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1	1	QA H.H. Kohl	<i>H.H. Kohl</i>	8/30/94	T4-19						1
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PANEL FIRST UNIT RE-BUILT

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This document was reviewed following the
procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

* * * * *

WHC Information Release Administration Specialist:

Kara Broz

(Signature)

9/14/94

(Date)

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SUPPORTING DOCUMENT		1. Total Pages 31
2. Title ENGINEERING WORK PLAN FOR PFP CRITICALITY ALARM PANEL FIRST UNIT RE-BUILD	3. Number WHC-SD-CP-WP-023	4. Rev No. 0
5. Key Words CRITICALITY ALARM SYSTEM, CAS, CRITICALITY ALARM PANEL, CAP, PLUTONIUM FINISHING PLANT, PFP <i>KMB 9/14/94</i>	6. Author Name: W. E. Clem <i>W.E. Clem</i> Signature Organization/Charge Code 15520 KLC4E	
7. Abstract <p>This document describes the first step in increasing the quality, reliability, and ease of maintenance of the nine Criticality Alarm Panels (CAP) at PFP. Development control practices and guidelines of WHC-CM-6-1, EP-2.4 and WHC-IP-1026, EPG-2.4 are applied to develop a prototype of a replacement Criticality Alarm Panel (CAP) with facility-use potential. During the development of the prototype CAP, the design requirements of all of PFP's nine CAPs are considered to develop standardized hardware and detailed design drawings that are tailored to PFP maintenance needs. Increased quality and reliability is achieved through quality hardware, proven technology and design techniques, and the use of the Class 1E workmanship standards of WHC-CM-8-1. The end result of the work described by this work plan is a verified/ready-to-install replacement for CAP Z4 and verified/released H-2 drawings that are formatted such that they can easily be replicated when producing design drawings for the other eight CAPs.</p>		
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CRITICALITY ALARM SYSTEM ACRONYMS:

AMS - Alarm Monitoring System	CBS - Central Battery System
ASG - Audible Signal Generator	CDL - Criticality Detector Lamp
CAD - Criticality Alarm Detector*	CDS - Criticality Detector Station
CADM - Criticality Alarm Detector Module*	ECN - Engineering Change Notice
CAF - Criticality Alarm Flasher	EO - Engineering Order
CAH - Criticality Alarm Howler	MIR - Master Intertie Relay
CALM - Criticality Alarm Logic Module	MUX - Multiplexer
CAP - Criticality Alarm Panel	NIM - Nuclear Instrument Module
CARM - Criticality Alarm Relay Module	PFP - Plutonium Finishing Plant
CAS - Criticality Alarm System	PRF - Plutonium Recovery Facility
	SPP - Sound Powered Phone

* GA-2TMO is the vendor part number for the CAD/CADM pairs.

1.0 STATEMENT OF NEED. The nine Criticality Alarm Panels (CAPs) at PFP must be standardized, documented in detail, and re-fabricated to recognized workmanship standards to increase reliability, ensure personnel safety and facilitate maintenance.

2.0 SCOPE. This Engineering Work Plan describes a process by which cost, time expenditures and unscheduled soundings of the PFP CAS can be reduced through the use of the development control practices and guidelines of WHC-CM-6-1, EP-2.4 and WHC-IP-1026, EPG-2.4. These practices and guidelines will be used to develop a first-unit CAP as a prototype with facility-use potential. The first-unit CAP shall be configured as the replacement for CAP Z4. Pending fabrication, documentation, verification, and approval of the first unit, the remaining eight CAPs can be produced in an assembly-line fashion using the normal design process whereby each CAP will be fabricated to released drawings. Note that work on the remaining 8 CAPs is not part of this engineering work plan.

A CAP comprises electrical, electronic, and mechanical hardware and criticality detection-alarm instrumentation (CADMs, CALMs & CARM). This document describes the development process used to fabricate, assemble, document, and verify the electrical, electronic, and mechanical hardware of the new CAP Z4 (see Section 3.0 OBJECTIVES for more complete work description). This document does not cover installation activities of the new CAP Z4.

The new CAP Z4 shall use the same CADMs, CALMs, and CARM as the present CAP Z4 and will thus be functionally identical. Conformance to the requirements of references 1, 5, 6, and 14 (Section 10.0) shall not be compromised by the new CAP Z4. The new CAP will differ from the old in that it shall be designed for reliability and ease of maintenance (quick component change-out capability, for example), fabricated to accepted workmanship standards, and documented by detailed design drawings that fulfill PFP maintenance needs.

Development control practices, referenced above, allow for hardware fabrication prior to preparation, approval and release of formal H-2 drawings. Development Control drawings/sketches (see section 6.0 of this work plan) are used to keep the design on-track, to ensure conformance to design inputs (performance requirements, standards/regulatory/DOE Order requirements, and, in this case, maintenance requirements) and to facilitate preparation of as-built H-2 drawings depicting the finished, fabricated prototype.

It should be noted that requirements for installation of a prototype are the same as those for an item that has approved-released design drawings prior to fabrication; in both cases accurate design documentation and performance verification are prerequisites. The prototype development process can reduce design and drafting errors (typical of Rev 0 design drawings), and allow design refinements for added safety, added reliability, reduced fabrication cost, and easier maintenance.

PFP Maintenance input will be solicited throughout the hardware procurement and fabrication phase of the prototype. In addition, their input will be solicited during the subsequent preparation and approval of the H-2 design drawings (per WHC-CM-6-3) for the prototype.

Prior to installation of the prototype CAP Z4, an Acceptance Test Procedure/Report shall be completed and approved. The ATP/R shall document the following:

- 1 Hardware drawing conformance.
- 2 Workmanship standard conformance.
- 3 Wiring continuity.
- 4 Verification of performance.

This Engineering Work Plan covers activities to fabricate and develop a prototype CAP and to document its design and performance to qualify it for facility-use. A work package for the installation (per ECN to current architectural drawings) and operational testing per existing calibration procedure ZSE-99A-021 will be prepared subsequent to the successful completion of the activities described by this Engineering Work Plan.

