7.0 Instrumentation and Control Systems

7.1 Introduction

The information in this section of the reference ABWR DCD, including all subsections and tables, and figures, is incorporated by reference with the following departures and supplements.

STD DEP T1 2.3-1

STD DEP T1 2.14-1 (Table 7.1-1)

STD DEP T1 3.4-1 (Figure 7.1-1, 7.1-2)

STD DEP 1.8-1 (Table 7.1-2)

STD DEP 7.1-1

STD DEP 7.1-2

STD DEP 7.1-3

STD DEP 7.2-1

STD DEP 7.4-1

STD DEP Admin (Table 7.1-1)

7.0.1 Identification of Safety-Related Systems

7.0.1.1 General

STD DEP T1 3.4-1

Divisional separation is also applied to the ~~essential multiplexing system (EMS)~~ <u>Essential Communication Function (ECF) for Safety System Logic and Control (SSLC)</u>*, which provides data highways for the sensor input to the logic units and for the logic output to the system actuators (actuated devices such as pump motors and motor-operated valves). Systems which utilize the SSLC are: (1) Reactor Protection (trip) System; (2) High Pressure Core Flooder System; (3) Residual Heat Removal System; (4) Automatic Depressurization System; (5) Leak Detection and Isolation System; (6) Suppression Pool Monitoring System; and (7) Reactor Core Isolation Cooling System. The equipment arrangement for these systems and other supporting systems is shown in Figure 7.1-2.*

7.0.1.3 Engineered Safety Features (ESF) Systems

7.0.1.3.9 HVAC Emergency Cooling Water System

STD DEP Admin

Automatic instrumentation and control is provided to assure that adequate cooling is provided for the main control room, the control building essential electrical equipment rooms, and the ~~diesel generator cooling coils~~ reactor building essential electrical equipment rooms.

7.0.1.4 Safe Shutdown Systems

7.0.1.4.1 Alternate Rod Insertion Function (ARI)

STD DEP 7.4-1

Though not required for safety, instrumentation and controls for the ARI provide a means to mitigate the consequences of anticipated transient without scram (ATWS) events. ~~Upon receipt of an initiation signal (based on either high reactor dome pressure or low reactor water level from the Recirculation Flow Control System), the RCIS System controls the fine motion control rod drive (FMCRD) motors such that all operable control rods are driven to their full-in position.~~ The Recirculation Flow Control System (upon detection of either high reactor dome pressure, low reactor water level or Manual ARI initiation) activates opening signals for the ARI valves of the Control Rod Drive (CRD) System (i.e., for backup hydraulic insertion of the control rods) and activates ARI initiation command signals to the Rod Control and Information System (i.e., for electric motor insertion of all operable control rods to the full-in position). *This provides a method, diverse from ~~the hydraulic control units (HCUs), for scramming the reactor.~~* the SCRAM function of the Reactor Protection System and associated CRD hydraulic control units (HCUs), for achieving insertion of control rods.

7.0.2 Identification of Safety Criteria

7.0.2.1.4 Instrument Errors

STD DEP 7.1-1

The design considers instrument drift, testability, and repeatability in the selection of instrumentation and controls and in the determination of setpoints. Adequate margin between safety limits and instrument setpoints is provided to allow for instrument error. ~~(safety limits, setpoints, and margins are provided in Chapter 16).~~ The amount of instrument error is determined by test and experience. The setpoint is selected based on the known error. The recommended test frequency is greater on instrumentation that demonstrates a stronger tendency to drift.

7.0.2.1.4.1 Safety System Setpoints

STD DEP 7.1-1

The safety system setpoints are listed in the ~~Chapter 16~~ Instrument Setpoint Summary Report *for each safety system. The settings are determined based on operating experience and conservative analyses. The settings are high enough to preclude inadvertent initiation of the safety action but low enough to assure that significant margin is maintained between the actual setting and the limiting safety system settings. Instrument drift, setting error, and repeatability are considered in the setpoint* *determination (Subsection 7.1.2.1.4). The margin between the limiting safety system settings and the actual safety limits includes consideration of the maximum credible transient in the process being measured.*

7.0.2.1.6 [Protection System Inservice Testability

STD DEP T1 3.4-1

The RPS and ESF Systems can be tested during reactor operation by six separate tests. The first five tests are primarily manual tests and, although each individually is a partial test, combined with the sixth test they constitute a complete system test. The sixth test is the self-test of the safety system logic and control which automatically tests the complete system excluding sensors and actuators.

