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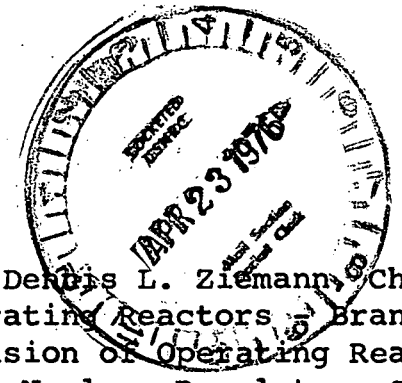
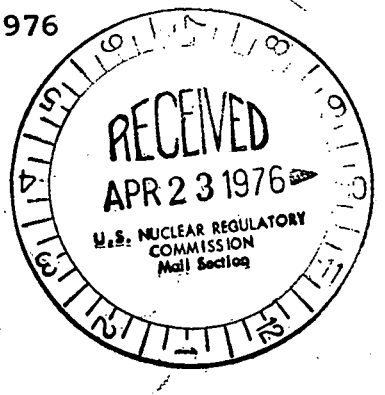


April 19, 1976



Mr. Dennis L. Ziemann, Chief
Operating Reactors - Branch 2
Division of Operating Reactors
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Dresden Station Unit 2
Response to Request for Additional
Information dated March 19, 1976
NRC Docket No. 50-237

Reference (a): R. L. Bolger letter to D. L. Ziemann
dated April 6, 1976

Reference (b): G. A. Abrell letter to D. L. Ziemann
dated April 8, 1976

Dear Mr. Ziemann:

Reference (b) requested withdrawal of General Electric Specification 22A2501 submitted in error as part of reference (a).

Enclosed are 40 copies of the revised response to Item 8 of your request for additional information dated March 19, 1976.

Very truly yours,

G. A. Abrell
Nuclear Licensing Administrator
Boiling Water Reactors

Enclosure: 40 copies

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SEPARATION REQUIREMENTS FOR

REACTOR SAFETY AND ENGINEERED SAFEGUARDS SYSTEMS

1. SCOPE

1.1. This document defines the requirements for the separation and identification of reactor safeguards electrical equipment and power and control cabling. This equipment includes interconnecting wiring, sensory equipment and power sources associated with the Reactor Protection Systems (RPS), Primary Containment Isolation System (PCIS), and Engineered Safeguards Systems (ESS).

1.2. The objective of this document is to set forth a coherent and definitive set of criteria for technically feasible separation of wiring, cabling, and electrical control and power supply equipment to achieve true independence of safeguards functions compatible with the redundant equipment provided. The resulting installation should satisfy the "single failure criterion" such that no single failure can prevent the operation of the required functions of the Reactor Protection System, Primary Containment Isolation System, and the Engineered Safeguards Systems. These systems are defined below.

2. GENERAL DESCRIPTION

2.1. Systems

2.1.1. The following systems are affected by the requirements of this document

2.1.2. Reactor Protection System (RPS). The overall complex of instrument channels, power supplies, trip system and trip actuators and all wiring involved in generating or transmitting a reactor scram trip signal.

2.1.3. Primary Containment Isolation System (PCIS). The instrument channels, except those common to RPS, power supplies, trip systems, manual controls and interconnecting wiring involved in generating or transmitting a primary containment isolation function.

2.1.4. Engineered Safeguards Systems (ESS). That combination of subsystems which takes automatic action to provide the cooling necessary to prevent melting of fuel cladding in the event of a design basis reactor accident. These systems include but are not limited to the following:

2.1.4.1. Core Spray System (CSS)

2.1.4.2. Automatic Blowdown System (ABS)

2.1.4.3. High Pressure Coolant Injection System (HPCI)

2.1.4.4. Low Pressure Coolant Injection System (LPCI) or Residual Heat Removal System (RHR)

2.2. Definitions

2.2.1. The following definitions are applicable to this document:

2.2.2. Instrument Channel. An arrangement of sensory and intermediate components as required to generate a single trip signal related to a particular plant parameter and introduce this trip signal into a trip system. The channel loses its identity upon combination of its trip signal with others.

