## ArevaEPRDCPEm Resource

**From:** BRYAN Martin (EXTERNAL AREVA) [Martin.Bryan.ext@areva.com]
**Sent:** Friday, January 07, 2011 3:39 PM
**To:** Tesfaye, Getachew
**Cc:** DELANO Karen (AREVA); ROMINE Judy (AREVA); HALLINGER Pat (EXTERNAL AREVA); WILLIFORD Dennis (AREVA); RYAN Tom (AREVA); COLEMAN Sue (AREVA); PANNELL George (AREVA); SCHMUGGE Paul (AREVA)
**Subject:** DRAFT Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7, Questions 7.1-29, 7.1-32, and 7.9-67
**Attachments:** RAI 442 Supplement 1 Response US EPR DC - DRAFT.pdf

Getachew,

To support a final response date of February 9, 2011, a draft response to RAI 442 questions 7.1-29, 7.1-32, and 7.9-67 is being provided.
Let me know if the staff has questions or if the response can be sent as final.

Thanks,

Martin (Marty) C. Bryan
U.S. EPR Design Certification Licensing Manager
AREVA NP Inc.
Tel: (434) 832-3016
702 561-3528 cell
Martin.Bryan.ext@areva.com

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**From:** BRYAN Martin (External RS/NB)
**Sent:** Friday, January 07, 2011 11:15 AM
**To:** Tesfaye, Getachew
**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); RYAN Tom (RS/NB); PANNELL George (CORP/QP)
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7, Supplement 1

Getachew,

On November 19, 2010, AREVA NP Inc. (AREVA NP) provided a schedule for a technically correct and complete response to the questions in RAI 442. To allow additional time to interact with the staff a revised schedule is provided below for questions 7.1.29, 7.1.32, 7.9-65 and 7.9-67. The schedule for the other questions remains unchanged.

AREVA NP's schedule for providing a technically correct and complete response to all questions in RAI 442 is provided below.

| Question # | Response Date |
|---|---|
| RAI 442 — 7.1-26 | March 15, 2011 |
| RAI 442 — 7.1-27 | March 15, 2011 |
| RAI 442 — 7.1-28 | March 15, 2011 |
| RAI 442 — 7.1-29 | **February 9, 2011** |
| RAI 442 — 7.1-30 | February 9, 2011 |
| RAI 442 — 7.1-31 | March 15, 2011 |
| RAI 442 — 7.1-32 | **February 9, 2011** |

| | |
|---|---|
| RAI 442 — 7.3-32 | February 9, 2011 |
| RAI 442 — 7.3-33 | February 9, 2011 |
| RAI 442 — 7.3-34 | March 15, 2011 |
| RAI 442 — 7.9-61 | February 9, 2011 |
| RAI 442 — 7.9-62 | February 9, 2011 |
| RAI 442 — 7.9-63 | February 9, 2011 |
| RAI 442 — 7.9-64 | March 15, 2011 |
| RAI 442 — 7.9-65 | **March 15, 2011** |
| RAI 442 — 7.9-66 | February 9, 2011 |
| RAI 442 — 7.9-67 | **February 9, 2011** |

Sincerely,

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**From:** BRYAN Martin (External RS/NB)
**Sent:** Friday, November 19, 2010 5:12 PM
**To:** 'Tesfaye, Getachew'
**Cc:** DELANO Karen (RS/NB); ROMINE Judy (RS/NB); BENNETT Kathy (RS/NB); PANNELL George (CORP/QP)
**Subject:** Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7

Getachew,

Attached please find AREVA NP Inc.'s response to the subject request for additional information (RAI). The attached file, "RAI 442 Response US EPR DC.pdf" provides a schedule since a technically correct and complete response to the 17 question (s) is not provided.

The following table indicates the respective pages in the response document, "RAI 442 Response US EPR DC.pdf," that contain AREVA NP's response to the subject questions.

| Question # | Start Page | End Page |
|---|---|---|
| RAI 442 — 7.1-26 | 2 | 2 |
| RAI 442 — 7.1-27 | 3 | 3 |
| RAI 442 — 7.1-28 | 4 | 4 |
| RAI 442 — 7.1-29 | 5 | 5 |
| RAI 442 — 7.1-30 | 6 | 6 |
| RAI 442 — 7.1-31 | 7 | 8 |
| RAI 442 — 7.1-32 | 9 | 9 |
| RAI 442 — 7.3-32 | 10 | 10 |
| RAI 442 — 7.3-33 | 11 | 11 |
| RAI 442 — 7.3-34 | 12 | 12 |
| RAI 442 — 7.9-61 | 13 | 13 |
| RAI 442 — 7.9-62 | 14 | 14 |
| RAI 442 — 7.9-63 | 15 | 15 |
| RAI 442 — 7.9-64 | 16 | 16 |

| | | |
|---|---|---|
| RAI 442 — 7.9-65 | 17 | 17 |
| RAI 442 — 7.9-66 | 18 | 18 |
| RAI 442 — 7.9-67 | 19 | 19 |

A complete answer is not provided for the 17 questions. The schedule for a technically correct and complete response to these questions is provided below.