(4) The fourth test checks calibration of analog sensor inputs at the analog inputs of the ~~remote multiplexing units.~~ Remote Digital Logic Controllers (RDLCs). *With a division-of-sensors bypass in place, calibrated, variable ~~ramp~~ signals are injected in place of the sensor signals and monitored ~~at the SSLC control room panels~~ for linearity, accuracy, fault response, and downscale and upscale trip response. ~~The test signals are adjustable manually from the control room and also are capable of performing an automatic sequence of events.~~ When surveillance testing during plant shutdown, trip coincidence and actuated device operation can be verified by simultaneous trip tests of coincident channels. Pressure transmitters and level transmitters are located on their respective local panels. The transmitters can be individually valved out of service and subjected to test pressure to verify operability of the transmitters as well as verification of calibration range. To gain access to the field controls on each transmitter, a cover plate or sealing device ~~must~~* may *be removed. Access to the field controls is granted only to qualified personnel for the purpose of testing or calibration adjustments.*

(6) The sixth test is an integrated self-test provision built into the microprocessors within the SSLC. It consists of an online, continuously operating, self-diagnostic monitoring network, and an offline semi-automatic (operator initiated, but automatic to completion), end-to-end surveillance program. Both online and offline functions operate independently within each of the four divisions. There are no multi-divisional interconnections associated with self-testing.

The hierarchy of test capability is provided to ensure maximum coverage of all ~~EMS~~ ECF*/SSLC functions, including logic functions and data communication links. Testing shall include:*

(a) Online Continuous Testing

The following standard supplement enhances the design description.

The test function does not degrade system reliability. The logic returns to its original state after the test sequence is completed. Indications of test status (normal or in-test) and results (pass, fail) is provided.

Self-diagnosis includes monitoring of overall program flow, reasonableness of process variables, RAM and PROM condition, and device interlock logic. Testing includes continuous error checking of all transmitted and received data on the ~~serial data~~ data communication *links of each SSLC controller; for example, error checking by parity check, checksum, or cyclic redundancy checking (CRC) techniques.*

Self-test failures (except intermittent failures) are annunciated to the operator at the main control room console and logged by the ~~process~~ plant *computer. Faults are identified to the replacement board or module level and positively indicated at the failed unit.*

The ~~Essential Multiplexing System (EMS)~~ Essential Communication Function (ECF) *is included in the continuous, automatic self-test function. Faults at the ~~Remote Multiplexing Units (RMUs)~~* Remote Digital Logic Controllers (RDLCs) *are alarmed in the main control room. Since the ~~EMS~~* ECF *is dual in each division, self- test supports automatic reconfiguration or bypass of portions of ~~EMS~~* ECF *after a detected fault, such that the least effect on system availability occurs.*

(b) Offline Semi-automatic End-to-End (Sensor Input to Trip Actuator) Testing

To reduce operator burden and decrease outage time, a surveillance test controller (STC) is provided as a dedicated instrument in each division of ~~SSLC~~ ELCS. *The STC performs semi-automatic (operator-initiated) testing of ~~SSLC~~* ELCS *functional logic, including trip, initiation, and interlock logic. Test coverage includes verification of correct operation of the following capabilities, as defined in each system IBD:*

(i) Each 2/4 coincident logic function.

(ii) Serial and parallel I/O, including manual control switches, limit switches, and other contact closures.

~~*(iii) The 1/N trip selection function.*~~

~~*(iv)*~~ (iii) *Interlock logic for each valve or pump.*

The STC injects test patterns through the ~~EMS~~ Essential Communication Function (ECF) of the ELCS *communications links to the ~~RMUs~~* RDLCs. *It then tests the ~~RMUs~~* "RDLCs" *ability to format and transmit sensor data through and across the ~~EMS/SSLC~~* ECF of the ELCS *interface, in the prescribed time, to the load drivers. Under the* *proper bypass conditions, or with the reactor shut down, the load drivers themselves may be actuated.*]*

7.0.2.4 Safe Shutdown Systems—Instrumentation and Controls

7.0.2.4.1 Alternate Rod Insertion Function (ARI)—Instrumentation and Controls

STD DEP 7.4-1

(2) Non-safety-Related Design Bases

The general functional requirements of the instrumentation and controls of the ARI function are to:

(a) Provide alternate and diverse method for inserting control rods using ~~*fine motion control rod drive (FMCRD) electric motors.*~~ the ARI valves of the Control Rod Drive System or using the ARI motor run-in function of the Rod Control and Information System.