2.2.3. Trip System. An interconnected arrangement of components making use of instrument channel outputs in the generation of a trip function when appropriate logic is satisfied.

2.2.4. Trip Actuator. The mechanism which carries out the final action of the protection system.

2.2.5. Standby Power Sources. Emergency "on site" power sources designed for use when off site power is not available. These include engine driven generators and station batteries.

2.2.6. Average Power Range Monitor (APRM). System providing continuous indication of the bulk power level of the reactor during operation in the power range.

2.3. Potential Hazard Areas

2.3.1. The degree of separation required varies with the potential hazards in a particular zone of the power plant. These zones may be classified in four separate categories as follows:

2.3.2. Mechanical Damage (Missile) Zone. Zones of potential missile damage in th vicinity of heavy rotating machinery or other source of mechanical energy (which would require substantial physical separation).

2.3.3. Fire Hazard Zone. Any area where combustible materials are present in quantities that could support a damaging fire.

2.3.4. Cable Spreading Room. The area provided under the main control room panels where cables leaving the various panels are dispersed into their various cable trays for routing to all parts of the plant.

2.3.5. Main Control Room Panels. Panels, cubicles, relay racks and similar enclosures in the main control room.

3, REQUIREMENTS

3.1. Single Failure Criterion.

3.1.1. The single failure criterion is defined in accordance with Para. 4.2. of "Proposed IEEE Criteria for Nuclear Power Plants Protection Systems", Rev. 10, dated March 4, 1968 (IEEE 279) and further clarified and limited below. Design basis events shall include the following:

3.1.2. Electrical fires in wireways that could cause failure of unprotected insulation on other cables up to three feet away.

3.1.3. Gross failure of electrical equipment in any single compartment of an instrument or control panels that could result from a short circuit.

3.1.4. Mechanical damage of equipment in a single location, the area of which is limited by the damaging potential of surrounding equipment. However, the area of destruction is not considered to exceed a 20 ft. diameter and the force of destruction is not considered sufficient to disable electrical cables, switchgear, etc., protected by a six inch thick reinforced concrete wall or equivalent. Locations where environmental factors may reasonably be considered to exceed these two limitations shall be considered unsuitable for electrical equipment for safeguards systems.

3.1.5. No single design basis event shall disable an essential automatic protective function, viz. Reactor Protection, Primary Containment Isolation or Engineered Safeguards Systems.

3.2. Identification

3.2.1. Trays. Those trays which carry RPS, PCIS and ESS wiring are to be identified at entrance points of each room they pass through (and exit points unless room is small enough to facilitate convenient following of cable) with a conspicuous tag bearing the initials ESS-I for Division I and ESS-II for Division II, etc.

3.2.2. Conduits, Junction or Pull Boxes. Tags for the conduits, junction or pull boxes external to cabinets and/or panels for the RPS, PCIS and ESS shall be conspicuously different from other similar tags (yellow color is suggested), and the identification shall include the division numeral (I or II, etc.), as applicable.

3.2.3. Cables. ESS cables shall be identified by colored tags at each end as to being part of Division I or Division II.

3.2.4. PCIS System. The PCIS cables and components may be included with the ESS cables and components for identification marking purposes.

3.3. System Separation Requirements

3.3.1. Reactor Protection System (RPS)

3.3.1.1. The following general rules shall apply to RPS wiring:

3.3.1.2. Wiring for the Reactor Protection System outside of the main protection system cabinet shall be run in conduits or metal enclosures used for no other wiring and shall be conspicuously identified at all junction or pull boxes. See Para. 3.2.

3.3.1.3. Wiring from duplicate sensors connected to a common process tap should be run in separate conduits to their separate destinations in order to meet the single failure criterion of Para. 3.3.2.

3.3.1.4. Wiring for sensors of more than one variable in the same instrument channel may be run in the same conduit.

3.3.1.5. Wires from both RPS trip actuators to a single group of scram solenoids may be run in a single conduit; however, a single conduit shall not contain wires to more than one group of scram solenoids. Wiring for two solenoids on the same control rod may be run in the same conduit.

3.3.1.6. Neutron monitoring cables routed through drywell penetrations shall be so separated that loss of all cabling in a single penetration cannot prevent a reactor scram.