3.0 OBJECTIVES. The PFP CRITICALITY ALARM PANEL FIRST-UNIT RE-BUILD is part of an overall objective to standardize and document (see Attachment 1, p. 15) the PFP CAS to facilitate maintenance and increase the quality, safety, and reliability of the system. The overall objective will be accomplished in four phases:

- o Phase 1 - PFP CAS BUILDING-LEVEL AS-BUILD
- o Phase 2 - PFP CRITICALITY ALARM PANEL FIRST-UNIT RE-BUILD
- o Phase 3 - PFP CRITICALITY ALARM PANEL RE-DESIGN/RE-BUILD
- o Phase 4 - PFP CRITICALITY POWER SYSTEMS UP-GRADE

This Engineering Work Plan addresses Phase 2, only. The main objectives of Phase 2 are:

- 1 CAP hardware standardization.
- 2 Fabrication of a first-unit CAP using uniform workmanship standards.
- 3 Creation of detailed design drawings for the new CAP Z4 that are tailored to the needs of maintenance personnel and formatted on AutoCAD so that design drawings for subsequent CAPs can be easily replicated.
- 4 Documented verification of hardware, design, and performance of the first-unit CAP in preparation for facility-use.

In addition to conformance to the Drafting Standards Manual (WHC-CM-6-3), the design drawings of item # 3, above, shall depict circuits that are shown in such a way as to facilitate the understanding of their function as well as their maintenance and fault location.

NOTE: A typical CAP consists of Criticality Alarm Detector Modules (CADM), Criticality Alarm Logic Modules (CALM), a Criticality Alarm Relay Module (CARM), an Audible Signal Generator (ASG), alarm*/annunciation** interface relays, detector Inhibit Switches (one for each CADM) and various common hardware, all housed in/on an instrument cabinet. CAPs at PFP house from 3 to 21 CADMs, and each CADM contains the support electronics for a remote Criticality Alarm Detector (CAD). Modified Nuclear Instrument Module (NIM) bins, also installed in the instrument cabinet, house up to 6 CADMs each. A key operated Inhibit Switch is installed immediately above each CADM and prevents false alarms during calibrations. Another modified NIM bin houses the CALM(s) and the CARM which are responsible for the 2-of-N alarm logic employed by the PFP CAS. One CALM handles the alarm relay contact closures for up to six CADMs.

- * Alarm interface relays cause all Criticality Alarm Howlers except those of CAP Z8 to be activated when a Criticality is detected. CAP Z8 is remote and operates independently.
- ** Four annunciations from each CAP are fed into AMS MUXs to be monitored at a continually occupied location. They are ALARM (hi-trip of two detectors), ALERT (hi-trip of one detector), SYSTEM FAILURE (low-trip of any detector), and POWER FAILURE (failure of primary power supply/operation on battery back-up power).

With the exception of an ASG and the Inhibit switches, the active CAP Safety Class components, i.e. CADM, CALM, and CARM, shall remain unchanged as a result of work described by this engineering work plan. (During the installation of CAP Z4, these modular components will be un-plugged from the old CAP and plugged into the new one.) An ASG for the prototype will be modified to accommodate input power isolation of its otherwise redundant "A" and "B" circuit alarm-signal generators. This modification will eliminate a single-point-failure potential, but will not alter the ASG's performance. Pending verification of the design and performance of the prototype, the ASG

modification will be accomplished for all other CAPs during subsequent rebuild activities which are not part of this engineering work plan. The majority of the work described by this engineering work plan involves changes to and documentation of passive Safety Class components and hardware, i.e. cabinet, NIM bins, wire, and other common hardware.

3.1 DESIGN INPUTS. Activities described by this document shall, in no way, compromise conformance with the requirements of DOE Order 5480.5, ANSI/ANS-8.3 and WHC-CM-4-29 to which the PFP Criticality Alarm System presently conforms. The following additional design requirements are conclusive in defining specific engineering objectives:

- 1 CAP instrument cabinets shall be standardized. (This includes the use of identical instrument cabinets for all CAPs and the conversion of double cabinet installations (CAPs Z5 & Z6) to single cabinet installations.)
- 2 CAP component layout shall be standardized.
- 3 Capability of electrical isolation of (1) the "D" circuit (power to CADMs, CALMs, & CARM), (2) the "C" circuit (power to alarm/annunciation control relays), (3) the "B" circuit (power to even numbered howlers), and (4) the "A" circuit (power to odd numbered howlers) shall be provided.
- 4 Dry-circuit-rated switches (or relays) shall replace the obsolete Inhibit Switches.
- 5 Provisions shall be made to eliminate the single-point-failure potential of the Audible Signal Generator (ASG) by operating the ASG "A" amplifier on power from the howler "A" circuit and the ASG "B" amplifier on power from the howler "B" circuit.
- 6 Fabrication and assembly of the First Unit CAP (and future CAPs) shall conform to WHC-CM-8-1 Section 101 Parts 1.0, 2.0 & 3.0, Sections 201 through 205, Section 208, and Section 301.
- 7 CAP design drawings shall be standardized and formatted as appropriate for compatibility with new "next-used-on" CAS installation drawings. (Note that CAS installation as-building is not part of this work plan.)
- 8 CAP design drawings shall be tailored to the needs of PFP maintenance personnel to facilitate trouble-shooting and repairs.
- 9 Standard Nuclear Instrument Module (NIM) bin modifications shall be documented.
- 10 CADM remote reset capability, now required by DOE Order 5480.24 and WHC-CM-4-29, shall be provided for future connection to facility wiring. (Note that a future ECN must be prepared to add a resistor, diode and wire between the "RR" buss on each CADM circuit board and its NIM connector so that it can accommodate remote reset capability.)

3.2 Achievement of the objectives of this work plan may be compromised by any of the following:

- 1 Resources (personnel) are not available when needed.

- 2 Cost exceeds available funding.
- 3 Schedule exceeds commitment date.
- 4 Significant changes in work scope or priority.
- 5 Proper fabrication tools are not available.
- 6 Component parts are not available when required.
- 7 An adequate assembly/staging/bench-test facility is not available.
- 8 Recognized workmanship practices are not used for CAP fabrication.
- 9 Labor agreements which prevent a "one-stop-shop".

4.0 DESCRIPTION OF END RESULT. The "finished" prototype CAP Z4 is intended to be suitable and ready for installation. The CAP will comprise a new standardized instrument cabinet, containing a modified ASG; an empty, modified, NIM bin for the CALMs and CARM; an appropriate number INHIBIT SWITCH panels; 3 empty, modified, CADM NIM bins; a Sound Powered Phone panel and blank panels to cover any unused front panel space. As viewed from the back, the prototype CAP will contain CAP internal wiring and inside/side mounted electrical hardware, including terminations for facility wiring.

