APS

10 CFR 50.90

Palo Verde Nuclear Generating Station

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U.S. Nuclear Regulatory Commission
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Rockville, MD. 20852

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Docket Nos. STN 50-528/529/530
Response to Request for Additional Information to Proposed Amendment to Technical Specifications 3.2.4, 3.3.1, and 3.3.3

Reference: Letter 102-04864-CDM/TNW/DWG, "Request for Amendment to Technical Specifications: 3.2.4, Departure From Nucleate Boiling Ratio (DNBR), 3.3.1, Reactor Protective System (RPS) Instrumentation - Operating, 3.3.3, Control Element Assembly Calculators (CEACs)," dated November 7, 2002, from C.D. Mauldin, APS to USNRC

Dear Sir or Madam:

In the letter referenced above, Arizona Public Service Company (APS) requested an amendment to Technical Specifications (TS) 3.2.4, Departure From Nucleate Boiling Ratio (DNBR), 3.3.1, Reactor Protective System (RPS) Instrumentation - Operating, 3.3.3, Control Element Assembly Calculators (CEACs). During the review, staff from the NRC Electrical and I&C Branch requested additional information related to the proposed amendment. APS has provided the additional information requested in the enclosure to this letter.

The following commitment is being made to the NRC by this letter:

> APS will relocate the requirements of TS LCO 3.3.1 Condition E and LCO 3.3.3 Condition C from the TS to the PVNGS Technical Requirements Manual (TRM) prior to declaring the installed Common Q Core Protection Calculator System operable.

Should you have any questions, please contact Thomas N. Weber at (623) 393-5764.

Sincerely,

David Mauldin

A001

CDM/SAB/TNW/DWG

Enclosures:

- Notarized affidavit
- Arizona Public Service Company's Response to Request for Additional Information to Proposed Amendment to Technical Specifications 3.2.4, 3.3.1, and 3.3.3

Attachments:

1. 13-JN-1000, Engineering Specification For The Core Protection Calculator/Control Element Assembly Calculator (CPC/CEAC) System For Palo Verde Nuclear Generating Station
2. Summary of PVNGS Plant Procedure Changes to Support CPCS Implementation
3. Listing of Hardware for Channel A of CPCS

cc: Regional Administrator, NRC Region IV
J. N. Donohew
N. L. Salgado
A. V. Godwin

STATE OF ARIZONA)
) ss.
COUNTY OF MARICOPA)

I, David Mauldin, represent that I am Vice President Nuclear Engineering and Support, Arizona Public Service Company (APS), that the foregoing document has been signed by me on behalf of APS with full authority to do so, and that to the best of my knowledge and belief, the statements made therein are true and correct.

David Mauldin

Sworn To Before Me This 13th Day Of August, 2003.

Notary Public

OFFICAL SEAL
Karen D. Greiner
NOTARY PUBLIC - STATE of ARIZONA
MARICOPA COUNTY
MY COMM. EXPIRES AUGUST 28, 2004

Notary Commission Stamp

ENCLOSURE

Response to Request for Additional Information to Proposed Amendment to Technical Specifications 3.2.4, 3.3.1, and 3.3.3

Response to Request for Additional Information to Proposed Amendment to Technical Specifications 3.2.4, 3.3.1, and 3.3.3

Detailed below are Arizona Public Service Company's (APS) responses to the following requests for additional information (RAIs) by the NRC's Electrical and I&C Branch pertaining to the implementation of the new Core Protection Calculator System (CPCS) at Palo Verde Nuclear Generating Station (PVNGS):

- 17 RAIs requested on March 20, 2003
- 10 RAIs requested on May 14, 2003
- 11 RAIs requested on June 5, 2003
- 2 RAIs requested on July 17, 2003

A. MARCH 20, 2003 RAIs

NRC Request #A.1:

Please provide the following documentation:

a. The software requirements specification (SRS) for the PVNGS CPC.
b. The procurement document the licensee is using to procure the CPC.
c. The system requirements specification (SysRS) for the PVNGS CPC.
d. A copy of any plant procedures which will change as a result of this upgrade.
e. A copy of the human/machine interface (HMI) review related to this change.

APS Response to Request #A.1:

Documentation has been provided as follows:

a. The Software Requirements Specifications (SRSs) for the Palo Verde Nuclear Generating Station (PVNGS) Core Protection Calculator System (CPCS) have been made available by Westinghouse for NRC review in Westinghouse's Rockville office.

b. The APS procurement specification for the Common Q CPCS is provided in Attachment 1 to this letter.

c. The System Requirements Specifications (SysRSs) for the PVNGS CPCS have been made available by Westinghouse for NRC review in Westinghouse's Rockville office.

d. Many of the procedures that are impacted by the CPCS upgrade are in the development stage with a target date for implementation to be coordinated with approval of this license amendment. As agreed upon during a phone conversation between APS and the NRC on March 27, 2003, a list of PVNGS procedures that are changing as a result of the CPCS upgrade has been

provided in Attachment 2 to this letter. Upon request, APS will make available to the NRC staff any specific procedure the staff would like to further review.

e. A copy of the Westinghouse Requirements Phase Human Factors review has been submitted by APS for NRC review on April 25, 2003 (Ref. 1).

<u>NRC Request #A.2:</u>

Discuss the operation of the CPC using a more detailed diagram than provided in Figure 2-2 of the licensee's submittal. As examples of the detail to include in the response, consider the following:

- A diagram of the reed switch position transmitters (RPSTs) (e.g., a resistor ladder diagram)
- The signal path from all sensors to the RPS
- Other circuit paths such as between the Plant Computer and the RPS
- The CPC communication protocols
- Sensor input type (analog 4-20 ma, digital, smart sensor)
- The interconnections between the four proposed channels of the CPC

Please note that an engineering level drawing is preferred. The above list is not exhaustive of the topics to be discussed.