| Question # | Response Date |
|---|---|
| RAI 442 — 7.1-26 | March 15, 2011 |
| RAI 442 — 7.1-27 | March 15, 2011 |
| RAI 442 — 7.1-28 | March 15, 2011 |
| RAI 442 — 7.1-29 | January 7, 2011 |
| RAI 442 — 7.1-30 | February 9, 2011 |
| RAI 442 — 7.1-31 | March 15, 2011 |
| RAI 442 — 7.1-32 | January 7, 2011 |
| RAI 442 — 7.3-32 | February 9, 2011 |
| RAI 442 — 7.3-33 | February 9, 2011 |
| RAI 442 — 7.3-34 | March 15, 2011 |
| RAI 442 — 7.9-61 | February 9, 2011 |
| RAI 442 — 7.9-62 | February 9, 2011 |
| RAI 442 — 7.9-63 | February 9, 2011 |
| RAI 442 — 7.9-64 | March 15, 2011 |
| RAI 442 — 7.9-65 | January 7, 2011 |
| RAI 442 — 7.9-66 | February 9, 2011 |
| RAI 442 — 7.9-67 | January 7, 2011 |

Sincerely,

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**From:** Tesfaye, Getachew [mailto:Getachew.Tesfaye@nrc.gov]
**Sent:** Wednesday, October 20, 2010 8:09 AM
**To:** ZZ-DL-A-USEPR-DL
**Cc:** Zhao, Jack; Morton, Wendell; Mott, Kenneth; Spaulding, Deirdre; Truong, Tung; Zhang, Deanna; Jackson, Terry; Canova, Michael; Colaccino, Joseph; ArevaEPRDCPEm Resource
**Subject:** U.S. EPR Design Certification Application RAI No. 442(4295,5076,5068,5067), FSAR Ch. 7

Attached please find the subject requests for additional information (RAI). A draft of the RAI was provided to you on September 10, 2010, and discussed with your staff on October 13, 2010. Drat RAI Questions 07.01-26 and 07.03-33 were modified as a result of that discussion. The schedule we have established for review of your application assumes technically correct and complete responses within 30 days of receipt of RAIs. For any RAIs that cannot be answered within 30 days, it is expected that a date for receipt of this information will be provided to the staff within the 30 day period so that the staff can assess how this information will impact the published schedule.

Thanks,
Getachew Tesfaye
Sr. Project Manager

NRO/DNRL/NARP
(301) 415-3361

**Hearing Identifier:** AREVA_EPR_DC_RAIs
**Email Number:** 2412

**Mail Envelope Properties** (199EBB4D1CD9644D9472AA84D5D8EFA70BAF2D)

**Subject:** DRAFT Response to U.S. EPR Design Certification Application RAI No. 442, FSAR Ch. 7, Questions 7.1-29, 7.1-32, and 7.9-67
**Sent Date:** 1/7/2011 3:38:47 PM
**Received Date:** 1/7/2011 3:38:52 PM
**From:** BRYAN Martin (EXTERNAL AREVA)

**Created By:** Martin.Bryan.ext@areva.com

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| **Files** | **Size** | **Date & Time** | |
|---|---|---|---|
| MESSAGE | 5984 | 1/7/2011 3:38:52 PM | |
| RAI 442 Supplement 1 Response US EPR DC - DRAFT.pdf | | | 632660 |

**Options**
**Priority:** Standard
**Return Notification:** No
**Reply Requested:** No
**Sensitivity:** Normal
**Expiration Date:**
**Recipients Received:**

**Response to**

**Request for Additional Information No. 442(4295, 5076, 5068, 5067), Supplement 1, Revision 1**

**10/20/2010**

**U.S. EPR Standard Design Certification**
**AREVA NP Inc.**
**Docket No. 52-020**
**SRP Section: 07.01 - Instrumentation and Controls - Introduction**
**SRP Section: 07.03 - Engineered Safety Features Systems**
**SRP Section: 07.09 - Data Communication Systems**

**Application Section: FSAR Ch 7**

**QUESTIONS for Instrumentation, Controls and Electrical Engineering 1 (AP1000/EPR Projects) (ICE1)**

DRAFT

**Question 07.01-29:**

Clarify FSAR and technical report figures associated with manual engineered safety feature actuation.