5.0 RESTRICTIONS/SPECIAL CONSIDERATIONS.

5.1 Engineering Practices. WHC-CM-6-1, EP-2.4, "DEVELOPMENT CONTROL", and its applicable references, including WHC-IP-1026, EPG-2.4, shall govern all engineering work described by this engineering work plan. The prototype CAP Z4 will have Facility-Use Potential, and its development shall conform to the applicable requirements of EP-2.4 for this developmental category.

5.2 NEC Class Locations. Existing and planned Criticality Alarm Panels are not designed or intended for operation in National Electrical Code Class I (flammable gases), Class II (combustible dust), or Class III (ignitable fibers) locations and SHALL NOT be installed in such locations.

5.3 Wire Types for CAP Internal Wiring. DOE Order 6430.1A Section 1605-2.2.1 specifies the use NFPA 70 - National Electrical Code (NEC) wiring types including Teflon TFE (Teflon is a trademark of Du Pont de Nemours and Co.). The arbitrary use of Teflon TFE wiring in DOE Special Facilities is unusual in view Teflon TFE's relatively low tolerance to radiation induced damage (see M.H. Van de Voorde, European Organization for Nuclear Research, CERN 70-5, "EFFECTS OF RADIATION ON MATERIALS AND COMPONENTS", Geneva 1970).

It is unclear if DOE Order 6430.1A Section 1605-2.2.1 intends the specified wire types to be used for applications other than those described in Article 90-2 of the NEC. In all cases, Section 1605-2.2.1 of this DOE Order specifies wire types that are available in only 14 AWG size or larger. The criticality system components in each CAP require wire no larger than 16 AWG - in some cases, 22 AWG is the largest that can be used. If this DOE Order is interpreted to mean that 14 AWG or larger wire is required inside instrument racks, then the CAP re-build

effort can be terminated at this time. However, Section 0101-2 of this DOE Order states that "...these criteria are not intended to impose unnecessary design restrictions or requirements...". Section 1600 of this DOE order states, "These criteria are not intended to supersede more stringent or equivalent criteria or standards for specific facilities or used by any DOE power administration."

Wire requirements for the CAP cabinets are as follows:

- 1 Conductor:
 - o copper - probably the most common electrical conductor
 - o annealed/soft - discourages breakage
 - o 19 tin-coated strands - stranding allows flexibility, tinning allows high-quality solder connections & retards corrosion
 - o available in 22 AWG - 14 AWG
- 2 Insulation:
 - o breakdown - 300 V or greater (the CAS is a 24 V system)
 - o moisture, oil resistant
 - o flame-retardant
 - o operating temperature range - 4°C - 65°C

NEC AND MIL STANDARD WIRE COMPARISON:

The NEC does not describe the wire types specified by DOE Order 6430.1A Section 1605-2.2.1 in sufficient detail to determine conformance to the above requirements. For detailed wire classification information from sizes No. 14 through 2000 kcmil, Article 310-13 refers to un-numbered "...standards or directories, such as those published by the Underwriters Laboratories Inc." Article 310-13 does not mention similar information for wire sizes smaller than 14 AWG..

Table 310-13 of NFPA 70 lists type MTW (machine tool wire). Per this table, type MTW is the only wire type available in the 22 - 14 AWG range needed for CAP fabrication. Its "thermoplastic" insulation is rated at 60°C (uncovered) or 90°C (nylon covered), and is flame retardant and moisture-heat-oil resistant. No insulation voltage rating was found. NFPA 79 defines thermoplastic as "a synthesized compound whose characteristic constituent is polyvinyl chloride or a copolymer of vinyl chloride or vinyl acetate."

MIL-W-16878F TYPE M16878/1-B wire is available in 32 - 0000 AWG. Its PVC insulation is rated at 105°C and 600 V. The "/17-B" version of this wire has a nylon jacket and is also rated at 105°C and 600 V. PVC is defined as "polyvinyl chloride or its copolymer polyvinyl acetate".

The references of NFPA 79 and MIL-W-16878F indicate that the conductors of both MTW and M16878 wire conform to ASTM B33 "*Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes*", and to ASTM B286, "*Standard Specification for Copper Conductors for Use in Hookup wire for Electronic Equipment*". MTW wire is either bare copper or coated (tinned) copper; only a minimum stranding number is given. M16878/1-B or /17-B is coated copper only and is available in a wide selection of stranding for flexibility requirements.

Material certification of NEC wiring is judged to be difficult due to incomplete descriptions in the NEC and reference to un-numbered "...standards or directories, such as those published by the Underwriters Laboratories Inc." Complete descriptions and references for military standard wire can be obtained by requesting a copy of MIL-W-16878F(NAVY) from the Kaiser Library. For this reason, properly sized wiring conforming to "more stringent or equivalent" military standard criteria will be used for the fabrication of all CAPs.

To allow high-quality solder connections, to retard corrosion and to reduce the effects of flexing, tin-coated, 19-strand, soft-copper, PVC insulated wire meeting the requirements of MIL-W-16878/1 or MIL-W-16878/17 shall be used in the fabrication of all Criticality Alarm Panels. Except for facility interface wiring, no bare (un-tinned) copper wire or aluminum (copper-clad or otherwise) wire shall be permitted in a Criticality Alarm Panel. In addition, no Teflon TFE insulated wire shall be used.

5.4 Applicability of Standards. For machine tool wiring, Table 310-13 of the NFPA 70 lists wiring type MTW per the provisions of NFPA 79. Section 1-2(a) of NFPA 79 states that, "The provisions of this standard shall apply to the electrical/electronic equipment, apparatus, or systems of industrial machinery operating from a nominal voltage of 600 volts or less, and commencing at the place of connection of the supply to the electrical equipment of the machines." Even though a CAP cannot be classified as electrical equipment of machines, NFPA 79 establishes a precedent for the electrical wiring of equipment to standards other than NFPA 70. However, per NFPA 79: Section 1-2(d), "The installation of a machine and the wiring between component machines of "manufacturing systems cells" shall be in accordance with NFPA 70, National Electrical Code...". For purposes of this work plan, the applicabilities of standards will be as follows:

- o NFPA 70 National Electrical Code - installations of electric conductors and equipment as described by Article 90-2 of NFPA 70, commencing at the place of connection to the utility supply/transmission wiring¹ and ending at the points of connection to electrical loads which include installed appliances, machines, and other equipment. Installation of inter-connecting wiring

between installed equipment, appliances, and machines shall also be covered by NFPA 70.

