

Recent Significant Events

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Introduction

- **There are three significant events that have caused reactor trips since Jan. of 2004 in Taiwan:**
 - 1. Turbine Trip on DEH System Malfunction at Chinshan NPS**
 - 2. Inadvertent Actuation of Reactor Protection System(SSPS) at Maanshan NPS**
 - 3. Main Feedwater Control Valve Malfunction at Maanshan NPS**
- **All three events are initiated by the failure of I&C devices.**

Event 1: Turbine Trip on DEH System Malfunction at Chinshan NPS

Background:

- **Chinshan NPS is a GE BWR-4 plant with two units, each rated at 636 Mwe. Turbine-Generator is manufactured by Westinghouse. Unit 1 went commercial operation on 1978. Unit 2, 1979.**
- **Turbine control system was upgraded to DEH MODIII, Westinghouse Distributed Precessing Family(WDPF) in 1993.**

Event 1: Turbine Trip on DEH System Malfunction at Chinshan NPS

Description:

- Jan. 24, 2004 Chinshan NPS Unit 1 DEH Primary Process Unit DPU2 for Over Speed Control Failed**
- Backup Process Unit DPU52 didn't takeover within 4 seconds (set point)**
- With the loss of both DPU2 and DPU52, Relay Actuated and Caused Turbine Trip**
- Reactor Trip Followed**

Corrective Actions

- **Both DPUs returned to normal after Reset . No failure was found.**
- **Both process units were replaced. Power Supply of DPU52 was replaced, too. No failure was found on replaced units after further check.**



Corrective Actions(Cont'd)

- From DEH status log, backup DPU52 went off network data highway when a power shock happened in transmission line in Dec.6, 2003. Since then DPU52 had changed status several times between time-off and normal within a second.**
- No action on Backup DPU for the consideration of on-line replacement risk and time off never exceed 4 seconds before the reactor trip.**
- Because the scheduled outage was only a few weeks away, the plant management decided not to work on DEH, only to closely monitor the backup DPU.**

Conclusion of Event 1

- **The plant should have replaced the DPU cards and power supply of primary and backup DPU for reliability concerned.**
- **Conservative decision making is necessary when any DPU appear abnormal, corrective actions have to be made with careful evaluation, otherwise, the price is too high.**

Event 2. Inadvertent Actuation of Reactor Protection System(SSPS)

Background


- **Maanshan NPS is a Westinghouse 3-loop PWR plant with two units, each rated 951 Mwe. Unit 1 went commercial on 1984, unit 2 on 1985.**
- **The Solid State Protection System has many Universal Logic Cards(ULC) in it. Maanshan NPS has replaced some original Westinghouse ULCs with new cards developed by Taiwan's Institute of Central Scientific Research.**

Event 2. Inadvertent Actuation of Reactor Protection System(SSPS)

Description

- **On January 29, 2005, when Maanshan NPS Unit 2 was in normal 100 percent power operation, all in a sudden, Auxiliary Feed Water(MD) actuated and Reactor tripped at the same time.**
- **Right after Rx tripped, the signal of AFS (MD) Train B actuated for three times, without any trigger signal.**

Root Cause Analysis and Discussion

1. **Chatting noise from SSPS TR. B relay cabinet was noticed where master relay and slave relay actuated intermittently (on and off).** 
2. **UV Coil Voltage Meter swing between 0 ~ 48 V. Normal at 48 Vdc without Trip Signal. Otherwise at 0 Vdc.**
3. **No trip signals found except UV Coil Voltage Meter swing .**

Root Cause Analysis and Discussion (Cont'd)

- 5. The Universal Logic Card A316 (O1) TP1 measured 0.6 Vdc which had actuated AFS (MD) TR B and caused Rx Trip**
- 6. The A316 card was tested OK on ROMP Tester. A316 (O1) TP1 return to normal voltage of 14.78 Vdc after the card A316 was reinserted.**
- 7. Check every related input and output wire connections, but no problem was found.**

Conclusion of Event 2

- 1. Root Cause investigation Continues .**
- 2. A comprehensive EMC plan is required for SSPS Card Retrofit Program.**
- 3. Perform ESD test on new SSPS card and SSPS cabinet .**

Event 3. Reactor Trip Due To Main Feedwater Control Valve Malfunction

Background

- **Maanshan NPS is a 3-loop PWR plant. The main feedwater control valve on each loop has dual control channels with independent positioners(Fisher).**
- **Maanshan NPS has upgraded its feedwater control system from analog to digital(Foxboro). New control system has redundant channels that can switch to the standby channel automatically once an abnormal condition is detected.**