10 CFR 52.47(a)(2) requires, in part, a description of structures, systems, and components sufficient to permit understanding of the system designs. The staff, noticed there are some differences between the logic drawings that depict a "typical ESFAS actuation sequence" in Figure 8-1 ANP-10281P, "US EPR Digital Protection System Technical Report, Revision 0, and Figure 7.3-1 of US EPR FSAR Tier 2, Section 7.3. The staff also observed that there is no manual actuation signal line depicted in either figure for ESF, whereas a manual actuation is shown for RT functions shown in Figures 7-4 and 7.2-3 of ANP-10281P, "US EPR Digital Protection System Technical Report, Revision 0, and US EPR FSAR Tier 2, Section 7.2, respectively. The staff presented its observations to the applicant in a teleconference and the applicant agreed to modify Figure 8-1 ANP-10281P, "US EPR Digital Protection System Technical Report, Revision 0, and Figure 7.3-1 of US EPR FSAR Tier 2, Section 7.3 to bring them in line with each other. The applicant also verbally committed to adding detail for manual actuation for each ESF figure to accurately reflect that this functionality does exist in the typical ESF actuation sequence.

**Response to Question 07.01-29:**

U.S. EPR FSAR Tier 2, Figure 7.3-1, Sheet 2 will be added to show detail of the typical engineered safety features (ESF) manual actuation sequence. U.S. EPR FSAR Tier 2, Section 7.3.1.1 will be revised to reference the added figure.

Technical Report ANP-10281P, Figure 8-1 was not revised. However, Technical Report ANP-10281P, Figure 8-3 will be added to show the typical ESF manual actuation during the next revision, as shown in the attached Technical Report ANP-10281P markup. In addition, Technical Report ANP-10281P, Section 8.5 will be revised to reference the added figure. Technical Report ANP-10281P, Figure 8-3 is identical to U.S. EPR FSAR Tier 2, Figure 7.3-1, Sheet 2.

**FSAR Impact:**

U.S. EPR FSAR Tier 2, Section 7.3.1.1 will be revised and Figure 7.3-1, Sheet 2 will be added as described in the response and indicated on the enclosed markup.

**Technical Report ANP-10281P Impact:**

Technical Report ANP-10281P, Section 8.5 will be revised and Figure 8-3 will be added in the next revision as described in the response and indicated on the enclosed markup.

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**Question 07.01-32:**

**Follow-up RAI to 321, Question 07.01-19.**

The staff requests that the following additional information be provided:

AREVA NP addressed the issue concerning the language "without further NRC review" in its Software Program Manual (SPM). How will AREVA NP address this language in the EPR FSAR, Tier 2?

In the Question 07.01-19, the staff requested the following:

> Describe the software development process (SDP) used for the video display that will be used in the safety information and control systems (SICS), particularly with respect to identification of aspects that differ from the SDP used for the TELEPERM XS.
>
> The applicant needs to provide a description of the differences in the SDP for the safety-related video display. The staff needs to be able to determine acceptability with regards to the quality requirements of 10 CFR 50.55a(a)(1); 10 CFR Part 50, Appendix A, General Design Criteria 1; 10 CFR Part 50, Appendix B; and 10 CFR 50.55a(h) are met.

The staff reviewed the AREVA NP response to RAI 321, Question 07.01-19, and found that the proposed FSAR markup (Tier 2, Revision 2 Interim, Page 7.1-5) contains language which is problematic. The problematic phase is "without further NRC review." AREVA NP addressed this issue in its Software Program Manual (SPM). How will AREVA NP address this language in the EPR FSAR, Tier 2?

**Response to Question 07.01-32:**

The phrase "without further NRC review" will be deleted from U.S. EPR FSAR Tier 2, Section 7.1.1.2.1 to provide consistency with the Software Program Manual.

**FSAR Impact:**

The U.S. EPR FSAR Tier 2, Section 7.1.1.2.1 will be revised as described in the response and indicated on the enclosed markup.

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**Question 07.09-67:**

Describe the communication pathway used to initiate a turbine trip upon an automatic or manual reactor trip to meet 10 CFR Part 50, General Design Criterion (GDC) 20.

GDC 20 requires, in part, that the protection system is designed to initiate automatically the operation of the appropriate systems and to sense accident conditions and to initiate the operation of systems and components important to safety. Section 7.1.1.4.7 of the U.S. EPR, Tier 2, FSAR states that the TG I&C system regulates the operation of the turbine-generator for power generation. Demonstrate that upon a reactor trip, initiated either manually by the operator or automatically by the PS or the DAS, reliable communication pathways between the PS and the TG I&C system, and between the DAS and the TG I&C system, exist to ensure that the TG I&C system receives the reactor trip signal to meet the requirements of GDC 20.

**Response to Question 07.09-67:**

The turbine generator (TG) instrumentation and controls (I&C) system section that was located in U.S. EPR FSAR Tier 2, Section 7.1.1.4.7 (Revision 1) is now located in U.S. EPR FSAR Tier 2, Section 7.1.1.5.13 (Revision 2).

For the protection system (PS), an automatic or manual reactor trip results in a turbine trip (TT) signal being sent to the TG I&C system via four isolated hardwired outputs (one per division). U.S. EPR FSAR Tier 2, Figure 7.3-29 shows the TT logic for the PS.

