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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application RAI Numbers 14.3-174 and 14.3-263**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) Response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letter dated December 20, 2007 (Reference 1).

Enclosure 1 contains the GEH response to RAIs 14.3-174 and 14.3-263. The enclosed changes will be incorporated in the upcoming DCD Revision 5 submittal.

Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(s) may not be fully developed and approved for inclusion in DCD Revision 5.

If you have any questions or require additional information, please contact me.

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN 07-718, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request For Additional Information Letter No. 126 Related To ESBWR Design Certification Application*, December 20, 2007.

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application –14.3-174 and 14.3-263

cc:	AE Cubbage	USNRC (with enclosure)
	GB Stramback	GEH/San Jose (with enclosure)
	RE Brown	GEH/Wilmington (with enclosure)
	DH Hinds	GEH/Wilmington (with enclosure)
	eDRF	0000-0080-7606 – RAI 14.3-263
		0000-0081-5323 – RAI-14.3-174

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Enclosure 1

Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application

RAI Numbers 14.3-174 and 14.3-263

VERIFIED DCD CHANGES ASSOCIATED WITH THIS RAI RESPONSE ARE IDENTIFIED IN THE ENCLOSED DCD MARKUPS BY ENCLOSING THE TEXT WITHIN A BLACK BOX. THE MARKED-UP PAGES MAY CONTAIN UNVERIFIED CHANGES IN ADDITION TO THE VERIFIED CHANGES RESULTING FROM THIS RAI RESPONSE. OTHER CHANGES SHOWN IN THE MARKUP(S) MAY NOT BE FULLY DEVELOPED AND APPROVED FOR INCLUSION IN DCD REVISION 5.

NRC RAI 14.3-174

NRC Summary:
Provide ITAAC for the inplant airborne radioactivity monitoring system, including a description of system sensitivity and provision of local alarms

NRC Full Text:
Although DCD Tier 1, Revision 4, Table 3.4-1 is entitled "ITAAC for Ventilation and Airborne Monitoring and Shielding," the ITAAC for airborne radioactivity monitoring has been removed from Table 3.4-1. Provide ITAAC for the in-plant airborne radioactivity monitoring system that state that airborne radioactivity monitoring is provided for those normally occupied areas of the plant in which there exists a significant potential for airborne contamination. The airborne radioactivity monitoring system should have the capability of detecting the time integrated concentrations of the most limiting internal dose particulate and iodine radionuclides in each area equivalent to the occupational concentration limits in 10 CFR 20, Appendix B for 10 hours. The airborne radioactivity monitoring system should also provide local audible alarms (visual alarms in high noise areas) with variable alarm set points, and readout/annunciation capability.

GEH RESPONSE

ESBWR Process Radiation Monitoring Systems, (PRMS), encompass Airborne Radioactivity Monitoring Systems as described in DCD Tier 2 Sections 11.5 and 12.3. Area Radiation Monitoring Systems provide local audible and visual alarms as described DCD Tier II, Section 12.3. Both systems arte designed to minimize occupational exposure.

DCD Tier 1 Revision 4, Table 3.4-1 as described did not have the ITAAC section for Airborne Radioactivity Monitoring removed from the table. The table was revised to more accurately reflect the requirements as described per SRP 12.3-12.4. The ESBWR Ventilation and Radiation Monitoring Systems encompass those requirements including provisions for audible and visual alarms as required for personnel protection.

The current DCD Tier 1 table 3.4-1 “ITAAC for Ventilation and Airborne Monitoring and Shielding” is configured consistent with the requirements of SRP 14.3.8 for Radiation Protection. The SRP states that Tier 1 identifies and describes, commensurate with their safety significance, those SSC’s that provide radiation shielding, confinement or containment of radioactivity, ventilation of airborne contamination, or radiation (or radioactivity concentration) monitoring for normal operations and during accidents. This is further reflected per DCD Tier 2, subsection 14.3.7.