(b) Provide for automatic and manual operation of the ~~*system*~~ function*.*

(c) Provide assurance that the ARI shall be highly reliable and functional in spite of a single failure.

(d) Provide assurance that the ARI shall operate when necessary ~~*(FMCRD motors shall be connected to the emergency diesel generators).*~~ (e.g., the stepping motor driver modules (SMDMs), which control the fine motion control rod drive (FMCRD) motors, shall derive their input power from a power bus that can automatically receive power from an emergency diesel generator, if necessary).

(e) Mitigate the consequences of anticipated transient without scram (ATWS) events.

7.0.2.6 Other Safety-Related Systems

7.0.2.6.1 Neutron Monitoring System (NMS)—Instrumentation and Controls

7.0.2.6.1.1 Startup Range Neutron Monitoring (SRNM) Subsystem

STD DEP 7.1-2

(1) Safety Design Bases

* See Subsection 7.1.1.2.

General Functional Requirements:

(d) The SRNM subsystem will provide Anticipated Transient Without Scram (ATWS) permissive signals to the ESF Logic and Control System (ELCS).

(2) Non-safety-Related Design Bases

The SRNM Subsystem shall be able to perform the following functions:

(d) Provide a continuous measure of the time rate of change of neutron flux (reactor period) over the range from –100 s to (–) infinity and (+) infinity to ~~+10s~~ +3s.

7.0.2.6.1.2 Flow Rate Subsystem

STD DEP 7.1-2

(1) Safety Design Bases

General Functional Requirements:

The flow rate subsystem, as part of the APRM Subsystem, provides the control and reference signal for the APRM core flow-rate dependent trips. It ~~consists of a flow measurement from the recirculation system and signal conditioning equipment~~ does this by converting a core plate differential pressure signal from the Recirc Flow Control System (RFC) into a core flow rate signal*.*

7.0.2.6.1.4 Average Power Range Monitor (APRM) Subsystem

STD DEP 7.1-2

(1) Safety Design Bases

General Functional Requirements:

The general functional requirements are that, under the worst permitted input LPRM bypass conditions, the APRM Subsystem shall be capable of generating a trip signal in response to average neutron flux increases in time to prevent fuel damage. The APRM generator trip functions with trip inputs to the RPS also include: simulated thermal power trip, APRM inoperative trip, core flow rapid decrease trip, and core power oscillation trip of the oscillation power range monitor (OPRM). The OPRM design basis is to provide a trip to prevent growing core flux oscillation to prevent thermal limit violation, while discriminating against false signals from other signal fluctuations not related to core instability. The independence and redundancy incorporated into the design of the APRM Subsystem shall be consistent with the safety design bases of the Reactor Protection System (RPS). The RPS design bases are discussed in Subsection 7.1.2.2.

<u>The APRM subsystem also provides Anticipated Transient Without Scram (ATWS) permissive signals to the ESF Logic and Control System (ELCS) as described in Subsection 7.6.1.1.2.2(5).</u>

7.0.2.6.1.5 Automated Traversing Incore Probe (ATIP) Subsystem

STD DEP 7.1-3

(2) Non-Safety-Related Design Bases

The ATIP shall meet the following power generation design bases:

<u>(d)</u> <u>Provide an automatic function of retracting ATIP and closing the containment isolation valves for the ATIP lines in response to an LDI signal</u>

7.0.2.6.2 Process Radiation Monitoring System

STD DEP T1 2.3-1

STD DEP 7.2-1

STD DEP 7.1-1

(1) Safety Design Bases

General Functional Requirements:

(d) Provide channel trip inputs ~~to the RPS and LDS~~ <u>to the system logic</u> *on high radiation in the MSL tunnel area. If the ~~protection~~ system logic is satisfied, the ~~following shall be initiated:~~* <u>system will initiate shutdown of the mechanical vacuum pump and closure of the mechanical pump discharge line isolation valve.</u>

~~(i) Reactor scram.~~

~~(ii) Closure of the main steamline isolation valves.~~

~~(iii) Shutdown of the mechanical vacuum pump and closure of the mechanical pump discharge line isolation valve.~~