For the diverse actuation system (DAS), an automatic or manual reactor trip generates a TT sent directly to the TG I&C system via four hardwired output (one per division). U.S. EPR FSAR Tier 2, Section 7.8.1.2.1 and Section 7.8.1.1.3 addresses the TT logic for the DAS.

The TG I&C performs two-out-of-four voting on the TT signals received from the PS or the DAS to verify high reliability of the trip function.

There is no data communication path between the PS and TG I&C or the DAS and TG I&C.

**FSAR Impact:**

The U.S. EPR FSAR will not be changed as a result of this question.

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# U.S. EPR Final Safety Analysis Report Markups

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- Level 3: business management systems – These consist of plant information management systems. Other than interfaces provided from Level 2, these systems are not within the scope of this document and are not shown on Figure 7.1-2.

- Level 2: unit supervision and control – These I&C systems are provided as an interface between the operator and the automation systems. Typical functions include monitoring plant processes and manual control of plant components.

- Level 1: system automation – These I&C systems acquire and process sensor information to perform automatic system control functions and transmit information for display to the operator. These systems also process manual commands to operate plant equipment.

- Level 0: process interface – These I&C systems act as the coupling between the physical process and the I&C systems. They include sensing components, actuation devices, and actuated equipment such as pressure sensors, thermocouples, switchgear, pumps and valves.

### 7.1.1.2 Use of TELEPERM XS and Qualified Display System in the U.S. EPR

TELEPERM XS (TXS) is a digital I&C platform that has been specifically designed and qualified for use in nuclear safety-related applications.

The qualified display system (QDS) is a digital human machine interface (HMI) that is qualified for use in safety-related applications through a commercial grade dedication process.

#### 7.1.1.2.1 TXS Platform Design

The TXS platform is described in the Reactor Protection System Topical Report (EMF-2110(NP)(A) (Reference 3). Because of advances in technology and rapid obsolescence of components, the various modules described in EMF-2110(NP)(A) (Reference 3) will be modified and upgraded over time, and new modules will be developed.

The aspects of the TXS platform discussed in EMF-2110(NP)(A) can be classified in three broad categories:

1. Hardware design and qualification.

2. System software design and qualification.

3. Various configurations and arrangements of hardware and software to form a project-specific system architecture.

07.01-32

Modified, upgraded or new TXS hardware modules and system software modules will be used in the U.S. EPR ~~without further NRC review~~ provided they conform to the key TXS principles, features, and methods described in EMF-2110(NP)(A) and

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## 7.3 Engineered Safety Features Systems

### 7.3.1 Description

The U.S. EPR provides safety-related instrumentation and controls to sense accident conditions and automatically initiate the engineered safety features (ESF) systems. ESF systems are automatically actuated when selected variables exceed setpoints that are indicative of conditions that require protective action. Additionally, the ability to manually initiate ESF systems is provided in the main control room (MCR). Manual system-level actuation of ESF systems initiates all actions performed by the corresponding automatic actuation, including starting auxiliary or supporting systems and performing required sequencing functions. Component-level control ESF system actuators is also provided in the MCR.

#### 7.3.1.1 System Description

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Automatic actuation of ESF systems and auxiliary supporting systems is performed by the protection system (PS) when selected plant parameters reach the appropriate setpoints. These automatic actuation orders are sent to the priority and actuator control system (PACS) for prioritization and interface to the actuators. The typical ESF actuation sequence performed by the protection system is illustrated in Figure 7.3-1—Typical ESF Actuation (Sheet 1 of 2), and is described as follows:

- An acquisition and processing unit (APU) in each division acquires one-fourth of the redundant sensor measurements that are inputs to a given ESF actuation function.
- The APU in each division performs any required processing using the measurements acquired by that division (e.g., filtering, range conversion, calculations). The resulting variable is compared to a relevant actuation setpoint in each division. If a setpoint is breached, the APU in that division generates a partial trigger signal for the appropriate ESF function.
- The partial trigger signals from each division are sent to redundant actuation logic units (ALU) in the PS division responsible for the associated actuation. Two out of four voting is performed in each ALU on the partial trigger signals from all four divisions. If the voting logic is satisfied, an actuation order is generated.
- The actuation signals of the redundant ALU in each subsystem are combined in a hardwired "OR" configuration so that either redundant unit can actuate the function.

Actuation orders are sent from the PS to the PACS priority module associated with each actuator required for the function. Exceptions to this are the emergency diesel generator (EDG) start function and the turbine trip function. These actuation orders are received by the associated control system (EDG or turbine controls) and do not involve the PACS. The PS and the PACS are discussed in Section 7.1.

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The safety automation system (SAS) performs closed loop automatic controls of certain ESF systems following their actuation by the PS. These controls are described in Section 7.3.1.2 with their associated actuation functions. The SAS is described in Section 7.1.

The capability for manual system-level ESF actuations is available to the operator through the safety information and control system (SICS) in the MCR. These manual actuations are acquired by the ALUs in the protection system and combined with the automatic actuation logic. The manual actuations are described with the corresponding automatic function in Section 7.3.1.2.