Currently DCD Tier 1, subsection 3.4 "Radiation Protection", describes the application of the design and radiation control principles, which include ventilation of airborne contamination, radiation monitoring, and shielding. For "radiation" monitoring, Tier 1 subsection 2.3.2 is referenced. Subsection 2.3.2 is for Area radiation monitoring which contains the relevant ITAAC to show sufficient monitoring and alarm capability to alert operating personnel to avoid unnecessary or inadvertent radiation exposures.

The Process Radiation Monitoring Systems, (PRMS), ITAAC are contained in DCD Tier 1, subsection 2.3.1 and include airborne radioactivity monitoring systems as described in DCD Tier 2, subsection 12.3.4 paragraph 4. The ITAAC for the PRMS are described in Table 2.3.1-2 and contain the systems, which provide continuous monitoring of exhausted air within the facility. The ITAAC described in Table 2.3.1-2 and Table 3.4-1, DC 1 contain the applicable requirements and is commensurate with the defined safety significance of the in-plant airborne radioactivity monitoring system as described in DCD Tier 2, subsection 12.3.4 bullet 4. This Tier 2 subsection will be revised to address visual alarms in high noise areas.

DCD IMPACT

DCD Tier 2, subsection 12.3.4 will be revised as noted in the attached markup.

NRC RAI 14.3-263

NRC Summary:
Please provide this figure

NRC Full Text:
This figure 2.2.14-1, DICS Diagram is not in the DCD as referenced

GEH RESPONSE

The information from Tier 1, Rev. 3, Figure 2.2.14-1 is described by Tier 1, Rev. 4, Table 2.2.14-2. References to Figure 2.2.14-1 in Section 2.2.14 and Table 2.2.14-4 will be removed as a part of the next DCD revision process. Table 2.2.14-2 will be updated to reflect all of the DICS Functions, Initiators, and Interfacing Systems that were available elsewhere in Revision 4, as some of this information was inadvertently omitted from Table 2.2.14-2 in Revision 4.

The DICS Controls, Interlocks, and Bypasses will be clarified in Table 2.2.14-3.

GEH letter MFN 07-645, "GE-Hitachi Nuclear Energy – Changes to ESBWR Design Control Document (DCD) Tier 1 Sections," removed SLC system initiation from Table 2.2.14-2 as an administrative change for a duplicate entry. This response restores the SLC system initiation entry, and clarifies Table 2.2.14-2 functions to delineate which DICS functions are performed by the ATWS/SLC platform and which are performed by DPS.

DCD Tier 2, Rev. 4, Figure 7.8-1 was a duplicate of Tier 1, Rev. 3, Figure 2.2.14-1 and will be retained in Tier 2. Figure 7.8-1 will be updated for the next revision to reflect the DPS interfaces and boundaries that were not described by this figure in previous revisions. The updates to this figure reflect the system interfaces described in the text of Tier 2, Rev. 4, Section 7.8.

ITAAC Item 8 of DCD Tier 1, Rev. 4, Table 2.2.14-4 requires confirmatory analysis to support and validate the DPS design scope. ITAAC item 9 requires that a Failure Modes and Effects Analysis per NUREG/CR-6303 of the RPS and SSLC/ESF platforms be completed to validate the DPS diverse protection function. Completion of these analyses may change the list of functions and initiators described in the next revision to DCD Tier 1, Table 2.2.14-2 and DCD Tier 2, Section 7.8. ITAAC items 8 and 9 in DCD Tier 1, Table 2.2.14-4 will be identified as Design Acceptance Criteria {{DAC}} in the next revision of the DCD.

DCD IMPACT

DCD Tier 1, Rev. 4, Section 2.2.14, including Tables 2.2.14-2, 2.2.14-3, and 2.2.14-4 will be revised as shown in the attached markup.

DCD Tier 2, Rev. 4, Figure 7.8-1, will be revised as shown in the attached markup.

