



US-APWR

Discussion on Non-safety Automatic Control Signals to Safety Related functions

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Non-safety Automatic Control Signals to Safety Related functions



- **There are several automatic control signals interface from PCMS to PSMS which actuate safety-related components in order to enhance the plant safety.**
- **These automatic controls enhance the plant safety, but are not credited in Safety Analysis of DCD Ch.15.**
- **The priority logic within PSMS ensures that a safety-related signal has higher priority than those automatic control signals from PCMS.**
- **These automatic controls from PCMS to PSMS are same as the conventional standard PWR plants**

Non-Safety Signal from PCMS to PSMS (SLS)

- (1) Closure signal of Steam Generator Blowdown Line and Blowdown Sampling Line Isolation Valve from non-safety Radiation Monitor related signal**
 - ✓ Radioactive material releases at SGTR accident, etc. can be minimized by this function.
- (2) Closure signal of Letdown Orifice Isolation Valve from Pressurizer Water Level Control**
 - ✓ The pressurizer water level at an abnormal condition can be maintained in high level, and the reactor coolant inventory decrease can be minimized by this function.
- (3) Actuation signal of Class 1E Battery Room Exhaust Fan from Battery Room Exhaust Fan Outlet Airflow Control.**
 - ✓ Hydrogen concentration can be minimized by this function to protect the Class 1E battery room from the fire and explosion.
- (4) Trip signal of RCP from Non-Class 1E AC Bus under voltage signal**
 - ✓ By this function, the non-safety onsite load can be minimized at the LOOP, and the offsite power from the reserved transmission line can feed to the Class 1E buses.
- (5) Start permissive signal of RCP from RCP monitor signal**
 - ✓ This function prevents the damage of the RCP to minimize reactor coolant release from the RCP seal, and the reactor coolant inventory decrease can be protected by this function.
- (6) Actuation signal of Pressurizer Back-up Heater from Pressurizer Pressure Control**
 - ✓ The pressurizer pressure at an abnormal condition can be maintained in high conditions, and the reactor coolant inventory decrease can be minimized by this function.
- (7) Off signal of Pressurizer Back-up Heater from Pressurizer Water Level Control**
 - ✓ This function de-energizes the backup heaters to prevent damage on the safety-related back-up heaters, therefore, this non-safety automatic function enhances the plant safety.

Enhance Plant Safety (2/2)



(8) Closure signal of Excess Letdown Line and Letdown Line Isolation Valve from Pressurizer Water Level Control

- ✓ The pressurizer water level at an abnormal condition can be maintained in high level, and the reactor coolant inventory decrease can be minimized by this non-safety automatic function.

(9) Closure signal of VCT Outlet Isolation and CHP Suction Alternate Supply Valve from VCT Water Level Control

- ✓ The VCT water level at an abnormal condition can be maintained in high level, and the reactor coolant inventory supply capability decrease can be minimized by this non-safety automatic function.

(10) Open signal of Main Steam Relief Valve from Main Steam Line Pressure Control

- ✓ The main steam line pressure at an abnormal condition can be maintained in low level and the heat removal capability of secondary side can be maintained by this non-safety automatic function.

(11) Closure signal of Main Feedwater and Bypass Regulation Valves from SG Water Level Control

- ✓ The SG water level at an abnormal condition can be maintained in appropriate level and the heat removal capability of secondary side can be maintained by this non-safety automatic function.

Non-Safety Signal from PCMS to PSMS (ESFAS)

(1) Actuation signal of Emergency Feedwater Pump from Main Feedwater Pump trip signal

- ✓ The steam generator water level at an abnormal condition can be maintained in high level, and the secondary side coolant inventory decrease can be minimized by this function.

(2) Open permissive signal of Turbine Bypass Valve from Condenser Available signal

- ✓ By this function, inadvertent opening of the turbine bypass valves at the shutdown condition, and excessive cooldown of the reactor coolant can be minimized.

(3) Closure signal of CV Purge Isolation Valve from Non-safety CV Radiation Monitor signal

- ✓ Radioactive material releases can be minimized by this function.

Response to 07.09-24 (RAI 778-5866)



Answer

- The non-safety automatic control signals of the safety-related functions from the PCMS enhance the plant safety as described in Subsection 7.7.1.13 of the DCD markup submitted to the NRC on May 31st (MHI Letter No.UAP-HF-11159).
- The interface logics for the non-safety automatic control signals from the PCMS consist of simple “AND” and “OR” logic functions within the PSMS, as shown typically in Figures 1 (a) and (b), below. Therefore, the added complexity for these additional signals and logic functions in the PSMS is very limited. In all cases, safety-related signals in the PSMS have priority over these non-safety automatic control signals from the PCMS.
- If the non-safety automatic control signals from the PCMS to the PSMS are interfaced by hardwired cables, the “AND” and “OR” logic functions shown in Figures 1 (a) and (b) are still needed in the PSMS. In addition, for the hardwired cables interface design must require additional hardware devices in the PSMS, such as, binary I/O modules, isolation modules, etc.
- On the other hand, the Unit Bus interface can minimize the hardware devices and reduce the complexity of the system architecture of the PSMS, to compare with the hardwired cables interface because the Unit Bus interface does not require any additional hardware devices. Therefore, the Unit Bus interface results in the simplest architecture of the PSMS, as complying with the guidance of ISG-04, Staff Position 1.3.