<u>APS Response to Request #A.2:</u>

Engineering level documents and diagrams providing more detailed discussion of the CPCs have been made available by Westinghouse for NRC review in Westinghouse's Rockville office.

<u>NRC Request #A.3:</u>

Please provide an assembly drawing for one channel of the CPC to allow the staff to understand the front level view of the system.

<u>APS Response to Request #A.3:</u>

Documents providing single channel assembly drawings of the CPCs, have been made available by Westinghouse for NRC review in Westinghouse's Rockville office.

<u>NRC Request #A.4:</u>

Provide the schematic capture drawings written in the application specific software that will allow the staff to trace the flow path from field inputs to the RPS system. Include the calculation algorithms in diagram form to allow the staff to evaluate how the proposed system conforms to the SRS and SysRS.

APS Response to Request #A.4:

Schematic capture drawings for the application software that allows the staff to trace the flow path from field inputs to the contact outputs that ultimately go to the RPS system have been made available for NRC review in Westinghouse's Rockville office.

NRC Request #A.5:

Discuss the organizational structure at APS that ensures the software system life-cycle activities are in conformance with the licensee's software quality assurance (SQA) requirements. Please be detailed enough to allow the staff to review the SQA process APS personnel use for the CPC. If APS does not have a Configuration Control Board, how will the configuration be controlled, and who will be responsible for the configuration control.

APS Response to Request #A.5:

The CPC system is maintained by the Operations Computer Systems (OCS) group within the PVNGS Maintenance Department. OCS Engineering and Maintenance personnel are responsible for proper implementation of the Process Control and Monitoring System (PCMS) SQA.

At PVNGS, process software is treated as an installed plant component, and therefore, comes under the site's Design Control, Configuration Management, Plant Modification, and Conduct of Maintenance Programs. The PCMS SQA Program interfaces closely with these site programs.

PVNGS administrative control procedure 80DP-0CC01, Control of Software and Data for Process Control and Monitoring Systems, provides a graded approach to quality assurance for process software throughout its life cycle.

Four Software Integrity Levels (SILs) have been established for categorizing PCMS software, SIL1 being the highest integrity level and SIL4 being the lowest. The CPC software providing protection functions is categorized as SIL1, and must comply with the strictest requirements of the Program.

Fundamental SQA elements apply across all SILs. The depth and breadth of documentation and the rigor of activities required for each element are a function of SILs. The following describes the fundamental program elements:

- The design requirements for PCMS software are defined and documented.
- Software procurement, design, development, testing, acceptance, and installation are completed and documented in accordance with an approved Project Plan, Software Quality Assurance Plan (SQAP), and all applicable procedures.

- The software configuration for each PCMS is identified utilizing the appropriate level of detail to define its constituent software configuration items (SCIs).

- Changes to software design requirements and configuration are identified, evaluated, documented, and approved for implementation utilizing an approved change control process (i.e., the Plant Modification, Deficiency Work Order, and Corrective Maintenance processes).

- Approved software design and configuration changes are implemented under the PVNGS Work Control Program, and the as-built configuration is statused in the Site Work Management System (SWMS) throughout the installed life of the SCIs.

- Software design output information is accurately reflected in the physical as-installed software configuration, and in the configuration documents which specify procurement, installation, operation, maintenance, testing, and training requirements.

- Appropriate physical and cyber security measures and suitable environmental conditions are provided to minimize inadvertent, unauthorized, or unapproved changes to both production process software and backup/disaster recovery software stored on media.

- Appropriate system software configuration management, backup, and disaster recovery plans for each system are developed and implemented to provide timely support of system and plant operations.

In addition to receiving review and approval of any design change as part of the Plant Modification process, the PCMS SQA Program imposes additional requirements for software including:

- Review and approval of all changes to SIL1 software by the Advisory and Support Committee (ASC) established by the PCMS SQA Program. The ASC, similar to a software configuration control board, is a cross-discipline committee comprised of management level representatives from OCS, I&C Design, I&C System Engineering, I&C Maintenance Engineering, and Operations to provide oversight of and assistance with implementation of the PCMS SQA Program.

- Review and approval of all Project Plans and SQAPs by the ASC.