2.2.14 Diverse Instrumentation and Controls

Design Description

The ~~diverse~~ Diverse ~~instrumentation~~ Instrumentation and ~~control~~ Control ~~system~~ System (DICS) comprises the Anticipated Transients Without Scram Standby Liquid Control (ATWS/SLC) system and the ~~diverse~~ Diverse ~~protection~~ Protection ~~system~~ System (DPS).

Functional Arrangement

(1) DICS functional arrangement is defined in Tables 2.2.14-1 and 2.2.14-2 ~~and Figure 2.2.14-1~~.

Functional Requirements

(2) DICS automatic functions, initiators, and associated interfacing systems are defined in Table 2.2.14-2.

(3) DICS controls, interlocks and bypasses in the ~~main control room (~~MCR~~)~~ are defined in Table 2.2.14-3.

(4) DICS minimum inventory of alarms, displays, controls, and status indications in the ~~main control room~~MCR are addressed in Section 3.3.

(5) The equipment qualification of DICS components defined in Table 2.2.14-1 is addressed in Section 3.8.

(6) The containment isolation components that correspond to the isolation functions defined in Table 2.2.14-2 are addressed in Subsection 2.15.1.

(7) Conformance with IEEE Std. 603 requirements by the safety-related control system structures, systems, and components defined in Table 2.2.14-1 is addressed in Subsection 2.2.15.

(8) Confirmatory analyses to support and validate the DPS design scope.

(9) Failure Modes and Effects Analysis (FMEA) per NUREG/CR-6303 of safety-related protection system platforms (RPS and SSLC/ESF) completed to validate the DPS diverse protection function.

(10) DICS software is developed in accordance with the software development program described in Section 3.2.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.2.14-4 defines the inspections, tests, and/or analyses, together with associated acceptance criteria for the DICS.

Table 2.2.14-2

DICS Functions, Initiators, and Interfacing Systems

Function	Initiator	Interfacing System
SLC system initiation (ATWS/SLC)	RPV dome pressure high and Startup Range Neutron Monitor (SRNM) signal greater than ATWS setpoint (SRNM ATWS permissive) with time delay	NMS, NBS, SLC
	RPV water level low (Level 2) and SRNM ATWS permissive with time delay	NBS, NMS, SLC
	RPV water level low (Level 1)	NBS, SLC
FWRB (ATWS/SLC)	RPV dome pressure high and SRNM ATWS permissive	NBS, NMS, FWCS
ADS inhibit (ATWS/SLC)	RPV water level low (Level 2) and APRM ATWS permissive	NBS, NMS, SSLC/ESF
	RPV dome pressure high and APRM ATWS permissive with time delay	NBS, NMS, SSLC/ESF
ADS inhibit (DPS)	RPV water level low (Level 2) and SRNM ATWS permissive	NBS, NMS
	RPV dome pressure high and SRNM ATWS permissive with time delay	NBS, NMS
ATWS ARI and FMCRD motor run-in (DPS)	RPV dome pressure high	NBS, CRD, RC&IS
	RPV water level low (Level 2)	NBS, CRD, RC&IS
	Manual ATWS mitigation signal present	CRD, RC&IS
	~~RPS~~ DPS scram ~~signal~~ command	~~RPS~~CRD, RC&IS
	SCRRI/SRI signal and power levels remain elevated	~~RPS~~NMS, CRD, RC&IS
	~~Manual DPS scram signal~~	-