07.01-29

The capability for component-level control of ESF system actuators is available to the operator on both the PICS and the SICS. Commands from the PICS are processed by the PAS and sent to the PACS for prioritization. Commands from the SICS are processed by the SAS and sent to the PACS for prioritization. For any ESF actuator commands from the SICS have priority over those from the PICS. The typical manual ESF actuation sequence is shown in Figure 7.3-1 (Sheet 2 of 2).

The capability for manual reset of sense and command ESF actuation outputs is provided on both the process information and control system (PICS) and the SICS. Not all ESF actuations require a manual reset. There are cases where a sense and command output is cleared after the PS determines that the initiating condition has cleared. The reset functionality related to each ESF actuation is described in Section 7.3.1.2. Further description of the operation of the PICS and SICS is presented in Section 7.1.

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### 7.3.1.2 Engineered Safety Features Actuation Functional Descriptions

#### 7.3.1.2.1 Safety Injection System Actuation

To mitigate a loss of coolant accident (LOCA), a safety injection signal is required to actuate the appropriate ESF and support systems and to isolate non-qualified reactor coolant system (RCS) piping.

In case of a decrease in RCS water inventory due to a LOCA, the RCS is supplied by medium head safety injection (MHSI) in the high pressure phase of the event and low head safety injection (LHSI) in the low pressure phase.

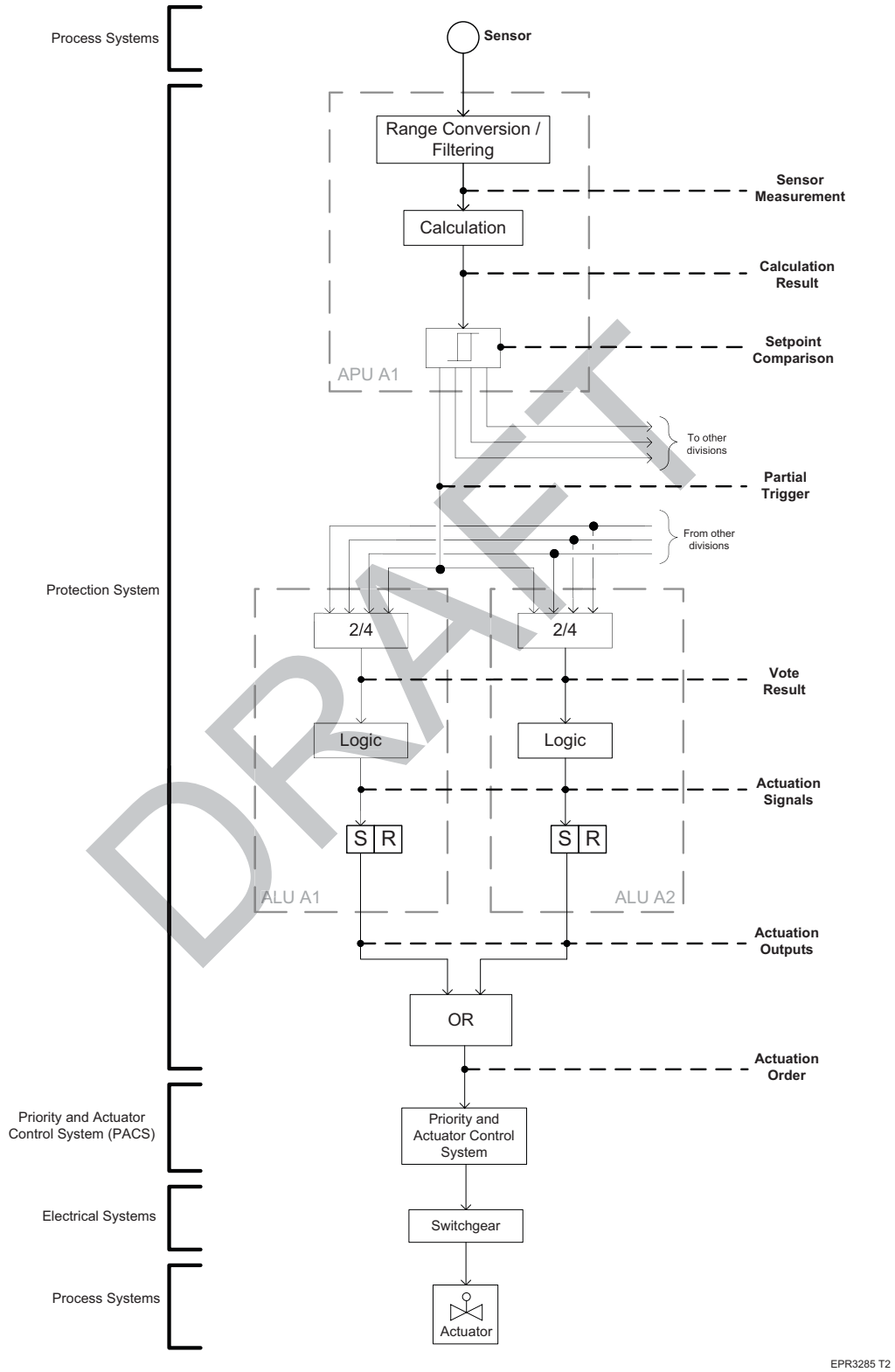
The operation of the MHSI and LHSI systems is described in Section 6.3.