(2) Non-safety-Related Design Bases

(e) Provide alarm annunciation signals to the main control room if alarm or trip levels are reached or the radiation monitoring subsystem becomes inoperative, and provide input to the offgas system when the radioactive gas concentration in the offgas system discharge is at or in excess of the restrictive concentration limit derived from ~~Technical Specification~~ <u>the Offsite Dose Calculation Manual</u> *release rate limits and that discharge from the offgas system must be terminated.*

7.0.2.6.6 Containment Atmospheric Monitoring (CAM) Systems

STD DEP T1 2.14-1

(1) Safety Design Bases

General Functional Requirements:

~~Monitor the atmosphere in the inerted primary containment for radiation levels and for concentration of hydrogen and oxygen gases, primarily during post-accident conditions. Monitoring shall be provided by two independent safety-related divisional subsystems.~~

Monitor continuously the radiation environment in the drywell and suppression chamber during reactor operation and under post-accident conditions.

~~Sample and monitor the oxygen and hydrogen concentration levels in the drywell and suppression chamber under post-accident conditions, and also when required during reactor operation. The LOCA signal (low reactor water level or high drywell pressure) shall activate the system and place it into service to monitor the gaseous buildup in the primary containment following an accident.~~

(2) Non-Safety-Related Design Bases

Separate hydrogen and oxygen gas calibration sources shall be provided for each CAM Subsystem for periodic calibration of the gas analyzers and monitors.

Monitor the atmosphere in the inerted primary containment for radiation levels and for concentration of hydrogen and oxygen gases, primarily during post-accident conditions.

Sample and monitor the oxygen and hydrogen concentration levels in the drywell and suppression chamber under post-accident conditions, and also when required during reactor operation. The loss of coolant accident (LOCA) signal (low reactor water level or high drywell pressure) shall activate the system and place it into service to monitor the gaseous buildup in the primary containment following an accident.

7.0.2.8 Independence of Safety-Related Systems

STD DEP Admin

(See Subsection ~~8.3.1.3 and 8.3.1.4~~ 8.3.3.6.2.*)*

7.0.2.9 Conformance to Regulatory Requirements

7.0.2.9.1 Regulation 10CFR50.55a

STD DEP 1.8-1

The only portion of 10CFR50.55a applicable to the I&C equipment is 10CFR50.55a(h), which requires the application of IEEE-~~279~~603 for protection systems (Subsection 7.1.2.11.1).

7.0.2.10 Conformance to Regulatory Guides

7.0.2.10.9 Regulatory Guide 1.105—Instrument Setpoints

STD DEP 7.1-1

The I&C systems are consistent with the requirements of Regulatory Guide 1.105. The trip setpoint (instrument setpoint) and the analytical or design basis limit are contained in the Instrument Setpoint Summary Report. ~~*The trip setpoint (instrument setpoint) allowance value (Tech Spec limit) and the analytical or design basis limit are all*~~ The allowable values are contained in the Technical Specifications (Chapter 16). ~~*These parameters are all appropriately separated from each other based on instrument accuracy, calibration capability and design drift (estimated) allowance data. The setpoints are within the instrument best accuracy range. The established setpoints provide margin to satisfy both safety requirements and plant availability objectives.*~~

7.0.2.11 Conformance to Industry Standards

~~The following standard supplement addresses design-related information originally provided in Appendix 7A of the reference ABWR DCD.~~

STD DEP 1.8-1

7.0.2.11.1 ~~IEEE-279—Criteria for Protection Systems for Nuclear Power Generating Stations~~ IEEE-603—Standard Criteria for Safety Systems for Nuclear Power Generating Stations

All safety related systems are designed to meet the requirements of IEEE-~~279~~603. Clarifications of any of the provisions are discussed for hte applicable systems in the analysis portions of Sections 7.2, 7.3, 7.4, ~~and~~ 7.6, and 7.9S.

IEEE-603, Section 4, Safety System Designation

A specific basis is established to determine the design of each safety-related I&C system. This basis evolved from the identification of Design Basis Events (DBE) that are postulated in Chapter 15. The plant operating conditions and the safety analysis acceptance criteria applicable for each event are shown in Chapter 15. Credited systems, interlocks, and functions are evaluated for each DBE. Information provided for each design base item enables the detailed design of the system to be carried out. The number of sensors and their location, including spatial effects, is determined during this design basis analysis. The identification of variables are derived from the

DBEs as well as the requirements for varied manual initiation and control of protective functions. Safety system design basis descriptions are included in the various sections of this Chapter.

