

## **Enclosure 1**

### **MFN 15-064, Revision 1, Supplement 2**

### **GEH's Revised Response and Supplemental Information to RAI 09.05.01-1**

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**Item #1:**

Subsection 9.5.1.1.7, "Spurious Control Actions," mentions Remote Multiplexing Units, and a de-multiplexer. The NRC asked if these are the same? If they are not the same thing, then define what each does. If they are the same, then use a common terminology.

**GEH Response:**

Yes, at a high level, from a practical perspective, and in certain functional scenarios, de-multiplexers (Demux) and remote multiplexing units (RMUs) are terms used to refer to essentially the same equipment. Also, in certain functional scenarios, Multiplexers (Mux) and remote multiplexing units (RMUs) are the same thing. However, as will be explained below, it is appropriate to refer to these using the appropriate functional term.

RMU, Mux, and Demux are all generic terms used to describe functions performed by components or elements of digital data communications or networking systems and their equipment. Digital data communications packets or messages must be transformed or multiplexed so that they may be carried or transported on shared physical media from their origin to their destination. The physical media used to carry the digital data communications packets is optical fiber cable or sometimes referred to as fiber optic cable. When these digital communications data packets reach their target location (i.e., equipment), then they must be de-multiplexed into serial data packets so that they can be sent to the downstream components for subsequent processing or action. The first downstream component after de-multiplexing is either a digital-to-analog signal converter or a digital-to-discrete (i.e., on or off) signal converter. In modern digital data communications or networking systems and equipment, this data or signal processing is bi-directional. Therefore, the data communications or networking systems equipment at the both the source and target locations perform both multiplexing and de-multiplexing functions. An RMU is the generic term used to describe Mux-Demux digital data communication and networking equipment (e.g., cabinets) located in the field that is remote from the centralized data processing computers or logic controllers.

In the ABWR certified design, the Mux-Demux equipment, which includes the RMU equipment, is part of the overall integrated digital instrumentation and control and digital data communications and networking system. The safety-related portion of this overall integrated system is the Essential Multiplexing System (EMS).

Portions of the EMS equipment that provide Mux-Demux data communications and networking functions or services for safety-related digital logic controllers are located in the back-panel rooms of the Main Control Room (MCR). There are two MCR back panel rooms, which also contain the safety-related digital logic controller equipment and cabinets. The two MCR back panel rooms are physically separate from each other and are on opposite sides of the MCR. The MCR and the two back panel rooms are located in the Control Building (C/B). EMS RMUs provide Mux-Demux functions for safety-related instruments, sensors, transducers, transmitters and actuators

throughout the plant (i.e., in the field). There are no RMUs located in the MCR or in the two separate back panel rooms.

The EMS is connected to and provides digital data communications with the digital logic controllers using optical fiber cables. The EMS is connected to and provides data communications within itself (e.g.; Mux-Demux or RMU cabinets located throughout the plant) using optical fiber cables. The digital data communications networks and their supporting optical fiber cables are redundant and physically separate within a safety-related division. The RMU equipment is connected to and provides analog or discrete signal interfaces to the plant process instruments and actuators, either directly or through marshalling or terminal cabinets, using electrical wires.

**Impact on DCD:**

No changes to the DCD are proposed for this item.

**Item # 2:**

Subsection 9.5.1.1.7: Regarding the following sentence: “The probability of two identical spurious signals matching, induced by physical damage (including fire damage) to the fiber-optic transmission cables, is minuscule.” This sentence appears to be mixing probabilistic language with a deterministic fire protection program and, therefore, should be changed to avoid confusion.

**GEH Response:**

GEH agrees that there could be confusion regarding the use of “probability.” GEH proposes to change “probability” to “likelihood” in Subsection 9.5.1.1.7, as shown on the attached DCD markups. For further clarity, GEH also proposes to add the phrase “sent simultaneously and” to the text addition proposed for this same sentence by Supplement 1 of this letter.

**Impact on DCD:**

Changes to Tier 2, Subsection 9.5.1.1.7 of the DCD are proposed for this item.

**Item # 3:**

Subsection 9.5.1.1.7, first paragraph: This section makes no mention that the digitized control signals must match at the de-multiplexer in order for control action to take place. The staff suggests that this statement be clarified.

**GEH Response:**

The phrase “that must match” is added to Subsection 9.5.1.1.7, first paragraph, third sentence, to clarify the design description to address the NRC’s concern.

**Impact on DCD:**

Changes to Tier 2, Subsection 9.5.1.1.7 of the DCD are proposed for this item.

**Item # 4:**

Subsection 9.5.1.1.7: “Damage to the fiber optic transmission cable” appears to imply that the concern is limited to fiber optic cables in a digital system creating an MSO. The staff is concerned about fire and smoke damage to the termination cabinets as well and recommends that this paragraph be clarified.