EXCEPTION: Installation of special purpose wires, such as thermocouple extension wires, shall be permitted providing that appropriate measures are taken to prevent insulation and/or conductor damage when pulling wiring through conduits and pull boxes.

- o Other electrical/electronic standards - internal wiring of equipment, appliances or machines commencing at the place of connection to facility power. For CAP internal wiring, applicable Class 1E Workmanship Standards of WHC-CM-8-1 will be used.
- 1 Generation control, transmission and sub-station wiring is covered by ANSI C2, *National Electrical Safety Code*.

For the fabrication of the CAPs, guidance from NFPA 79 will be used to determine proper wire size. For strength/ruggedness considerations, all wiring within a CAP shall be as large as practicable. In Article 14-4(b) of NFPA 79, the routine use of solder-type MS (Military Standard) connectors and general soldering-workmanship is discussed. In the fabrication of the CAPs, military standard electrical hardware shall be used where ever practical to assure uniform and verifiable quality. MS connectors and hardware shall be used in cases when high density and high quality wiring connections are required. The specific soldering workmanship practices of WHC-CM-8-1 shall be used to assure high-quality solder connections.

5.5 Applicability of 29CFR Part 1910.96.F. During the review of this document, a comment concerning the applicability of 29CFR1910.96.F, "*Immediate evacuation warning signal*", was addressed.

Re-designing the criticality evacuation signal is beyond the scope of work described by this document. At present, there is no intent of altering the standard "AH-OO-GAH" that has been the required criticality evacuation signal at Hanford for the last fifty years. Per DOE Order 6430.1A, Part 0101-2, the decision to do so would have to be made by the Department of Energy. The Hanford criticality evacuation signal provides the required safety, without alteration, and conforms to the requirements of the appropriate national standard (ANSI/ANS-8.3) and Westinghouse Hanford controlled manual (WHC-CM-4-29).

The Hanford criticality evacuation signal at PFP was designed to meet the requirements of ANSI N2.3-1979, "*American National Standard Immediate Evacuation Signal for Use in Industrial Installations*". In 1986, this standard was discontinued and incorporated, verbatim in many cases, into Part 4.4 of ANSI/ANS-8.3-1986, "*American National Standard Criticality Accident Alarm System*". In describing the many attributes of the evacuation signal, both standards state, "The fundamental

frequency should not exceed 1000 Hz. Modulation should be at a rate less than 5 Hz."

29CFR1910.96.F also describes an evacuation signal. In many cases, ANSI N2.3, ANSI/ANS-8.3, and the CFR descriptions are verbatim. However, in describing the attributes of the evacuation signal, 29CFR1910.96.F.1.i requires "...a fundamental frequency (f_1) between 450 and 500 hertz (Hz) modulated at a subsonic rate between 4 and 5 hertz". This section in the CFR addresses preventative measures that must be taken to ensure lowest possible radiation doses to personnel in radiation areas including airborne radioactivity areas. 29CFR1910.96.F describes an evacuation signal similar to that of the Continuous Air Monitors (CAMs) used throughout the Hanford site, including PFP.

A criticality evacuation signal is activated within 1/2 second after an inadvertent criticality event. It does not prevent an initial radiation dose to personnel, but it mitigates the consequences by limiting any further radiation exposure. The response to accidental criticality is very different from that of excessive airborne or other radioactivity. For safety considerations the criticality evacuation signal must be distinctly different from the CAM evacuation signal. Re-designing the criticality alarm signal to conform to a 450-500 Hz fundamental frequency and a 4-5 Hz modulation rate could compromise the safety of PFP personnel by (1) making it more difficult to distinguish the criticality evacuation signal from the CAM evacuation signal, and (2) increasing the potential of improper personnel response to a different criticality evacuation signal during the transition from old to new signals.

6.0 DOCUMENT/HARDWARE CHANGE CONTROL. The Cognizant Engineer shall maintain two sets of design documentation (i.e. drawings, sketches and/or specifications) which are labeled "DEVELOPMENT CONTROL", have numbered pages, and are referenced to this engineering work plan. Fabrication of the prototype CAP shall conform to one set of the Development Control documentation provided by the Cognizant Engineer. The Cognizant Engineer, shall retain the other set. Any changes, additions, or deletions to the Development Control documentation shall be controlled by either of the two following methods:

- 1 The Cognizant Engineer shall mark any change in "red" and sign and date the change, also in red, on both sets of Development Control documentation, prior to any work to implement the change to the hardware. If red lined changes compromise comprehensibility, then the changes shall be incorporated into new Development Control documentation that is signed, dated and provided by the Cognizant Engineer. The old red-lined documentation shall be retained for the design file.
- 2 Additional Development Control documentation pages with traceability, as appropriate, to the original Development Control documentation are signed, dated and provided by the Cognizant Engineer.

The Development Control documentation attached to this engineering work plan shall signify the starting point for development and shall not be controlled following initial release of this engineering work plan.

Following completion of fabrication of the First Unit Prototype, all Development Control drawings and sketches (and specifications if appropriate) will be used to aid in the creation of as-build design drawings that conform to the Drafting Standards Manual (WHC-CM-6-3) requirements.

NOTE: References to the "Cognizant Engineer" in this document are intended to imply "Cognizant Engineer or his delegate".

7.0 SAFETY CLASS, APPROVAL DESIGNATOR, SAFETY AND QUALITY ASSURANCE. The PFP Criticality Alarm System (CAS) addresses the health and safety of PFP facility workers by promptly detecting a criticality event and sounding the facility criticality evacuation alarms to mitigate the consequences. It is classified as a WHC Safety Class 2 system. The CAS comprises nine stand-alone criticality alarm sub-systems consisting of independently powered Criticality Alarm Panels (CAPs) and remotely connected criticality detectors and alarm howlers.

Per WHC-CM-3-5, Table 1, Item T3.5, the initial release of engineering documents for WHC Safety Class 2 items requires an SQ approval designator. Thus, this engineering work plan and documentation required for activities described in this work plan shall be approved by the Cognizant Engineer, the Cognizant Manager, the Responsible Independent Safety Review Organization, and the Responsible Quality Assurance Organization. Since the objectives of this effort include facilitating maintenance, the Responsible Maintenance Organization should also have approval authority for documents and hardware produced for and by this activity. In addition, since this effort affects Facility Operations, it too should have approval authority.

Per WHC-CM-3-5, Table 1, Item T4.1, procurement/fabrication documentation for a Safety Class 2 item requires a Q approval designator.