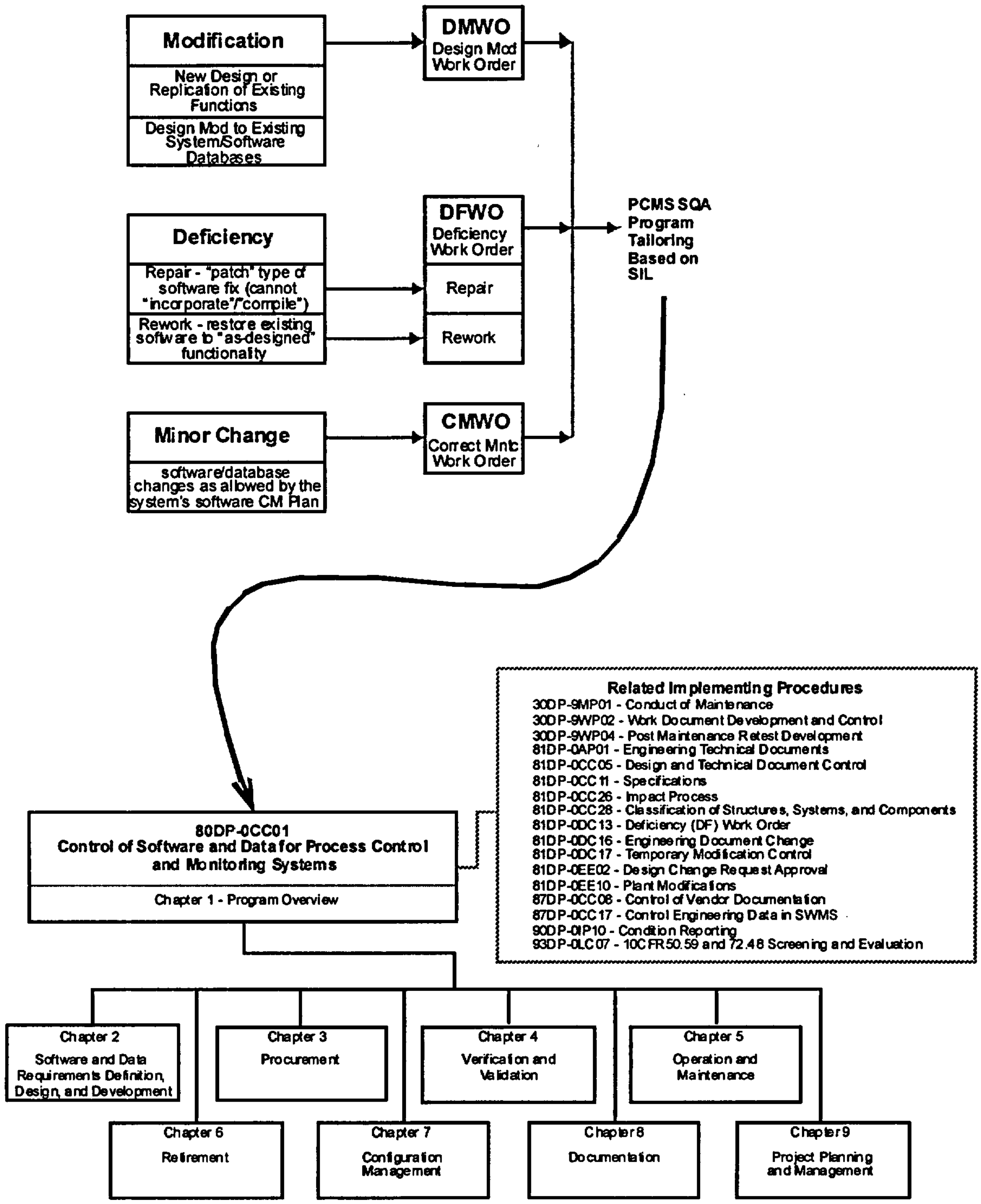
- Completion of all changes to PCMS software in accordance with the system's approved Software Configuration Management Plan and applicable procedures.

The implementation of the integrated site programs in conjunction with the function of the oversight committees, as described above, provides adequate assurance that configuration control is maintained for all PCMS.

Figure 5-1 below outlines the PCMS Software Change Mechanisms and Change Implementation via Integrated Programs at PVNGS.

Figure 5-1

PCMS Software Change Mechanisms and Change Implementation



NRC Request #A.6:

What differences exist between the system to be delivered to PVNGS and the system approved by NRC staff? As part of answering this question please consider new software versions, hardware design changes, and corrections or modifications as a result of factory acceptance testing (FAT) and site acceptance testing (SAT).

APS Response to Request #A.6:

A summary of the differences between the system to be delivered to PVNGS and the system approved by NRC staff are listed below. In no case was functionality removed or deletions made from what was presented to and approved by the NRC.

Software Differences

- Software Version Update
  The NRC reviewed Westinghouse's AC160 base software version AC160 1.2/0 as documented in the August 11, 2000 SE. APS plans to implement the AC160 base software version AC160 1.3/4 for the upgraded CPCS at PVNGS. The manufacturer Asea Brown Boveri (ABB) updated the AC160 base software version for all users. Since the Palo Verde CPCs were still in development, the decision was made to use the new version of software. Using the new version allows for easier future support by ABB, and full testing could still be performed by Westinghouse using the new software.
- CPC Program Timing Modification
  In Table A2.1.2-3 of Appendix 2 of the Westinghouse topical for the Common Q (Ref. 2), the CPC program execution intervals and input sampling rates are described. During analysis and testing of the CPC Algorithms, as implemented on the Common-Q hardware, the required PVNGS safety analysis response times were not met for all postulated accidents due to the hardware chosen for the Common-Q system. To ensure safety analysis response times were met, changes were made to the program timing from that described in the topical report by speeding up the cycle times of the Power module (from 1 second to 0.25 seconds) and Update module (from 100 ms to 50 ms). Further discussion on this change was provided in APS response to the NRC's Reactor System Branch requests for additional information (RAI) (Ref. 3).
- Reactor Power Cutback (RPCB) Flag Algorithm Modification
  A general description of the Reactor Power Cutback Flag is found in section A2.1.3.2.8 of Appendix 2 of the Westinghouse topical report for the Common Q (Ref. 2). At the request of APS, Westinghouse made changes to the RPCB Flag algorithm to correct an identified coding deficiency in the legacy CPCS. This subject is discussed further in Section 4.1 of the original APS license amendment submittal (Ref. 4).
- CPCS Auxiliary Trip Pre-Trip Alarms Addition
  The Westinghouse topical report for the Common Q (Ref. 2) made no mention to CPCS Auxiliary Trip Pre-Trip alarms. As part of the CPCS human factor

improvements, APS will be adding Auxiliary Trip Pretrip alarms for Axial Shape Index (ASI), Asymmetric Steam Generator Trip (ASGT), and Variable Over Power Trip (VOPT). These alarms that were designed by APS apart from Westinghouse will use information transmitted to the Plant Monitoring System. These alarms are intended only as operator aids and serve no safety function. This function is performed by the Non-Safety Plant Monitoring System (PMS) Datalink.