IEEE-603, Sections 5, 6 and 7, Safety System Criteria

The safety-related systems are designed to maintain plant parameters within acceptable limits that are established by design basis events. This is done with precision and reliability meeting the requirements of IEEE-603. The scope of IEEE-603 includes safety-related I&C systems and is described in more detail in Sections 7.2 through 7.6 and 7.9. The safety-related I&C design conforms with IEEE-603 and has been qualified to demonstrate that all required performance requirements are met. Nonsafety-related systems generally are not required to meet any of the requirements of IEEE-603 with the exception of their independence from safety-related systems. The STP 3&4 safety-related I&C design descriptions related to IEEE-603, Sections 5, 6, and 7 requirements are provided below.

(1) Paragraph 5.1, Single Failure: The safety-related I&C systems are designed to ensure that safety-related functions required for design basis events (DBE) are performed in the presence of: (a) single detectable failure within safety-related systems concurrent with all non-detectable failures; (b) failures caused by the single failure; and (c) failures and spurious system actions that cause, or are caused by the design basis event, requiring the safety-related functions as identified in the applicable failure modes and effects analysis (FMEA).

(2) Paragraphs 5.2 & 7.3, Completion of Protective Actions: The safety-related I&C systems are designed so that a) once initiated (automatically or manually), the intended sequence of the safety-related functions of the execution features continue until completion, and b) after completion, deliberate operator action is required to return the safety-related system to normal.

(3) Paragraph 5.3, Quality: A: safety-related I&C equipment is provided under the 10 CFR PArt 50 Appendix B quality program. This satisfies all applicable requirements of the following: 1) 10 CFR Part 50 Appendix B and 2) ANSI/ASME NQA-1. The safety-related digital I&C software and/or firmware conform with the quality requirements of IEEE 7-4.3.2.

(4) Paragraph 5.4, Equipment Qualification: The safety-related I&C equipment is designed to meet its functional requirements over the range of environmental conditions for the area in which it is located. The equipment is designed to meet the equipment qualification requirements set forth by this criterion.

(5) Paragraph 5.5, System Integrity: The safety-related I&C systems are designed to demonstrate that the safety system performance is adequate to ensure completion of protective actions, over a range of transient and steady state conditions, as enumerated in the design basis.

(6) Paragraph 5.6, Independence: For the safety-related I&C systems, there is physical, electrical, and commmunication independence between redundant portions

of safety-related systems and between safety-related systems and nonsafety-related systems, as discussed in the applicable Sections.

(7) Paragraph 5.7, Capability for Test & Calibration: The safety-related I&C systems are designed with the capability to have their equipment tested and calibrated while retaining their capability to accomplish their safety functions.

(8) Paragraph 5.8, Information Displays: The information display design is discussed in Chapter 18. This design process includes the necessary steps to ensure compliance with regulatory requirements and the guidance provided in RG 1.47 for bypass and inoperable status indication and in RG 1.97 for accident monitoring instrumentation as discussed in Section 7.5.

(9) Paragraph 5.9, Control of Access: The safety-related I&C systems have features that facilitate the administrative control of access to safety-related system equipment.

(10) Paragraph 5.10, Repair: The safety-related analog and digital based I&C systems are designed to allow the timely recognition of malfunctioning equipment location to allow the replacement, repair and/or adjustment. Self-diagnostic functions will identify and locate the failure of hte component. Individual bypassing allows the failed component to be replaced or repaired on-line without affecting the protection function.

(11) Paragraph 5.11, Identification: Safety-related I&C equipment conforms with the identification requirements of this criterion. Safety-related equipment is distinctly marked for each redundant portion of a system with identifying markings. Hardware components or equipment units have an identification label or a nameplate. For digital platforms, versions of computer hardware, software and/or firmware are distinctly identified. Proper configuration management plans are implemented as a way to formalize this identification process.

(12) Paragraph 5.12, Auxiliary Features: STP 3&4 safety-related I&C system auxiliary supporting features satisfy the requirements of this criterion where applicable. For example, power supply and HVAC are key auxiliary supporting systems that satisfy the applicable requirements of IEEE-603. Other key auxiliary features are designed such that these components will not degrade the safety-related I&C systems below an acceptable level.