**GEH Response:**

GEH understands that the NRC staff is concerned about fire and smoke damage to the termination cabinets. In this case, the termination cabinets are the RMUs, and this is the reason that Supplement 1 of this letter proposed to add a new sentence immediately following the sentence in question that reads; “Spurious operation of equipment controlled by Remote Multiplexing Units (RMU) in the field due to physical damage because of fire or smoke will be considered in cases where the connection between the RMU and the field devices is transmitting a command signal.” This was also committed to previously as a COL action in this subsection and in Subsection 9.5.13.22.

**Impact on DCD:**

No changes to the DCD are proposed for this item.

**Item # 5:**

Subsection 9.5.1.1.7: Sentence “Spurious operation of equipment controlled by Remote Multiplexing Units (RMU) in the field due to physical damage because of fire or smoke will be considered in cases where the connection between the RMU and the field devices is transmitting a command signal.” 1) The staff does not understand the statement... “will be considered in the case where the connection between the RMU and field devices are transmitting a command signal.”... The staff understands that these cables are analog and covered by NEI 00-01, Rev 2. Is this correct? 2) RMUs with respect to smoke and fire damage....what device receives the damage?

**GEH Response:**

With regards to the NRC staff question 1) concerning, Subsection 9.5.1.1.7, second paragraph, first sentence, which states; “Spurious operation of equipment controlled by Remote Multiplexing Units (RMU) in the field due to physical damage because of fire or smoke will be considered in cases where the connection between the RMU and the field devices is transmitting a command signal.”, GEH confirms that the referenced “connections” are realized using electrical wire that is carrying either an analog or discrete (i.e., on or off) control signal. These “connections” are covered by NEI 00-01, Revision 2, “Guidance for Post-Fire Safe Shutdown Circuit Analysis.”

NRC staff question 2) concerning, Subsection 9.5.1.1.7, second paragraph, first sentence, which states: “Spurious operation of equipment controlled by Remote Multiplexing Units (RMU) in the field due to physical damage because of fire or smoke will be considered in cases where the connection between the RMU and the field devices is transmitting a command signal.” GEH

clarifies that the devices associated with the RMUs which receive physical damage due to fire or smoke are the following: 1) RMU, 2) electrical wire connecting the RMU with the field component or device that performs the control action (e.g., actuator), and 3) field component or device.

GEH has identified that the scope of the equipment described that is subject to spurious operation due to physical damage because of fire or smoke should be clarified. Various digital instrumentation and control, as well as digital data communications and networking equipment, could be in the same fire area. This equipment is connected together and to equipment outside the fire area using optical fiber cable. Unlike an electrical wire, which can only fault in a short or open circuit condition, optical fiber cable either conveys the pulses of light or it does not.

The digital data communications transmitter and receiver components that are part of the EMS can:

- determine if there has been a loss of data communications,
- determine if the message is valid and for action or corrupted and not valid [e.g.; spurious] for action, and then
- identify and process the data communications packet or message.

Additionally, loss of data communication produces EMS alarms.

The likelihood of fire or smoke-induced spurious signals initiating in and propagating through the integrated digital instrumentation and control systems and the supporting EMS is miniscule due to the use of message authentication, which requires the message format and sequence to be correct to be recognized, and the use of optical fiber cabling, which cannot “hot short” to other cables.

Nevertheless, spurious operation of plant equipment due to fire or smoke damage to the following digital instrumentation and EMS equipment will be considered regardless of its location:

- Main Control Room (MCR) components or equipment that is connected via electrical wires to other equipment, both digital controller EMS equipment, located in two (2) separate rooms in the C/B arranged adjacent to and on opposite sides of the MCR, and to other equipment in other plant locations,
- Digital controller and EMS equipment that is connected via fiber-optic cable, which is arranged as Divisions 1 and 3 and Divisions 2 and 4, located in their own separate rooms in the C/B wherein each room is adjacent to and on opposite sides of the MCR,
- EMS equipment located in the two (2) separate rooms in the C/B that is connected via fiber-optic cable to other EMS equipment in other plant locations, and
- Remote Multiplexing Units (RMUs) located in the field that are connected via electrical wires to plant process components [e.g. instruments and actuators].

GEH proposes to clarify and add text to Tier 2, Subsections 9.5.1.1.7, 9.5.13.22, and 9.5.14 to clarify the scope of equipment to be considered for evaluating spurious operation.

GEH also proposes to delete Tier 2, Subsection 9.5.1.6.5 in its entirety, and move the COL commitment that is currently shown there to Tier 2, Subsection 9.5.1.1.7, where the description more appropriately belongs.

**Impact on DCD:**

Changes to Tier 2, Subsections 9.5.1.1.7, 9.5.1.6.5, 9.5.13.22, and 9.5.14 of the DCD are proposed for this item.