GUIDELINE 1

SAFETY DESIGN CRITERIA - PERSONNEL HAZARDS

1. Purpose. This guideline establishes safety design criteria and provides guidelines for personnel protection.

2. Applicable Documents.

MIL-STD-464	Interface Standard for Electromagnetic Environmental Effects Requirements for Systems
MIL-STD-1310	Shipboard Bonding, Grounding, and Other Techniques for Electromagnetic Compatibility and Safety
MIL-STD-1425	Safety Design Requirements for Military Lasers and Associated Support Equipment
MIL-STD-1472	Human Engineering
DOD Manual 6050.5-M	Hazardous Materials Information System Procedure
DOD Instruction 6055.11	Protection of DoD Personal from Exposure to Radiofrequency Radiation and Military Exempt Lasers
ANSI C95.1	Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
ANSI C95.2	Radio Frequency Radiation Hazard Warning Symbol
ANSI N2.1	Radiation Symbol
ANSI Z136.1	Safe Use of Lasers
ANSI Z535.1	Safety Color Code
ANSI Z535.2	Environmental and Facility Safety Signs
ANSI Z535.3	Criteria for Safety Symbols
ANSI Z535.4	Product Safety Signs and Labels
ANSI Z535.5	Accident Prevention Tags (for Temporary Hazards)
NFPA 70	National Electrical Code
10 CFR 20	Code of Federal Regulations, Title 10, Chapter I, Part 20
21 CFR 1000-1050	Code of Federal Regulations, Title 21, Chapter I, Parts 1000-1050
29 CFR 1910	Code of Federal Regulations, Title 29, Chapter XVII, Part 1910
ASTM F 1166	Human Engineering Design for Marine Systems, Equipment and Facilities, Standard Practice for

3. Definitions.

3.1 Battleshort. A switch used to bypass normal interlocks in mission critical equipment; (i.e., equipment which must not be shut down or the mission function will fail) during battle conditions.

3.2 Chassis, electrical equipment. The chassis is a structural item fabricated in such manner as to facilitate assemblage and interconnection of electrical or electronic items for the specific purpose of providing a basis for electrical or electronic circuits. It normally has drilled or stamped holes to accommodate the items but may include only the items necessary for its own mounting and support.

3.3 Commercial off-the-shelf (COTS) equipment. Commercial off-the-shelf equipment that can be purchased through commercial retail or wholesale distributors as is (i.e., equipment that is available as a cataloged item) or with only minor modifications that does not alter its form, fit or functional characteristics.

3.4 Frame. The frame is any construction system fitted and united together, designed for mounting or supporting electrical or electronic parts or units.

3.5 Fail-safe. The design feature of a part, unit or equipment which allows the item to fail only into a non-hazardous mode.

3.6 Interlock. An interlock is an automatic switch which eliminates all power from the equipment when an
access door, cover or plate is removed.

3.6.1 Bypassable interlock. A bypassable interlock is an automatic switch with a manually operated electrical bypass device to allow equipment maintenance operations on energized equipment.

3.7 Leakage current. Leakage current is that current which flows through the equipment conductive paths to a solidly grounded source.

3.8 Procuring activity. A unit of the DoD which originates a procurement document for equipment or hardware.

4. General Guidelines.

4.1 Commercial off-the-shelf (COTS) equipment. Commercial off-the-shelf equipment that has been listed or certified to an appropriate commercial standard by a Nationally Recognized Test Laboratory (NRTL) (e.g., Underwriters Laboratories (UL), Canadian Standards Association (CSA), or TUV Rheinland (TUV)) should be considered as having met the provisions of this requirement and from a product safety perspective, should be accepted for use without further modification. COTS equipment which has any modifications and is required to meet commercial standards requires recertification by a NRTL.

4.2 Fail-safe. The design and development of all military electronic equipment should provide fail-safe features for safety of personnel during the installation, operation, maintenance, and repair or interchanging of a complete equipment assembly or component parts thereof.

4.3 Bonding in hazardous areas. Electronic equipment to be installed in areas where explosive or fire hazards exist should be bonded in accordance with MIL-STD-464 for aerospace systems, MIL-STD-1310 for shipboard systems, and NFPA 70, chapter 5, for facilities, or as otherwise specified in the detail equipment specification.