Event 3. Reactor Trip Due To Main Feedwater Control Valve Malfunction

Description

- On March 25, 2005, when Maanshan NPS Unit 1 was running at 100% power, SG C high water level alarm was triggered. Operator noticed that SG C water level was rising up while its main feedwater control valve kept on opening.**
- Operator tried to close MFW valve by transfer primary AUTO to Manual. But the valve stayed in open position and SG level continued to rise.**

Event 3. Description(Cont'd)

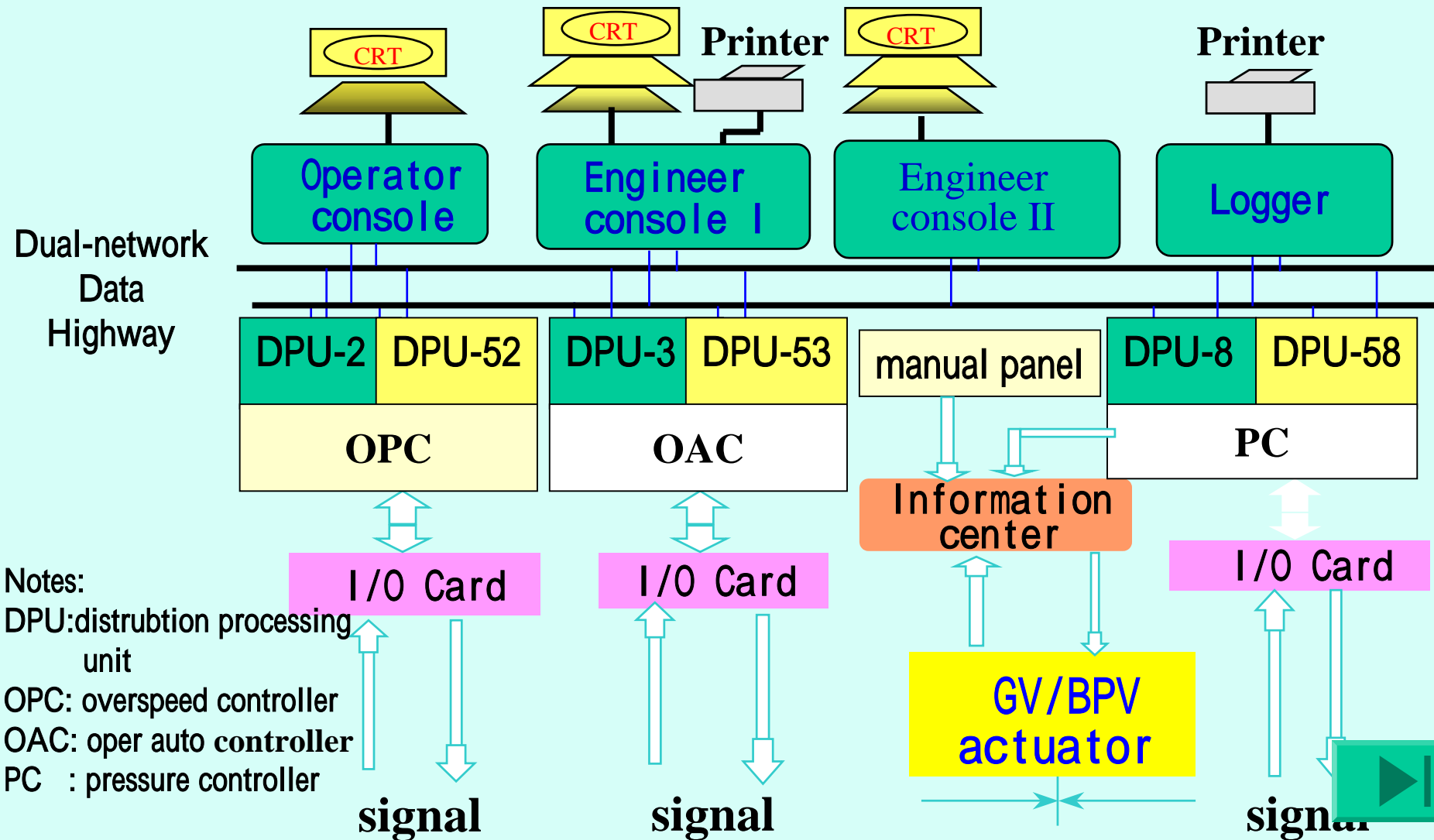
- **Valve close immediately after operator transfer to Backup AUTO. SG water level went down instantly.**
- **Operator tried to re-open MFW valve by switching back to primary AUTO. The MFW valve did start to open, however, the SG water level had no time to recover and hit low-low level, and initiated reactor trip, with main turbine and generator trip followed.**

Root Cause Analysis and Corrective Action

1. The feedback arm connection was found loose on SG C main feed water control valve primary positioner.
2. The feedback arm screw provided by vendor could not withstand the high vibration of the MFW control valve.
3. The connection was modified to fasten tightly(double nut).
4. Operator was retrained on the switching between primary and backup controller.



