PPC (Plant Process Computer) Replacement Project for TEPCO

Summary and Lessons Learned

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Object of this Presentation

TEPSCO recently replaced PPC for 1F-2 Unit in TEPCO plants, so I will introduce the overview of the project.

On the other hand, we encountered three major issues after installation.

By this presentation, we will share the issues with you and would like to obtain feedback from you.

Contents

1. Introduction
2. Background of this project
3. PPC System configuration
4. Process of this project
5. Overview of Replacement
6. New features and Samples of displays
7. Post Installation issue
8. Lessons Learned

1.Introduction - TEPCO / TEPSCO -

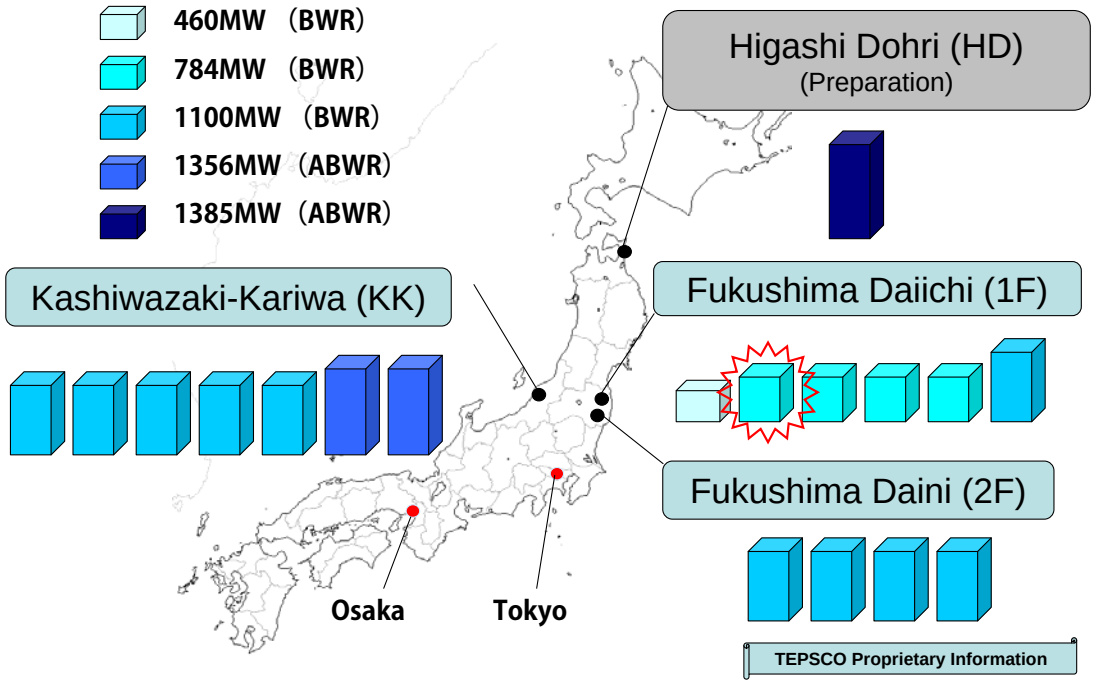
- The Tokyo Electric Power Company :
  - Provides electric service for Tokyo area in Japan, and
  - Performs business from generation (nuclear, fossil and hydro), transmission through power delivery
- TEPCO Operates :17 Nuclear Power units at 3 sites

  (17 BWRs including 2 ABWRs)
- TEPSCO is a Subsidiary company of TEPCO to support engineering works for TEPCO
- The objective of the project is to design and deliver new PPC based on TEPCO's utility needs by R*TIME system as a replacement of original PPC for one of old unit, 1F2