3.3.1.7. Power supplies to systems which de-energize to operate (so-called "failsafe" power supplies) require only that separation which is deemed prudent to give reliability (continuity of operation). Therefore, the protection system fly-wheel motor generator (MG) sets and load circuit breakers are not required to comply with the separation requirements of this document for safety reasons even though the load circuits go to separated panels.

TABLE I

REACTOR PROTECTION SYSTEM AND
PRIMARY CONTAINMENT ISOLATION INPUTS
SENSOR SUFFIX LETTERS & DIVISION ALLOCATION*

Total No. Sensors	DIV. IA Trip Sys. A1	DIV. IB Trip Sys. B1	DIV. IIA Trip Sys. A2	DIV. IIB Trip Sys. B2
4	A	B	C	D
8	AE	BF	CG	DH
16	AEJN	BFKP	CGLR	DHMS
	(Trip sys. sub-chan. A1)	(Trip sys. sub-chan. B1)	(Trip sys. sub-chan. A2)	(Trip sys. sub-chan. B2)

* This Division does not apply to the six channel APRM System which must have a special four group arrangement to allow for maintenance bypassing of a single channel in each protection system without violating the single failure criterion (See Table II).

Divisions IA and IB may be combined into a single division to suit equipment layout.

This table shows a typical interconnection system. The actual system used for a particular reactor plant is detailed on each project's "Reactor Protection System Interconnection Scheme".

TABLE II

REACTOR PROTECTION SYSTEM FOUR DIVISION SENSOR GROUPING
FOR A SIX CHANNEL NEUTRON MONITORING SYSTEM

DIVISION	IA	IIA		IB	IIB	
Channel Designation						
APRM Number	3	1	5	4	2	6
Trip System	A1	A1	B1	B1	A2	B2
Sub-Channel	A2			B2		

3.3.2. RPS Special Considerations

3.3.2.1. The RPS has a minimum of four (4) independent input instrument channels for each measured parameter. The four separate conduits for the four sensors for a specific parameter may (in some cases) be combined into two groupings or divisions for routing purposes if desired by combining divisions IA and IB shown in Table I and Figure I. However, in no case shall the total disabling of equipment within a single division be capable of preventing a required scram action under permitted bypass conditions. In the case of the six channel APRM system this will require separation of the sensor cables into four groups or divisions instead of two (as illustrated in Table II).

3.3.2.2. Inasmuch as the RPS circuits are "failsafe", the physical separation distance specified below for the ESS and PCIS circuits does not apply to the RPS circuits. However, division of RPS circuits into separate conduits and enclosures must assure the prevention of short-circuiting of Division I to Division 2 circuits as indicated in Tables I and II.

3.3.3. Engineered Safeguard System (ESS) and Primary Containment Isolation System (PCIS)

3.3.3.1. The following general rules shall be used to determine the allocation and separation of electrical wiring between the two major divisions of the ESS and PCIS.

3.3.3.2. Separation shall be such that no single failure can prevent operation of the engineered safeguard function (i.e., core cooling). Redundant (even dissimilar) systems may be required to perform the required function to satisfy the single failure criterion. Table III illustrates the separation of subsystems of the ESS and the PCIS valves. Figure 2 illustrates the concept of separation of ESS divisions.

3.3.3.3. The High Pressure Core Cooling System (HPCI or FWCI) may be in either separation division so long as it is separated from at least one of each of its backup low pressure core cooling systems such as Automatic Blowdown and one of the Core Spray Systems.

3.3.3.4. The inboard primary containment isolation valve wiring between the control panel and the valve proper must be separated from the outboard isolation valve wiring. See Figure 1 which illustrates this requirement. The manual controls for the isolation valves may be treated as an exception to this inboard, outboard division if deemed necessary from an operability point of view provided that no single failure can prevent the required automatic operation of at least one of a pair of isolation valves.

3.3.3.5. The sources of emergency and standby power, such as steam turbines, gas turbines, diesel generators, and storage batteries and their associated cabling and control devices, must meet the same separation criteria as specified for the PCIS and ESS Systems. Proper separation will assure a source of power for operation of the components of these systems.

