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## REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

### APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.: 356-7881

SRP Section: 07 – Instrumentation and Controls – Overview of Review Process

Application Section:

Date of RAI Issue: 01/04/2016

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### **Question No. 07-18**

Describe the mechanisms in place that would allow operators to determine whether the QIAS-N and IFPDs have undergone a failure.

10 CFR 50.55a(h)(3) requires compliance with IEEE Std 603-1991. IEEE Std. 603-1991, Clause 5.6.3, states, in part, that the safety system design shall be such that credible failure in and consequential actions by other systems, as documented in Clause 4.8 of the design basis section of this standard, shall not prevent the safety systems from meeting the requirements of this standard. The QIAS-N and IFPDs, located in the main control room (MCR) provide alarm, display and controls for operators. In Section 7.7.1.4 of APR1400 FSAR Tier 2, regarding the IFPDs, the applicant states that, "If a data communication error occurs, an appropriate message is generated." For information displays, the applicant does not appear to state in the licensing documentation how an operator can determine whether a failure such as a common cause failure has occurred such that the displays are frozen up or affected by some other means. Therefore, it is not apparent that an appropriate error message could be generated to alert the operator(s) to a random or common cause failure, for non-safety or safety-displays. Failures of the IFPDs are addressed in Technical Report APR1400-Z-J-NR-14012-P, Rev.0, "Control System CCF Analysis." However this document does not address how operators would make the initial determination that IFPDs have experienced a failure of some type.

Describe the mechanisms, procedures, or processes in place for the APR1400 design that would allow operators to be alerted to a failure of either the QIAS-N or the IFPDs (e.g. frozen displays or controls).

### **Response – (Rev. 1)**

The applicant's response to RAI 323-8281 07.03-19 provides the mechanisms that will alert operators when the information flat panel display (IFPD) is malfunctioning.

The QIAS-N processor receives safety system signals via the ITP. The QIAS-N MTP receives non-safety system signals via the multi-channel gateway. Isolation devices are used between the ITP and QIAS-N processor, and between the multi-channel gateway and QIAS-N MTP. The QIAS-N processor performs applicable calculations based on the data received from the safety systems and non-safety systems. The QIAS-N MTP provides maintenance and testing means of the QIAS-N, and a gateway function with the multi-channel gateway to provide communication from the non-safety P-CCS. The QIAS-N server contains the process database, updates the values and status of the database records, executes the alarm processing function, and functions as a gateway between the QIAS-N network and QIAS-N display network.

The data from the QIAS-N processor (safety system signals) and the data from the QIAS-N MTP (non-safety system signals) are broadcasted on the QIAS-N network. The QIAS-N server captures the data from the QIAS-N network and updates the QIAS-N process database. The QIAS-N server broadcasts them on the QIAS-N display network for indication on the QIAS-N displays (QIAS-N FPDs, mini-LDPs, and SODPs).

To inform operator of QIAS-N failure, the QIAS-N server provides system diagnostic functions as follows:

- a. Monitor the QIAS-N MTP, QIAS-N processor, QIAS-N network, QIAS-N display network.
- b. Detect QIAS-N trouble and generate QIAS-N trouble status signals.
- c. Transfer the QIAS-N trouble status to the non-safety IPS for alarm purpose.
- d. Transfer the QIAS-N trouble status to the QIAS-N MTP via QIAS-N network for indication on the QIAS-N MTP displays.
- e. Transfer the QIAS-N trouble status to the QIAS-N FPDs, mini-LDPs, and SODPs via QIAS-N display network.

The operator controls the plant utilizing four ESCMs, four IFPDs, and the associated mouse on the operator console. An operator console is considered inoperable when one of the following occurs: 1) Three IFPDs and each mouse are unavailable, 2) Three ESCMs are unavailable, or 3) The workstation disable switch is switched to "disable mode."

The workstation disable switch on the operator console is a hardwired two-position type of cam switch. This switch can disconnect the non-safety power to the IFPD and peripheral devices by switching the mode to the "disable mode."

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### **Impact on DCD**

The APR1400 DCD Tier 2, Subsection 7.5.1.1, Figure 7.5-2, and Figure 7.9-1 will be revised as indicated in the Attachment associated with this response.

### **Impact on PRA**

There is no impact on the PRA.

**Impact on Technical Specifications**

There is no impact on the Technical Specifications.

