R*TIME-Based Monitoring System in Fukushima Daiichi Nuclear Power Station

Manabu Murata
Tokyo Electric Power Services Co., LTD

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Agenda

Introduction; What We Do in Fukushima

• Current situation of Fukushima Daiichi nuclear power station

• 1F Monitoring System

• Radiation Monitoring System (openATOMS)
What We Do in Fukushima

Actual achievement

**Before the Fukushima Accident**
- 1F-2 PPC Replacement (R*Time-Based) 2008 Completed → Stopped Now
- 1F-5 PPC Replacement (R*Time-Based) 2011 Completed → Keep Running
- 1F-4 PPC Replacement (R*Time-Based) Uncompleted

**After the Fukushima Accident**
- 1F Monitoring System (R*Time-Based) Aug/2012 Installed
- Radiation Monitoring System (openATOMS) Aug/2012 Installed
  openATOMS: [open Advanced Topological On-demand Monitoring System]
Current situation of Fukushima Daiichi nuclear power station

Countermeasures Against Accumulated Water Increased

[Accumulated water treatment]

- Groundwater intrusion prevention
  - Pump well
  - Groundwater

- Injection water tank

- Seawater desalination
  - Desalination system
    - Reverse osmosis (RO)
    - Evaporative concentration

- Process Main Building
  - High Temperature Incinerator Building
  - (Mainly) Cesium removal
  - Accumulated water treatment facility
  - Temporary storage facility
    - Spent vessels
    - Spent sludge
    - Spent adsorbent

- Reactor Building
  - Turbine Building
  - Water circulation

- Mid-to-low level tanks
  - Multi-nuclide removal equipment (ALPS)
  - Water storage tank, underground water storage tank

Current situation of Fukushima Daiichi nuclear power station

The 1F Monitoring System is connected to local facilities below.

- Water storage tanks
- Groundwater bypass
- ALPS: Multi-nuclide removal equipment

The Monitoring System receives data from the local facilities.

Ever Increasing Water storage tanks
Ever Increasing Water storage tanks

Storage of contaminated water/treated water (Additional tanks)

- The total capacity of existing storage tanks is approx. 400,000m³.
- Then approx. 300,000m³ is planned to be added within the next 3 years.
- The estimated maximum capacity: 700,000m³.
Groundwater Bypass facility

- For Suppressing Increase of Contaminated Water -

In our plan, the groundwater bypass will gradually lower the water level of groundwater, and eventually suppress the inflow into the buildings to approx. 100 tons a day.

Groundwater Bypass facility

- For Suppressing Increase of Contaminated Water -
Seismic Base-Isolated Key Buildings at Fukushima Daiichi Nuclear Power Station

This facility is required by Japanese nuclear regulation, NRA.

External Appearance

Seismic Base Isolation Floor

Emergency Response Room

Seismic Base-Isolated Key Buildings at Fukushima Daiichi Nuclear Power Plant

This building was designed by architect team of TEPSCO.

External Appearance

Seismic Base-Isolated Key Buildings
at Fukushima Daiichi Nuclear Power Plant

Seismic Base Isolation Floor

Base Isolation Equipment: Rubber support with lead plug + rigid sliding support + oil damper
Floor Response Acceleration: Highest floor: 218 Gal
Horizontal Clearance: 750 mm
Seismic Base-Isolated Key Buildings at Fukushima Daiichi Nuclear Power Plant

Emergency Response Room
• Command and control centre for HQ personnel during an emergency.
• The other members of the emergency response team will be situated around the Emergency Response Room.

Seismic Base-Isolated Key Buildings at Fukushima Daiichi Nuclear Power Plant

In Emergency Response Room

1F Monitoring System
Challenges

Customer’s request

- Monitoring local facility Operating Conditions & Alarm Conditions
- Monitoring remotely (In Seismic Base-Isolated Key Buildings)
- Equivalent functions as Plant process computer (PPC)

We have designed a R*TIME-Based “1F Monitoring System”.

In order to connect between the Local facilities and R*TIME, We have developed some New Interface Softwares.
System Overview

Hardware (Minimum Configuration)
• Server: Fujitsu PRIMEGY TX120 × 2
  → Redundant
• Client: Fujitsu Desktop PC × 2
• Monitor: 19inch LCD × 3
• Printer: Non

Software
• OS: Windows Server 2008 (32bit)
• New Features: Following page
New Features

We have developed the following New Interface Softwares in order to connect between the Local facilities and R*TIME.

- For “ALPS”, “Water storage tank”, and “Groundwater bypass” facility
  → Transmission interface Software with Mitsubishi Electric MELSEC-Q PLC
  → Transmission interface Software with Yokogawa FL100 Telemeter

- For “Leakage Monitoring”
  → The leakage monitoring function using SNMP (Netmon)

- For “Plant parameters”
  → Transmission interface Software with Yokogawa MV Recorder

- For “Web Camera”
  → Image processing

This system has capable to communicate with various kinds of components.
Transmission interface Software with Mitsubishi Electric MELSEC-Q PLC

Monitoring of “ALPS”, “Water storage tank”, and “Groundwater bypass” facility → Use the Mitsubishi-Electric MELSEC-Q PLC

We have developed a new interface software for MELSEC-Q PLC.