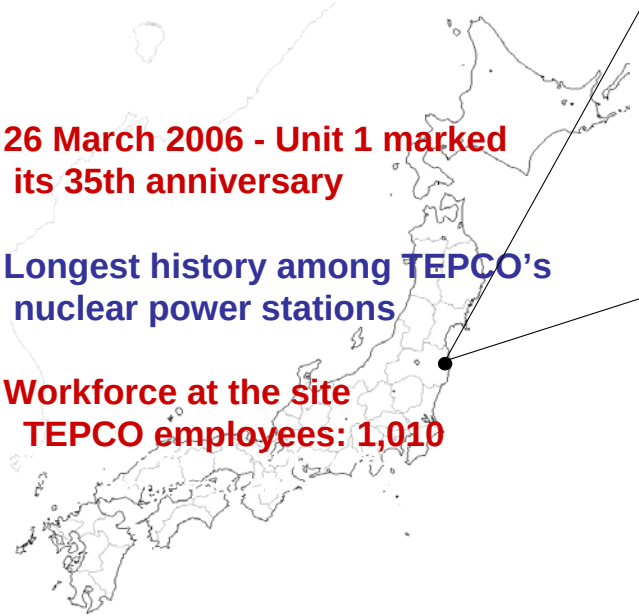
1.Introduction

- TEPCO NPP -

460MW （BWR）
784MW （BWR）
1100MW （BWR）
1356MW （ABWR）
1385MW （ABWR）



1. Introduction of TEPCO (1F site)



26 March 2006 - Unit 1 marked its 35th anniversary

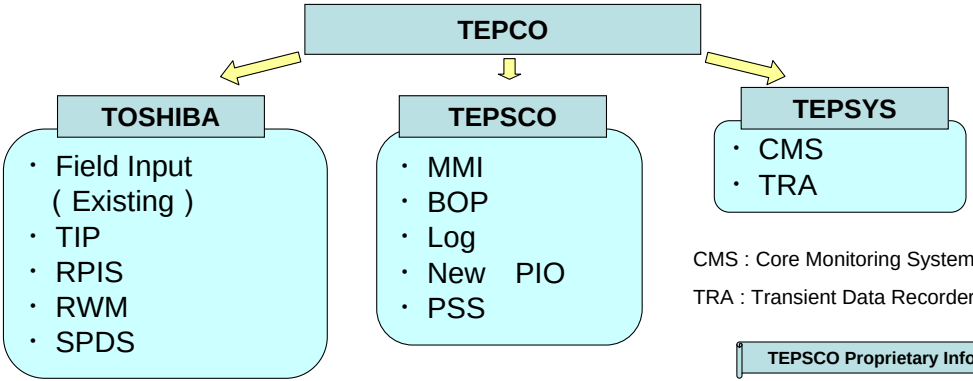
Longest history among TEPCO's nuclear power stations

Workforce at the site
TEPCO employees: 1,010

2.Background of this project

- This was the first time
  : to replace the PPC by TEPSCO, and
  : to adopt the Windows system for Servers in Japan

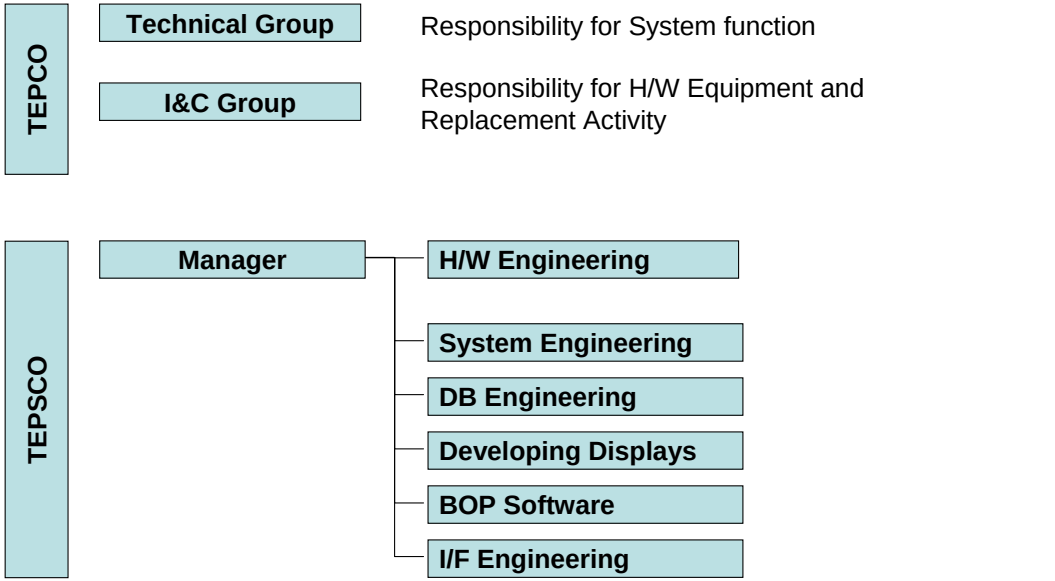
- Roles for new PPC replacement were assigned to three companies for each PPC function