(13) Paragraph 5.13, Multi Unit Stations: The safety-related I&C systems meet the requirements of GDC 5, Sharing of structures, systems and components. The capability to simultaneously perform required safety functions in both Units is not impaired by interactions between Units.

(14) Paragraph 5.14, Human Factors Considerations: Human factor scenarios are considered throughout all stages of the design process. Detailed information regarding these considerations can be found in Chapter 18.

(15) Paragraph 5.15, Reliability: The degree of redundancy, diversity, testability, and quality of the STP 3&4 safety-related I&C design adequately addresses the functional

reliability necessary to perform its safety protection functions. As stated above, the safety-related I&C equipment is provided under an Appendix B quality program.

(16) Paragraphs 6.1 and 7.1, Automatic Control: The safety-related I&C systems provide the means to automatically initiate and control the required safety-related functions.

(17) Paragraphs 6.2 and 7.2, Manual Control: The safety-related I&C systems have features in the main control room and remote shutdown system to manually initiate and control the automatically initiated safety-related functions at the division level.

(18) Paragraph 6.3, Interaction between the Sense and Command Features and Other Systems: The safety-related I&C systems meet the independence and separation requirements such that nonsafety-related systems failures will not affect of prevent any safety-related protection function. The normal communication path is one-way such that the safety-related systems will only broadcast to nonsafety-related systems and not vice versa. There is limited nonsafety-related communication under programmatic control to safety-related systems as discussed in Section 7.9S.

(19) Paragraph 6.4, Derivation of System Inputs: To the extent feasible, the protection system inputs are derived from signals that directly measure the designated process variables.

(20) Paragraph 6.5, Capability for Testing and Calibration: The operational availability of the protection system sensors can be checked by perturbing the monitored variables, by cross-checking between redundant channels that have a known relationship with each other, and that have read-outs available, or introducing and varying and substitute input to the sensor of hte same nature as the measured variable. When one channel is placed into maintenance bypass mode, the condition is alarmed in the MCR and actuation logic capability is maintained to ensure the continued availability of all protective actions. Most sensors and actuators are designed to provide actual testing and calibration during power operation.

(21) Paragraphs 6.6 and 7.4, Operating Bypasses: The safety-related I&C systems automatically prevent the activation of an operating bypass whenever the applicable permissive conditions for an operating bypass are not met, and remove activated operating bypasses if the plant conditions change so that an activated operating bypass is no longer permissible.

(22) Paragraphs 6.7 and 7.5, Maintenance Bypasses: The safety-related I&C systems are capable of performing their safety-related functions when on division is in maintenance bypass.

(23) Paragraph 6.8, Setpoints: STP 3&4 safety-related instrument setpoints are determined by a methodology that follows the guidance contained in the STP 3&4 setpoint methodology program. This methodology uses STP 3&4 plant specific analyses to ensure that characteristics such as range, accuracy, and resolution of the instruments meet the performance requirements assumed n the safety analyses in

Chapter 15. The response times of the I&C systems are assumed in the safety analyses and verified by STP 3&4 surveillance testing or system analyses.

The power source design requirements for the safety-related I&C systems are discussed in Chapter 8.

~~7.0.2.11.7 IEEE 603 Standard Criteria for Safety Systems for Nuclear Power Generating Stations~~

~~The microprocessor hardware and software which make up the Safety System Logic and Control (SSLC) is designed to make logic decisions which automatically initiate safety actions based on input from instrument monitored parameters for several nuclear safety systems. In that sense, the SSLC integrates the nuclear safety systems.~~

~~Most positions stated in IEEE 603 (as endorsed by RG 1.153) pertain to the nuclear safety systems, and are similar to those of IEEE 279, which are addressed for each system in the analysis sections of Chapter 7. Safety system design bases are described for all I&C systems in Section 7.1, beginning at Subsection 7.1.2.2. Setpoints and margin may be found in the Instrument Setpoint Summary Report.~~

~~The safety system criteria in Section 5 of IEEE 603 are not compromised by the introduction of the SSLC. All positions regarding single-failure, completion of protective actions, etc., are designed into the protection systems. All SSLC components associated with the protection systems are Class 1E and are qualified to the same standards as the protection systems.~~

~~Independence of the four SSLC electrical divisions is retained by using fiber-optic cable for cross-divisional communication such as the two-out-of-four voting logic. Capability for test and calibration is greatly enhanced by the SSLC's self-test subsystem (STS) as described in Subsection 7.1.2.1.6.~~