Per WHC-CM-6-1, EP-2.4, Part 2.1(1), the cognizant engineer will establish "hold" points within the (engineering) work plan when critical features require quality or safety inspection and approval. The required hold points are found in ATTACHMENT 2 of this document and are identified by a Q and/or S in the RESOURCE NAME columns. During prototype fabrication, it is possible to discover features that cannot be verified once assembly is complete. In this case, the cognizant engineer may temporarily stop fabrication until such time that the proper verification is completed and documented.

8.0 VERIFICATION

8.1 COMPONENT PARTS VERIFICATION

8.1.1 ENGINEERING SUITABILITY VERIFICATION. Component parts suitability shall be verified by independent engineering (peer) review prior to or during verification of the First-Unit-CAP, H-2, as-built drawings as described in 8.2 below.

8.1.2 QUALITY ASSURANCE CONFORMANCE VERIFICATION. Quality assurance shall have approval authority for procurement and fabrication documents as described by Section 7 of this engineering work plan. Such documents shall specify or otherwise indicate attributes which are necessary for Commercial Grade Items (CGI) to reliably perform their function. Qualification of CGI for Safety Class applications shall conform to the guidelines of WHC-IP-1026, EPG-5.3. Nuclear Instrument Module (NIM) and NIM bin hardware from existing spares and from existing Criticality Alarm Panels will be used in the fabrication of the new Criticality Alarm Panels. These items may be verified to conform to DOE/ER-0457T which will be supplied by the Cognizant Engineer upon request. The Cognizant Engineer shall notify the Quality Assurance Representative when parts, that must be verified prior to assembly, are received. The Quality Assurance Representative may consult with the Cognizant Engineer or fabrication personnel, as appropriate, when conformance verification requires specialty knowledge (vendor specification sheets, part number encoding, or resistor value coding, for example).

8.2 DOCUMENTATION/ASSEMBLED EQUIPMENT VERIFICATION

8.2.1 VERIFICATION OF DESIGN DOCUMENTATION. Prior to installation, new CAP Z4 as-built design documentation (formal H-2 drawings and supporting documentation) shall be verified as required by EP-4.1.

8.2.2 VERIFICATION OF ASSEMBLED EQUIPMENT. Prior to installation, the new CAP Z4 shall be verified via approved Acceptance Test Procedure/Report (ATP/R) as described in Section 2.0 of this engineering work plan. Fabrication personnel (PFP Maintenance) shall be the test performance party. Acceptance Testing shall be witnessed by the Quality Assurance Representative, the Safety Representative, and the Cognizant Engineer. The Acceptance Test Report shall be appropriately approved (see part of 7.0 of this document).

The main purpose of the ATP/R is to verify that the new CAP is properly and correctly wired and ready to accept the NIMs (CARM, CALMs, and CADMs) from the old CAP Z4. Prior to the ATP, spare NIM bins will be modified (see 3.1(9) of this document), documented, and installed in the new CAP. Spare NIMs and detectors will be used to verify wiring during power-on testing and then removed; the NIMs from CAP Z4 will be transferred to the new CAP upon installation. A spare ASG (not a NIM) will be modified as described in 3.1(5) of this document, installed in the new CAP, and left in-place once its performance is verified during power-on testing. Inhibit Switch Panels and a Sound Powered Phone panel will be fabricated and installed prior to the ATP.

9.0 MAN-HOUR ESTIMATE TOTALS

NOTE: See ATTACHMENT 2 - ESTIMATE WORK SHEETS for detailed estimates.

o	DRAFTING CHECKING	-	7.5 man-days	-	60 man-hr
o	DESIGN DRAFTING	-	103.5 man-days	-	828 man-hr
o	ELECTRICAL CRAFTS	-	52 man-days	-	416 man-hr
o	ENGINEERING	-	117.5 man-days	-	940 man-hr
o	ENGINEERING PEER	-	16.5 man-days	-	132 man-hr
o	FACILITY OPERATIONS	-	5.0 man-days	-	40 man-hr
o	INSTRUMENT CRAFTS	-	24.5 man-days	-	196 man-hr
o	QUALITY ASSURANCE	-	26 man-days	-	208 man-hr
o	SAFETY	-	8.5 man-days	-	68 man-hr

TOTAL ESTIMATED MAN-HOURS - 2888

10.0 REFERENCES

1. ANSI/ANS 8.3-1986, Criticality Accident Alarm System
2. ASTM B33-91, Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
3. ASTM B286, Standard Specification for Copper Conductors for Use in Hookup wire for Electronic Equipment
4. DOE/ER--0457T, May 1990, Standard NIM Instrumentation System
5. DOE Order 5480.5, 9/23/86, U.S. Department of Energy, Safety of Nuclear Facilities
6. DOE Order 5480.24, 8/12/92, U.S. Department of Energy, Nuclear Criticality Safety
7. MIL-W-16878F(NAVY), 9/11/92, Military Specification, Wire, Electrical, Insulated, General Specification For
8. NFPA 70, National Electrical Code 1993
9. NFPA 79, Electrical Standard for Industrial Machinery 1991
10. WHC-IP-1026, Westinghouse Hanford Company, Engineering Practice Guidelines
11. WHC-CM-1-3, Westinghouse Hanford Company, Management Requirements and Procedures
12. WHC-CM-3-5, Westinghouse Hanford Company, Document Control and Records Management Manual
13. WHC-CM-4-2, Quality Assurance Manual
14. WHC-CM-4-29, Westinghouse Hanford Company, Nuclear Criticality Safety Manual
15. WHC-CM-6-1, Westinghouse Hanford Company, Standard Engineering Practices
16. WHC-CM-6-3, Westinghouse Hanford Company, Drafting Standards Manual
17. WHC-CM-8-1, 100 Maintenance Administration Manual, Workmanship Standards
18. 29CFR Part 1910, General Industry Safety and Health Standards

ATTACHMENT 1 - WORK FLOW DIAGRAM

* CAP RE-BUILT DRAWINGS AND NEW ASSEMBLY DRAWINGS WILL BE REVIEWED AND RELEASED, AS THEY ARE DONE, TO SUPPORT INSTALLATION.

** EXISTING CBSs ARE TO BE DOCUMENTED ON STAND-ALONE DRAWING(s). NEW CBS DRAWING IS TO REPLACE EXISTING CBS DRAWING(s) IN ITS ENTIRETY, AT LATER DATE.

