

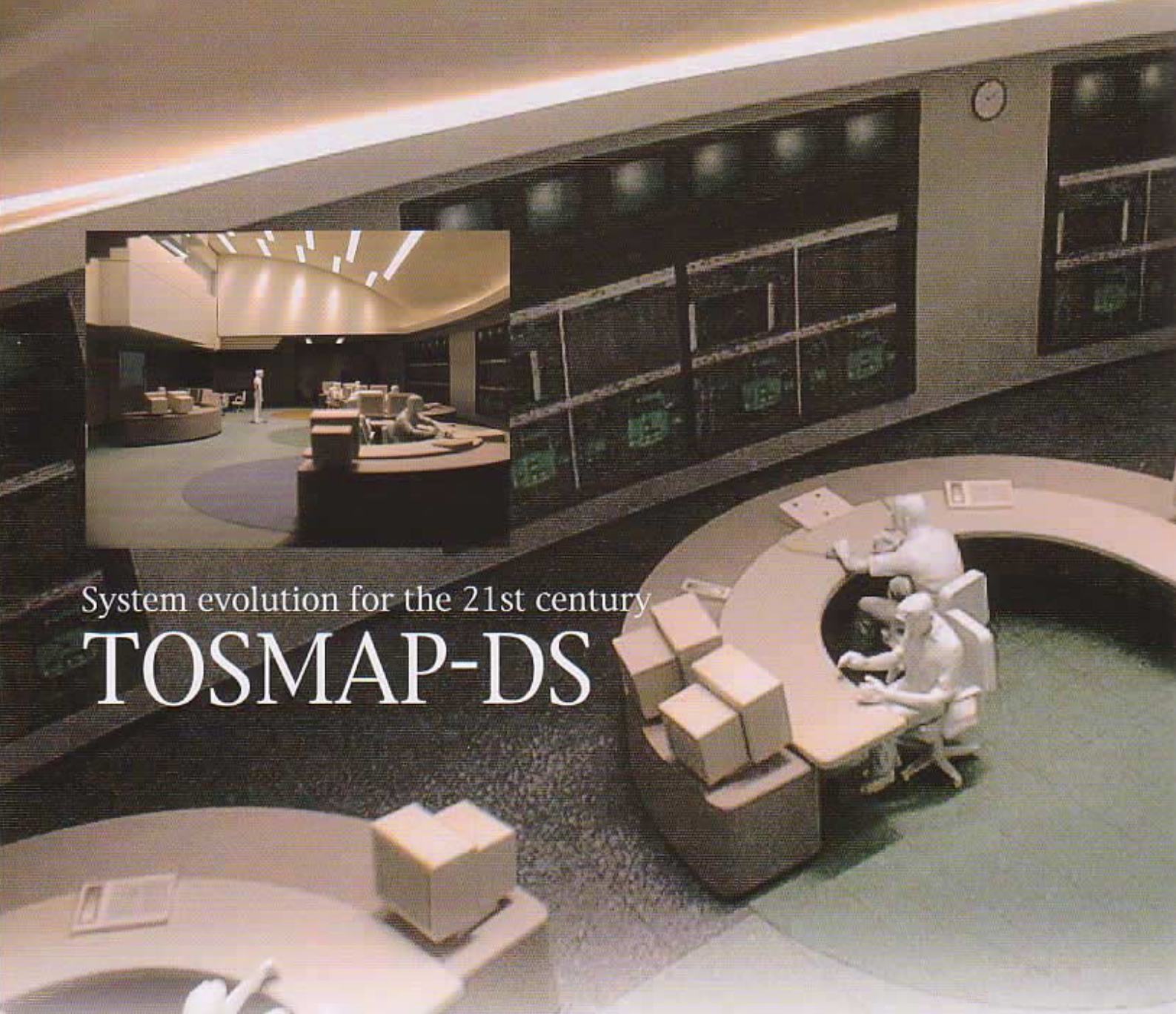
TOSHIBA



Dynastream

TOSMAP-DS Dynastream

Toshiba Distributed Control and Information System for Power Plants



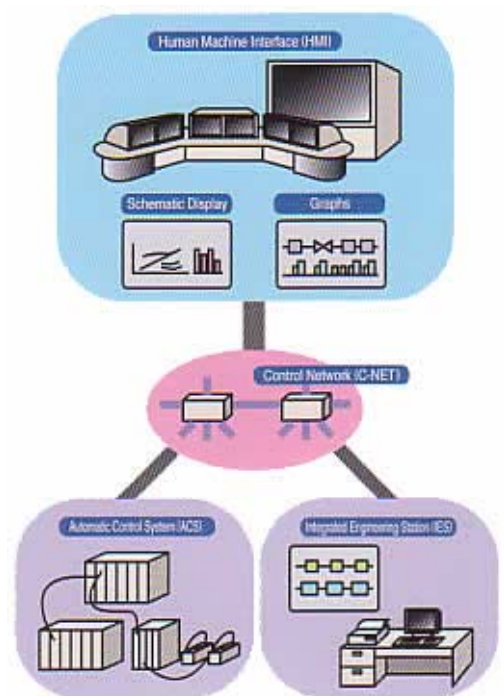
System evolution for the 21st century

TOSMAP-DS

Electricity is a vital commodity for maintaining and improving the living standards of society today. To ensure adequate and reliable supplies of electric power whenever and wherever needed, Toshiba now offers *a dynamic stream for the 21st century*, the TOSMAP-DS, Toshiba Microprocessor Aided Power system control *Dynastream*, which is a state-of-the-art Distributed Control System (DCS) developed for total power plant control. To satisfy customer needs, TOSMAP-DS features:

- Comprehensive integration of plant control
- Open and flexible system
- Easy and unified engineering environment
- Fully independent Human-Machine Interface stations
- Powerful and reliable controller

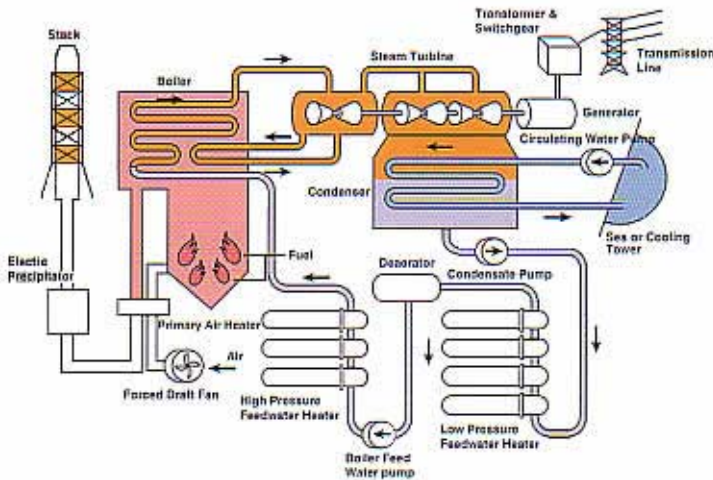
Toshiba's TOSMAP-DS covers a wide range of systems to meet diverse needs - geothermal power plant control, coal fired power plant control, combined cycle power plant control and so on. The TOSMAP-DS serves as a key to provide superlative operation and control, excellent reliability, and ease of maintenance for power-plant control. TOSMAP-DS embodies Toshiba's unrivaled expertise in power-plant control systems, accumulated through decades of experience supplying power plants equipped with the latest electronic technologies.