Impact on DCD

- The following is added to Section 7.9.1.1.2 of the DCD Chapter 7.

The interface logics for the non-safety automatic control signals from the PCMS consist of simple “AND” and “OR” logic functions (within the PSMS). Therefore, the added complexity for these additional signals and logic functions in the PSMS is very limited. In all cases, safety-related signals in the PSMS have priority over these non-safety signals from the PCMS.

Example of Signal I/F from PCMS (1)

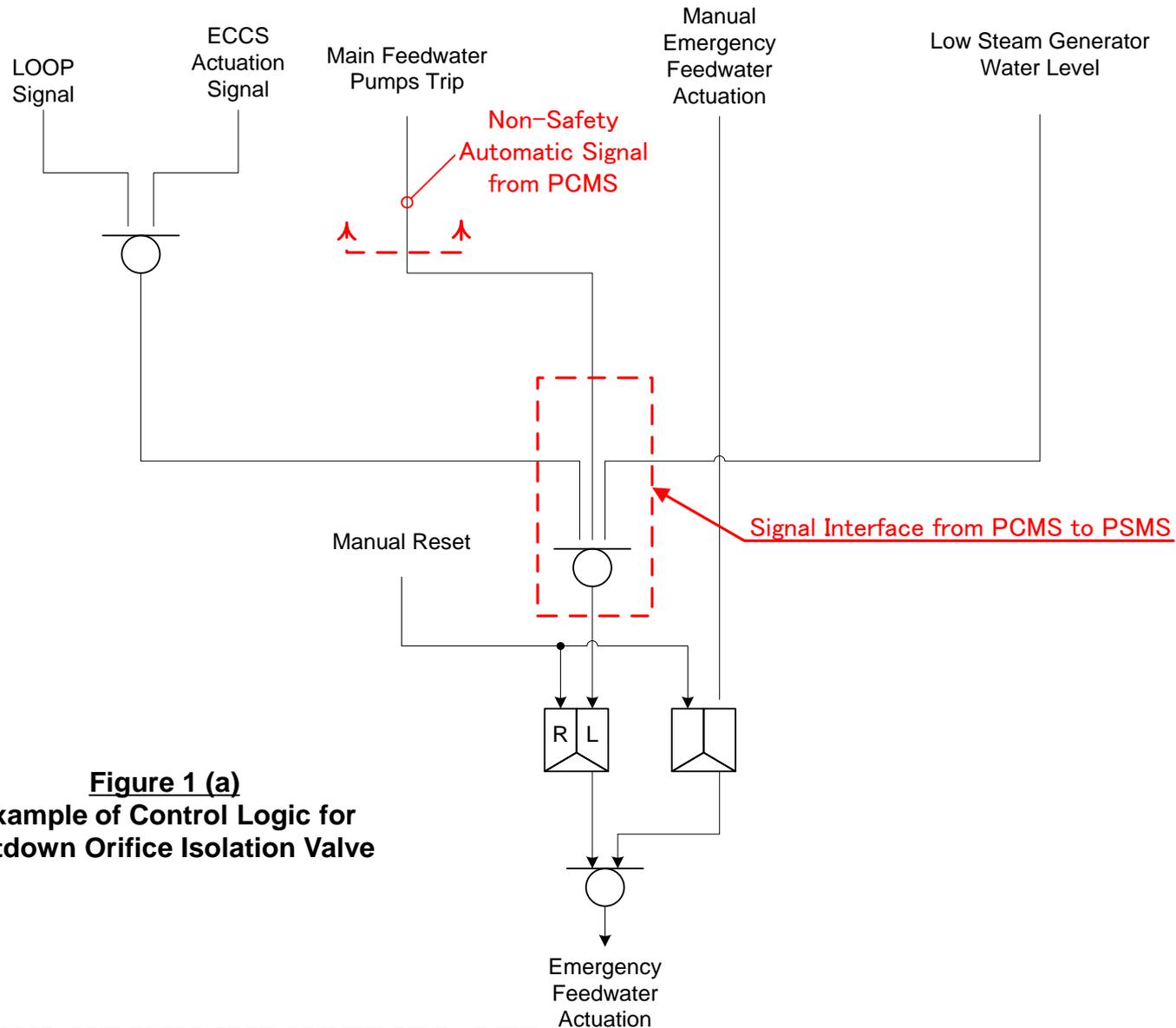


Figure 1 (a)
Example of Control Logic for
Letdown Orifice Isolation Valve

Example of Signal I/F from PCMS (2)