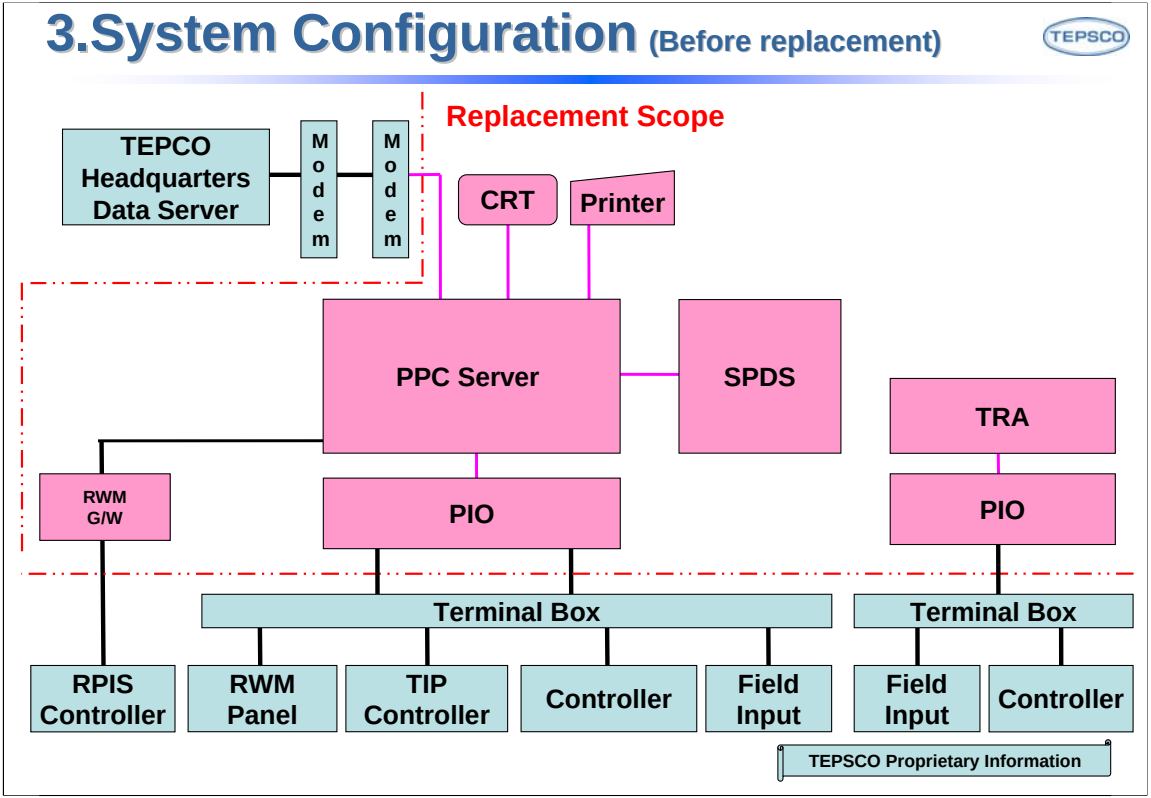
CMS : Core Monitoring System

TRA : Transient Data Recorder System

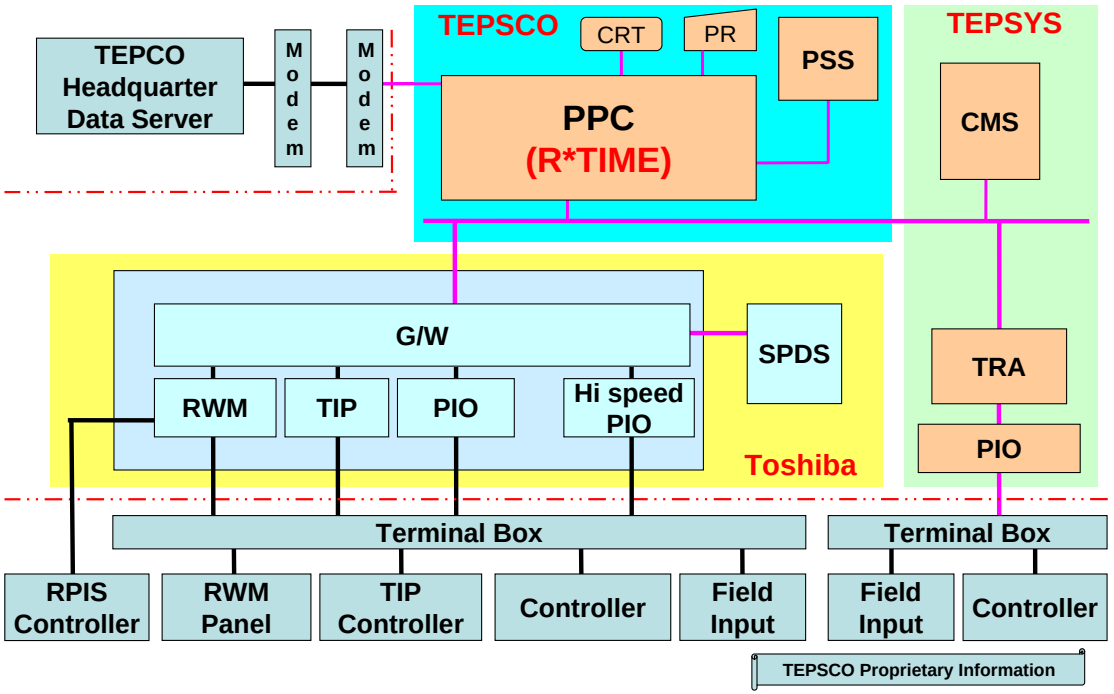
2. Background of this Project



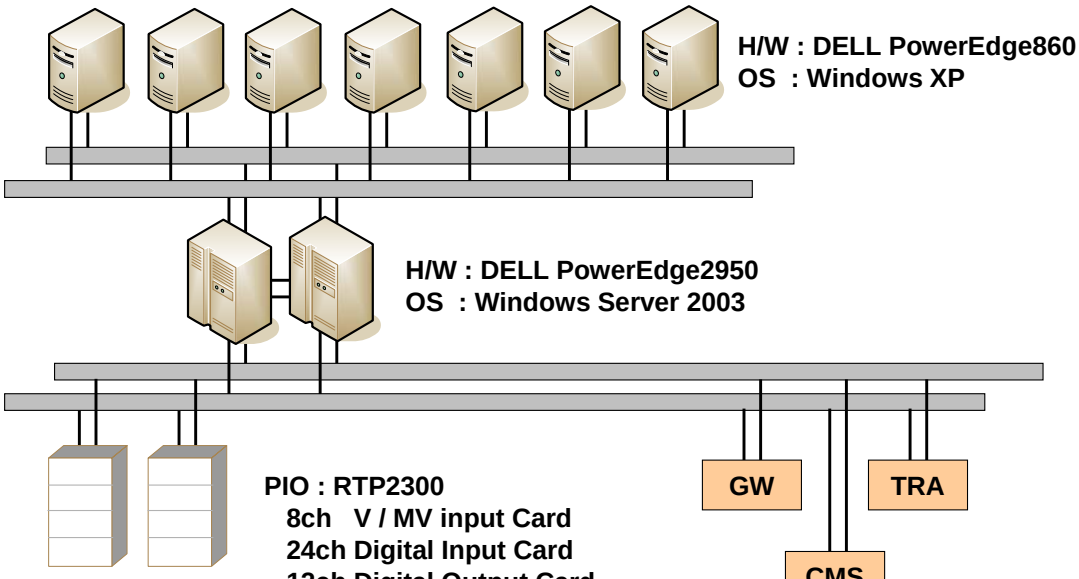
3.System Configuration (Before replacement)



3.System Configuration (After replacement)