TOSMAP-DS overview

Comprehensive integration of plant controls

TOSMAP-DS is applicable to high-speed control, such as governor control, as well as standard control, such as heater level control. Toshiba is not only a DCS supplier, but also a supplier of plant equipment including turbine, generator, heat recovery boiler. Toshiba is the power plant supplier that has decades of comprehensive experience. Integration of boiler, turbine, generator and auxiliary control into a DCS is accomplished by Toshiba's engineering ability and the wide applicability of TOSMAP-DS. An Operator/Engineer can access/maintain all the plant control systems including boiler, turbine and generator control in the simple manner based on Windows- NT™.

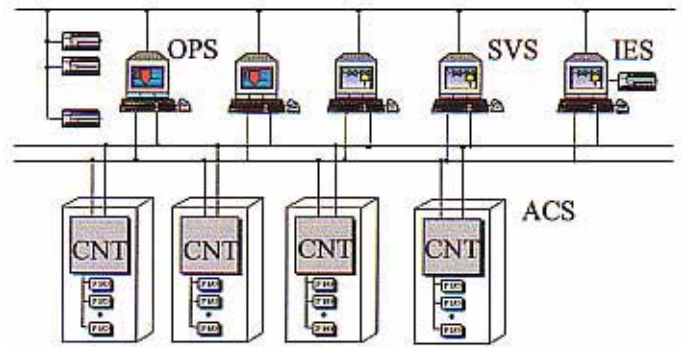


Fully independent Human-machine Interface stations

Every HMI station provides all the functions that are essential to monitor and control a power station. This provides the maximum level of duplication and therefore a more reliable system.

Each HMI Station in the system simultaneously and independently receives plant data via C-NET, so the failure of any HMI Station never affects the essential data processing of other HMI Stations. Other systems that use a client/server architecture may be less reliable, as the failure of the server may make plant operation impossible.