WORK BREAK-DOWN:

- 1 PFP CAS BUILDING-LEVEL AS-BUILT DRAWINGS (5 EA ESTIMATED). THIS WORK CAN BE DONE CONCURRENTLY WITH BELOW WORK.
- 2 PFP CAP FIRST-UNIT RE-BUILD AND SUB-ASSEMBLY DESIGN.
- 3 CDS, CAH, & CBS ASSEMBLY DRAWINGS AND "COOKIE CUTTER" DESIGNS OF CAPs Z8, Z5, Z6, Z7, Z3, Z2, Z1, & Z9 (listed in order). PFP CAS GENERAL DRAWINGS CAN BE COMPLETED WHEN ALL OTHERS ARE DONE.

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ATTACHMENT 2 - ESTIMATE WORK SHEETS (5 Pages)

file: TASKIN1.CAP

ID*	NAME	DURATION (MAN-DAYS REMAINING)	SCHED FINISH	RESOURCE NAME**
ACTIVITY NAME: CRITICALITY ALARM PANEL REBUILD WORK AUTHORIZATION: J1#93011244				
ENGINEERING PROCESS PHASE: CRITERIA DEVELOPMENT & PLANNING				
9.1	WALK-DOWN - CAP NON-STANDARDIZATION ASSESSMENT	1 1		DD E
9.2	WALK-DOWN - "AS IS" DETERMINATION OF FIRST CAP	2 1 1 1		DD E EC IC
9.3	DESIGN ROUGH-OUT	5 3		DD E
9.4	ENGINEERING DEVELOPMENT WORK-PLAN FINAL DRAFT			
	REVIEW MEETING	0.5 0.5 5 0.5 0.5 0.5 0.5 0.5 0.5		DC DD E EC EP FO IC Q S
	CONCURRENCE SIGNATURES			

* Relates to the task number of Section 9.0 of this Engineering Development Work Plan.

** Resource Name: DC = DRAFTING CHECKING FO = FACILITY OPERATIONS
 DD = DESIGN DRAFTING IC = INSTRUMENT CRAFTS
 E = ENGINEERING (WEC) Q = QUALITY ASSURANCE
 EC = ELECTRICAL CRAFTS S = SAFETY
 EP = ENGINEERING PEER

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ATTACHMENT 2 - ESTIMATE WORK SHEETS (5 Pages)

file: TASKIN2.CAP

ID*	NAME	DURATION (MAN-DAYS)	SCHED FINISH	RESOURCE NAME**
ACTIVITY NAME: CRITICALITY ALARM PANEL REBUILD WORK AUTHORIZATION: J1#93011244				
ENGINEERING DEVELOPMENT PROCESS PHASE: SOLUTION DEVELOPMENT/FABRICATION				
9.5	PROCUREMENT	20/10	TO FAB END	E/Q
9.6	DEVELOPMENT CONTROL DOCUMENTATION PREP	1 2		DD E
9.8	LOCAL RECEIVING INSPECTION OF CABINET	0.5 0.5 0.5 0.5		E EC IC Q
9.9	FAB (3 ea) INHIBIT SW PANELS	9		EC
9.10	QC CONFORMANCE VERIF.	1 0.5		EC Q
9.11	ASG MODIFICATION	1.5		EC
9.12	QC CONFORMANCE VERIF.	1 0.5		EC Q
9.13	CALM/CARM NIM bin MOD	1		EC
9.14	QC CONFORMANCE VERIF.	1 0.5		EC Q
9.15	3 ea CADM NIM bin MOD	9		EC
9.16	QC CONFORMANCE VERIF	2 1		EC Q
9.17	FAB SPP PANEL	1		EC
9.18	QC CONFORMANCE VERIF	0.5 0.5		EC Q
9.19	CAP ASSEMBLY	10 10		EC IC
9.20	HOLD POINT - CAP DEVELOPMENT CONTROL DOC. CONFORMANCE VERIF.	3 3 2		EC IC Q

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ATTACHMENT 2 - ESTIMATE WORK SHEETS (5 Pages)

file: TASKIN3.CAP

ID	NAME	DURATION (MANDAYS)	SCHED FINISH	RESOURCE NAME
ACTIVITY NAME: CRITICALITY ALARM PANEL REBUILD WORK AUTHORIZATION: J1#93011244				
ENGINEERING DEVELOPMENT PROCESS PHASE: VERIFICATION (DESIGN CONFIGURATION CONTROL)				
9.7	DWG TREE/FORMAT AGREEMENT MEETING - (NOTE: DRAFTING CAN BE PARALLEL EFFORT AT THIS POINT)	5 5 1 1 1		DD E EC EP IC
9.24	DESIGN SERVICES ACTIVITIES			
	1. INHIBIT SW PANEL (1 DWG)	5 1		DD E
	2. ASG MODIFICATION (1 DWG)	5 1		DD E
	3. CALM/CARM NIM bin MOD (1 DWG)	5 1		DD E
	4. CADM NIM bin MOD (1 DWG)	5 1		DD E
	5. SPP PANEL ASSEMBLY (1 DWG)	2 1		DD E
	6. CAP ASSEMBLY (10 DWGs)	50 11		DD E
9.25	DRAFTING CHECKING COMPLETE/RESOLVED	7 7 2		DC DD E

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ATTACHMENT 2 - ESTIMATE WORK SHEETS (5 Pages)

file: TASKIN4.CAP

ID*	NAME	DURATION (MAN-DAYS)	SCHED FINISH	RESOURCE NAME**
ACTIVITY NAME: CRITICALITY ALARM PANEL REBUILD WORK AUTHORIZATION: J1#93011244				
ENGINEERING DEVELOPMENT PROCESS PHASE: VERIFICATION				
9.19	DECISION POINT - ALL PLAYERS MEETING, FACILITY USE POTENTIAL DETERMINATION BASED ON HARDWARE SUITABILITY	2 1 0.5 0.5 0.5 0.5		E EP EC FO IC Q S
9.20	Verification/Acceptance Test Procedure Prep, Review, Release	10 1 3 1 1 1		E EC EP IC S Q
9.21	Verification/Acceptance Test Procedure Performance	4 4 4 4 2		E EC IC Q S
9.22	DECISION POINT - Suitability for Facility Use Determination Meeting	2 0.5 1 1 0.5 1 1		E EC EP FO IC Q S
9.23	Verification/Acceptance Test Report Prep, Review, Release	8 2 1 1 0.5 0.5 0.5		E EP Q S FO EC ET
	SUITABLE FOR FACILITY USE			
9.26	VI FILE PREPARATION	2		E