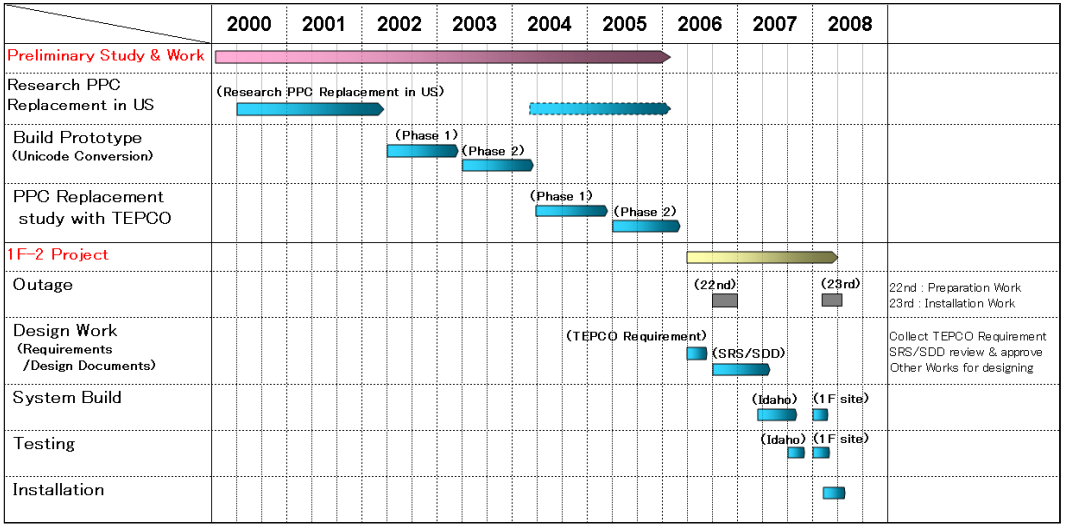


3.System Configuration (After replacement)



4.Process of this Project

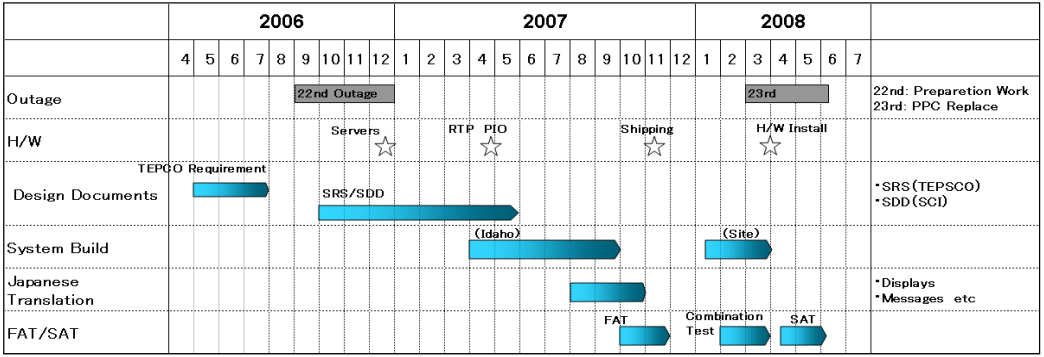
- Schedule Overview for PPC Replacement -



4.Process of this Project

- Project Schedule of Unit 2 -

Preparation Work : SEP-2006 ～ DEC-2006 (22nd Outage)
Design Work : MAY-2006 ～ JUN-2007
System Build : APR-2007 ～ MAR-2008
PPC Replacement : MAR-2008 ～ JUN-2008 (23rd Outage)