Hardware Differences

- Q Class Fiber Optic Distribution Box Addition
  There is no discussion of a fiber optic distribution box in the Westinghouse topical for the Common Q (Ref. 2). APS plans to use a fiber optic (FO) distribution box to terminate the runs of FO cable within APS' scope of supply. A FO distribution box is analogous to a field terminal rail, used to terminate long cable runs from outside the cabinet. Short and easily replaceable FO jumpers would then be used from the distribution box to the balance of the CPCS. APS worked with Westinghouse to qualify a Quality Class Fiber Optic Distribution box that will be used, and to verify that sufficient FO signal margin would be available to accommodate the additional connections.

- Non-Safety Ethernet Switch Addition
  APS plans to use a non-class ethernet switch to tie together the various non-class ethernet links supplied by the CPCS. The ethernet connections were functionally shown in documents reviewed by the NRC, but the existence of the device itself was not.

- Non-Safety PMS Computer Datalink Addition
  APS plans to use a non-class PMS Datalink computer to interface between the ethernet links and the PMS computer. In Figure A2.1-1 of Appendix 2 of the Westinghouse topical for the Common Q (Ref. 2), the CPC ethernet outputs appears to run directly to the PMS computer. In APS' implementation of the CPCS, the ethernet outputs of the CPCS must be translated to correspond to the six serial datalink that the existing PMS system can accept. The PMS Datalink performs this function.

NRC Request #A.7:

Please discuss the CPC response and operations personnel response to the following scenarios:

a. A disparity between redundant RPSTs
b. Multiple failed reed switches
c. Channel penalty factor disparity
d. Recovery of channel from loss of power or a channel reset

APS Response to Request #A.7:

There are no significant differences in how a channel of the legacy CPC and how a channel of the Common Q CPC would respond to the four scenarios provided. The CPC and Operator responses to these scenarios are essentially identical between the two systems with the following exceptions:

- A CEAC penalty factor would only affect one channel in the Common Q CPCS, whereas in the legacy CPCS, a CEAC penalty factor would affect all four channels.
- The Common Q Flat Panel Displays (FPDs) provide improved human factored indication and trending not seen in the legacy CPCS that would allow Operators greater monitoring capabilities of CPC/CEAC related information.
- The Common Q design supports RSPT substitution. However, this feature has been disabled by Westinghouse at APS' request until the appropriate regulatory review (10 CFR 50.59 or NRC submittal) has been obtained.

A discussion is provided below on CPC and Operations responses to the four scenarios based on implementation of the Common Q CPCS:

a. A disparity between redundant RSPTs

   CPC Response
   Each CEAC generates a penalty factor (PF) based upon indicated CEA position received from the RSPTs. There are two CEACs per channel each reading CEA position from a separate RSPT (i.e., CEAC 1 reads RSPT 1, CEAC 2 reads RSPT 2). Therefore, there are two CEAC PFs provided to each CPC. The CPC utilizes the most conservative PF generated from the two CEACs.

   Operations Response
   Any disparity between redundant RSPTs is monitored manually by surveillance. RSPT deviation checks are performed shiftly (once per 12 hours).

b. Multiple failed reed switches

   CPC Response
   The Common Q CPCS CEAC algorithm is unchanged in regards to handling up to three failed RSPTs before failing the CEAC. The CEAC monitors for failed RSPTs by checking for both out of range and rate of change in CEA position.

   Operations Response
   Multiple failed reed switches may or may not result in visual indication on the CPC Operator's Module (OM). If a failed CEAC is indicated, operators will enter the Tech Spec action statement for a failed CEAC (3.3.3 condition A or B) and investigate the cause as necessary. Failures not indicating on the OM will be identified by the shiftly channel check.

c. A channel penalty factor disparity

<u>CPC Response</u>
The most conservative PF from the two CEACs in that channel will be used by that channel's CPC.

<u>Operations Response</u>
The fact that a disparity exists between the PFs will require no direct response from Operations. If the disparity results in a CPC channel trip, then the trip will be evaluated in accordance with plant procedures.

d. Recovery of a channel from loss of power or a channel reset

<u>CPC Response</u>
The channel will trip resulting in an alarm in the control room. When a channel recovers from a loss of power or channel reset, the CPC algorithms will not begin executing until the Addressable Constants and Reload Data Block (RDB) constants are received over the AF100. The algorithms will then begin their initialization process, including an initial verification of the application checksum. During this initialization process, the channel remains in a tripped condition. If any RSPT were being substituted, they would be removed and would have to be manually substituted again. Other than that, no data is required to be entered manually from such a condition.

<u>Operations Response</u>
The alarm response procedure addressing the CPC channel trip directs placing the Low DNBR and High LPD trip parameters in bypass. The affected channel will be declared inoperable and the appropriate requirements of the Technical Specifications will be complied with until the CPC channel is restored to service.

In addition, the following concern associated with this question was identified by the NRC in a phone call on March 27, 2003:

e. If a software error is discovered, will all four channels be declared inoperable?

Each discovered error would be handled on a case by case basis. A generic software error in the CPC software in a non-conservative direction would be evaluated to determine if any channels should be declared inoperable. Software errors on the OM, Maintenance Test Panel (MTP), or CEA Position Display System (CEAPDS) node boxes would not normally result in declaring CPC channels inoperable since they are not required for channel operability.

<u>NRC Request #A.8:</u>

Please provide a hardware listing of one channel of the CPC. This listing can be at the card and rack level. For example, analog input card, digital output card, personal computer (PC) node box, flat panel display system (FPDS), etc.

APS Response to Request #A.8:

A list of the major hardware components for one channel of CPCs is provided in Attachment 3 to this letter.