Table 2.2.14-2

DICS Functions, Initiators, and Interfacing Systems

Function	Initiator	Interfacing System
SCRRI/SRI (DPS)	RC&IS SCRRI signal.	RC&IS, RPS
	ATLM SCRRI/SRI signal	ATLM, RPS, RC&IS
	Generator load rejection signal.	TGCS, RPS, RC&IS
	Loss of FW heating.	~~FWCS~~C&FS, NMS, RPS, RC&IS
	Turbine trip signal.	TGCS, RPS, RC&IS
	OPRM thermal neutron flux oscillation	NMS, RPS, RC&IS
Delayed FWRB (DPS)	SCRRI/SRI signal and power levels remain elevated	NMS, RC&IS, FWCS
	RPS scram command and power levels remain elevated	RPS, NMS, FWCS
DPS Scram (DPS)	RPV dome pressure high	NBS, RPS
	RPV water level high (Level 8)	NBS, RPS
	RPV water level low (Level 3)	NBS, RPS
	Drywell pressure high	CMS, RPS
	Suppression pool temperature high	CMS, RPS
	MSIV closure	NBS, RPS
	RPS Scram	RPS
	SCRRI/SRI command with power levels remaining elevated	NMS, RC&IS, RPS
	~~Manual scram~~	~~-~~
ADS initiation (DPS)	RPV water level low (Level 1)	NBS

Table 2.2.14-2

DICS Functions, Initiators, and Interfacing Systems

Function	Initiator	Interfacing System
GDCS initiation (DPS)	RPV water level low (Level 1)	NBS, GDCS
ICS initiation (DPS)	RPV water level low (Level 2)	NBS, ICS
	RPV water level low (Level 1)	NBS, ICS
	MSIV closure	NBS, ICS
	RPV dome pressure high	NBS, ICS
SLC system initiation (DPS)	RPV water level low (Level 1)	NBS, SLC
MSIV closure (DPS)	Steam flow high	NBS
	RPV pressure low	NBS
	RPV water level low (Level 2)	NBS
ICS isolation valve closure (DPS)	Steam flow high	ICS
	Condensate flow high	ICS
RWCU/SDC isolation valve closure (DPS)	Differential flow high	RWCU/SDC
~~FWRB (DPS)~~	~~RPV water level high (Level 8)~~	~~NBS~~
FW pump trip (DPS)	RPV water level high (Level 9)	NBS, C&FS

Table 2.2.14-2

DICS Functions, Initiators, and Interfacing Systems

Function	Initiator	Interfacing System
FW isolation (DPS)	Line differential pressure high coincident with high drywell pressure	C&FS, NBS

Table 2.2.14-3

DICS Controls, Interlocks and Bypasses

Control	Manual initiation of ADS- (DPS)[2]
	Manual initiation of ICS- (DPS)[2]
	Manual initiation of GDCS squib-initiated injection valves- (DPS)[2]
	Manual initiation of GDCS squib-initiated equalization valves (DPS)[2]
	Manual initiation of ATWS SLC- (ATWS/SLC)[2]
	Manual initiation of ATWS ARI (ATWS/SLC)[2]
	Manual initiation of ATWS FWRB- (ATWS/SLC)[2]
	Manual scram (DPS)[2]
	Manual MSIV isolation (DPS)[2]
	Manual inhibit of DPS ECCS functions under ATWS conditions[1] (DPS)[2]
	Manual inhibit of SSLC/ESF ECCS functions under ATWS conditions[1] (ATWS/SLC)[2]
	Manual SCRRI/SRI (DPS)[2]
Interlock	APRM ATWS Permissive (ATWS/SLC)[2]
	SRNM ATWS Permissive (DPS)[2]
	Reactor Mode (RPS, DPS)[2] ~~Switch position~~
	Time Delays
Bypass	Division of sensor bypass (ATWS/SLC)[2]
	Sensor channel bypass (DPS)[2]

[1]For applicable ATWS conditions, refer to Initiator column, Table 2.2.14-2, for the Functions "ADS inhibit (ATWS/SLC)" and "ADS inhibit (DPS)"

[2]Implementing system is shown in parentheses.