TEPSCO Proprietary Information

4.Process of this Project

- Preparation Work -

Preparation work at 22nd outage

Installation of Cabinets

Installation of Time keeper

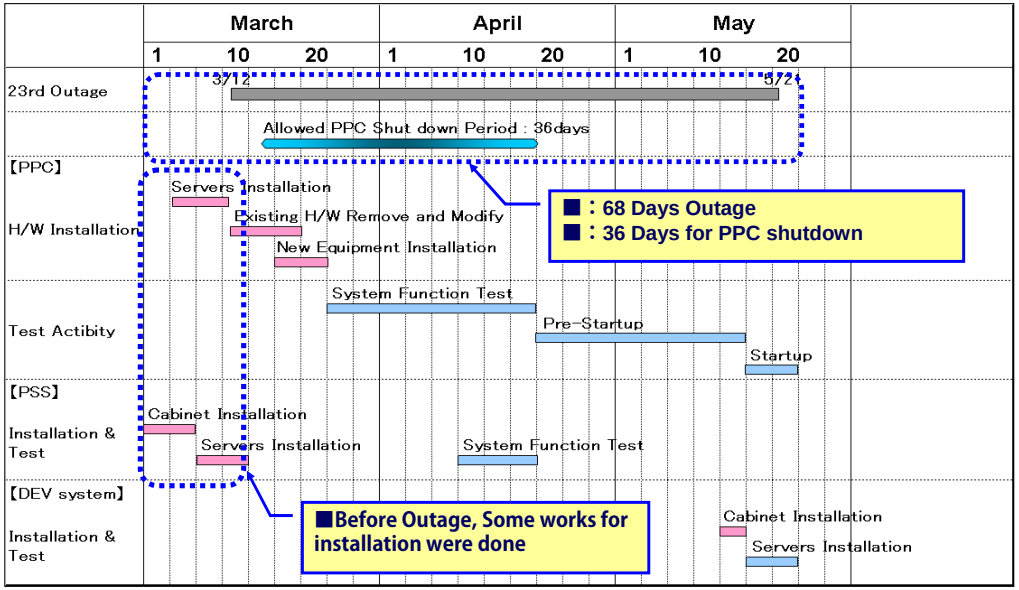
4.Process of this Project

- Preparation Work -

- **Pre-Combination Test at Staging Area**

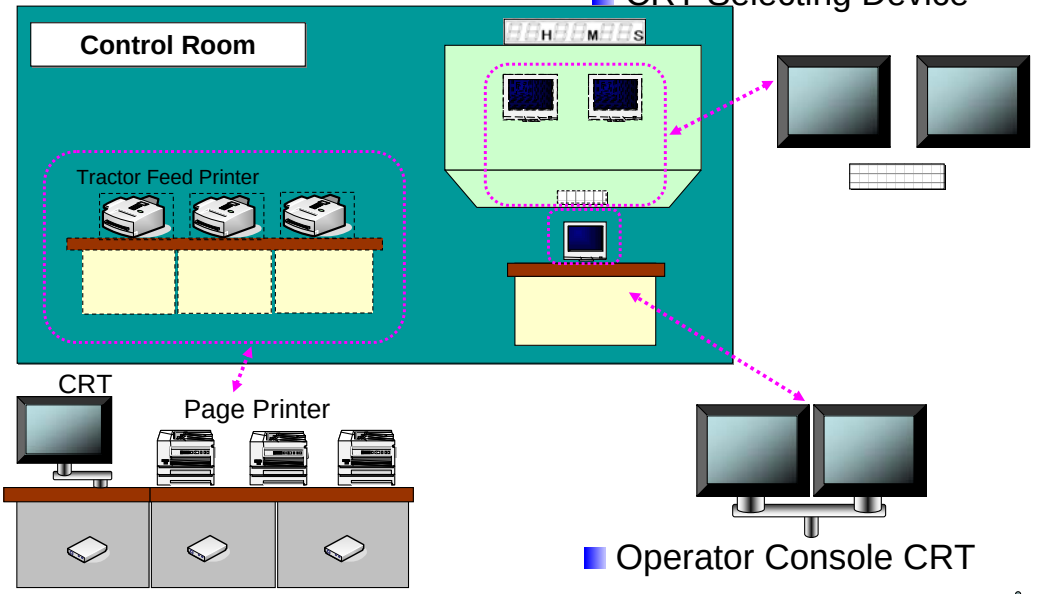
4.Process of this Project

- Detailed Installation and start-up Schedule -



5. Overview of replacement (Control Room<1/4>)

- Panel-mount CRT
- CRT Selecting Device



- Operator Console CRT
- Printer Desk Unit

5. Overview of replacement (Control Room<2/4>)

- Printer Unit Replacement

Tractor Feed Printer

A4 Page Printer

5. Overview of replacement (Control Room<3/4>)

- Operator Console Replacement (Dual Monitor)

5. Overview of replacement (Control Room<4/4>)

- Panel Mount CRT / C R T Selecting Device


10H 15M 47S
原子炉熱出力
99%
指差呼称
2号機
原子炉
運転中
3-way
指差し呼称
2008 5 26
TEPSCO Proprietary Information

6.New Features and Samples of displays

- New Features (1) -

Separation of the alarm into two categories

- **Plant Alarm**

  Points of field Input or external Input

- **System Alarm**

  Points associated with System Equipments

Indicating these information at frame

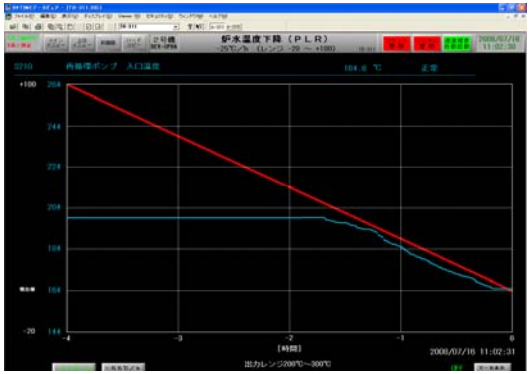
6.New Features and Samples of displays

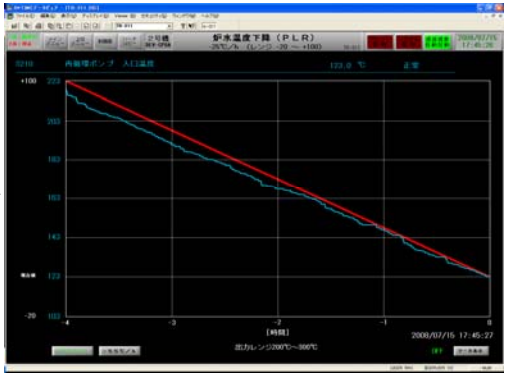
- New Features (2) -

Limit Line Trend display

Trend display with Limit Line (Rate of Change)

(For Start up or Shut down)