• TCP/IP Protocol (Using a “MC” Interface Unit)
• Support Redundant configuration
• Easy to establish additional connections (device connections)
Transmission interface Software with Yokogawa FL100 Telemeter

Monitoring of “ALPS (Transfer of water)” facility
→ Use the Yokogawa FL100 Telemeter

We have developed a new interface software for Yokogawa FL100-MF92.

• TCP/IP Protocol (Using a “FL100-MF92” Interface Unit)
The leakage monitoring function using **SNMP (Netmon)**

Monitoring of Leakage

→ PHN-D88 Interface Converter (Digital Input),
  using the “NETMON”
Transmission interface Software
with Yokogawa MV Recorder

Monitoring “Plant parameters”
We have developed a new interface software for Yokogawa MV Recorder

Features
• Modbus/TCP Protocol
• Maximum Connection to R*Time
  50 MV Recorders

Control Room

R*Time

Ethernet
Protocol : Modbus/tcp

MV Recorder-
Connect the cable of plant parameters
Monitoring of Indicator by Web Camera
We have developed a new software for Image processing of Web Camera.

Flow of Image processing
1. Get the Image File (Jpeg) from Web Camera
   ↓
2. Digitize the indicated position in PC.
   ↓
3. The number is stored in the database on R*Time.
Image processing with Web Camera

This function is still under the verification stage.
1F View of 1F Monitoring System

Seismic Base-Isolated Key Buildings

1F Monitoring System

Groundwater bypass

leakage monitoring

ALPS, Water storage tank

Local

Local

Local

TEPSCO Proprietary Information
Monitoring of ALPS Facility

P&ID Display

TEPSCO Proprietary Information
Monitoring of Water Storage Tank Facility

Tank Summary Display; Monitoring of Tank Level
Monitoring of Water Storage Tank Facility

Operation Display by Mitsubishi MELSEC-GOT
Monitoring of Water Storage Tank Facility

Operation Display by Mitsubishi MELSEC-GOT
Monitoring of Groundwater Bypass Facility

P&ID Display
Monitoring of Groundwater Bypass Facility

Tank Summary Display; Monitoring of Tank Level
Monitoring of Groundwater Bypass Facility

Annunciator Display

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TEPSCO Proprietary Information
Leakage Monitoring Display; Unit1 Reactor Building

Leakage Monitoring of Piping for Accumulated Water
Leakage Monitoring of Piping for Accumulated Water

Leakage Monitoring Display; Unit4 Turbine Building
The leakage monitoring with **SNMP (NETMON)**

Monitoring of Leakage

→ PHN-D88 Interface Converter, using the “NETMON”
Leakage Monitoring of Piping for Accumulated Water

Leakage Monitoring Display; Isotope Collection System by KURION
1F Monitoring System

Currently, 1F Monitoring System Monitors:

- Multi-nuclide removal equipment (ALPS)
- Water Storage Tank
- Groundwater Bypass facility
- Leakage Monitoring of Piping for Accumulated Water
- Additional facilities (In the near future)

TEPCO is planning to upgrade the System next year. We are supposed to design this new system (R*TIME-Based).
Radiation Monitoring System (openATOMS)

openATOMS: open Advanced Topological On-demand Monitoring System

• Overview
• Features of “openATOMS”
• Application
• Exhibition of Technology Night
Overview

After the Fukushima Accident, We provided “openATOMS” in Fukushima Daiichi Nuclear Power Station.

“openATOMS” is backup device of radiation monitoring post (MP). (Wireless network system)

• Radiation
• Dust
• Neutron
• Weather Information
What is the openATOMS technology?

- High reliable, low cost and useful wireless network system.
- Use ADHOC wireless communication technology, and realize a reliable wireless network.
- Adopt the ZigBee for network device.
- Developed intelligent, low electricity and high performance cell type computer (NICE).

What is openATOMS used for?

- Monitoring system at Power Plant.
- Back-up or temporary system in case of emergency.
Features of “openATOMS”
Features of “openATOMS”

Functions and features of NC(Network Computer):

[Function]
• TCP/IP <-> ZigBee Gateway
• Data Processing with XML
• Data transfer to Data center (PC)
• Data transfer to R*TIME-based system by UDP/IP protocol

[Feature]
• Developed by JAVA language
• Configuration, build by XML
Features of “openATOMS”

Functions and features of NICE (Networked Intelligent CELL):

[Function]
• Real time data processing, - AI / DI / Temp. / Humidity / Radiation
• GPS / Camera can be installed
• ZigBee wireless network system (Router)

[Feature]
• High performance
• Small and Low cost
• Power-saving, Does not need External Power Supply.

The NICE can keep running just a battery and solar panel.
Application

- Back-up or temporary system in case of emergency
- Monitoring small facility (e.g. Distribution panel, building maintenance, smart meter)
- Monitoring on-site environment
  Temperature, humidity, CO2, wind direction and speed
- Monitoring of pump vibration
- Agricultural sector,
  Such as Monitoring of greenhouse environment
Exhibition of Technology Night
Please come to our exhibition booth

Demonstration System

R*Time Server

NC (Data Center)

NICE (Sensor Unit)

- Temperature
- Humidity
- CO₂ Concentration
- AI
- DI

Temperature
Humidity

Wi-Fi

(Ethernet)

(ZigBee)

UDP/IP

TEPSCO Proprietary Information
Questions?