4.4 Temperature. At an ambient temperature of 25°C, the operating temperature of control panels and operating controls should be not greater than 49°C and not less than 12°C. The temperature of other exposed parts subject to contact by operating personnel should not exceed 60°C. The temperature of all other exposed surfaces should be not greater than 70°C.

4.5 Electrical. The design should incorporate methods to protect personnel from inadvertent contact with voltages capable of producing shock hazards.

4.5.1 Power. Means should be provided so that power may be cut off while installing, replacing, or interchanging a complete equipment, assembly, or part thereof. Interface with electrical power sources should be in accordance with the applicable regulations or requirements. If a main power switch is provided, it should be clearly labeled as such and should cut off all power to the complete equipment. Equipment that utilizes Uninterruptable Power Supplies (UPS) should have provisions to isolate the supply from the equipment.

4.5.2 Ground. The design and construction of equipment, excluding self-powered equipment, should insure that all external parts, surfaces, and shields, exclusive of antenna and transmission line terminals, are at ground potential at all times during normal operation. The design should include consideration of ground currents and voltage limits (possible arcing) established on a basis of hazardous location. Antenna and transmission line terminals should be at ground potential, except for Radio Frequency (rf) energy on their external surfaces.

4.5.2.1 Self-powered equipment. Self-powered equipment should have all external surfaces at the same potential.

4.5.2.2 Grounding methods. Plugs for use with metal cased portable tools and equipment should have provisions for automatically grounding the metal frame or case of tools and equipment when the plug is mated with receptacle, and the grounding pin should make first, break last. Ground connections to shields, hinges, and other mechanical parts should not be used to complete electrical circuits. Any external or interconnecting cable, where a ground is part of the circuit, should carry a ground wire in the cable terminated at both ends in the same manner as the other conductors. In no case, except with coaxial cables, should the shield be depended upon for a current-carrying ground connection. Static and safety grounds should not be used to complete electrical circuits. A point on the electrically conductive chassis or equipment frame should serve as the common tie point for static and safety grounding. The path from the tie point to ground should:

a. Be continuous and permanent.

b. Have ample carrying capacity to conduct safely any fault currents that may be expected, to be imposed on it by internally generated faults.

c. Have impedance sufficiently low to limit the potential above ground and to facilitate the operation of the over current devices in the circuits, and;

d. Have sufficient mechanical strength of the material to minimize possibility of ground disconnection.

4.5.2.3 Hinged or slide-mounted panels and doors. Hinges or slides should not be used for grounding paths. Panels and doors containing meters, switches, test points, etc., should be attached or hinged in such a manner as to insure that they are at the same ground potential as the equipment in which they are mounted, whether in a closed or open position. A ground should be considered satisfactory if the electrical connection between the door or panel and the system tie point exhibits a resistance of 0.1 ohm or less and has sufficient capacity to insure the reliable and immediate tripping of equipment over-current protection devices.

4.5.2.4 Shielding. Except where a conflict with single-point shield grounding guidelines would be created, shielding on wire or cable should be grounded to the chassis or frame. The shielding should be secured to prevent it from contacting exposed current-carrying parts or grounding to the chassis or frame at any point other than the ground termination. The shielding should end at a sufficient distance from exposed conductors to prevent shorting or arcing between the conductor and the shielding.

4.5.2.5 Leakage current. The equipment leakage current should not exceed 3.5 milliamperes dc or rms. When excessive leakage currents are required by design or operational requirements, redundant grounding or double insulation methods should be incorporated.

4.5.3 Accidental contact. The design should incorporate methods to protect personnel from accidental contact with voltages in excess of 30 volts rms. or dc during normal operation of a complete equipment.

4.5.3.1 Guards and barriers. All contacts, terminals and like devices having voltages greater than 30 volts rms or dc with respect to ground should be guarded from accidental contact by personnel if such points are exposed to contact during direct support or operator maintenance. Guards or barriers may be provided with test probe holes where maintenance testing is required.

4.5.3.2 High voltage guarding. Assemblies operating at potentials in excess of 500 volts should be completely enclosed from the remainder of the assembly and equipped with non-bypassable interlocks.