The supervisory software and GUI developed by Toshiba on the Windows-NT™ platform, provides state-of-the-art process operation and monitoring most suitable for thermal power plants.



HMI system architecture

Open and flexible system

The TOSMAP-DS utilizes the latest standards and de-facto standards as much as possible to make use of advanced technology and enable an open and flexible system:

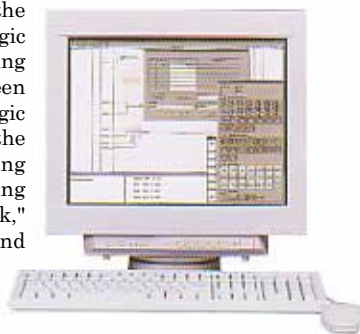
- Windows-NT™ for HMI and IES
- Ethernet (100M and 10M) for C-NET and I-NET
- Compact PCI bus for ACS CPU backplane
- DeviceNet™ for local I/O bus

The HMI and IES using Windows-NT™ provide excellent operational capability, and the C-NET and I-NET using Ethernet, provide an open network for the entire plant communication. The expandable, compact PCI backplane of the ACS CPU provides open system connectivity to industrial standards, and DeviceNet™ I/O bus enables a flexible interface with plant equipment.

Easy and unified engineering environment

To achieve easy engineering, Toshiba provides an Integrated Engineering Station (IES) that is used for engineering, system configuration and maintenance of the HMI, ACS and C-NET. All the engineering work, TAG database creation, logic configuration, display design and log design are unified on the IES station.

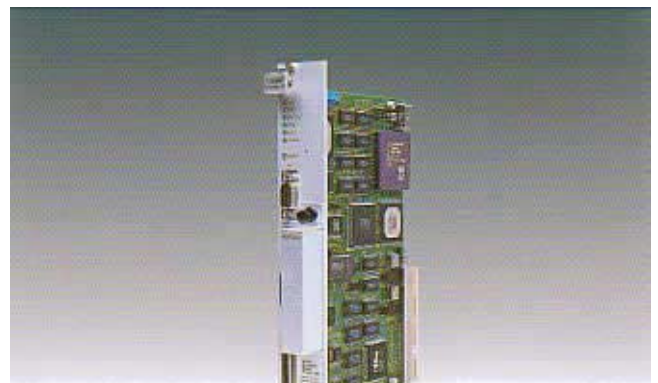
Automatic TAG linkage between the HMI data and the ACS control logic data dramatically reduces engineering work for communication between display information and logic inputs/outputs. The IES uses the Windows-NT™ environment providing a familiar graphical user interface using functions such as "point and click," "drag and drop," "pull down menu" and "copy and paste".



IES

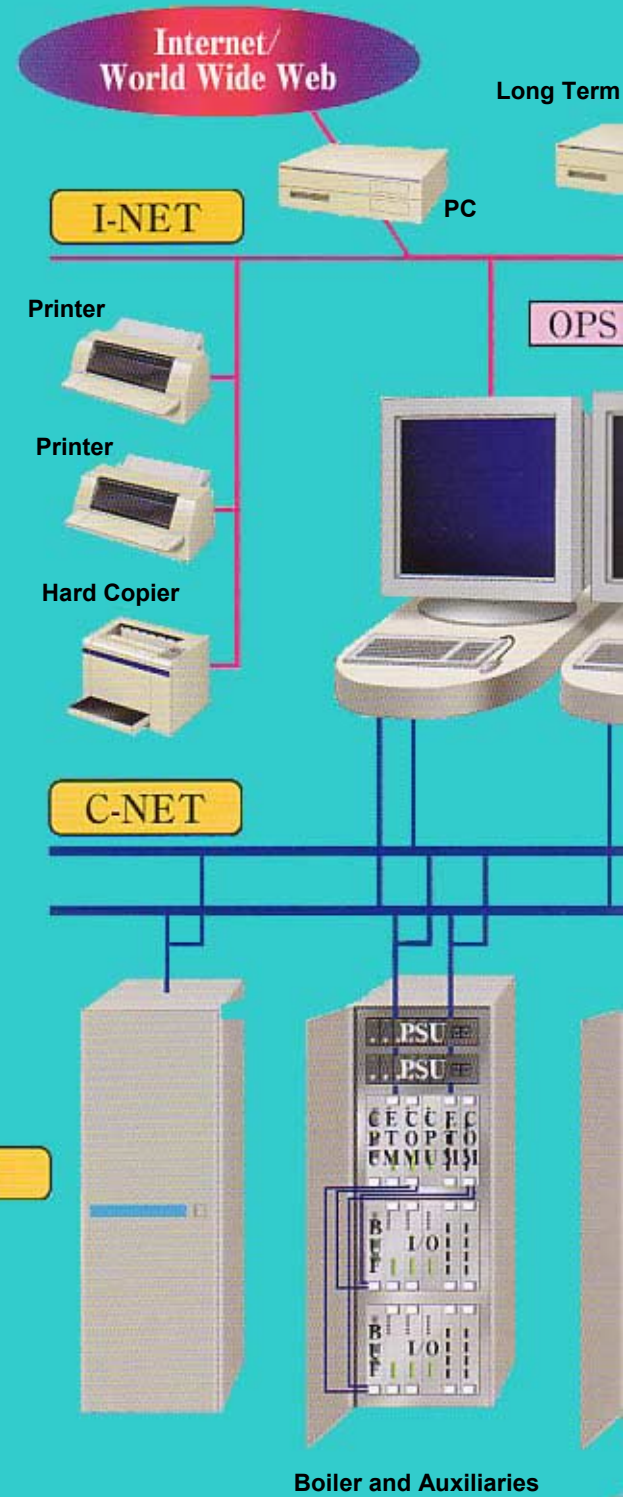
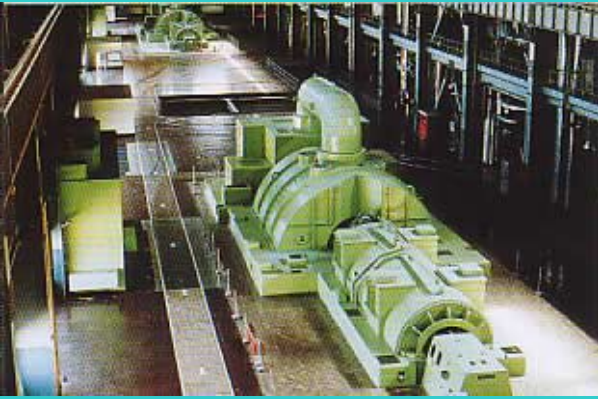
Powerful and reliable Controller