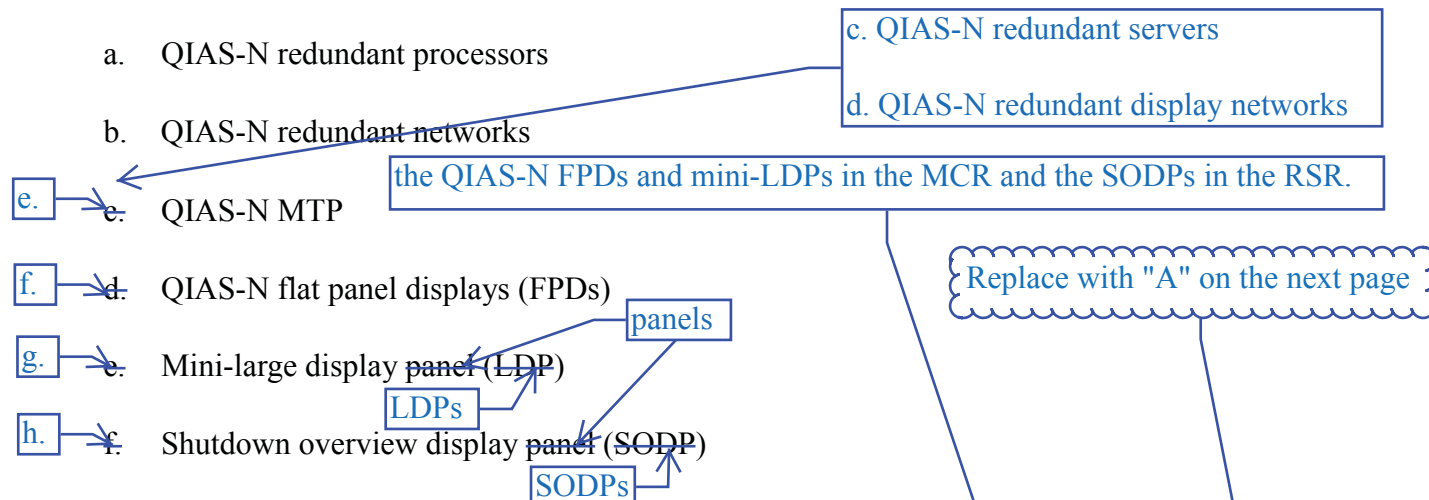
**Impact on Technical/Topical/Environmental Reports**

There is no impact on any Technical, Topical, or Environmental Report.

## APR1400 DCD TIER 2

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The QIAS-N consists of the following equipment:



The QIAS-N receives analog and digital signals from both safety and non-safety systems, analyzes the data, and presents the information to the operator via the FPDs and the mini-LDPs located in the safety console, and the SODP in the RSR. The QIAS-N interfaces with the IPS via DCN-I network and multi-channel gateway to integrate alarm and process status information.

Each QIAS-N redundant processors and networks are designed such that the fail-over to the backup processor is accomplished without interrupting the information being displayed, as shown in Figure 7.5-2. Isolation devices are used between the ITP and QIAS-N.

The QIAS-N is physically separated and electrically isolated from the IPS and QIAS-P so that the failure of QIAS-N does not cause a loss of the IPS or QIAS-P.

The QIAS-N is seismically qualified for physical and functional integrity to enhance information availability.

The block diagram for the QIAS-N is shown in Figure 7.5-2.

### Information Processing System (IPS)

The IPS displays all AMI variables on the information flat panel display (IFPD) of the consoles in the MCR and RSR and provides permanent historical recordings of AMI variables. All information displayed and recorded within the IPS is provided and available upon the operator's demand. The IPS also displays AMI information on the IFPD and LDP. The IPS also includes a historical data storage, retrieval, and trending capability. The IPS design includes data links to the on-site TSC and to the EOF to provide the capability for monitoring plant conditions at these locations. The IPS is described in Subsection 7.7.1.4.

“A”

The QIAS-N processor receives safety system signals via the ITP. The QIAS-N MTP receives non-safety system signals via the multi-channel gateway. Isolation devices are used between the ITP and QIAS-N processor, and between the multi-channel gateway and QIAS-N MTP. The QIAS-N processor performs applicable calculations based on the data received from the safety systems and non-safety systems. The QIAS-N MTP provides maintenance and testing means of the QIAS-N, and a gateway function with the multi-channel gateway to provide communication from the non-safety P-CCS. The QIAS-N server contains the process database, updates the values and status of the database records, executes the alarm processing function, and functions as a gateway between the QIAS-N network and QIAS-N display network.