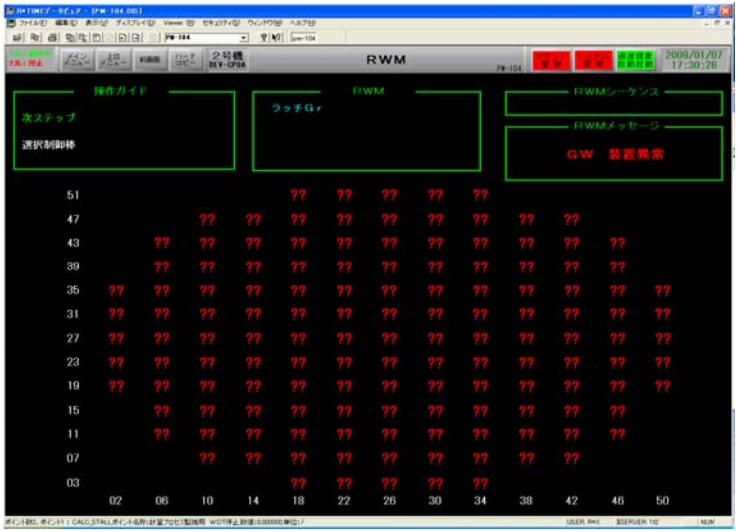




6.New Features and Samples of displays

- New Features (3) -

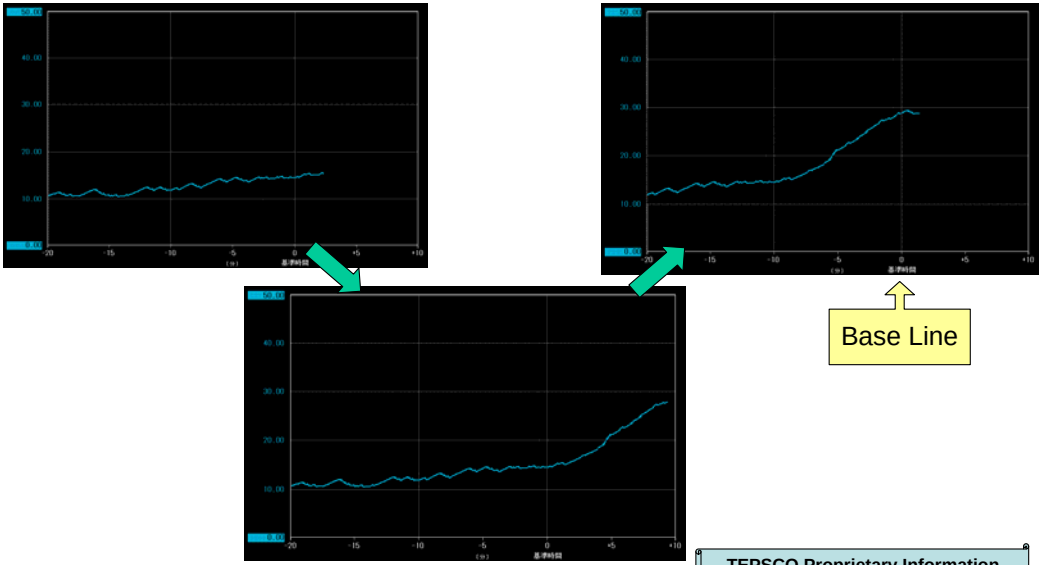
RWM Guide Display



6.New Features and Samples of displays

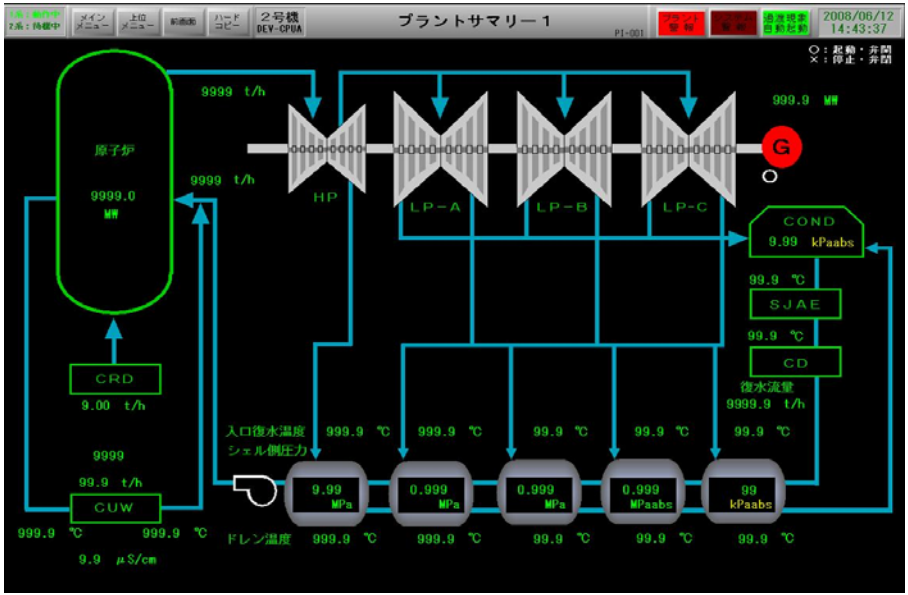
- New Features (4) -

Roper Trend Display



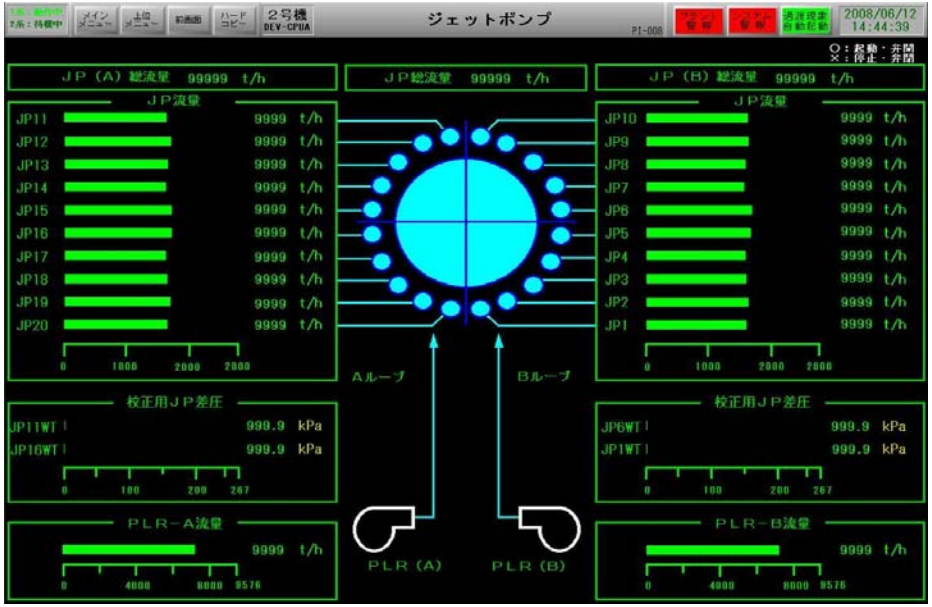
6.New Features and Samples of displays

- Sample of display (Plant Summary Display)-



6.New Features and Samples of displays

- Sample of display (Jet Pump Display)-

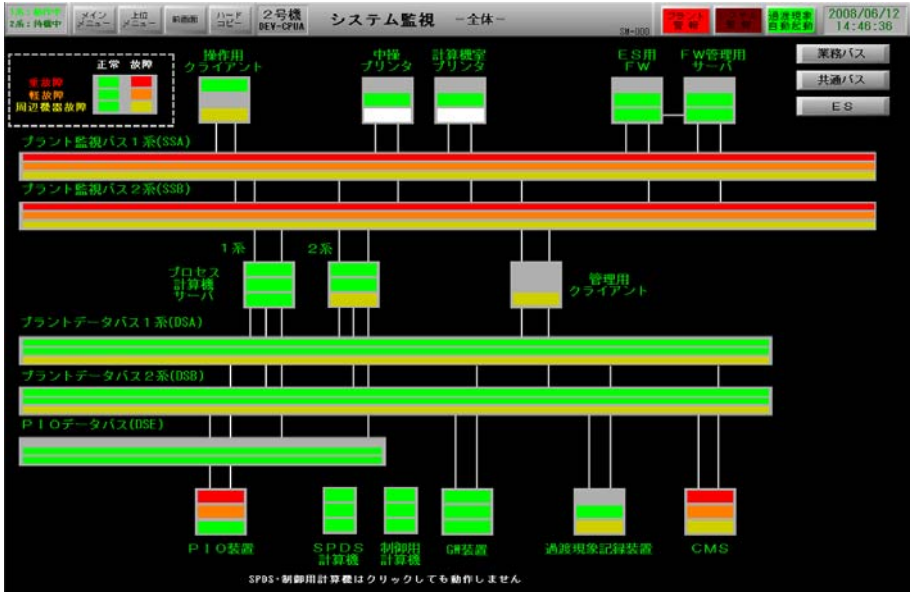


6.New Features and Samples of displays

- Sample of display (P-F Map Display)-

6.New Features and Samples of displays

- Sample of display (System Monitoring Display)-



7.Post Installation Issue

(1) RTC and System time synchronization Problem

SDZTIME was instantly delayed by 3 minutes

(2) Firmware of Raid controller Problem

Server restarted frequently caused by a bug of Raid controller