The U.S. EPR design provides for automatic generation of the safety injection signal during all modes of plant operation by utilizing three different initiation parameters depending on the current plant state:

- Pressurizer pressure <Min3p.

## Figure 7.3-1—Typical ESF Actuation

(Sheet 1 of 2) 07.01-29

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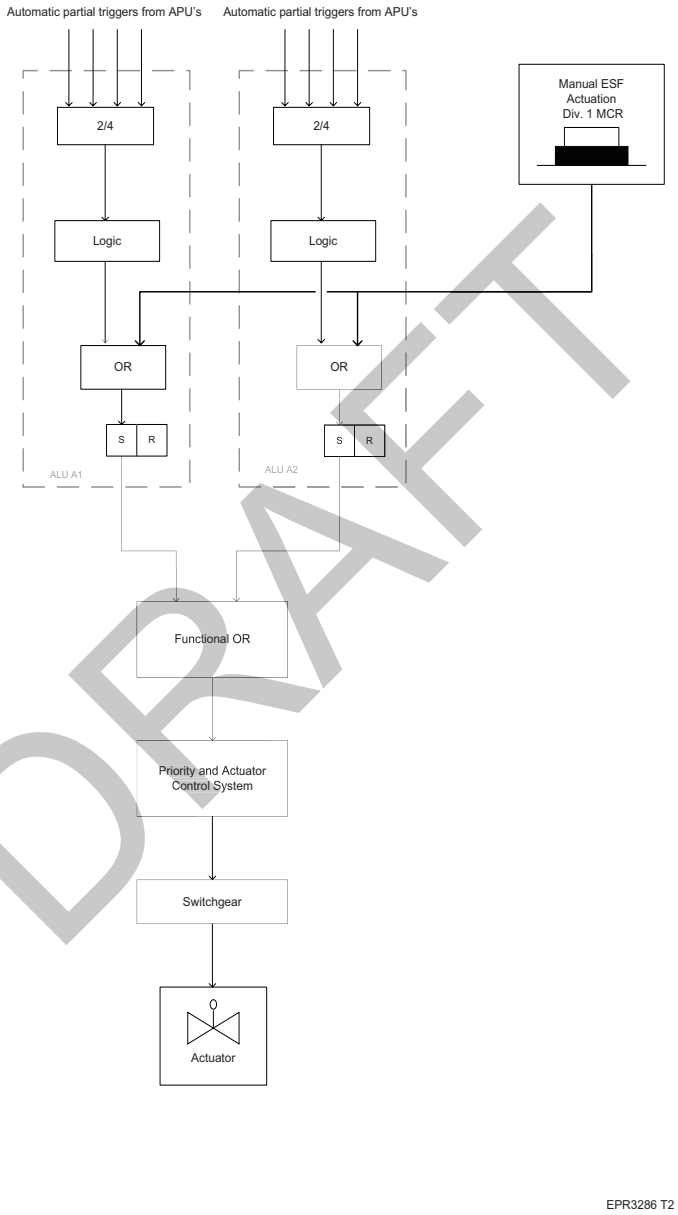
## Figure 7.3-1—Typical ESF Actuation
(Sheet 2 of 2)

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07.01-29

# ANP-10281P, "US EPR Digital Protection System Technical Report," Revision 0 Markups

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## 8.5 *System Level Manual ESF Actuations*

In addition to the automatic ESF actuation functions performed by the PS, the capability to manually initiate these functions at the system level is provided in the MCR. While the U.S. EPR design includes the ability to manually manipulate these actuators at the individual component level from the non-safety-related PICS (the component level manipulations are not processed through the PS), the system level actuations addressed in this section are implemented through Class 1E actuation paths and are single failure tolerant.

Figure 8-3 illustrates the implementation of a typical manual ESF actuation.

The manual ESF actuation functions are available to the operator on the safety information and control system (SICS). The signals from the SICS are acquired by the ALUs of the PS and are combined with the automatic actuation logic for the corresponding automatic ESF function. This way, the same PS outputs are energized whether the actuation occurred automatically or manually. The implementation of each system level manual ESF function is described in U.S. EPR FSAR Tier 2, Section 7.3.

