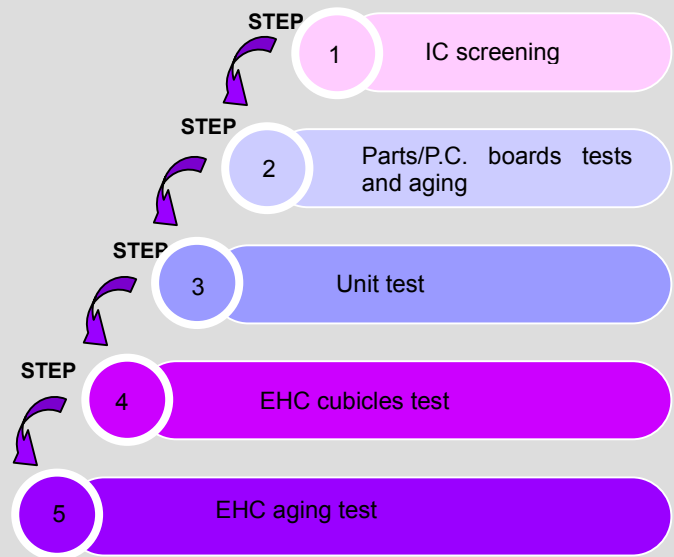


LOGIC LOADER

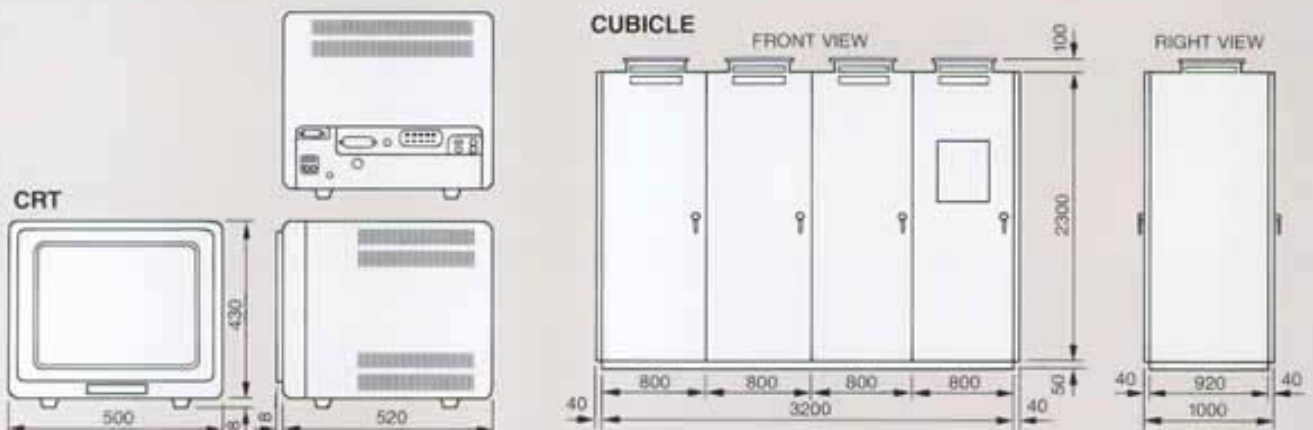
Quality control

5 step QA

With the objectives of maintaining as well as improving, the quality of the D-EHC cubicles, the following five test steps are provided in line with respective production stages, thus ensuring strict quality control.



Hardware outline (TYPE 1)



TOSHIBA

TOSHIBA CORPORATION

Energy Systems Group,

Thermal Power Plant Engineering Division

1-6, Uchisaiwai-cho 1-chome, Chiyoda-ku, Tokyo 100-8510, Japan

Phone: (03) 3597-2424

Facsimile: (03) 5511-8108

Telex: J22587 TOSHIBA