The ACS of the TOSMAP-DS system uses an advanced high-speed 32-bit microprocessor that enables the system to meet the diverse requirements of today's power plant operation. Toshiba's supreme semiconductor and manufacturing technology is used to realize a powerful and reliable controller. Execution time is flexibly selectable from 50 to 500 ms according to the control requirement. An extra-high-speed controller with 1 ms control cycle is also available for special purposes such as governor control and generator control.



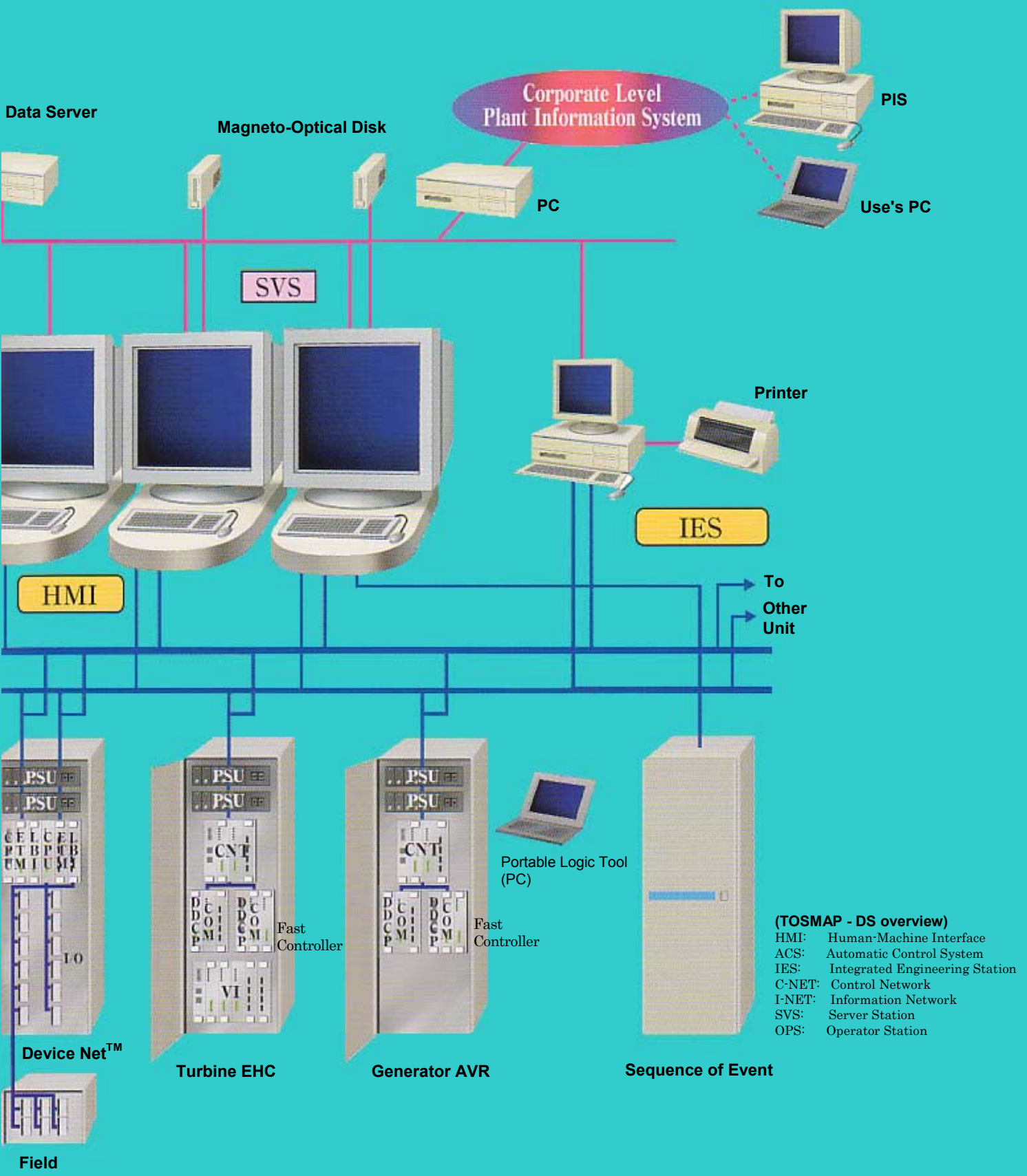
Controller PCB

Advanced Distributed Control



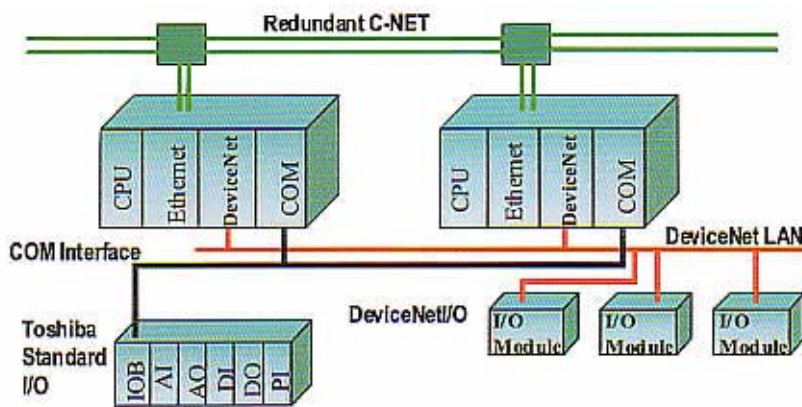
Example of a Sys

System for Power Plants



tem Overview of TOSMAP - DS

Automatic Control System (ACS) and Control Network (C-NET)



The TOSMAP-DS Automatic Control System (ACS) is specifically designed to control the entire power plant, which enables complete integration of boiler, turbine, generator, balance of plant and switchyard control into a DCS. Operation and maintenance work, as well as the number of spare parts, can be reduced by using a unified control system architecture. Toshiba's highly sophisticated surface mount technology (SMT) and semiconductor technology utilized for high-density Gate Arrays (GA) minimizes the printed circuit