TABLE III

ENGINEERED SAFEGUARDS SUB SYSTEMS AND PRIMARY CONTAINMENT ISOLATION SYSTEMS SEPARATION

DIVISION I	DIVISION II
Core Spray A	Core Spray B
Automatic Blowdown	HPCI or FWCI (See paragraph 4.3.3.3.)
LPCI A or Containment Spray A or RHR A	LPCI B or Containment Spray B or RHR B
Inboard Primary Containment Isolation Valves	Outboard Primary Containment Isolation Valves
Emergency Equipment Cooling Water A	Emergency Equipment Cooling Water B

3.4. Physical Separation Requirements for PCIS and ESS Systems

3.4.1. Electrical equipment and wiring for Primary Containment Isolation Systems and the Engineered Safeguards Subsystems shall be segregated into at least two separate divisions designated I and II, etc., such that in the event of a design basis accident, removal of decay heat from the core and isolation of the primary containment will be assured. Separation requirements shall apply to control power and motive power for all systems concerned.

3.4.2. Consideration should be given to the likely dispersion pattern in the case of a potential missile source such as the turbine generator. Missiles are likely to be flung perpendicular to but not parallel to the axis of rotation. Cables or equipment redundant to each other should not be in a straight line along a likely missile path.

3.4.3. This document does not attempt to classify every area of the reactor plant in one of the following categories, but specifies minimum requirements and guidelines to be applied with good engineering judgment as an aid to prudent and conservative lay-out of electrical equipment and wireways throughout the plant. Separation requirements for protection against missile and fire hazards are stated in terms of distance. Suitable missile barriers or fire barriers between redundant safety systems will permit closer spacing.

3.4.4. Mechanical Damage (Missile) Zone. Arrangement and/or protective barriers shall be such that no locally generated force or missile can destroy both redundant PCIS and ESS functions. In the absence of confirming analysis to support less stringent requirements, the following rules are to be used:

3.4.4.1. In rooms or compartments having rotating heavy machinery such as the main turbine generator, the reactor recirculating pump MG sets and the reactor feed pumps or in rooms containing high pressure feedwater piping or high pressure steam lines such as exist in the drywell and between the reactor and the turbine, a minimum separation of 20 ft. or a 6 in. thick reinforced concrete wall (or equivalent) is required between trays containing cables of different divisions.

In making field runs of cable and conduit in the drywell, it may be impractical to meet this requirement in some instances. In cases where the above requirements cannot be met, the proposed design layout must be reviewed by Domestic Turnkey Projects Engineering to assure the adequacy of separation.

3.4.4.2. Any switchgear, panels, or instrument racks associated with two safety systems redundant to each other and located in a missile prone zone such as discussed above must have a minimum horizontal separation of 20 ft. or must be separated by a protective wall equivalent to a 6 in. thick reinforced concrete wall. The switchgear or equipment of redundant safety systems may be less than 20 ft. apart if the two pieces of equipment are not in a straight line along a likely missile path.

3.4.4.3. In any compartment containing an operating crane such as the turbine building main floor and the region above the reactor pressure vessel, there must be enough separation between trays containing cables of the two divisions such that a moving crane load cannot damage cables of both divisions in a single accident.

3.4.5. Fire Hazard Zone. Arrangement of PCIS and ESS cabling shall be such as to eliminate insofar as practical all potential for fire damage to cables and to separate the PCIS and ESS divisions so that fire in one division will not propagate to another division. In the absence of confirming analysis to support less stringent requirements, the following general rules shall be followed:

3.4.5.1. Routing of cables for PCIS and ESS control or power through rooms or spaces where there is potential for accumulation of large quantities (gallons) of oil or other combustible fluids through leakage or rupture of lube oil or cooling systems should be avoided. Where such routing is practically unavoidable, only one division of PCIS or ESS cables shall be allowed in any such place.

3.4.5.2. No PCIS or ESS cables shall be routed through the turbine oil storage room.

3.4.5.3. In any room or compartment in which the only source of fire is of an electrical nature, cable trays containing PCIS or ESS cables must have a minimum horizontal separation of 3 ft. if no physical barrier exists between trays. If a horizontal separation of 3 ft. is unattainable, a fire resistant barrier is required between the two trays. Cable trays may be of the open bottom type (ladder type or expanded metal bottom type).