NRC Request #A.9:

How does the close out of generic open items, as discussed in staff safety evaluation for the Westinghouse Common Q platform issued in February 24, 2003, affect this submittal?

APS Response to Request #A.9:

The close out of the generic open items (GOIs) does not affect this submittal. The NRC's February 24, 2003 safety evaluation documents that all GOIs are now closed with the exception of GOI 7.8, which is only applicable to future integration of multiple Common Q safety systems. This item is not applicable to PVNGS.

The NRC staff evaluation does, however, discuss the operational anomaly related to the RE102 radiated emissions test. APS, through the use of CHAR Services, has evaluated these radiated emissions at higher than the specified limits and has determined that they do not affect equipment within the surrounding area of impact.

The safety evaluation also discussed the failure of the PM646A processor module and AI685 analog input module at the Safe Shutdown Earthquake (SSE) level. This has been reviewed by APS and also found to be acceptable. The acceptance is justified by substituting one of the seven Operating Basis Earthquake (OBE) test results in place of the SSE. The OBE test response spectra is higher than PVNGS' specific SSE required response spectra.

NRC Request #A.10:

For justification to remove condition E, CPC cabinet high temperature, the submittal mentions "extensive online diagnostics." Please provide a justification that the diagnostics mentioned in Section 2.2, page 3, meet the intent of the original TS which requires a channel functional test. How does the licensee ensure that the diagnostics provide sufficient coverage to perform the functional test as originally intended?

APS Response to Request #A.10:

As discussed with the NRC staff on July 17, 2003, and in lieu of removing Technical Specification (TS) Limiting Conditions for Operation (LCOs) 3.3.1 Condition E and 3.3.3 Condition C requirements altogether, APS requests that they instead be relocated to the PVNGS Technical Requirements Manual (TRM). The following information provides the basis for relocating these requirements to the TRM:

1. These two LCO conditions do not meet all of the requirements of 10 CFR 50.36. APS acknowledges that the CPCS does in fact meet the four criteria of 10 CFR 50.36(c)(2)(ii) and should continue to have LCO requirements (as reflected in LCO 3.3.1 Conditions A, B, C, D and G and LCO 3.3.3 Conditions A, B, and E).

   However, 10 CFR 50.36(c)(2)(i) states that LCOs are "*the lowest functional capability or performance levels of equipment required for safe operation of the facility*". APS believes that the requirements to perform a functional test on a CPC cabinet high temperature alarm, as stated in LCO 3.3.1 Condition E and LCO 3.3.3 Condition C, do not meet the definition for an LCO in 10 CFR 50.36(c)(2)(i). The following is a basis for this conclusion:

   a. A high CPC cabinet temperature alarm does not indicate the lowest functional capability or performance level of a CPC or CEAC. These alarms (122 deg F) are actuated well below the qualification temperature of the CPCs and CEACs (140 deg F) and merely inform the Operations staff of a potential challenge to CPC/CEAC operability. Typically only one of four channels is affected on high cabinet temperature since each cabinet has its own independent cooling system.

   b. These LCO requirements have no follow up requirements for continuous monitoring after the initial test to determine if functionality may be affected in the future with an existing high temperature condition. In contrast, the improved Common Q CPCS provides more extensive online diagnostics than the legacy CPCS and will continuously monitor and assess CPC/CEAC module functionality. These diagnostics address numerous failure conditions from many causes, temperature stress being only one such cause. Failures are flagged by pertinent error messages and a channel trouble alarm on the Operator's Module (OM), Maintenance Test Panel (MTP) and remote annunciation. The improved CPCS design provides greater confidence in identifying and alarming an actual loss of CPC/CEAC functionality.

2. A CPC high cabinet temperature alarm does not meet any of the four criteria of 10 CFR 50.36(c)(2)(ii) as addressed below:

   a. *Criterion 1 - Installed instrumentation that is used to detect, and indicate in the control room, a significant abnormal degradation of the reactor coolant pressure boundary.*

      The CPC cabinet temperature alarm is not used to detect, and indicate in the control room, a significant abnormal degradation of the reactor coolant pressure boundary. The alarm indicates degraded cooling to an individual CPC Auxiliary Protection Cabinet which could potentially only impact the performance of one channel of CPCs/CEACs.

b. *Criterion -2 A process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.*

   The CPC cabinet temperature alarm is not an initial condition of any design basis accidents or transient analyses. The alarm only serves to warn of a potential challenge to functionality in one channel of CPCs/CEACs.

c. *Criterion 3 - A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.*

   The CPC cabinet temperature alarm is not part of the primary success path which functions or actuates to mitigate a design basis accident or transient. The alarm only serves to warn of a potential challenge to functionality in one channel of CPCs/CEACs.

d. *Criterion 4 - A structure, system, or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety.*

   The CPC cabinet temperature alarm is not significant to public health and safety. Historically, there have been no significant plant events that depended upon operator response to a CPC high cabinet temperature alarm to prevent or mitigate the abnormal condition. PVNGS administrative control procedures continue to require Operators to be constantly aware of all alarmed conditions and to respond appropriately.

   By design, the alarm only serves to warn of a potential challenge to functionality in one channel of CPCs/CEACs. These alarms (122 deg F) are actuated well below the qualification temperature of the CPCs and CEACs (140 deg F). The CPCS is a subsystem of the Reactor Protection System (RPS) which requires two-out-of-four channels to actuate a reactor trip. The loss of functionality of a single channel of CPC/CEAC regardless of the cause would provide no greater risk than being in a two-out-of-three RPS trip logic which is a condition currently authorized by the NRC. The CPC cabinet temperature alarms are not significant contributors to plant risk and therefore are not modeled in the plant Probability Risk Assessment (PRA).