4.5.3.3 Voltage measurement. When the operation or maintenance of equipment employing potentials in excess of 300 volts peak could require that these voltages be measured, the equipment should be provided with test points so that these voltages can be measured at a relatively low potential level. In no case should the potential exceed 300 volts peak relative to ground. Test points with voltages above 30 volts should have the conducting material recessed a distance no less than the diameter of the probe hole and a minimum of 1.5 mm. If a voltage divider is used, the voltage divider resistance between the test point and ground should consist of at least two resistors of equal value in parallel.

4.5.3.4 Guarding of RF voltages. Transmitter output terminals, antennas and other devices that carry sufficient rf voltage to burn or injure personnel should be protected from accidental contact in the same manner as for ac voltages greater than 30 volts rms. (see 4.5.3.1.)

4.5.3.5 Main power switch. The power input side of the main power switch and the incoming power line connections should be given physical protection against accidental contact.

4.5.4 Protective devices.

4.5.4.1 Interlocks. When a unit is provided with access doors, covers or plates, these access points should be interlocked as follows:

a. No interlocks are required when all potentials between 30 and 500 volts are completely protected with guards or barriers to prevent accidental contact under all conditions of operation or any level of maintenance.

b. Bypassable interlocks are required when voltages in excess of 30 volts are exposed as the result of an access door, cover, or plate being opened. Note that these internal voltages are allowed to be unguarded only if they are not exposed during direct support or operator maintenance. The bypass device should be of such design that closing the associated door, cover or plate will automatically open the bypass device and leave the interlock in position to function normally. Visual means should be provided to indicate when the interlock is bypassed.

c. Non-bypassable interlocks are required when any voltage in excess of 500 volts is exposed as a result of an access door, cover or plate being opened.

4.5.4.2 Battle short indicator. In equipment with battleshort circuitry, an audio and visual warning system should be installed in the equipment. The visual warning should be clearly visible to operating personal. The audio warning should provide a means for manual silencing and automatic reset. Catastrophic fault interlocks should not be bypassed.

4.5.4.3 Safety switches. Safety switches, which will deactivate associated mechanical drive units, should be provided for the purpose of disconnecting these units without disconnecting other parts of the equipment. Such remotely located units and assemblies should have provision for non-overrideable safety switches to allow independent disconnection in the associated equipment.

4.5.5 Discharging devices.

4.5.5.1 Automatic discharge devices. High voltage circuits and capacitors should be provided with discharging devices unless they discharge to 30 volts or less within two seconds after power removal. The particular discharging device that is chosen should insure that the capacitor or high voltage circuit is discharged to 30 volts or less within two seconds. These protective devices should be positive acting, highly reliable, and should actuate automatically either by mechanical release or by electrical solenoid when the door or cover is opened. When resistive bleeder networks are used to discharge capacitors, the bleeder network should consist of at least two equal valued resistors in parallel.

4.5.5.2 Shorting rods. Shorting rods should be provided with all transmitting equipment where voltages are in excess of 70 volts rms or dc. Where size permits, shorting rods should be stored within the transmitting equipment, permanently attached, and readily accessible to maintenance personnel. The permanently attached rod should be connected through a flexible stranded copper wire (covered with a transparent sleeving) to the stud provided at the transmitter main frame. Where size does not permit internal storage of the shorting rod, a grounding stud should be provided to permit attachment of a portable shorting rod. The connection to the stud should be such that accidental loosening or high resistance to the ground is prevented.

4.5.6 Connectors. Connectors used in multiple electric circuits should be selected to preclude mismating. Where design considerations require plug and receptacles of similar configuration in close proximity, the mating plugs and receptacles should be suitably coded or marked to clearly indicate the mating connectors. Plugs and receptacles should not be of similar configuration if the major unit contains explosive items. The design of the connector should be such that the operator is not exposed to electrical shock or burns when normal disconnect methods are used. Exposed pin contacts should not be energized (hot) after being disconnected from the socket contacts.

4.6 Radiation. The design of all equipment for which a federal standard exists under 21 CFR Pt. 1000 - 1050, " The Radiation Control for Health and Safety Act of 1968", should conform to the appropriate federal standard.

4.6.1 Microwave and rf radiation. All electronic equipment or electrical devices capable of emitting microwave or RF radiation between 3 kHz and 300 GHz should be so designed, fabricated, shielded and operated as to avoid overexposure of personnel. Exposure to RF radiation should meet the Controlled and/or Uncontrolled environment Maximum Permissible Exposure Levels called out in IEEE/ANSI C95.1. In areas where unintended radiation levels exist, equipment design and installation in any unrestricted area accessible to personnel should meet the Uncontrolled environment requirements of IEEE/ANSI C95.1. Shields, covers, doors, etc, which when opened or removed will allow microwave and rf radiation to exceed the above, should be provided with non-bypassable interlocks.