board size and enables high-density mounting and superlative reliability. Due to proper design of heat radiation, the ACS standard cabinet is naturally ventilated, so that cooling fans, which require periodic replacement, are not necessary.



Panel-21

Standard-type controller

The standard-type ACS controller uses an advanced 32-bit microprocessor that provides high performance and large capacity, which enables versatile application to plant control.

Up to 128 control loops can be configured in a single controller and individually maintained on-line, while other task loops are operating. The compact PCI backplane used for the CPU bus provides open system connectivity to industrial standard.

One of the ACS's distinguishing Features is flexible I/O configuration. Two types of I/O configurations are applicable to the ACS:

- The DeviceNet™ interface, which is an industrial standard based on CAN (Controller Area Network) ISO11898, can be used for universal process I/O. Any type of I/O module that conforms to the standard, DeviceNet™ can be connected to the ACS.



Unit Chassis



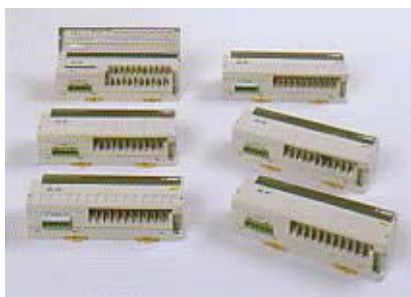
I/O card

●Toshiba's proprietary I/O is used for special purposes, such as high-speed pulse input, remote process I/O, or where large numbers of inputs/outputs are required.