DEH System Configuration

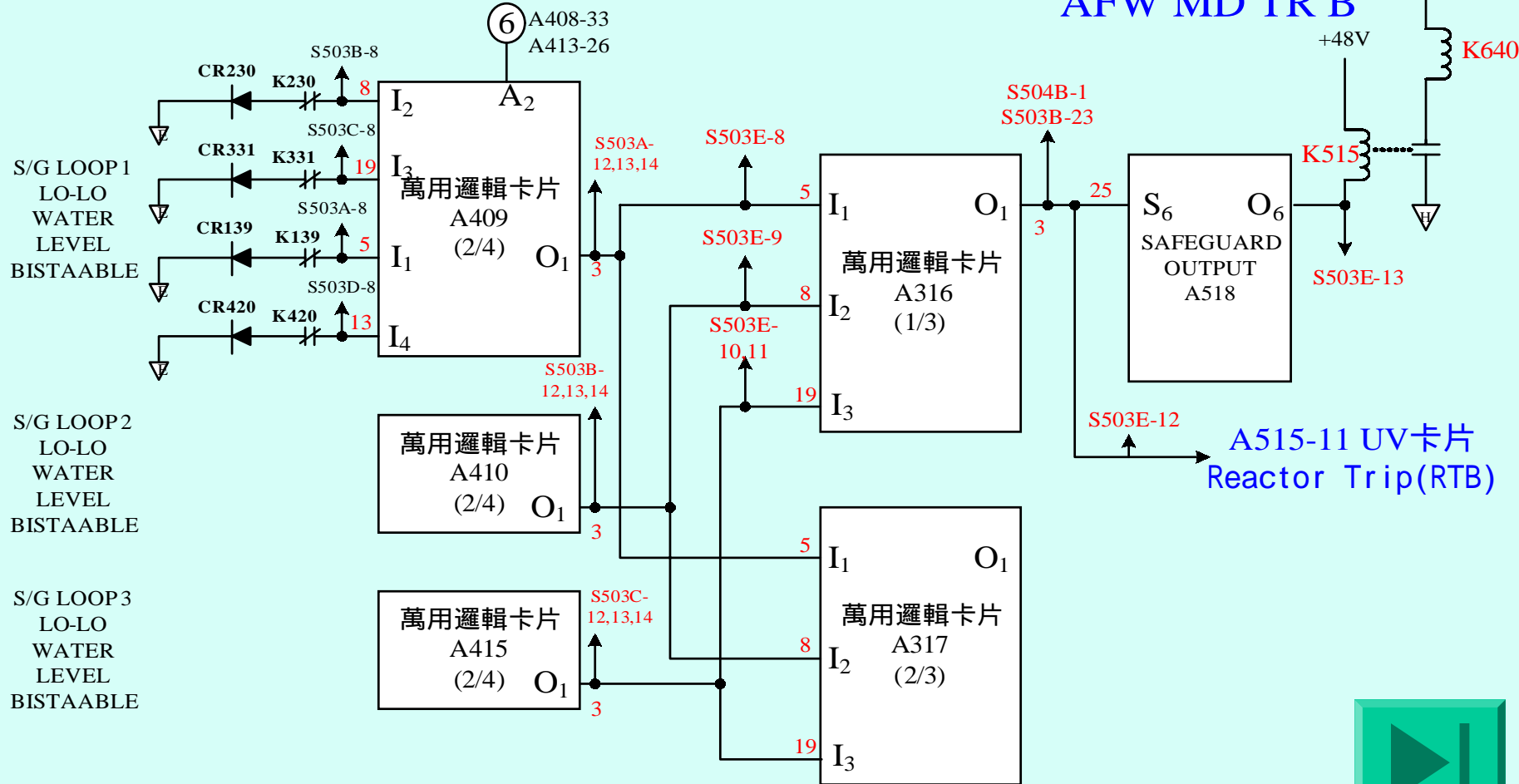


AFW MD TR B

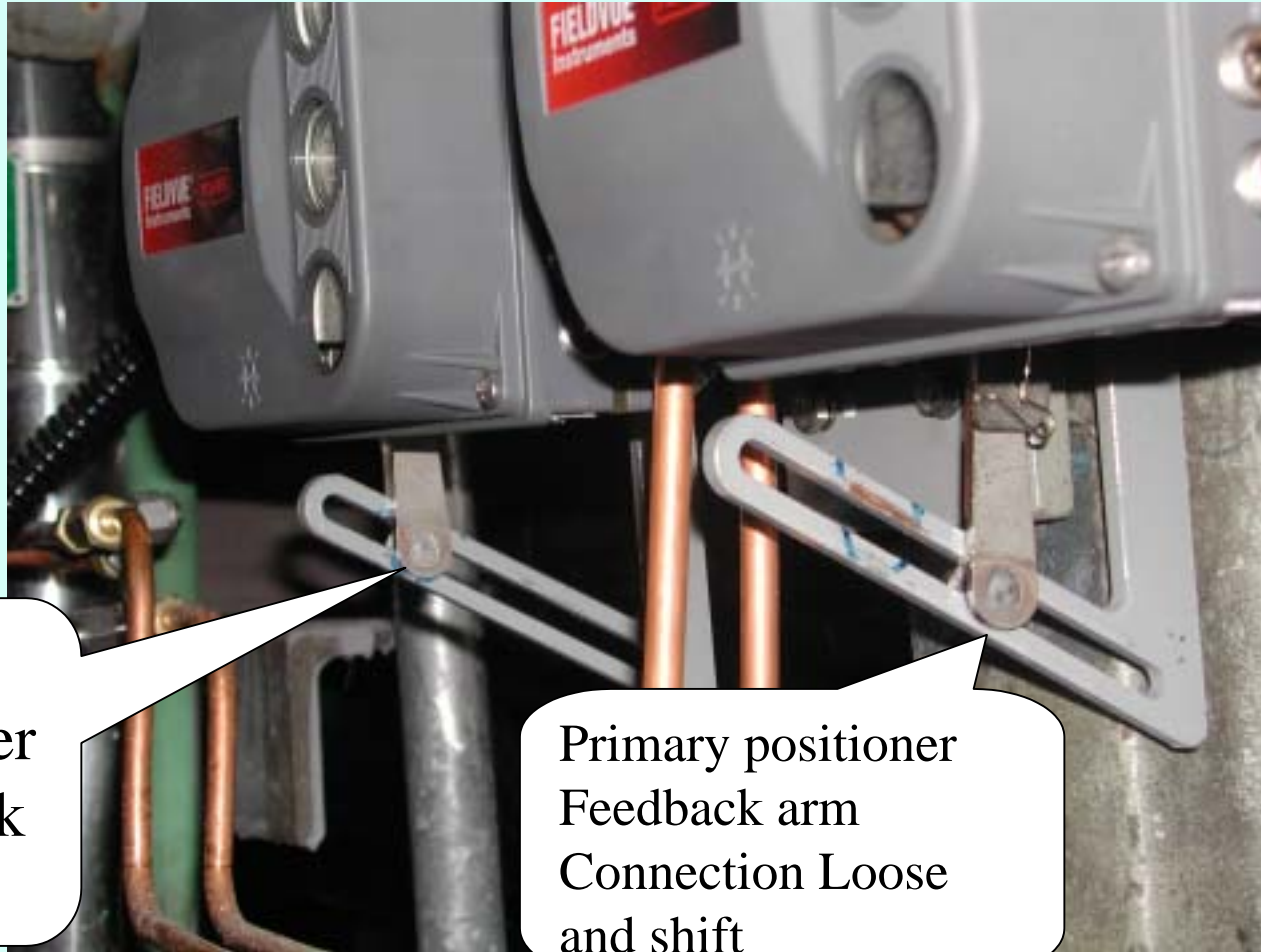
118VAC

+48V

K640



Loose Connection found on Primary Positioner



Backup
positioner
Feedback
arm

Primary positioner
Feedback arm
Connection Loose
and shift

TRA Unit 1 Trend Chart Type 1

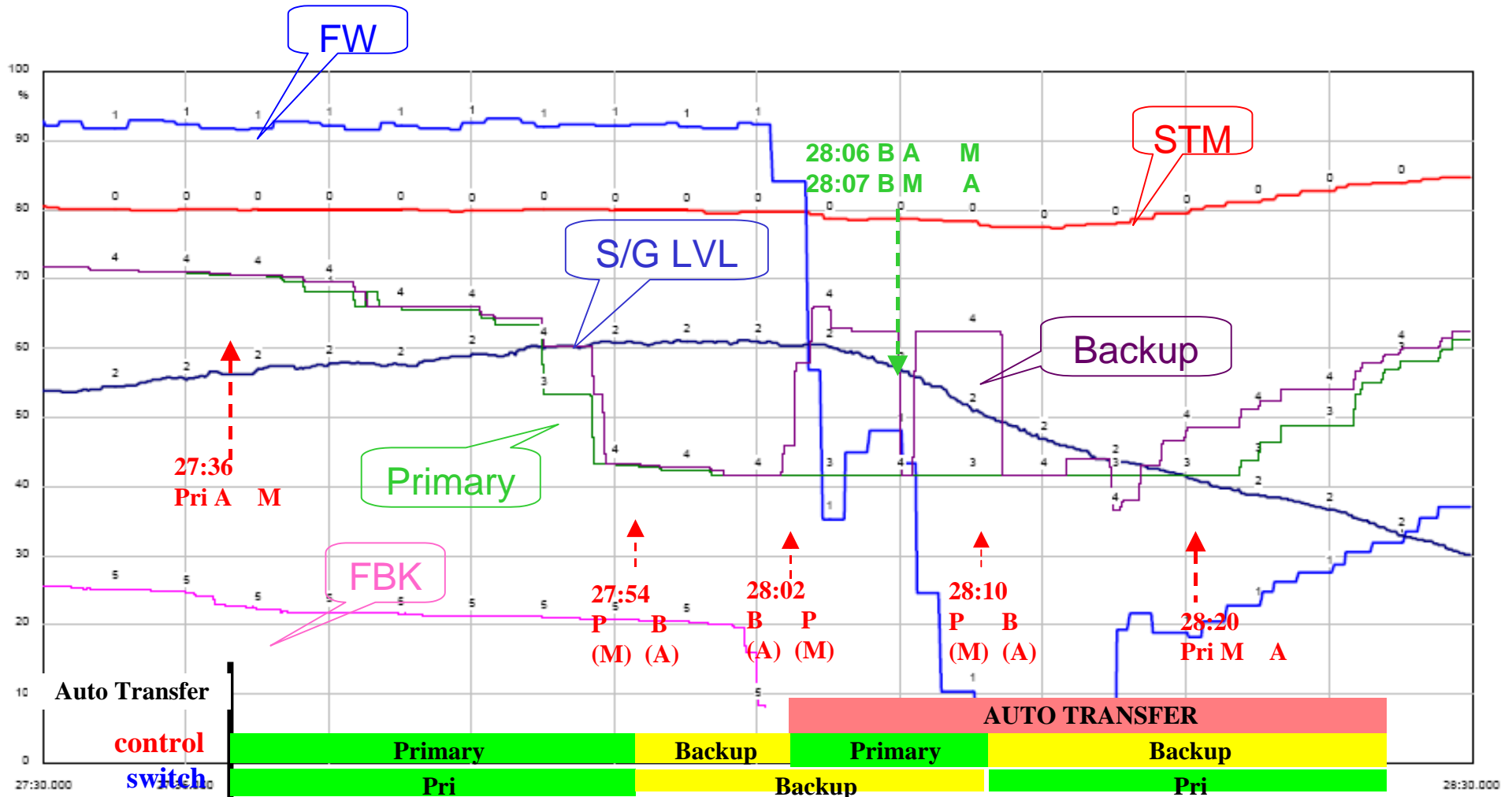
Description:

Start Time: 2005/03/25 18:27:30 End Time: 2005/03/25 18:28:30

Print Time: 2005/03/27 04:02:22