4.6.2 X radiation. All electronic or electrical devices capable of producing X radiation should be so designed, fabricated, shielded and operated as to keep personnel exposure as low as reasonably achievable. For equipment and installation design, shielding guidelines should be maintained at all times which limit radiation levels to not greater than 2 milliroentgens (mr) in any one hour and 100 mr in any 7 consecutive days at the operator position or within 5cm from the equipment (whichever is closer) in any unrestricted area accessible to personnel. In addition, these levels should be reduced whenever necessary to ensure that exposed personnel never receive an absorbed dose to the whole body or any critical organ in excess of 125 millirem per calendar quarter or 500 millirem per year. Other exposure should be based on application criteria and limits as required by Nuclear Regulatory Commission Rules and Regulations, 10 CFR 20; OSHA Regulations, 29 CFR 1910.96; and FDA Regulation, 21 CFR, chapter I, subchapter J, Radiological Health. Equipment which, when shields, covers, doors, etc, are removed, will allow X radiation to exceed 2.0 mr per hour should be provided with nonbypassable interlocks.

4.6.3 Laser radiation. Laser equipment and system design, installation, and operational and maintenance procedures should conform to 21 CFR 1040 and ANSI Z136.1. If these cannot be met because of operational requirements, an exemption should be requested from the FDA through the procuring activity, and applicable military laser safety requirements in MIL-STD-1425 must be considered.

4.7 Mechanical. The design of the equipment should provide personnel maximum access and safety while installing, operating, and maintaining the equipment. Equipment design should include provisions to prevent accidental pulling out of drawers or rack mounted equipment components. Suitable protection should be provided to prevent contact with moving mechanical parts such as gears, fans, and belts when the equipment is complete and operating. Sharp projections on cabinets, doors, and similar parts should be avoided. Doors or hinged covers should be rounded at the corners and provided with stops to hold them open.

4.7.1 Mechanical interconnection. The design should provide positive means to prevent the inadvertent reversing or mismating of fittings; couplings; fuel, oil, hydraulic, and pneumatic lines; and mechanical linkage. When prevention of mismating by design consideration is not feasible, coding or marking should be employed when approved by the procuring activity. Coding and marking will not be approved as a substitute for proper design or items involving explosive, emergency, or safety critical systems.

4.7.2 Power switch location. Equipment power switches should be selected and located so that accidental contact by personnel will not operate the switch.

4.7.3 Cathode ray tubes. Provision should be incorporated to protect personnel from injury due to implosion of cathode ray tubes.

4.7.4 Battery Enclosures. Battery Enclosures should be vented. The enclosure design should prevent shattering, or fragmenting of enclosure parts or covers in the event of a violent gas venting or rupture of battery cells causing explosive high pressure within the compartment.

4.8 Equipment safety markings. Danger, warning, caution, signs, labels, tags and markings should be used to warn of specific hazards such as voltage, current, thermal, or physical. The signs, labels, tags, and markings should be as permanent as the normal life expectancy of the equipment on which they are affixed. Guards, barriers, and access doors, covers or plates should be marked to indicate the hazard which may be present upon removal of such devices. When possible, marking should be located such that it is not removed when the barrier or access door is removed. Additionally, hazards internal to a unit should be marked adjacent to hazards if they are significantly different from those of surrounding items. Such a case would be a high voltage terminal in a group of low voltage devices.

a. Physical hazards should be marked with color codes in accordance with ANSI Z535.1 where applicable to electronic equipment.

b. For potentials between 70 and 500 volts, warning signs, labels, or tags should be in accordance with ANSI Z535.3, ANSI Z535.4, or ANSI Z535.5 contain the single word "WARNING", and the maximum voltage applicable (i.e., 110VAC).

c. For potentials in excess of 500 volts, warning signs, labels or tags should be in accordance with ANSI Z535.3, ANSI Z535.4, or ANSI Z535.5 contain the single word "DANGER", the descriptive words "High Voltage" and the maximum voltage applicable (i.e., High Voltage 550 VAC).

d. Microwave or RF radiation warning signs, labels or tags should be in accordance with ANSI Z535.3, ANSI Z535.4, or ANSI Z535.5 and ANSI C95.2. Labels should be provided on all radiation shields to warn personnel of the radiation hazards involved upon removal thereof. Any item, which can emit radiation levels in excess of those specified in 4.6.1, should be labeled. Minimum safe clearance distances should be clearly marked. Warning signs should be posted in all areas having electronic equipment designed to operate between 3 kHz and 300 GHz with intended electromagnetic radiation levels exceeding those in 4.6.1.

e. Laser labels

(1) Laser labels should be in accordance with 21 CFR 1040.