Table 2.2.14-4

ITAAC For Diverse Instrumentation and Controls

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. DICS functional arrangement is defined in Tables 2.2.14-1 and 2.2.14-2 ~~and Figure 2.2.14-1~~.	Inspection(s), test(s), and/or type test(s) will be conducted on the as-built system configuration defined in Tables 2.2.14-1 and ~~Figure~~ 2.2.14-~~1~~2.	Inspection(s), test(s), and/or type test(s) reports that document(s) ~~that~~ the system's conformances to the functional arrangement defined in Tables 2.2.14-1 and ~~Figure~~ 2.2.14-~~1~~2.
2. DICS automatic functions, initiators, and associated interfacing systems are defined in Table 2.2.14-2.	a. Tests will be performed on the DICS nonsafety-related components will be conducted on the as-built system configuration using simulated signals. b. For safety-related DCIS components, see Subsection 2.2.15.	a. Test report(s) confirm that the DICS is capable of performing the functions defined in Table 2.2.14-2. b. For safety-related DCIS components, see Subsection 2.2.15.
3. DICS interlocks and controls are defined in Table 2.2.14-3.	a. Test(s) and type test(s) will be performed on the DICS nonsafety-related logic process interlocks and controls defined in Table 2.2.14-3. b. For safety-related DCIS components, see Subsection 2.2.15.	a. Test report(s) document(s) that the DICS logic process interlocks and issue control signals defined in Table 2.2.14-3. b. For safety-related DCIS components, see Subsection 2.2.15.
4. DICS minimum inventory of alarms, displays, controls, and status indications in the main control room are addressed in Section 3.3.	See Section 3.3.	See Section 3.3.

Table 2.2.14-4

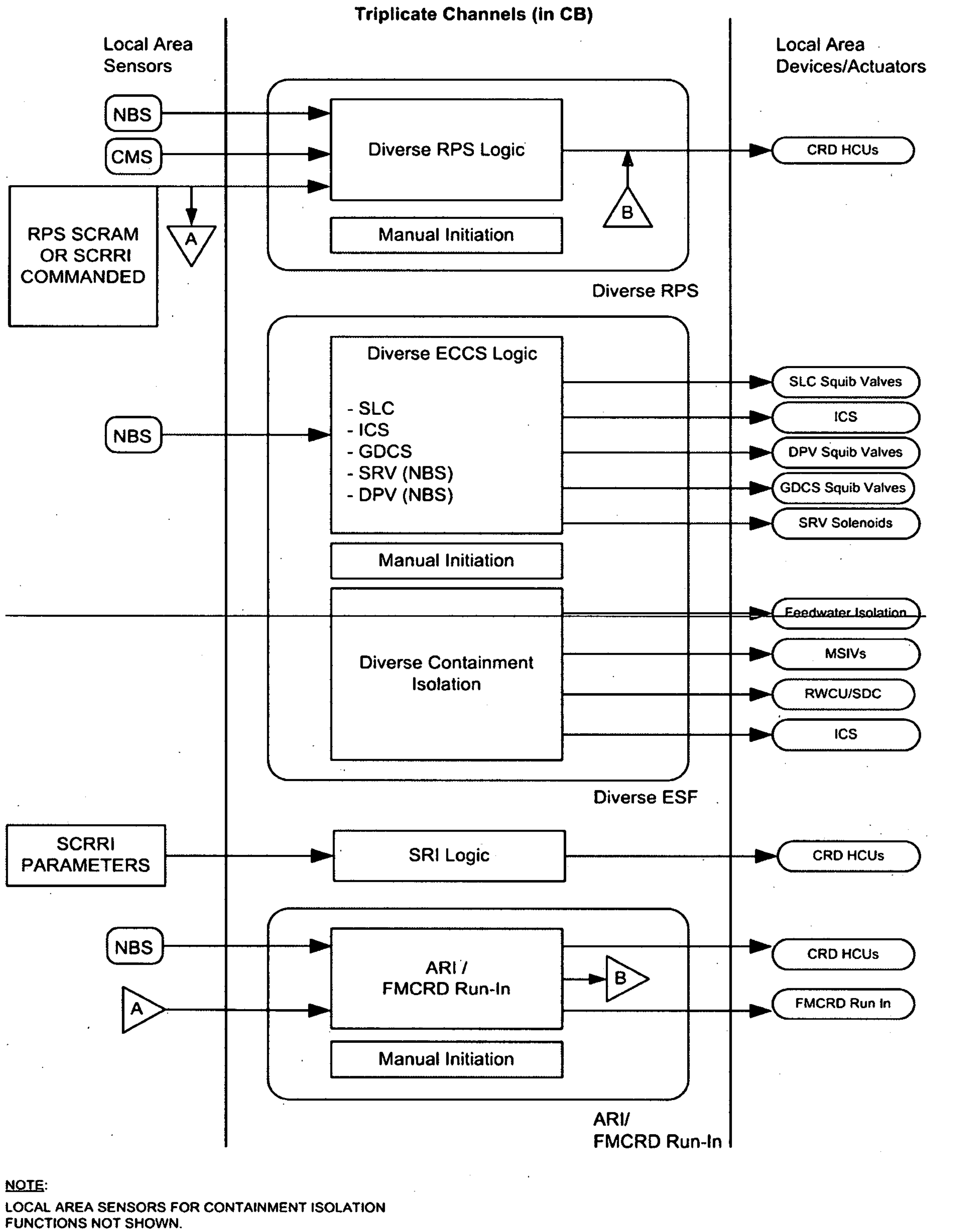
ITAAC For Diverse Instrumentation and Controls