3. Relocating these requirements to the TRM will not eliminate them. The PVNGS TRM is a licensee controlled document specified in the PVNGS Updated Final Safety Analysis Report (UFSAR) and therefore is controlled by 10 CFR 50.59. Should a functional test of the upgraded CPC or CEAC, performed in accordance with the TRM, demonstrate that either the CPC or CEAC is inoperable, the appropriate conditions of TS LCO 3.3.1 and 3.3.3 will still be complied with.

NRC Request #A.11:

The licensee submittal states that the existing Condition F for TS LCO 3.3.1, "One or more core protection calculator (CPC) channels with three or more auto restarts during a 12 hour period," and the associated Required Action will be deleted. The licensee's discussion on page 4 of its submittal states that the replacement CPC does not have an auto restart feature. A processor failure will result in a HALT condition, in which the CPC processor remains in a tripped state, the watchdog timer times out, and maintenance personnel must perform a restart or repair the affected module. Therefore, a marginally performing CPC processor cannot continue to remain in operation without deliberate action by the maintenance staff. Any repair will result in appropriate diagnostics being performed on the module to assure operability. Therefore Condition F and the associated Required Action are no longer required.

Discuss the corrective action intended such that maintenance personnel will be required to perform a restart or repair of the affected module within an appropriate time interval. This discussion should include the reason why a proposed Condition and Action item were not included in the licensee submittal, since a trip condition results from the failure of a channel.

APS Response to Request #A.11:

The existing LCOs provide appropriate time intervals. There is no difference between the legacy and the upgraded CPCS regarding the status of a tripped or bypassed CPC channel under maintenance. LCO 3.3.1 Condition A and B provides the time requirement (1 hour) to place an "inoperable" CPC in a tripped or bypassed condition. After a channel is placed in trip or bypass, LCO 3.3.1 Condition A requires that the channel be restored to operability prior to entering Mode 2 following the next Mode 5 entry. APS is not requesting that these LCO requirements change.

Since a HALT condition results in the generation of a channel trip, the channel will already be in the required position for compliance with LCO 3.3.1 Condition A before Maintenance begins work. At the time of the trip, Operations has the option, per LCO 3.3.1 Condition A or B, of leaving it in a tripped condition (since one other channel may already be in bypass) or else bypassing it. Whenever a CPC channel becomes inoperable, the Maintenance staff would be directed to evaluate the condition and work towards restoring the channel to operability within the time frame allotted under LCO 3.3.1 Condition A.

NRC Request #A.12:

The submittal regarding TS 3.3.1 proposes changes that would remove all limiting condition of operation (LCO) requirements associated with the CPC. Please justify why no LCO conditions exist in the "after CPC upgrade" TS for the CPC. When considering your response, please provide more than just a qualitative answer

regarding the existence of diagnostics. For example, provide the NEI Technical Specification Task Force (TSTF) citation addressing the use of online diagnostics as a justification for eliminating this TS LCO requirement.

APS Response to Request #A.12:

There are many more LCO requirements associated with the CPCs. The CPCS is a subsystem of the Reactor Protection System (RPS) and provides trips for Low Departure From Nucleate Boiling Ratio (DNBR) and High Local Power Density (LPD). Like all other RPS trip functions, there are four channels of CPCs that provide these trip features. Excluding Conditions E and F, the following existing LCO 3.3.1 requirements are associated with the CPCs that will not change:

> **LCO 3.3.1** - Four RPS trip and bypass removal channels for each Function in Table 3.3.1-1 shall be OPERABLE. *(Note that CPCs related functions are #14 & #15 of Table 3.3.1-1)*
>
> **Condition A** - One or more Functions with one automatic RPS trip channel inoperable.
>
> **Condition B** - One or more Functions with two automatic RPS trip channels inoperable.
>
> **Condition C** - One or more Functions with one automatic bypass removal channel inoperable.
>
> **Condition D** - One or more Functions with two automatic bypass removal channels inoperable.
>
> **Condition G** - Required Action and associated Completion Time not met.

In addition, Surveillance Requirements SR 3.3.1.1, SR 3.3.1.2, SR 3.3.1.4, SR 3.3.1.5, SR 3.3.1.6, SR 3.3.1.7, etc. are performed with each CPCS channel.

NRC Request #A.13:

In the discussion of FAT, the submittal states in part, "inputs calculated to exercise branches in C code."

a. What C code is the submittal referring to?
b. How many lines of code are there?
c. Please rank the code complexity considering and providing: the number of branches, recursion, function calls, variables, and similar items to help the staff understand how testing will "stress' the system.
d. Please describe the fault injection methods used at the unit or module level.
e. What calculations are performed to determine appropriate exercising of branches and conditional statements.

APS Response to Request #A.13:

a. The module structure of the legacy CPC was kept the same to a great extent. Each module in the legacy CPC is represented as a custom function block in the application. The custom function block is developed using the C language.

b. There are 37312 lines of C code for the CPC, CEAC, Auxiliary CPC (AUXCPC) and CEA Position Processor (CPP) functions. About 30% of this count is made up of comments.

c. The algorithms are coded directly from Appendix A of the CPCS System Requirements Specification. Appendix A is nearly identical to the legacy CPCS Functional Specification. Differences are in the area of data format differences and error corrections. Therefore, the complexity of the code is similar to the complexity of the original CPCS algorithms.

d. For those modules (custom function blocks) that map to the legacy CPC module, the existing "Phase 1" test cases were used. For those modules where the structure of the module had to change due to platform differences, then an adaptation of the legacy module test case was made. For new modules, new test cases were developed to test the custom function element. In all cases, inputs were injected with a number of test case signals to provide a comprehensive set of tests. Each module is tested individually on the AC160 platform using the Common Q I/O Simulator.