The ACS supports more than 130 Function Block Diagrams (FBD). These Macro instructions are most suitable for power plant control application.

Around forty of the function blocks named TAG Macro instructions automatically link the ACS control logic inputs/outputs to the HMI data with just the TAG No. configured in the IES, so that engineering work for linking between display data and logic data is dramatically reduced.

Any kind of control system, redundant controllers, redundant I/Os, combination of DeviceNet™ I/O and Toshiba proprietary I/O, etc. can be configured by means of the versatile ACS.



I/O module

High-speed controller

Primary control, such as governor control and generator control, requires extra-high speed execution. For this purpose, Toshiba developed the high-speed controller, capable of a minimum 1 ms control cycle, for use in the TOSMAP-DS system, which enables direct control of turbine governor and generator excitation. The high-speed controller features:

- Dual and triple redundant configurations for each.
- Special input cards such as speed input, 3 phase current and voltage input, etc.
- Recording of high resolution transients in CPU memory

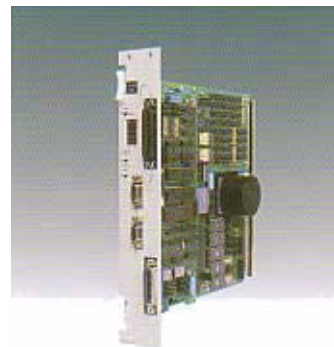
The high-speed controller is also applicable to protection logic, such as turbine trip logic, MFT logic, etc. which require high-speed execution. For customers who prefer hard-wired circuits rather than software logic, Toshiba can alternatively provide a Programmable Logic Device (PLD) card that programmable but solid state.

Control network (C-NET)

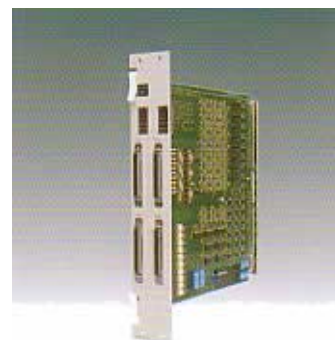
The TOSMAP-DS employs a powerful, reliable and open architecture for the control network (C-NET), used for communication among the ACS, the HMI and the IES.

Redundant 100BASE-TX Ethernet, which is an industrial standard, is used for the C-NET and assures openness for future enhancements. Ideal data transmission protocol is adopted for communication in order to ensure quick and reliable response, fast update and high control reliability, i.e. event reporting using UDP/IP multi casting, cyclic reporting using TCP/IP.

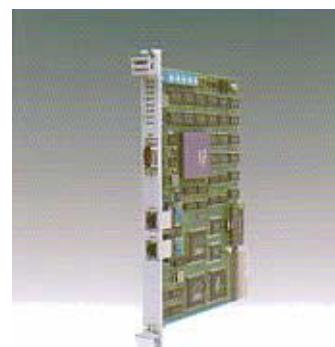
To respond to recent demands for comprehensive integration of switchyard control, flue gas desulphurization control, etc. into the plant control, fiber optical cable can be used for C-NET, to enable long-distance communication.



High-speed controller



PLD card



Ether card

Human – Machine Interface (HMI)

The TOSMAP-DS Human-Machine Interface (HMI) stations provide state-of-the-art process operation and monitoring for power plants. The HMI station meets the needs of power-station operators, engineers and managers for delivery of on-line, real-time data regarding plant status, performance information, and operation.

Operating and managing a power plant requires modern interfaces in the operations and management information systems to satisfy a wide range of user's needs.

The HMI software is developed on a Window-NT™ platform which is the most popular and user-friendly in the world and the HMI uses a Toshiba-developed graphical user interface which was designed specifically for power plant operation.

The display functions are designed to serve as an "operator's assistant", guiding and aiding personnel to carry out daily operations, plus handling the rare emergencies that require quick action. Using the multi-window capabilities of Toshiba's graphical user interface featuring the familiar Windows-NT™ pull down menus, pop-up windows, dialog boxes and icons, operators can easily control the selection of information display on the CRT.

There are two types of HMI Station, the Operator Station (OPS), which provides tailor-made views for plant operation, and the Server Station (SVS) which handles archival data in addition to providing the same functions as the OPS.

The Information Network (I-NET) is used for information data transmission between OPS, SVS and peripherals.

Fully independent HMI Stations consisting of the OPS and SVS realize a completely distributed system for superlative reliability. Each OPS and SVS

in a system independently receives plant control data through the C-NET and failure of any OPS never affects data processing of other OPS and SVS stations. Even if the SVS fails, only archival data is affected. On the other hand, if a server fails in the case of server/client system, plant operation via all the related client stations will be impossible.