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5. The equipment qualification of DICS components defined in Table 2.2.14-1 is addressed in Section 3.8.	The equipment qualification of DICS components defined in Table 2.2.14-1 is addressed in Section 3.8.	See Section 3.8.
6. The containment isolation components that correspond to the isolation functions defined in Table 2.2.14-2 are addressed in Subsection 2.15.1.	The containment isolation components that correspond to the isolation functions defined in Table 2.2.14-2 are addressed in Subsection 2.15.1.	See Subsection 2.15.1.
7. Conformance with IEEE Std. 603 requirements by the safety-related control system structures, systems, and components defined in Table 2.2.14-1 is addressed in Subsection 2.2.15.	Conformance with IEEE Std. 603 requirements by the safety-related control system structures, systems, and components defined in Table 2.2.14-1 is addressed in Subsection 2.2.15.	See Subsection 2.2.15.
8. Confirmatory analyses to support and validate the DPS design scope.	Confirmatory analyses to support and validate the DPS design scope.	Report(s) exist(s) and conclude(s) that the DPS design ensures releases during a common mode protection system failure coincident with the design basis events discussed in the Safety Analyses are within 10 CFR 100 limits (or percentage thereof) as specified in BTP HICB-19. {{DAC}}

Table 2.2.14-4

ITAAC For Diverse Instrumentation and Controls

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9. Failure Modes and Effects Analysis (FMEA) per NUREG/CR-6303 of safety-related protection system platforms (RPS and SSLC/ESF) completed to validate the DPS diverse protection function.	Complete FMEA per NUREG/CR-6303 to validate the DPS protection functions described in LTR NEDO-33251.	Report(s) exist(s) and conclude(s) that the completed FMEA ~~(which address NUREG/CR-6303 Type 1-3 failures)~~ for the RPS and SSLC/ESF safety-related platforms have been addressed in the DPS design scope. {{DAC}}
10. DICS software is developed in accordance with the software development program described in Section 3.2.	See Section 3.2.	See Section 3.2.



NOTE:
LOCAL AREA SENSORS FOR CONTAINMENT ISOLATION FUNCTIONS NOT SHOWN.