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## Figure 8-1—Typical ESFAS Actuation Sequence (One Division)

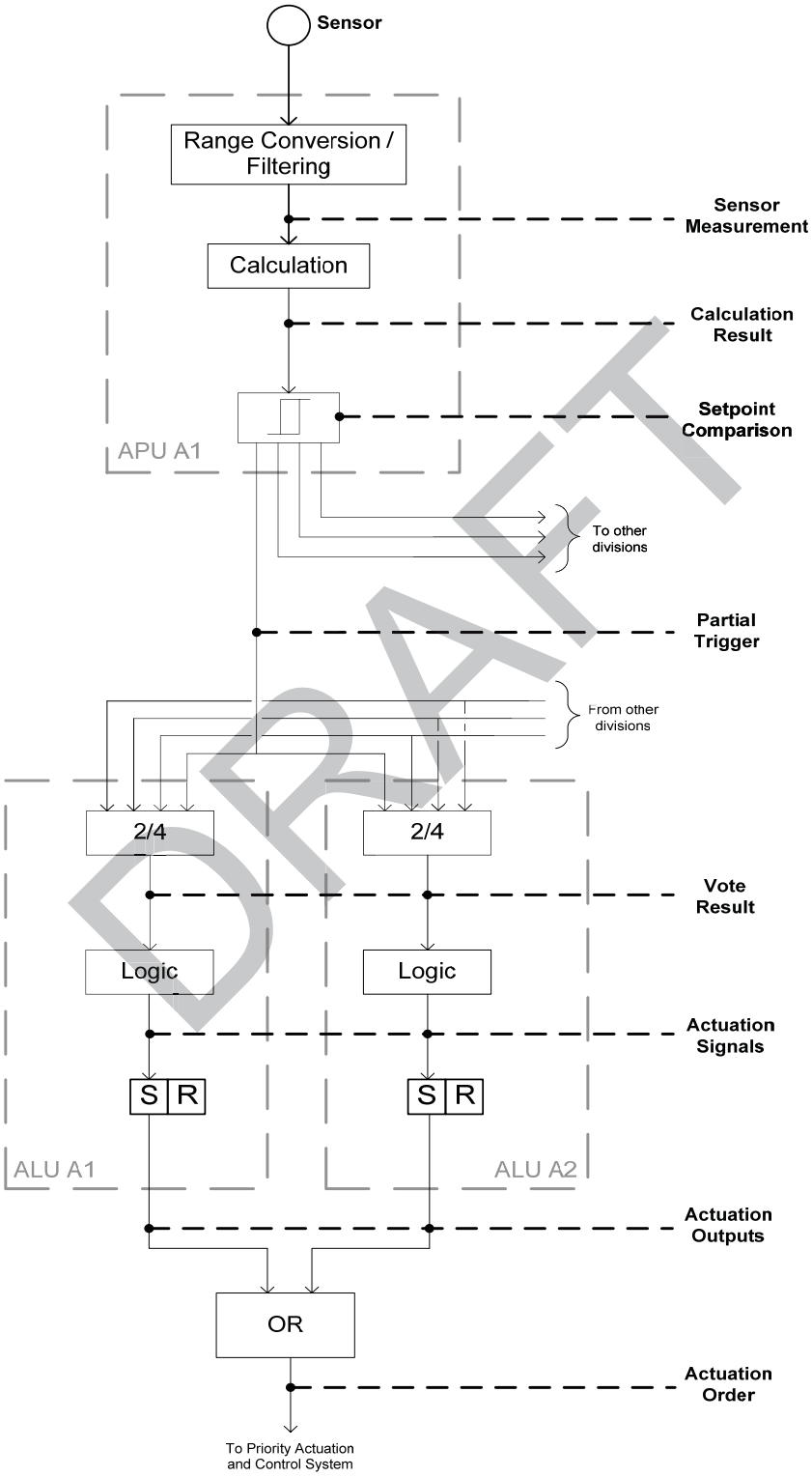


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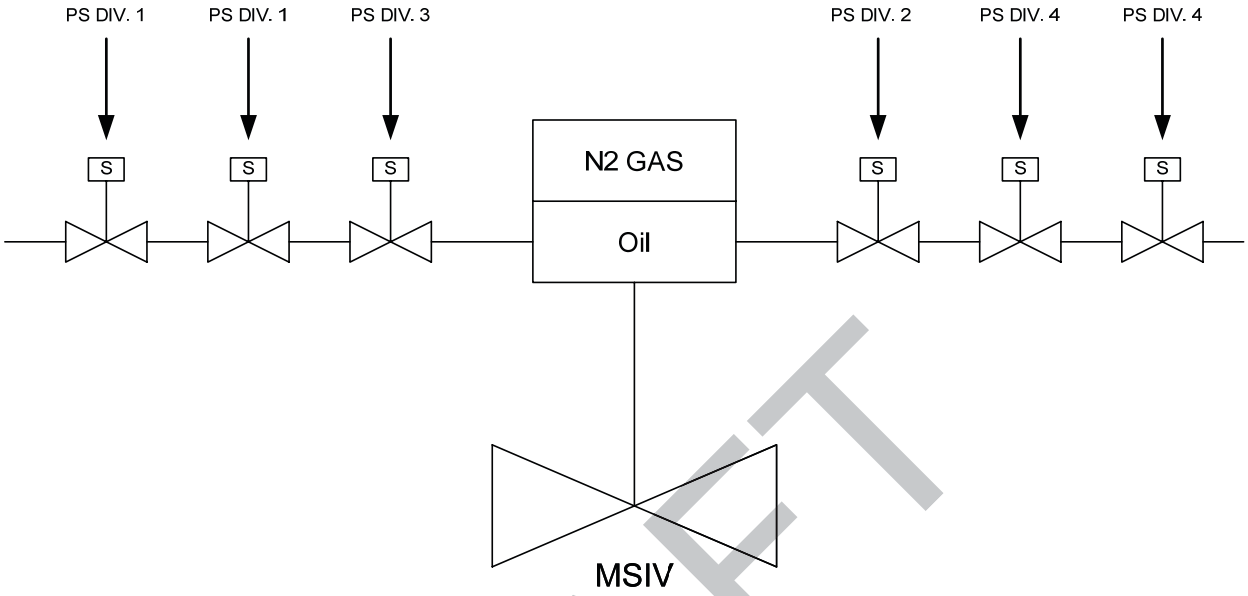
**Figure 8-2—Example of PS Divisional Assignment to an ESF Actuation**