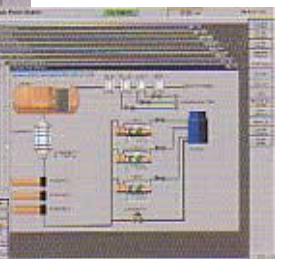
Standard functions

Schematic display

The HMI has a sophisticated, comprehensive real-time, state-assessment capability that provides plant status in schematic display. Scaleable displays supported by the Toshiba developed graphical user interface enable the use of multi-window displays for plant operation. TAG information dialog boxes, which contain values and states of each TAG parameter are available on the graphic displays. Screen-based control operations can be performed by selecting an object on a graphic display and requesting a window containing a specific control faceplate. Customized control displays and windows can also be built, using any display objects from a library.



Multi window display (Tile)



Multi window display (Cascade)

Graphic display with Face Plate & TAG information

Group display

The Group display is used to display up to 16 current TAG values in a group with list format.

Group operation

Predefined group-operation displays that show multiple controller faceplates are provided for performing control tasks. Screen-based tasks can be performed from the group-operation display.

Sequence display

Progress monitoring of plant automation sequential logic consisting of pre-conditions, step completion and completed conditions is available on this display.

Trend graph

Trend graphs are used to display the history of point values for any time period within the system's on-line historical storage. Up to eight points are displayed simultaneously on a single trend chart. Zoom and scroll functions facilitate operator analysis of time-scale process values.

X-Y plot

Correlation (X-Y point) between two assigned data is displayed on X-Y axes. Eight locus lines of correlation (X-Y points) can be simultaneously displayed.

Event list

The Event list is a display that shows in chronological order, occurrences of events such as status change of digital points, alarm conditions, etc. To assist operator analysis, an intelligent filtering algorithm is applied to this function.

TAG type and category classification can be used as filters.

Log service

TOSMAP-DS provides the following types of logs and reports. For each log, there are facilities to display and print the contents of log files and also to copy the files to external storage media such as a magneto optical disk (MO).

- Event log
- Periodic log
- Sequence of events log

Historical data storage

Points assigned to group displays, trend graphs, X-Y plots and specific groups are stored and can be output to a printer or a storage device.

Data summary

Data summary is a function to display or print summary lists which match specified criteria such as all TAG summary, alarm (inhibited) TAG summary, abnormal TAG summary, quality alarm inhibited TAG summary.

Other functions

TOSMAP-DS has distinctive features other than those shown above, including:

- Operator guidance which is supported by a standard function of Windows-NT™ is useful for plant operation.
- TAG information is a dialog box in which the values and status of each TAG condition are displayed. It is called from any indication of the target TAG on a display or from an abnormal indication on a control faceplate.

Alarm list

TOSMAP-DS has a sophisticated facility that continually checks every plant-state variable against a variety of alarm criteria, according to parameters individually set for each variable in the database. Most-recent alarm conditions and the affected parts of the plant are summarized on screen.

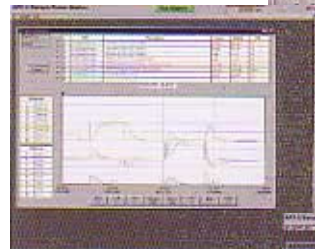
To assist operators during emergencies, the HMI modifies its usual alarm-processing procedure. Following a plant disturbance, an intelligent filtering algorithm is applied to every new alarm message prior to its display and audible notification. Importance level and category classification is used for the filtering,



Group display



Group operation display



Trend graph display



Event List display



Periodic log printout

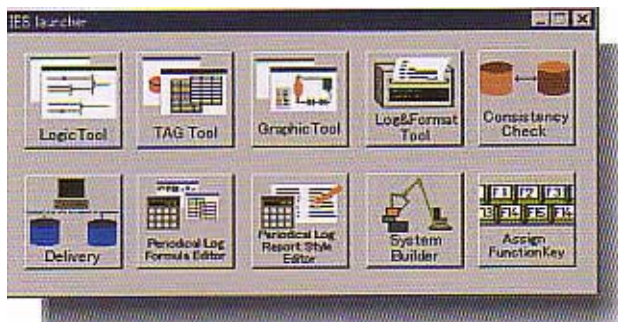


Alarm display

Integrated Engineering Station (IES)

The Integrated Engineering Station (IES) provides a comprehensive set of engineering and maintenance functions for the HMI and ACS of TOSMAP-DS.