The data from the QIAS-N processor (safety system signals) and the data from the QIAS-N MTP (non-safety system signals) are broadcasted on the QIAS-N network. The QIAS-N server captures the data from the QIAS-N network and updates the QIAS-N process database. The QIAS-N server broadcasts them on the QIAS-N display network for indication on the QIAS-N displays (QIAS-N FPDs, mini-LDPs, and SODPs).

In addition, the QIAS-N server provides system diagnostic functions as follows:

- a. Monitor the QIAS-N MTP, QIAS-N processor, QIAS-N network, QIAS-N display network.
- b. Detect QIAS-N trouble and generate QIAS-N trouble status signals.
- c. Transfer the QIAS-N trouble status to the non-safety IPS for alarm purpose.
- d. Transfer the QIAS-N trouble status to the QIAS-N MTP via QIAS-N network for indication on the QIAS-N MTP displays.
- e. Transfer the QIAS-N trouble status to the QIAS-N FPDs, mini-LDPs, and SODPs via QIAS-N display network.

The operator controls the plant utilizing four ESCMs, four IFPDs, and the associated mouse on the operator console. An operator console is considered inoperable when one of the following occurs: 1) Three IFPDs and each mouse are unavailable, 2) Three ESCMs are unavailable, or 3) The workstation disable switch is switched to “disable mode.”

The workstation disable switch on the operator console is a hardwired two-position type of cam switch. This switch can disconnect the non-safety power to the IFPD and peripheral devices by switching the mode to the “disable mode.”

## APR1400 DCD TIER 2

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This figure will be replaced with revised figure 7.5-2 on the next page.