~~In summary, the hardware and software functions of the microprocessors used in the SSLC comply with applicable portions of IEEE 603 and Regulatory Guide 1.153 (i.e., quality, qualification, testability, independence). The remaining portions, which apply to the nuclear safety systems, are not compromised by the SSLC design, but are in fact enhanced by self-test.~~

Table 7.0-1 Comparison of GESSAR II and ABWR I&C Safety Systems

I & C System	GESSAR II Design	ABWR Design
General	Hard wired sensor interfaces.	~~Multiplexed~~ **Networked** sensor interfaces.
Flammability Control System:	Part of combustible gas control system.	~~Independent system.~~**This system deleted**
Standby Gas Treatment System:	Redundant active and passive components.	Redundant active components; ~~single filter train.~~**two filter trains, two separate divisions.**

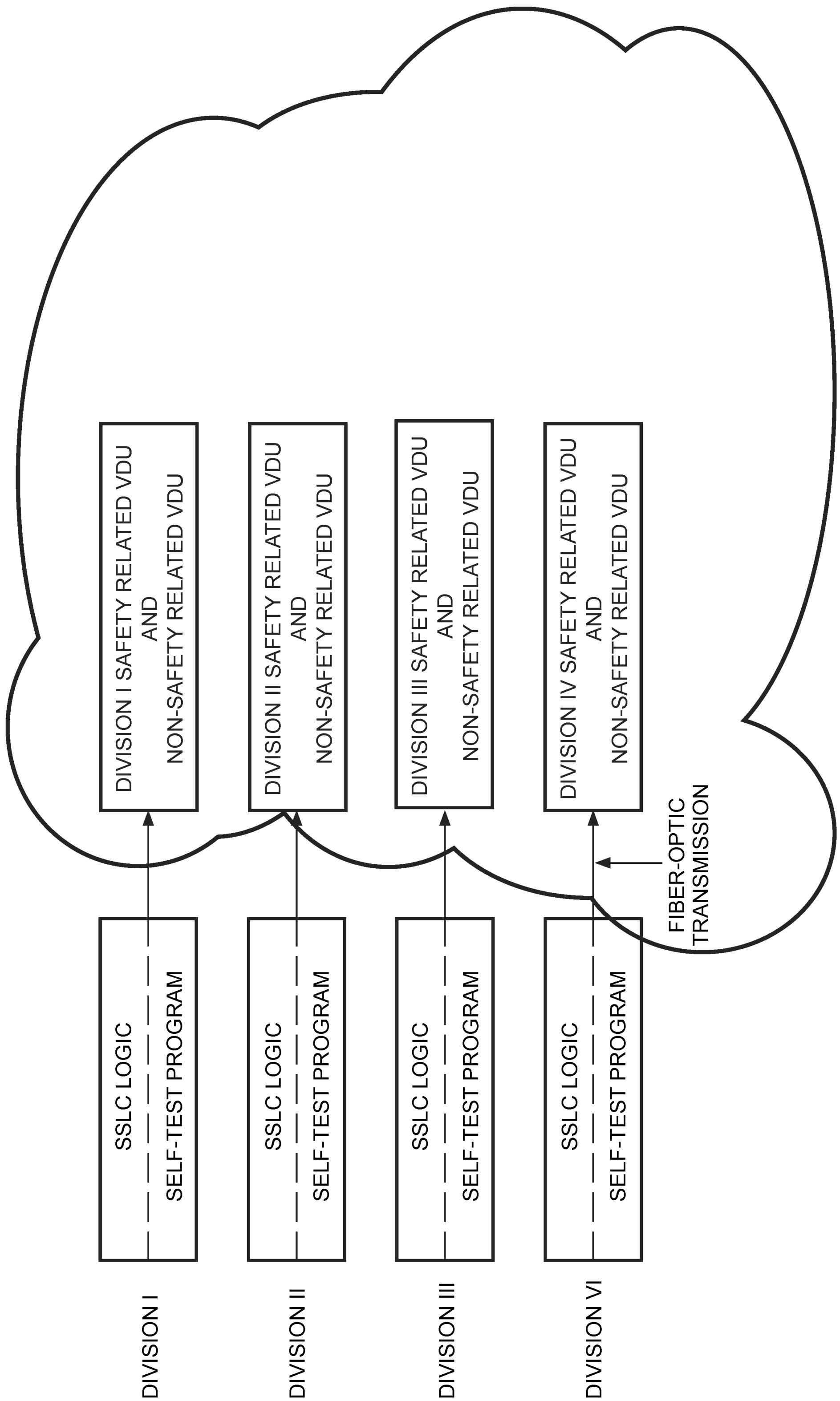

Figure 7.0-1 SSLC Self-Test System

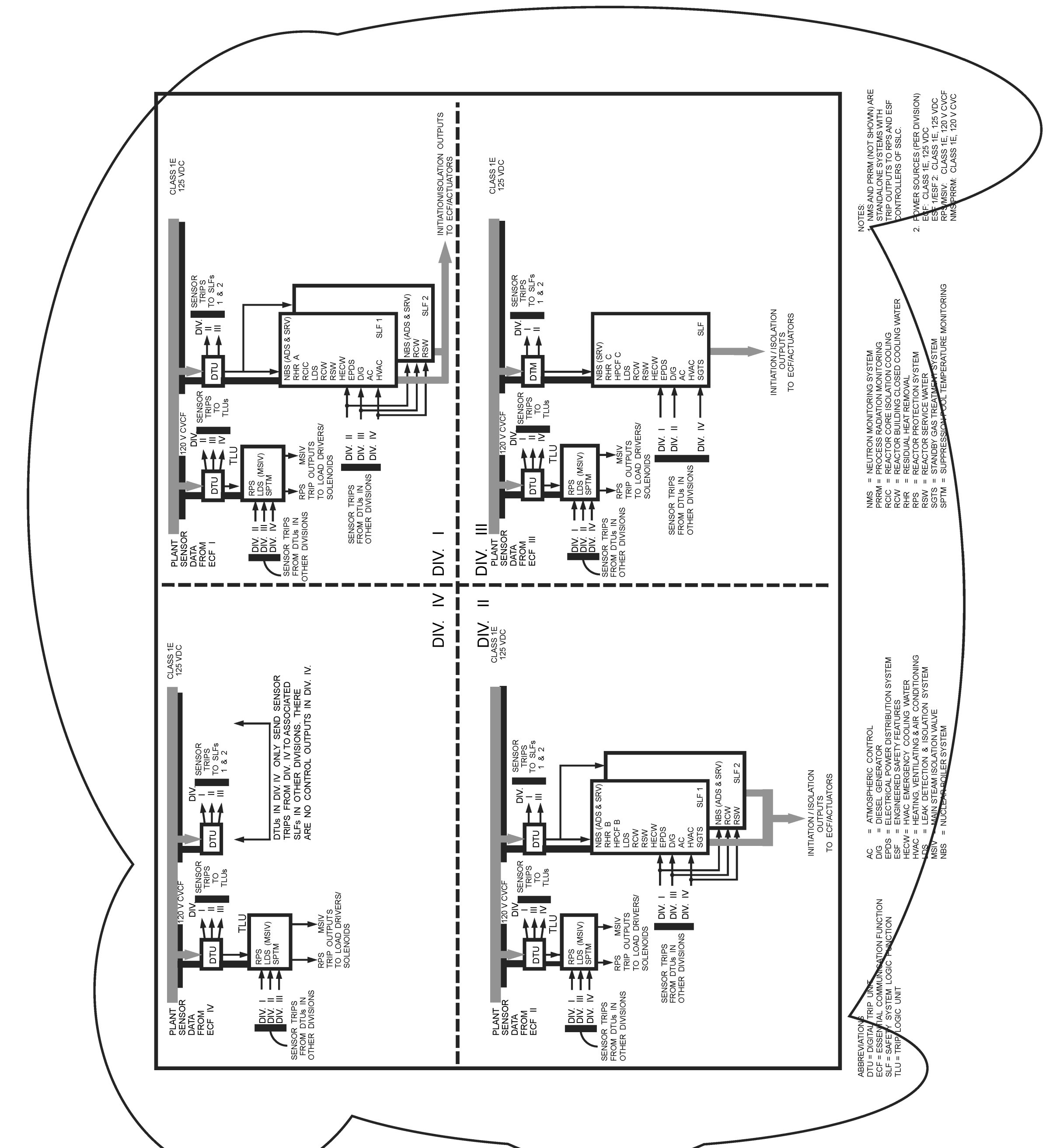

Figure 7.0-2 Assignment of Interfacing Safety System Logic to SSLC Controllers