A simple, integrated working environment can be provided by the IES which is designed to operate on a Windows-NT™ platform. It contains all the functions necessary to create, edit and modify the HMI and ACS, i.e. logic tool, TAG database tool, display tool, log & report tool, consistency check function, delivery function and launcher. All tools and functions are accessed from the launcher on the start screen.

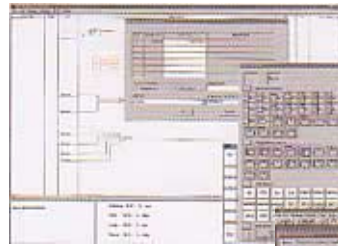


Logic tool

The Logic tool provides graphic methods for creating, editing, monitoring, tuning, simulation and to document control logic. Easy creation and editing of control logic can be performed by dragging and dropping of function blocks from pop-up windows supported by the Windows-NT™ environment. Dynamic operating values can be monitored on the control logic sheets of the IES. The value of each input/output data in control logic are periodically updated in real time and provide the ability to troubleshoot and maintain the system. With the tuning function, logic parameters (set values) can be changed during monitoring of the control logic and the changes directly affect the control operation. To ensure system security, password protection and an action record is taken into account for editing, monitoring and tuning functions. The simulation function enables simulated checks of the control logic without operating the actual plant equipment. The logic tool also provides complete documentation of control logic, parameter list and cross-reference list which can be used as drawings of the as-built system.

TAG database tool

TAG database tool is designed to manage a master TAG database into which both the HMI and ACS data are integrated. The master database is created from TAG lists made by Architect Engineers (A/E), plant engineers or others, in the form of MS-Excel or Lotus 1-2-3. TAG ID table and OPS initial database are generated from the master database in the TAG database tool downloaded to HMI stations by the delivery function. The master database is also used to create control logic for each ACS when the control logic is designed using the Logic tool. Thus the entire management of the whole DCS database is supported by the TAG database tool on the IES and it eliminates duplicate entry for configuration tasks. The consistency check function is available to check discrepancies between the master database and the database of other tools.



Logic tool display



Display tool display



Log and report tool display

Display tool

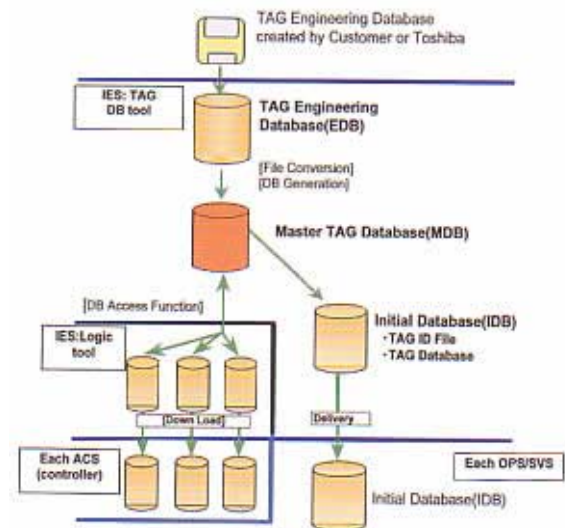
The Display tool utilizes an off-line version of the same graphical user interface as used on the HMI stations, which has been specifically designed for power plant operation. Easy creation and editing of various displays, graphs and lists can be performed using the Windows-NTTM environment. Versatile pre-built components that suit power plant operation are prepared in a library and displays are easily configurable by dragging and dropping the components from pop-up library palettes. The pre-built components are "functional objects" which not only have the shape and color data but also the attributes linked to the TAG database, i.e. a copy of the pre-built component contains a copy of the shape and attributes. The shape and size of a component are easily changed by dragging, without changing the attributes. The trend graph and the alarm list are examples of components. The combination of such displays and standard schematic displays on a screen is supported and provides efficient plant operation. Users can easily develop new components without recompiling.

Log and report tool

Logs and reports supported by the HMI are configured and edited by the log and report tool. Report formats can be defined using spread sheets in MS-Excel, which is popular and easy to use.

Portable logic tool

The IES comprehensively covers the engineering tasks required for a TOSMAP-DS system that consists of both an ACS and HMI. A stand-alone ACS for small-scale control does not need the IES, instead, the portable logic tool can be used for such a system. For large-scale control containing some ACSs and HMIs, the portable logic tool is also useful for test and commissioning periods, when tuning and re-configuration tasks are congested. The portable logic tool supports creation and editing of control logic, control constants (set values) and process input/output data of the ACS. An easy interface between the portable tool and the IES is available and assures consistency of control logic data and the database in each engineering tool.



Database flow by TAG database tool



Portable logic tool (Dynabook)



Thermal Power Plants Supplied and Awarded
by TOSHIBA in the International Market

TOSHIBA

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