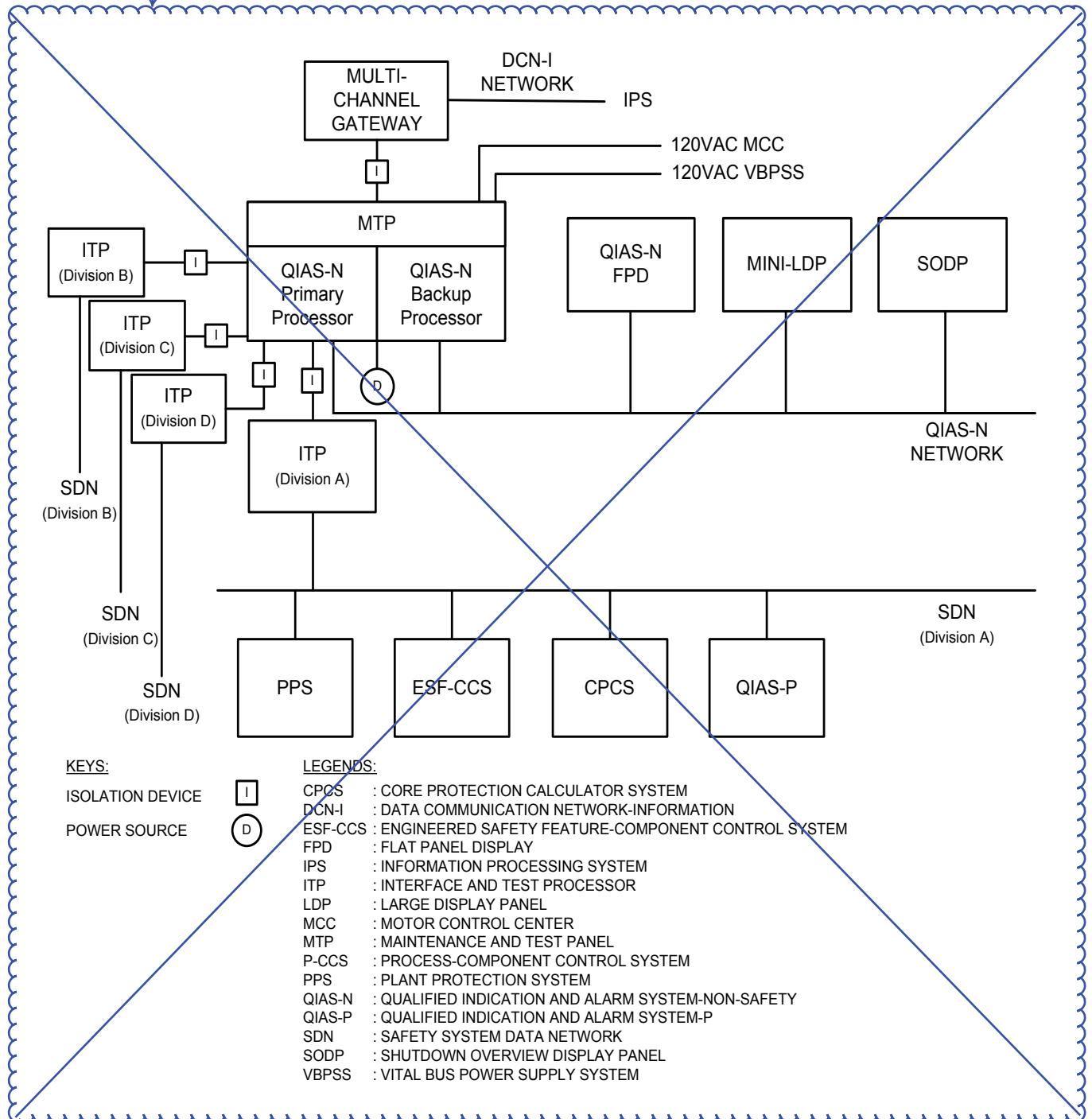


Figure 7.5-2 QIAS-N Block Diagram

Revised Figure 7.5-2

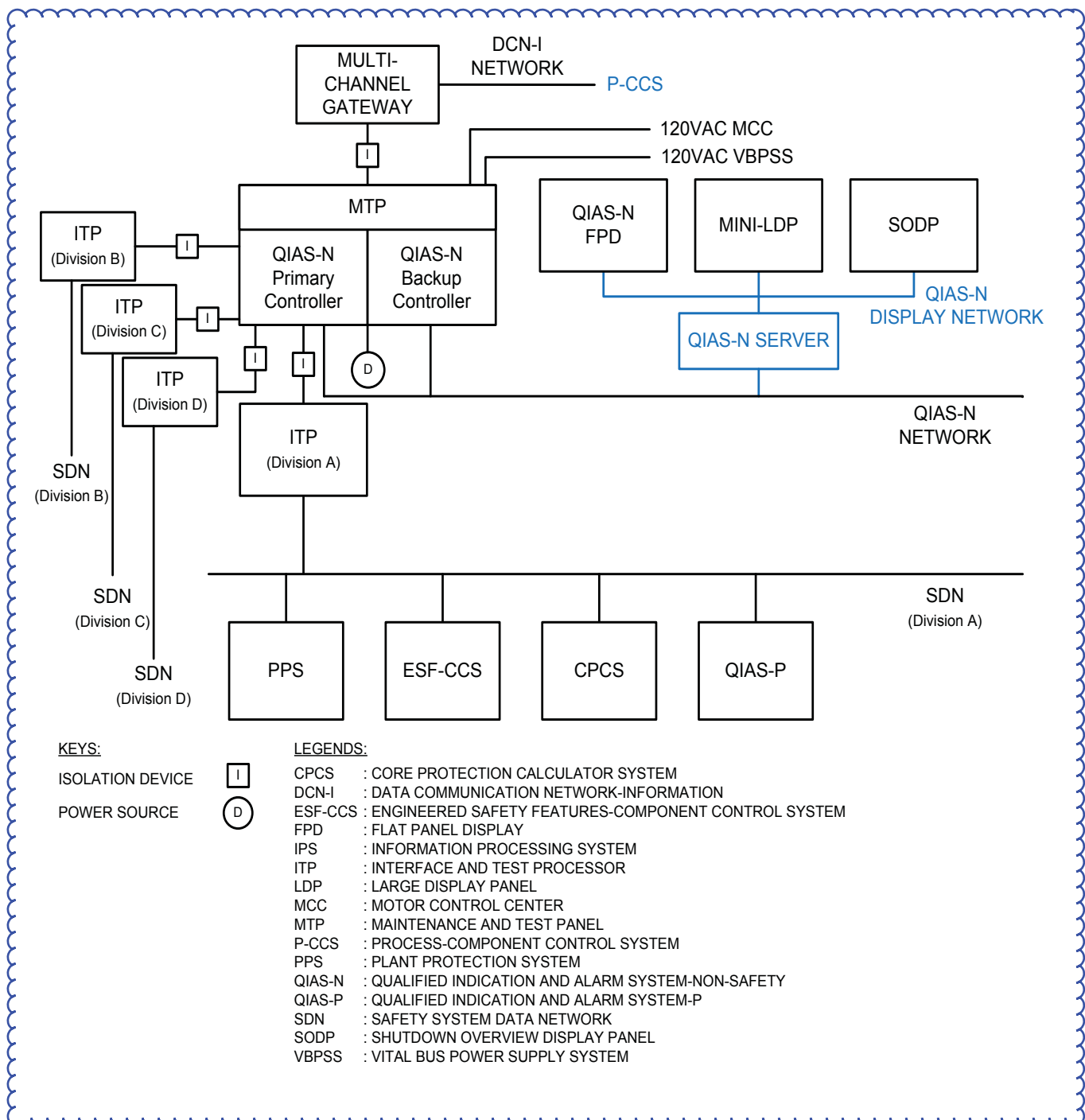
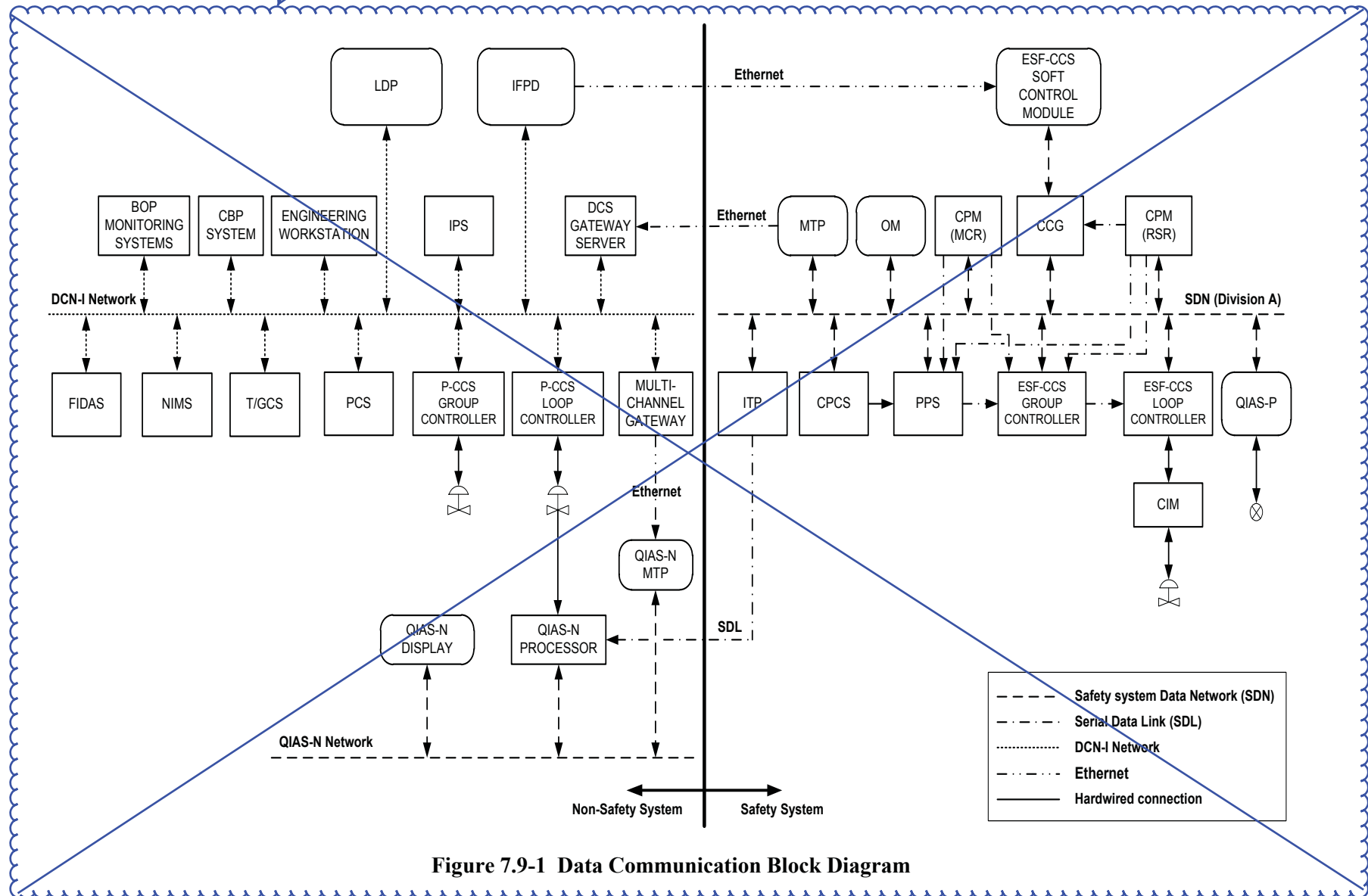


Figure 7.5-2 QIAS-N Block Diagram

## APR1400 DCD TIER 2

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This figure will be replaced with revised figure 7.9-1 on the next page.