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ATTACHMENT 2 - ESTIMATE WORK SHEETS (5 Pages)

9.27	FORMAL DESIGN REVIEW PREP	4		E
9.28	FORMAL DESIGN REVIEW	10 2 5 2 2 2 2		E EC EP FO IC Q S
9.29	DESIGN REVIEW REPORT PREP, REVIEW, RELEASE	10 0.5 3 0.5 0.5 0.5 0.5		E EC EP FO IC Q S
9.30	REV 0 H-2 DRAWINGS APPROVED/RELEASED	10 5		DD E
9.31	ENGINEERING DESIGN FILE RELEASED	5		E

ATTACHMENT 3
DEVELOPMENT CONTROL DRAWINGS
BEGINNING POINT
(10 PAGES)

GENERAL NOTES:

1. FOR CONDUCTOR REQUIREMENTS SEE WIRE RUN LIST, SH ____.
2. NOTES WILL BE FOUND ON THE DRAWING SHEET TO WHICH THEY APPLY.

LEGEND:

- CAD - CRITICALITY ALARM DETECTOR
CADM - CRITICALITY ALARM DETECTOR MODULE
CALM - CRITICALITY ALARM LOGIC MODULE
CARM - CRITICALITY ALARM RELAY MODULE
CDL - CRITICALITY DETECTOR LAMP
SPP - SOUND POWERED PHONE JACK
- CAH - CRITICALITY ALARM HORN
- CDS - CRITICALITY DETECTOR STATION, GAMMA TYPE
- CAP - CRITICALITY ALARM PANEL
- BC - BATTERY CHARGER

DRAWING INDEX:

- H-2-16419 WASTE DISPOSAL FACILITIES - WASTE SUMPS & STORAGE TANK PIT ARRANGEMENTS
H-2-28883 CRITICALITY ALARM SYSTEM - BLOCK DIAG & DWG INDEX
H-2-72419 CRITICALITY ALARM SYSTEM - AUDIBLE SIGNAL GENERATOR
H-2-74918 CRITICALITY ALARM DETECTOR - TYPICAL ASSEMBLY
H-2-80040 CRITICALITY INCIDENT ALARM - SUPPORT ASSEMBLY
H-2-91179 ASSEMBLY - CRITICALITY ALARM LOGIC MODULE (CALM)
H-2-91180 CRITICALITY ALARM RELAY MODULE (CARM)
H-2-91493 CRITICALITY ALARM SYSTEM - POWER LOSS RELAY
H-2-96431 CAM ALARM ANNUNCIATOR PANEL RELOCATION
H-2-98432 PANELBOARD SCHEDULES - EMERGENCY POWER

DWG NO	TITLE	ED

DRAWING TRACKABILITY LIST

NEXT

QTY REQD	PART/DASH NUMBER	NOMENCLATURE/DESCRIPTION	MATERIAL/REFERENCE	SHEET	ITEM NO
-022	-010				
		INSTALLATION			1
1		EQUIPMENT RACK, SINGLE BAY, W X D X H			2
4		NIM BIN			3
18		CRITICALITY ALARM DETECTOR MODULE, NMC GA-2 TWO			4
3		CRITICALITY ALARM LOGIC MODULE			5
1		CRITICALITY ALARM RELAY MODULE			6
1		AUDIBLE SIGNAL GENERATOR			7
19		SELECTOR SWITCH, KEY OPERATED, TWO POSITION MAINTAINED			8
2		SOUND POWERED PHONE RECEPTACLE			9
4		RELAY, 24VDC, GENERAL PURPOSE			10
4		SOCKET, OCTAL 8 PIN			11
		TERMINAL BLOCK, 600 VOLT, MEDIUM DUTY, PHENOLIC			12
		END SECTION, 600 VOLT, MEDIUM DUTY, PHENOLIC			13
		MOUNTING CHANNEL, STEEL			14
		CHANNEL CLAMPS			15
		PRE-PRINTED MARKING STRIPS			16
		WIRING DUCT, PVC, TYPE "E", 2" X 2 1/2"			17
		WIRING DUCT COVER, PVC, 2"			18
		WIRING DUCT, PVC, TYPE, 1" X 1"			19
		WIRING DUCT COVER, PVC, 1"			20
		CORNER STRIP, 1"			21
		WIRING DUCT, SNAP CLIP FASTENERS			22
		TERMINAL BLOCK, 600 VOLT, MEDIUM DUTY, POLYPROPYLENE			23
		END SECTION, 600 VOLT, MEDIUM DUTY, POLYPROPYLENE			24
		MOUNTING CHANNEL, MINIATURE			25
		CHANNEL CLAMPS, MINIATURE			26
		MODULAR TERMINAL BLOCK, 600 VOLT, 2 POLE			27
		MOUNTING RAIL, STAINLESS STEEL, 3/4 1/2"			28
		PLUG AND HOUSING ASSEMBLY			29
		PLUG AND CABLE CLAMP			30
		PLUG AND CABLE CLAMP			31
		PILOT LIGHT, OILTIGHT, 24VDC, SCREW TERMINALS, GREEN LENS			32
		NAME PLATES			33

H-2-817639	1	7	0
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[illegible]

U.S. DEPARTMENT OF ENERGY
DOE First Office, Rockwell
Washington, Maryland Company

CAP-Z4
FRONT VIEW

REF NO. 234-52
REV. 7501
H-2-817639 0

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ATTACHMENT 3
Page 23 of 31

H-2-817639 2 0

FRONT VIEW
(DOOR OPEN)

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DWG NO	TITLE	REV

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TS1D

TS1B

TS1B

TS1A

DWG NO	TITLE	
DRAWING TRACEABILITY LIST

VIEW
SH 3
SCALE: NONE

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ATTACHMENT 3
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DESIGNER: LA BROWN CHECKED: 11-12-84 DATE: 11-12-84 BY: 11-12-84 FOR: 11-12-84 APPROVED: 11-12-84 APPROVAL: 11-12-84		U.S. DEPARTMENT OF ENERGY DOE Field Office, Richmond Westinghouse Hanford Company	
CAP-Z4 PANEL LAYOUT VIEW A		REV: F REV NO: 234-5Z PACK NO: 7501 H-2-817639 0	
REFERENCES ON H-2-817639 SH 1		CADFILE: B8176390 CADCODE: 1CJBMAC02:12:SN

54-4000-017(5/88)