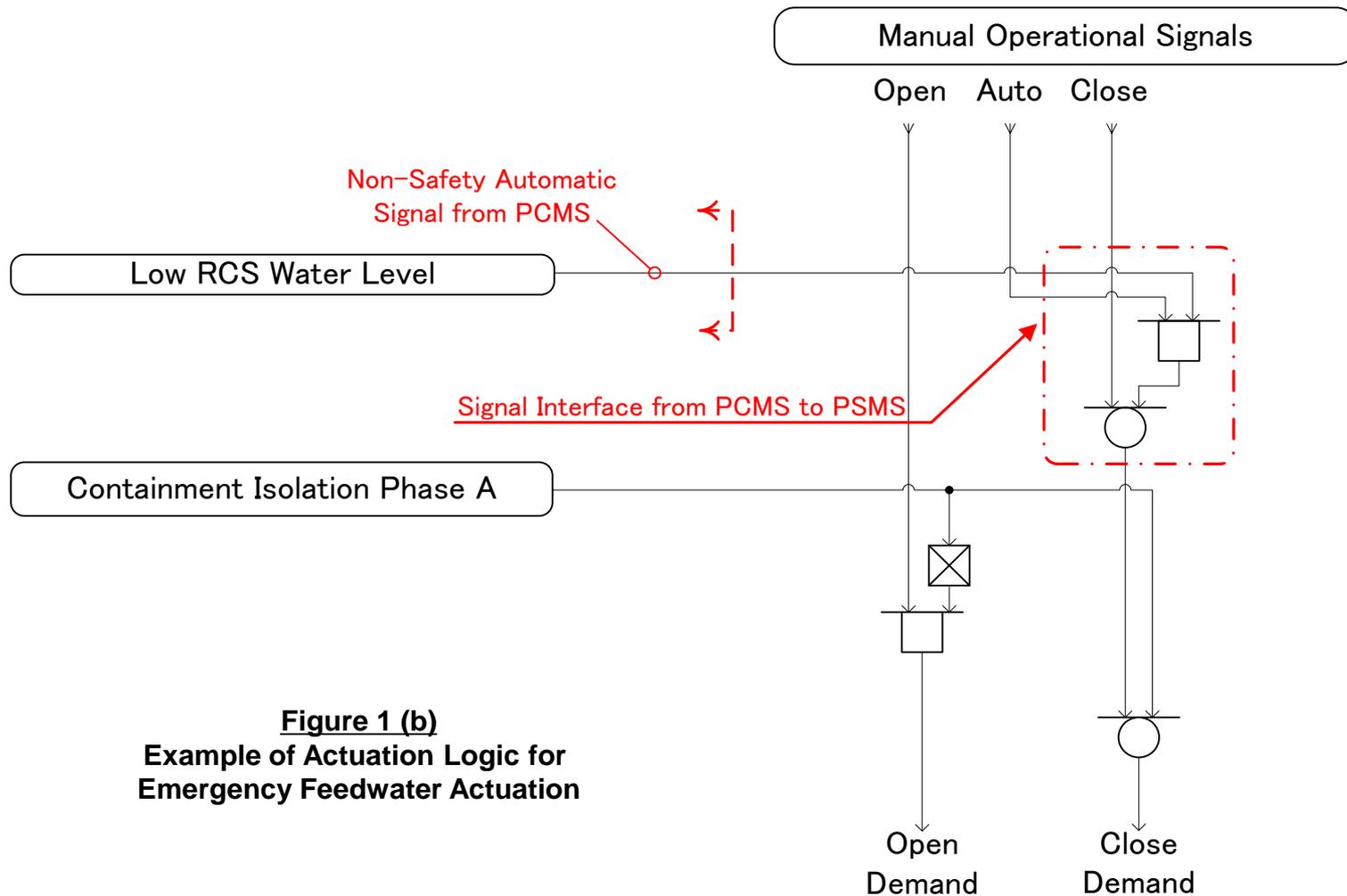


Figure 1 (b)
Example of Actuation Logic for
Emergency Feedwater Actuation

Reasons to select Unit Bus I/F



Section 7.9.1.1.2 of DCD Chapter 7

- The unit bus provides non-safety data communication between all I&C systems including the data communication from the non-safety system (PCMS) to the safety-related system (PSMS). The reasons to select the unit bus communication from the PCMS to the PSMS are as follows;
- The unit bus communication from the PCMS to the PSMS enhances the performance of the safety-related functions of the PSMS as described below.
- The unit bus communication conforms to IEEE Std 603-1991 (Reference 7.9-9) and other related regulatory requirements as described in Subsections 7.1.4, Subsection 7.9.2.7 and the Safety I&C Technical Report (Reference 7.9-2).
- The unit bus communication conforms to the all ISG-04 requirements (Reference 7.9-17) as described in Appendix E of the Safety I&C Technical Report (Reference 7.9-2).
- The reliability of the unit bus communication is higher than a conventional hardwired interface because it has fewer interface devices (it is not needed additional hardware) and it has a redundant architecture. The continuous self-diagnostic functions of the unit bus communication ensure there are no undetected latent failures, as there can be in the hardware interfaces.
- Based on higher reliability, immediate failure detection and short repair time, the availability of the unit bus communication is higher than for the hardwired interfaces.