Revised Figure 7.9-1

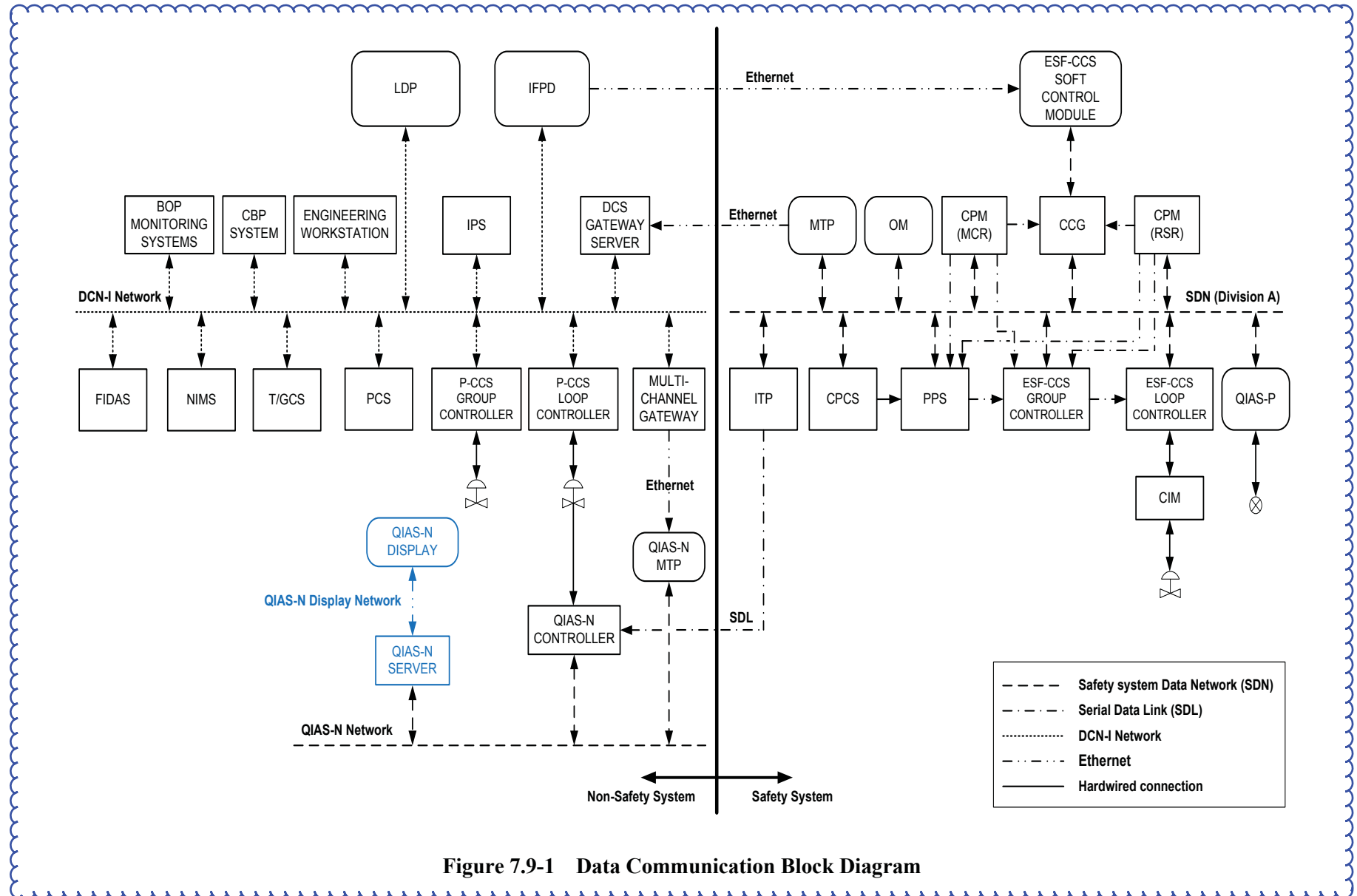


Figure 7.9-1 Data Communication Block Diagram