3.4.5.4. For PCIS and ESS cable trays, there shall be a minimum vertical separation of 5 ft. between horizontal trays stacked vertically one above the other; however, vertical stacking of trays should be avoided wherever possible. In cases where trays must be run stacked one above the other, and where the trays meet the 5 ft. vertical separation requirement, the lower tray must have a steel cover and the upper tray must have a solid steel bottom. If the lower tray contains power cables, the tray cover should be louvered in order to permit heat removal from the power cables.

3.4.5.5. In the case of cross-over of one tray over another (or over a panel), there shall be a minimum vertical separation of 18 in. (tray bottom to tray bottom) with the bottom tray covered with a steel cover and the top tray provided with a steel bottom for a distance of 5 ft. on each side of the tray. If the lower tray contains power cables, the tray cover should be louvered.

3.4.5.6. Any openings in floors for vertical runs of PCIS or ESS cables must be sealed with fire resistant material.

3.4.6. Cable Spreading Room. The minimum horizontal and vertical separation and/or barrier requirements in the cable spreading room are as follows:

3.4.6.1. Where cables of different separation divisions approach the same or adjacent control panels with spacing less than the 3 ft. minimum, both cables shall be run in metal conduit to a point where 3 ft. of separation exists.

3.4.6.2. A minimum horizontal separation of 3 ft. is required between trays containing cables of different separation divisions if no physical barrier exists between trays. If a minimum horizontal separation of 3 ft. is unattainable, a fire resistant barrier is required between the two trays. Cable trays may be of the open bottom type (ladder type or expanded metal bottom type).

3.4.6.3. Vertical stacking of trays should be avoided wherever possible. However, where unavoidable, there shall be a minimum vertical separation of 5 ft. between horizontal trays running parallel one above the other and the top trays must have solid steel bottoms and the bottom trays must have steel covers. Closer spacing is permitted if there is a suitable fire barrier between the trays.

3.4.6.4. In the case of crossing of a tray of one separation division over a tray of the other division, there shall be a minimum vertical separation of 18 in. (tray bottom to tray bottom) with the bottom tray covered with a steel cover and the top tray provided with a steel bottom for a distance of 3 ft. on each side of the tray.

3.4.6.5. Any switchgear, panels, or instrument racks located in a fire hazard zone outside the main control room shall meet the separation requirements as specified in Para. 4.4.7 for main control room electrical components.

3.4.7. Main Control Room Panels. No single control panel (or local panel or instrument rack) shall include wiring essential to the protective functions of two systems which are backups for each other (Division I and Division II) unless the separation requirements discussed below are met.

3.4.7.1. If two panels containing circuits of different separation divisions are less than 3 ft. apart, there shall be a fire barrier between the two panels. Panel ends closed by steel end plates are considered to be acceptable barriers provided that terminal boards and wireways are spaced at least one inch from the end plate.

3.4.7.2. Floor-to-panel fire barriers must be provided between adjacent panels having closed ends.

3.4.7.3. A panel can contain wiring and components of two ESS systems redundant to each other providing that the panel is subdivided into compartments by means of a fire barrier. No cable terminal blocks or other components shall be located less than one inch from such a barrier.

3.4.7.4. No single panel compartment shall contain wiring or other components of two safety systems that are redundant to each other.

3.4.7.5. Penetration of separation barriers within a subdivided panel is permitted provided that such penetrations are sealed or otherwise treated so that an electrical fire could not reasonably propagate from one section to the other and destroy the protective function. Penetration of separation barriers will permit necessary interconnections between safety system redundant to each other and located in adjacent panel compartments.

3.4.7.6. Interconnection cables between Divisions I and II (See Figures 1 and 2) of the ESS and PCIS systems may be considered neutral and routed as either Division I or Division II cabling provided the loss of such interconnections together with the loss of the adjacent Division I or II cabling will not prevent automatic initiation of the redundant ESS or PCIS system. Cabling in this category need not be identified as ESS or PCIS cabling as called for in Section 3.2.