   The function chart application is tested as a unit, where all the custom and standard function blocks are tied together. The unit test program is similar to the legacy CPCS Phase 2 test program. The CPC application undergoes an Input Sweep test that validates that the CPC algorithm can initialize from 2000 different initialized input conditions with expected calculated results being compared with the CPC FORTRAN model for verification. The CEAC application undergoes a separate Input Sweep program.

   The next unit test that is performed is the dynamic test. This is similar to the Dynamic Software Verification Test (DSVT) in the legacy CPCS. This test uses digitally simulated inputs and verifies that the CPC and CEAC algorithms respond correctly to dynamic simulation. The results of these tests are compared to the CPC FORTRAN model for verification.

   The next unit test that is performed is the live input test which is comparable to the Live Input Single Parameter (LISP) test in the legacy CPCS. The prior tests were all conducted using simulated inputs to stress the algorithms. This test verifies the correct connections between the data acquisition system and the algorithms.

   The last unit test is called the One Channel System Test. This test is comparable to the LISP part 2 in the legacy CPCS. This test focuses on the

CPCS Channel as a whole. It tests all the man-machine interface (MMI) requirements and fault detection and reporting requirements.

e. Once the module (Phase 1) testing is complete, the test cases and C source code for the module will be submitted to an independent team that runs the same test cases and source code through a branch coverage tool by Liverpool Data Research Associates (LDRA) to ensure complete coverage. Westinghouse discussed LDRA testing with the NRC during their NRC audit and provided additional information to the NRC staff regarding the LDRA testing tool.

<u>NRC Request #A.14:</u>

Please provide the FAT and SAT test procedures and results.

<u>APS Response to Request #A.14:</u>

The FAT test procedures and reports demonstrating the results have been made available by Westinghouse for NRC review in Westinghouse's Rockville office.

The SATs test procedures and reports are not complete at this time. The SAT, scheduled to be performed later this year during the last week of October, will be conducted in two phases: post installation prior to declaring the CPCS operational, and a smaller portion to be performed after the CPCS is operational and the reactor is at power. Westinghouse personnel are expected to be present during the SAT (in a support role only).

The portion of the SAT to be performed after the reactor is at power is described in response #1 to the NRC Reactor Systems Branch RAIs (Ref. 3). The remaining response in this section describes post installation testing.

Initially, dry runs of the official CPCS tests will be performed in a systematic fashion to assure that the constituent components perform in such a way that the system will fulfill its design function. These dry runs will be conducted so that any problems, either with connections or electronics, will be identified and corrected prior to the actual operability testing of the CPCS.

The following is a summary of the "post installation" SAT to be performed:

Point to Point Check
A point to point check on the below listed circuits will be performed prior to power application to verify that all connections are correct:

- Field inputs to Common Q harness (all channels)
- Field inputs from Common Q harness (all channels)
- Auxiliary Protection Cabinet (APC) Contact outputs to Plant Protection System (PPS) (all channels)
- APC Contact outputs to control room panel annunciators (all channels)

- Computer Room (Datalink) Contact outputs to annunciators (all channels)
- Alarm string (doors, blowers, APC high temps) (all channels)
- Fiber Optic paths (all channels)

Power Check
Following installation of the vendor supplied power panel and prior to powering up any Common Q CPCS equipment, the main power will be applied and the outputs for the appropriate breakers will be verified to be correct.

Initial Check
An initial check of the CPCs to identify potential problems will be performed as follows:

- Once power has been applied to the system with the I/O simulator connected, a verification that no unexpected alarms are present or indicated will be performed.
- A "dry" run will be performed of the Functional Tests on each channel to identify any problems.
- A heat gun will be applied to the cabinet temperature sensors to verify that a heat alarm is generated.
- An in-situ electro-magnetic and radio-frequency interference (EMI/RFI) test will be performed by Wyle Labs personnel to test the CPC in an open rack to verify that the CPC meets RE101, RE102, RS101, and RS103 specifications. Wyle labs will make recommendations if the CPC fails any of the tests regarding what type of shielding should be used on the CPC cabinet or rack to meet those standards.

Annunciator Window Check
A test of annunciators will be performed.

Functional Release Testing
The following tests will be performed to support functional release to operations for declaring the CPCS operable:

- <u>Time Response Tests</u>
  This test demonstrates that the reactor trip system response time of the Core Protection Calculator System (CPCS) is within the limits specified in Updated Final Safety Analysis Report (UFSAR) Table 7.2-4AA. This test checks the response time of the DNBR/LPD Calculator System from the time that it receives an input signal until the time the system outputs a trip signal.
- <u>Channel Calibration Tests</u>
  These tests ensure each major subcomponent of the CPC computer is calibrated. Upon completion of system alignment, the proper operation of the computer is demonstrated by running software test cases, diagnostic programs and verifying trip and alarm functions.

- Channel Functional Tests
  CPCs - These tests verify that the CPC is capable of performing its specified functions. Operability is proven by running software test cases, diagnostic programs, verification of trip and alarm functions, Type I and Type II addressable constants verification, and routine equipment checks.

  CEACs - These tests verify that the CEAC is capable of performing its specified functions. Operability is proven by running software test cases, diagnostic programs, verification of trip and alarm functions, a Type II addressable constant verification, and routine equipment checks.

NRC Request #A.15:

In response to plant-specific action item (PSAI) 6.1 in the staff's safety evaluation report approving the Westinghouse Common Q platform, the licensee's submittal discusses the SysRS input/output (I/O) subsystem requirements. If the licensee is using S600 I/O modules, please provide an assessment of the S600 I/O modules relative to PSAI 6.1.