(2) Military exempt laser labels: A permanent label should be affixed on all military laser systems that have been certified exempt from 21 CFR 1040 (Performance Standards for Light-Emitting Products). The label tags should be in accordance with ANSI Z535.3, ANSI Z535.4, or ANSI Z535.5, should use the single word caution, and should read:

<u>CAUTION</u>

This electronic product has been exempted from FDA radiation safety performance standards, prescribed in the Code of Federal Regulations, title 21, chapter I, subchapter J, pursuant to exemption no. 76 EL-01 DOD issued on 26 July 1976. This product should not be used without adequate protective devices or procedures.

f. Shields which protect personnel from X radiation should be labeled in accordance with 10 CFR 20.

g. Coding for accident prevention tags should be in accordance with ANSI Z535.5.

h. Coding for safety labels on equipment should be in accordance with ANSI Z535.4.

i. Coding for safety signs regarding facilities or the environment should be in accordance with ANSI Z535.3.

j. The marking or labeling of commodities containing radioactive materials should be in accordance with 10 CFR 20.

k. Ionizing radiation hazard symbols should be in accordance with ANSI N2.1.

l. Symbols used on hazard warning signs, labels, tags should be IAW ANSI Z535.2.

4.9 Hazardous and restricted materials.

4.9.1 Gases or fumes. The materials, as installed in the equipment and under service conditions specified in the equipment specification, should not liberate gases which combine with the atmosphere to form an acid or corrosive alkali, nor should they liberate toxic or corrosive fumes which would be detrimental to the performance of the equipment or health of personnel. The materials also should not liberate gases which will produce an explosive atmosphere.

4.9.2 Mercury. Materials and parts containing mercury should not be used unless use of mercury is specifically required or approved by the procuring activity.

4.9.3 Radioactive materials. Use of radioactive materials should conform to Nuclear Regulatory Commission regulations and should require approval of the procuring activity. Radium should not be used to achieve self-luminosity.

4.9.4 Glass fibers. Glass fiber materials should not be used as the outer surface or covering on cables, wire or other items where they may cause skin irritation to operating personnel. When maintenance procedures require access to glass fibers, such as insulation, a proper caution note should be provided.

4.9.5 Cadmium. Cadmium plating and devices using cadmium should not be used unless specifically approved by the procuring activity.

5. Detail Guidelines.

5.1 Human engineering. Human engineering factors affecting safety should be considered when establishing general or detailed design criteria. Rigorous detailed operational or maintenance procedures are not acceptable substitutes for an inherently safe design. Hazard and safety requirements of MIL-STD-1472 or ASTM F 1166 (for marine systems, equipment and facilities) should be used as a guide.

5.2 Electrical. Proper instructions in accident prevention and first-aid procedures should be given to all persons engaged in electrical work to fully inform them of the hazards involved.

5.2.1 Shock hazards. Current rather than voltage is the most important variable in establishing the criterion for shock intensity. Three factors that determine the severity of electrical shock are: (1) quantity of current flowing through the body; (2) path of current through the body; and (3) duration of time that the current flows through the body. The voltage necessary to produce the fatal current is dependent upon the resistance of the body, contact conditions, and the path through the body. See table 1-I. Sufficient current passing through any part of the body will cause severe burns and hemorrhages. However, relatively small currents can be lethal if the path includes a vital part of the body, such as the heart or lungs. Electrical burns are usually of two types, those produced by heat of the arc which occurs when the body touches a high-voltage circuit, and those caused by passage of electrical current through the skin and tissue. While current is the primary factor which determines shock severity, protection guidelines are based upon the voltage involved to simplify their application. In cases where the maximum current which can flow from a point is less than the values shown in table 1-I for reflex action, protection guidelines may be relaxed.