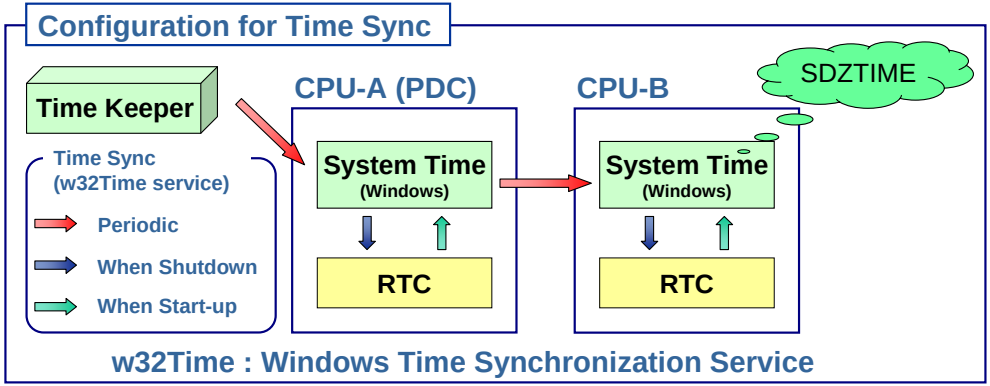
(3) Automatic Fail Over Problem

Server failed in automatic fail over when critical process stopped

7.Post Installation Issue

(1) RTC and System time synchronization problem

【Event】
After Restarting Standby Server (CPU-A) , SDZTIME (Windows System Time) of Active Server (CPU-B) was instantly delayed by 3 minutes



7.Post Installation Issue

(1) RTC and System time synchronization problem (Continued)

- Both CPU-A and CPU-B had been operating more than 3 months, and RTC of CPU-A was getting delayed and the delay was being accumulated from start-up
  (About 3 min delayed at that time)
- CPU-A was shutdown for some reasons.
- At that time, the time of RTC was not equalized to system time because of Bug in w32time. ※1
- After that, CPU-A made to restart-up, when system time of CPU-A was matched to the delayed RTC time and did not synchronize since then. ※2