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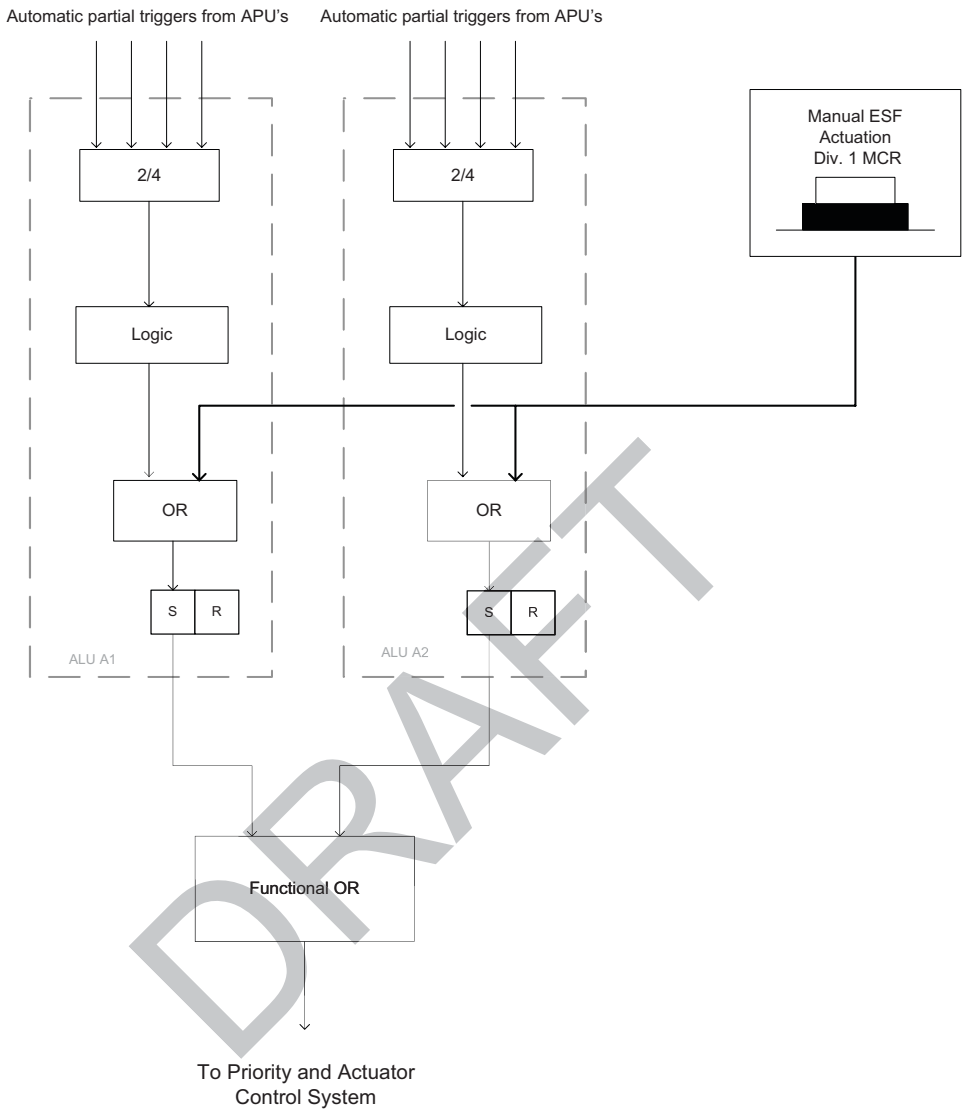
INSERT as Figure 8-3 - Typical Manual ESFAS Actuation Sequence (One Division)




DRAFT