TABLE 1-I. Probable effects of shock.

Current values (milliamperes)		Effects
AC 25 Hz to 400 Hz	DC	
0-1	0-4	Perception
1-4	4-15	Surprise
4-21	15-80	Reflex action
21-40	80-160	Muscular inhibition
40-100	160-300	Respiratory block
Over 100	Over 300	Usually fatal

5.2.2 Insulation of controls. All control shafts and bushings thereof should be grounded whenever practicable. Alternatively, the control knobs or levers and all attachment screws that can be contacted during use should be electrically insulated from the shaft.

5.2.3 Grounding to chassis. Ground connection to an electrically conductive chassis or frame should be mechanically secured by soldering to a spot welded terminal lug or to a portion of the chassis or frame that has been formed into a soldering lug, or by use of a terminal on the ground wire and then securing the terminal by a screw, nut, and lock-washer. The screw should fit in a tapped hole in the chassis or frame or it should be held in a through-hole by a nut. When the chassis or frame is made of steel, the metal around the screw hole should be plated or tinned to provide a corrosion resistant connection. When aluminum alloys are used, the metal around the grounding screw or bolthole may be covered with a corrosion resistant surface film only if the resistance through the film is not more than 0.002 ohm. Hardware used for mounting of meters, switches, test points, etc., should be grounded, whenever possible.

5.2.4 Accidental contact. Suitable protective measures are defined in table 1-II.

5.2.4.1 High current protection. Power sources capable of supplying high current can be hazardous regardless of the voltage at which they operate because of the arcing and heat generated if an accidental short circuit occurs. All power buses supplying 25 amperes or over should be protected against accidental short-circuiting by tools, jewelry or removable conductive assemblies. This may be accomplished by one or more of the following:

a. Use of guards and barriers;

b. Sufficient space separation to prevent short circuits;

c. Hazard warning - signs and Labels.

5.2.4.2 Interlocks. Various equipment designs require different approaches to the use of interlocks. Interlock use does not modify any other guidelines of this handbook and must be consistent with equipment or system specifications. Equipment sub-assemblies operating in excess of 500 volts should be considered guarded from accidental contact only if they are completely enclosed from the remainder of the equipment and are separately protected by non-bypassable interlocks. (An example of an equipment where such compartmentalization is desirable is a display unit which utilizes a high voltage power supply for a cathode ray tube.) Modularized or sealed high voltage assemblies which are opened only at depot level are exempt from interlocking guidelines when approved by the procuring activity.

5.2.4.3 Permanent terminations. Terminations such as soldered connections to transformers, connectors, splices, etc., which are normally permanent and not used during routine maintenance testing, may be protected by permanent insulation such as shrink sleeving, tubing, insulating shields, etc., provided the material is rated for the potential exposed voltage.

5.3 Mechanical. Design of rack-mounted equipment should maintain the center of gravity as low as possible to minimize tipping over.

5.4 Marking. DOD 6050.5 references known electronic items which require marking and may be used as a guide.

5.5 Materials. Certain chemicals have been identified in the Occupational Safety and Health Act (OSHA) as cancer-producing substances (carcinogens). Before using any materials which might contain these chemicals, they should be evaluated in accordance with 29 CFR 1910.

TABLE 1-II. Suitable protective measures. 1/

Voltage range	Type of protection 2/								
				Marking		Interlocks		Discharge devices	
	None 3/	Guards and barriers (4.5.3.1)	Enclosures (4.5.3.2 4.5.4.1	Cautio n (4.8b)	Danger (4.8c)	Bypassable (4.5.4.1b)	Non- 4/ bypassable (4.5.4.1c)	Automatic (4.5.5.1)	Shorting rods (4.5.5.1)
0 - 30 Volts	X								
> 30 - 70 Volts		X				X		X	
> 70 - 500 Volts		X		X		X		X	X
> 500 Volts		X	X		X		X	X	X

1/ Table is for reference only. See applicable paragraph for guidance.

2/ Confine the application of headings to voltage ranges indicated. More than one option may be available on design guidance.

3/ Although no specific guidance exist for servicing 0-30 volts, designs should be reviewed for possible hazards in accordance with table 1-I.

4/ Designs may use non-bypassable interlock applications below 500 volts, but the intent here is to imply complete enclosure.