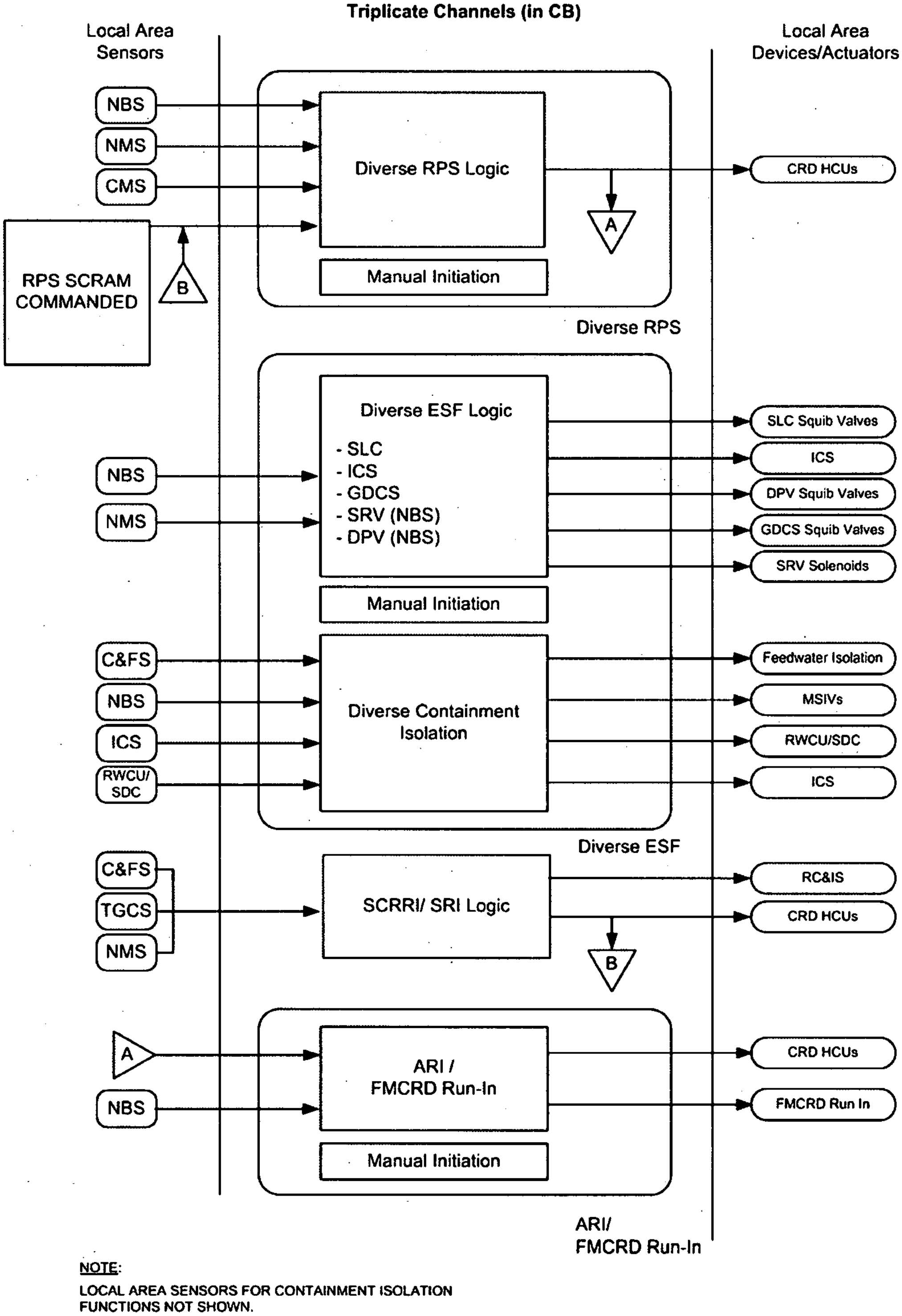


Figure 7.8-1. Simplified DPS Block Diagram

- With logic similar to the SSLC/ESF, the DPS initiates the ICS on high RPV dome pressure, low RPV water level (Level 2), or MSIV closure to provide core cooling.
- The DPS runs backtrips the feedwater pumps on high RPV water level (Level 89).. If the water level continues to increase, the DPS trips the feedwater pumps (Level 9).

The diverse protection logics for ESF function initiation, in combination with the ATWS mitigation feature, other diverse backup scram protection, and selected diverse RPS logics provides the diverse protection necessary to satisfy the design position specified in BTP HICB-19.