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Group Name: AE-FV498



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|--|--|---|---|---|---|
| ABF005 Symbol: 0 LOOP 3 STM FLOW 1 | AEFD11 Symbol: 1 LOOP 3 FW FLOW2 | AEL013 Symbol: 2 S/G 3 NR LEVEL 3 | AEY012 Symbol: 3 FW CTRL VLV FCV-498 DEMAND | AEYD18 Symbol: 4 FW CTRL VLV FCV-498 DMD B/U | AEZ005 Symbol: 5 S/G3 FW MAIN CTRL VLV POSITION |
| Unit: MKG/HR Hi Scale: 2.310 Lo Scale: 0.000 Begin Value: 1.863 End Value: 1.959 | Unit: MKG/HR Hi Scale: 2.310 Lo Scale: 0.000 Begin Value: 2.146 End Value: 0.860 | Unit: % Hi Scale: 100.000 Lo Scale: 0.000 Begin Value: 54.043 End Value: 30.302 | Unit: % Hi Scale: 100.000 Lo Scale: 0.000 Begin Value: 71.987 End Value: 61.367 | Unit: % Hi Scale: 100.000 Lo Scale: 0.000 Begin Value: 71.987 End Value: 62.649 | Unit: % Hi Scale: 100.000 Lo Scale: 0.000 Begin Value: 26.847 End Value: -5.767 |