3.4.7.7. In cases where circuits and components such as manual switches, indicating lights, and annunciators are not vital to the automatic operation of safety systems redundant to each other, these circuits and components may be grouped together on the same control room panel.

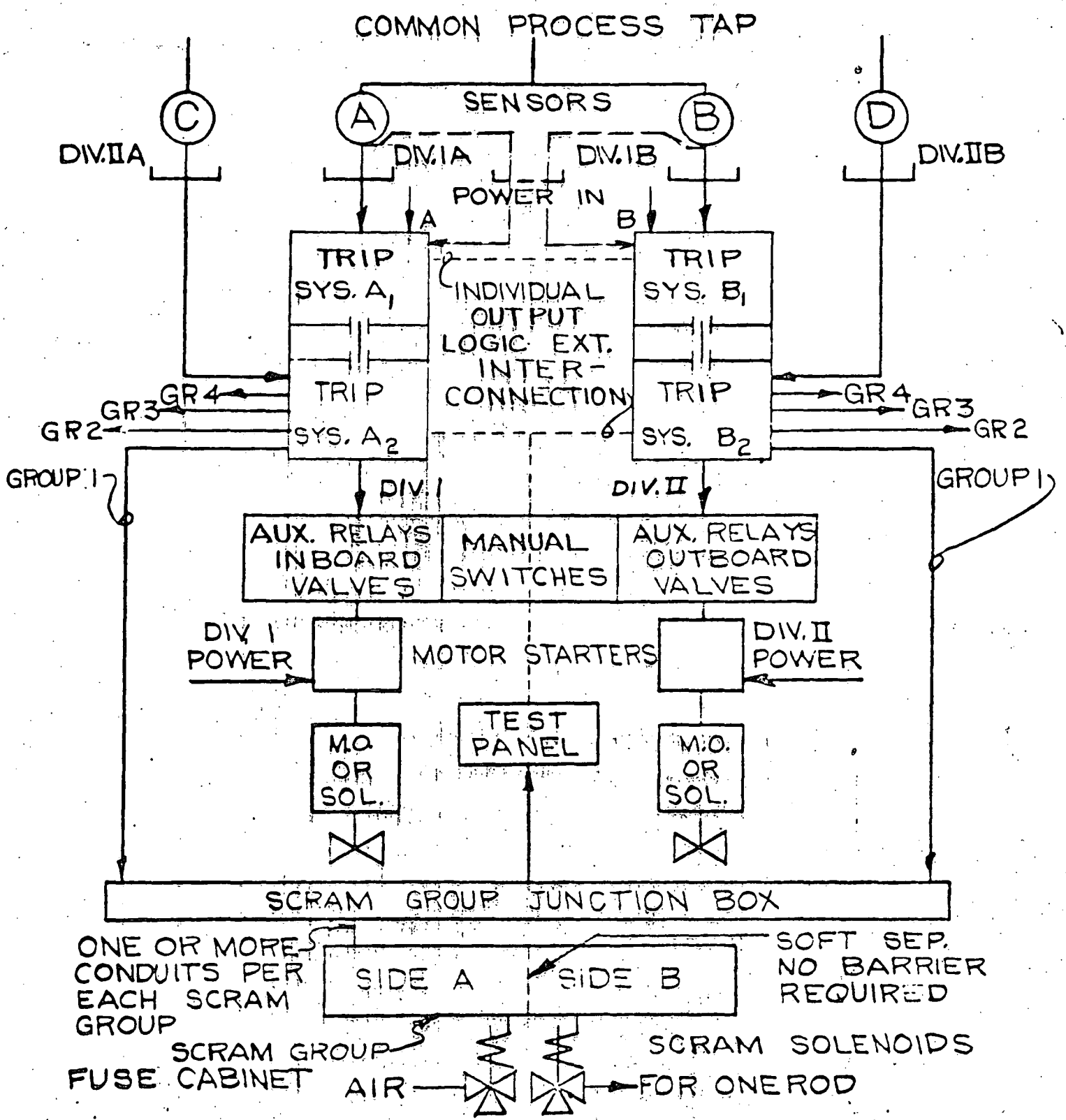

FIGURE 1

RPS & PCIS SEPARATION CONCEPT

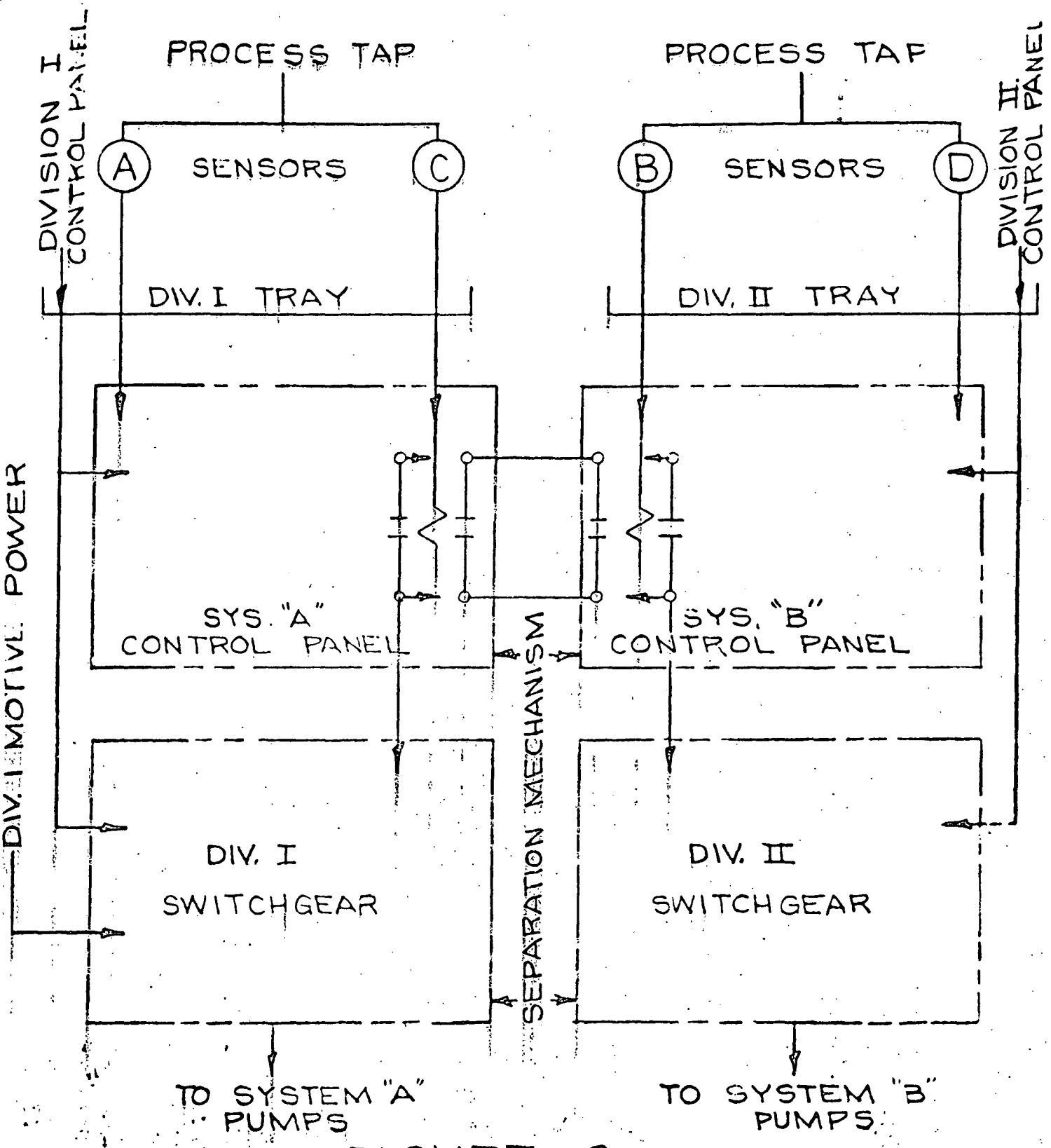

FIGURE 2

ESS SEPARATION CONCEPT SKETCH