7.8.1.3 Diverse Manual Controls and Displays

All safety-related systems have displays and controls located in the MCR that provide manual system-level actuation of their safety-related functions and monitoring of parameters that support those safety-related functions.

In addition to the manual controls and displays for the safety-related reactor protection and SSLC/ESF functions, the DPS also has displays and manual control functions that are independent from those of the safety-related protection and SSLC/ESF functions. They are not subject to the same common mode failure as the safety-related protection system components. The manual controls include the manual initiation of the SRV, DPV, GDCS, and SLC system valves, and the ICS.

The operator is provided with a set of diverse displays separate from those supplied through the safety-related software platform. The displays listed below provide independent confirmation of the status of major process parameters. These displays are:

- Reactor pressure,
- Reactor pressure high alarm,
- Reactor water level,
- Reactor water level high alarm,
- Reactor water level low alarm,
- Drywell pressure,
- Drywell pressure high alarm,
- Suppression pool temperature,
- Suppression pool temperature high alarm,
- SRV solenoid-controlled valves opening,
- DPV squib-initiation valves opening,
- GDCS squib-initiation valves opening,

- Airborne radioactivity in effluent releases and ventilation air exhausts is continuously sampled and monitored by the Process Radiation Monitoring System (PRMS) for noble gases, air particulates and halogens. As described in Section 11.5, airborne contamination is sampled and monitored at the stack common discharge, in the off-gas releases, and in the ventilation exhaust from the reactor, radwaste and turbine buildings. Samples are periodically collected and analyzed for radioactivity. In addition to this instrumentation, portable air samplers are used for compliance with 10 CFR 20 restrictions to check for airborne radioactivity in work areas prior to entry where potential radiation levels may exit that exceed the allowable limits.
- The in-plant airborne radiation monitoring instrumentation is located so that selected local areas and ventilation paths are monitored. Each location monitored is supplied with a local audible alarm (visual alarm in high noise areas) and the monitor has variable alarm set points. When appropriate, selected airborne radioactivity sampling points are located upstream of any ventilation filter trains to monitor representative radioactivity concentrations from the areas being sampled. Plant operating personnel are supplied with continuous information about the airborne radioactivity levels throughout the plant. The instruments used for monitoring airborne radioactivity are specified to detect the time integrated change of the most limiting particulate and iodine species equivalent to those concentrations specified in Appendix B of 10 CFR Part 20 (one derived air concentration (DAC)) in each monitored plant area within 10 hours). Locations are selected based on the potential for leakage into rooms and areas that contain radioactive processes that become airborne and for which personnel occupancy is required for operation of the reactor plant.
- The radiation instrumentation that monitors airborne radioactivity is classified as nonsafety-related. Airborne radiation monitoring operational considerations such as the procedures for operations and calibration of the monitors, as well as the placement of the portable monitors, are the COL applicant's responsibility (COL 12.3-2-A).

12.3.4.1 ARM System Description

Every ARM channel consists of a gamma sensitive detector and a digital area radiation processor; all channels are provided with local visual and audible alarms and local readouts. Where appropriate, additional readouts and alarms, provided by local auxiliary units, will be utilized. The output signals from the detectors are digitized and multiplexed for transmission to digital radiation monitors for measurement and display. Also, the radiation signals are transmitted to the process computer for recording. Each radiation monitoring channel has two adjustable trip alarm circuits, one for high radiation and the other for downscale indication (loss of sensor input). Also, each area radiation monitor has a built-in self test capability that checks for gross failures and activates an alarm on power failure or inoperative monitor. Auxiliary units with local audible alarms are provided in selected local areas to provide for immediate warning in order to minimize occupational exposure. Each area radiation monitor is powered from non-1E vital 120 VAC power source, which is continuously available during loss of off-site power.

12.3.4.2 ARM Detector Location and Sensitivity

The detector locations are shown on plant layout drawings for each building (Figures 12.3-23 through 12.3-42). The area radiation channels for each building are listed in Tables 12.3-2