8

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VIEW B
SCALE: NONE

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ATTACHMENT 3
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DRAWN: LA BROWN CHECKED: [] DATE: 11-12-83		U.S. DEPARTMENT OF ENERGY DOE Field Office, Richmond Westinghouse Hanford Company	
CAP-Z4 PANEL LAYOUT VIEW B		H-2-817639 0	
REVISIONS NO. DATE DESCRIPTION BY DATE		DATE: 11-12-83 TIME: 12:12:50	
REFERENCES H-2-817639 SH 1		CADFILE: B817639E CADCODE: 1C4BM:ACD2:12:SN

NM CONN-4

1	22	
2	23	TB4-18
3	24	TB4-14
4	25	TB4-17
5	26	
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19	40	
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21	42	

NM CONN-5

TB2-53	1	22	
TB2-57	2	23	TB4-12
TB2-55	3	24	TB4-8
	4	25	TB4-11
	5	26	
	6	27	
	7	28	
	8	29	
	9	30	
	10	31	
TB2-48	11	32	
	12	33	
TB2-54	13	34	
	14	35	
	15	36	
	16	37	
NC4-18	17	38	
NC6-17	18	39	
	19	40	
	20	41	
	21	42	

NM CONN-6

TB2-43	1	22	
TB2-47	2	23	TB4-5
TB2-45	3	24	TB4-2
	4	25	TB4-5
	5	26	
	6	27	
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	9	30	
	10	31	
TB2-38	11	32	
	12	33	
TB2-44	13	34	
	14	35	
	15	36	
	16	37	
NC5-18	17	38	
NC7-17	18	39	
	19	40	
	20	41	
	21	42	

NOTES:

1. SWITCHES ARE SHOWN IN THE OPERATE POSITION
2. SWITCH DECKS ARE NUMBERED FROM THE SHAFT END
3. SWITCH CONTACTS ARE IDENTIFIED AS FOLLOWS

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 ATTACHMENT 3
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DRAWN: LA BROWN CHECKED: 11-15-13		U.S. DEPARTMENT OF ENERGY DOE Field Office, Richland Westinghouse Hanford Company	
CAP-Z4 INTERNAL CONNECTION DIAGRAM		DATE: 234-SZ SHEET NO: 7502 H-2-817639	
REVISIONS 1. 11-15-13		SCALE: NONE SHEET: 6

S7D1-C1 — SPARE
S7D1-1 — SPARE
S7D1-C2 — TB5-31
S7D1-6 — TB5-32
S7D2-C1 — TB5-33
S7D2-2 — TB5-34
S7D2-C2 — TB5-35
S7D2-7 — TB5-36

S8D1-C1 — SPARE
S8D1-1 — SPARE
S8D1-C2 — TB5-25
S8D1-6 — TB5-26
S8D2-C1 — TB5-27
S8D2-2 — TB5-28
S8D2-C2 — TB5-29
S8D2-7 — TB5-30

S9D1-C1 — SPARE
S9D1-1 — SPARE
S9D1-C2 — TB5-19
S9D1-6 — TB5-20
S9D2-C1 — TB5-21
S9D2-2 — TB5-22
S9D2-C2 — TB5-23
S9D2-7 — TB5-24

TB-5
CAP Z-4

NOTES:

1. SWITCHES ARE SHOWN IN THE OPERATE POSITION
2. SWITCH DECKS ARE NUMBERED FROM THE SHAFT END
3. SWITCH CONTACTS ARE IDENTIFIED AS FOLLOWS

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DRAWN: LA BROWN CHECKED: 11-18-83 DATE: 11-18-83 FOR: 11-18-83 BY: 11-18-83 APPROVED BY: 11-18-83		U.S. DEPARTMENT OF ENERGY DOE Field Office, Richmond Westinghouse Hartford Company CAP-Z4 INTERNAL CONNECTION DIAGRAM	
TITLE: H-2-817639 SH 1 CAD FILE: BB17639G CAD CODE: 1CJBMACD2:12:SN		F 234-SZ 7502 H-2-817639 0 NONE NONE	

S-13

S13D1-C1 SPARE
 S13D1-1 SPARE
 S13D1-C2 TB5-31
 S13D1-6 TB5-32
 S13D2-C1 TB5-33
 S13D2-2 TB5-34
 S13D2-C2 TB5-35
 S13D2-7 TB5-36

S-14

S14D1-C1 SPARE
 S14D1-1 SPARE
 S14D1-C2 TB5-25
 S14D1-6 TB5-28
 S14D2-C1 TB5-27
 S14D2-2 TB5-28
 S14D2-C2 TB5-29
 S14D2-7 TB5-30

S-15

S15D1-C1 SPARE
 S15D1-1 SPARE
 S15D1-C2 TB5-19
 S15D1-6 TB5-20
 S15D2-C1 TB5-21
 S15D2-2 TB5-22
 S15D2-C2 TB5-23
 S15D2-7 TB5-24

MM CONN-13

MM CONN-14

MM CONN-15

TB-8
 CAP Z-4

CALM-3
J-1 CALM-3
J-2

DWG NO	TITLE	REV

1. SWITCHES ARE SHOWN IN THE OPERATE POSITION
2. SWITCH DECKS ARE NUMBERED FROM THE SHAFT END
3. SWITCH CONTACTS ARE IDENTIFIED AS FOLLOWS

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[illegible]

CALM P3

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CALM3-P3-28
CALM3-P3-30
CALM3-P3-31
CALM3-P3-34
CALM3-P3-35
CALM3-P3-36

CALM-1 P3

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CALM2-P3-27
TB2-136
CALM2-P3-28
CALM2-P3-30
CALM2-P3-31
CALM2-P3-34
TB2-137
CALM2-P3-35
CALM2-P3-36
CALM2-P3-21

CALM-2 P3

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CALM3-P3-27
CALM1-P3-26
CALM3-P3-28
CALM1-P3-28
CALM3-P3-30
CALM1-P3-30
CALM3-P3-31
CALM1-P3-31
CALM3-P3-34
CALM1-P3-34
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DESIGNER: LA BROWN CHECKED: 11-15-40		U.S. DEPARTMENT OF ENERGY DOE Field Office, Richmond Westinghouse Hartford Company	
DATE: 11-15-40 DESIGNED BY: [blank] DRAWN BY: [blank]		CAP-Z4 INTERNAL CONNECTION DIAGRAM	
REVISIONS: [blank]		REV: F REV NO: 234-SZ REV NO: 7502 REV NO: H-2-817639 REV NO: 0	
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