Note ※ 1 :

That bug was posted at the Microsoft web site in July 2008

7.Post Installation Issue

(1) RTC and System time synchronization problem (Continued)

- CPU-A was Primary Domain Controller, so the time of CPU-B was synchronized to CPU-A, when the Event happened

3 minutes delay occurred at CPU-B (Active Server)

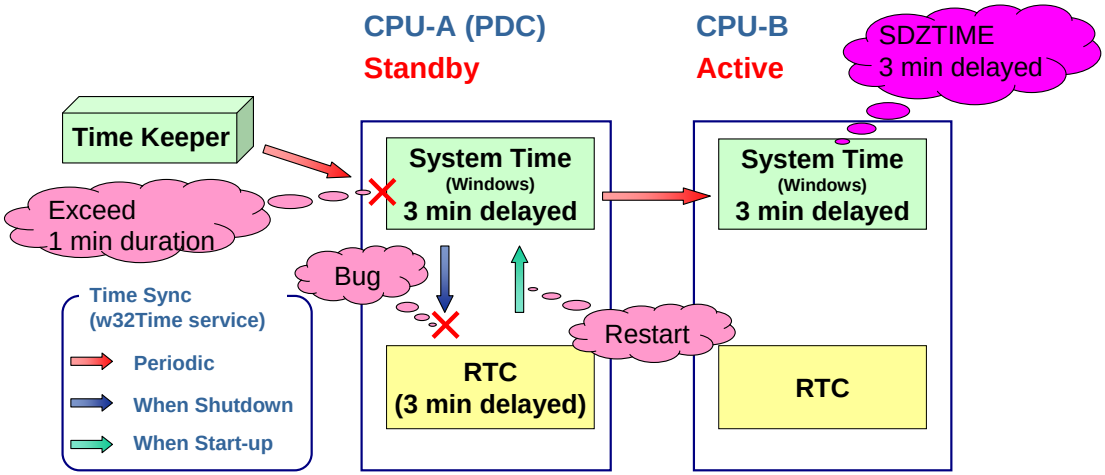
(BOP Log for one hour Cumulative Value for plant parameters recorded these parameters for 63 minutes)

Note ※2 :

According to w32Time configuration, system time of CPU-A was designed to be synchronized to time keeper when time difference is less than the duration of 1 min, in this case synchronization was not made due to 3 min delayed

7.Post Installation Issue

(1) RTC and System time synchronization problem (Continued)



7.Post Installation Issue

(1) RTC and System time synchronization problem (Continued)

【Countermeasures and Issues identified】

-Short term-

1) Update of the latest "w32Time.dll" to synchronize to RTC time to System time when server is shut down
2) Checking support site of Software vendor (Microsoft) frequently and available update should be evaluated whether to install that

-Questions-

1) How to validate technical base and reasonability of the "1 minute duration" of w32time configuration?
2) What is an effective method to synchronize the RTC time and Windows system time?
3) Is there any better way to achieve time synchronization? (Method and Configuration)

7.Post Installation Issue

(2) Firmware of Raid controller Problem

【Event】
Stand-by Server restarted frequently

- Background Patrol Read function(*1) detected HDD error and tried to recover the HDD

  *1: Raid Controller function supported by DELL

- That function seemed to lock the system including R*TIME application, however because HDD recovery was not effectively achieved and the cyclic phenomena happened (According to DELL Support site)

System restarted when Patrol read function locked the system

7.Post Installation Issue

(2) Firmware of Raid controller Problem

【Countermeasures and Issues identified】

-Short term-

1) Replacing the Failed HDD
2) Update of the latest version of firmware
3) Checking support site of Vendors frequently and available update should be evaluated whether to install that

-Questions-

1) Have you experienced any issue which was caused by 3rd party application, like this DELL Raid controller?
2) Do you have any preference for HW vendor?

7.Post Installation Issue

(3) Automatic Fail Over Problem

【Event】
When a critical process stopped at Active server, the automatic Fail Over did not occur

- When the Standby server experienced the frequent start-ups, some system points at the standby server became "OFF SCAN"

- One of the point is "SHEALTH" that point works for fail over function and active server recognized the standby server not normal state and a server mode for fail over became "Manual Mode"

Automatic Fail Over did not happen

7.Post Installation Issue

(3) Automatic Fail Over Problem

【Countermeasures and Issues identified】

1) “OFF Scan” seemed to be caused by the failure in reading “Warm up start file”
2) “Server Mode” for Fail Over can only be seen at the specific display, so it should be seen at any display

-Questions-
1) Have any of you experienced the same issue?

8.Lessons Learned

【Specifications】

- We could not effectively determine requirements at the initial project stage
- We needed to learn R*TIME system sufficiently, the work to describe some documents were delayed
- To review or approve the SRS/SDD documents were delayed

→ **To determine the specification quickly, requirements and R*TIME functions have to be understood well**

【Design Works】

- This is a first time for our replacement, and there was no in-company standard specification

→ **Prepare standard documents for Next Replacement**

8.Lessons Learned

【Testing】

- The behavior of emulator for the purpose of I/F testing was a little bit different to the actual behavior
  → **Consider transient behavior of each system**
- We could not spend much time to do the test activity.

(Post-Installation)

- We could not find Time synchronization issue and Fail-over issue at FAT
  → **Conduct more test under various server conditions**

8.Lessons Learned

【Communications / Supports】

- We had prepared Video conference system for this project, and have periodical meeting with SCI member
- SCI engineers stayed in 1F site while pre-combination testing and installation

Question ?