APS Response to Request #A.15:

APS will be using the S600 I/O modules in the Palo Verde CPCS. Specifically, the AI685, DI620, DP620, DO625 and AO650 I/O modules will be used. However, it should be noted that the NRC reviewed use of the AI620 module which Westinghouse has subsequently replaced with the AI685 module. In general, S600 I/O Modules were assessed for performance by ensuring that the overall CPCS system performance requirements were met. The FATs performed at Westinghouse have demonstrated that all appropriate performance requirements (e.g., time response, accuracy, etc.) were met, and therefore APS considers the individual modules having met their performance requirements for PVNGS.

The S600 I/O Modules were assessed for seismic and environmental qualification by ensuring the results of the testing performed by Westinghouse met the PVNGS specific seismic and environmental requirements. There were two areas of concern due to this testing. Each is addressed below.

a. The radiated emissions for the PM646A High Speed Link (HSL) cable exceeded the specified limits in the frequency range of 10 MHz to 30 MHz by 13db at the worst case when the Common Q Equipment was tested. Site specific testing (as discussed in response #A.9) was performed and demonstrated that these high emissions did not adversely impact other equipment in the affected area.

b. The AI685 (and PM646A) failed to perform satisfactorily at the SSE levels. This has been determined to not be an issue at PVNGS as discussed in response #A.9.

NRC Request #A.16:

Please provide the plant-specific failure modes and effects analysis (FMEA) mentioned in the licensee's response to PSAIs 6.3 and 6.10. Please include a diagram of sufficient detail that will allow the staff to review the FMEA to confirm its adequacy and completeness.

APS Response to Request #A.16:

The FMEA for the Palo Verde Nuclear Generating Station (PVNGS) Core Protection Calculator System (CPCS), has been made available for NRC review in Westinghouse's Rockville office.

NRC Request #A.17:

Please provide the timing requirements of the CPC. In this response, compare the timing requirements to the CPC response time required by the UFSAR.

APS Response to Request #A.17:

Refer to response #2 to the NRC Reactor Systems Branch RAIs (Ref. 3).

B. MAY 14, 2003 RAIs

NRC Request #B.1:

The connection of the CPC OM and MTP to the PMS using TCP/IP, has this been reviewed for non-safety to safety effect to ensure the addressable constants can not be inappropriately changed?

APS Response to Request #B.1:

The non-safety to safety effect has been evaluated and is discussed briefly in section 6.3.2.1 of the Common Q Topical (Ref 2). The only handshaking that is done is at the lower levels of the TCP/IP protocol handled by the Ethernet interface card and not the application program. The node box provides an IEEE 7.4.3.2 buffer circuit by providing separate interface cards and application programs for the Plant Computer Datalink function and the AF100 communication bus function that connects the OM and MTP to the AC160 controllers. Should a disruption occur on these lower level reply (acknowledge) messages, its effect will be isolated to the Plant Computer Datalink function. In addition, appropriate physical and cyber security measures are provided to minimize inadvertent, unauthorized, or unapproved changes to both production process software and backup/disaster recovery software stored on media.

NRC Request #B.2:

Safety-Related MTP uses IRIG-B cards, are they safety related?

APS Response to Request #B.2:

The IRIG-B card is not safety-related. It has been qualified as associated equipment to the safety-related flat panel display system. What this means is that the IRIG-B card has been subjected to the same equipment qualification tests (seismic, environmental, EMI/RFI), in-situ with the flat panel display system. This testing proved that the IRIG-B card does not adversely interfere with the safety-related function of the flat panel display system.

The time synchronization function only effects the time of day clock and not the interval timer used by the AC160 for program scheduling. The only adverse effect to erroneous time is the trip buffer report time stamp and the failed sensor stack time stamps which have no effect on the CPCS performing its protective functions.

NRC Request #B.3:

Safety-Related MTP uses Win NT, what is the impact to MTP function?

APS Response to Request #B.3:

The Safety-Related MTP has two modes, on-line and maintenance. The Software Load Enable (SLE) switch is used to change between the two. Windows NT is only used while in the maintenance mode. While in the maintenance mode, Low DNBR and High LPD trip contacts will be opened automatically in the affected channel (i.e., the channel is tripped). Therefore, Windows NT can only be used when the channel is tripped and therefore has no impact on the Safety-Related function of the MTP or the Protection function of the AC160 hardware while in an operating (i.e. untripped) state.

NRC Request #B.4:

Safety-related MTP and OM uses CI-527 cards, what is impact to MTP function?

APS Response to Request #B.4:

The CI527 card is the AF100 interface for the node box so that it can communicate with the AC160s. It is a safety-related component that went through equipment qualification. Its failure would cause the MTP to lose communication with the AC160. Its failure would have no effect on the CPC performing its protective function.

NRC Request #B.5:

Has the uncertainty analysis IAW procurement spec. been completed and what are the results?

APS Response to Request #B.5:

The CPC uncertainty calculations are divided into a "typical" hardware uncertainty calculation that covers the portion of the process while it is transmitted as an analog signal and converted to a digital signal, and the portion of the uncertainty while the information is processed as a digital value. This split is required due to the completely different approach in calculating uncertainty. The hardware uncertainty calculation determines the inaccuracies of the equipment up to and including the analog-to-digital converter. The digital uncertainty considers the inaccuracies of the algorithms and computational methods, and the machine inaccuracies inside the computer process. A summary of the results in both of the areas is provided below.

Analog Uncertainty
The installation of the upgraded CPCS involves only the equipment in the instrumentation cabinets. The field device and the resistance to voltage converter are unchanged. The only change in any equipment along the signal path from the process to the point where the signal is digital is the analog-to-digital converter. The uncertainty of this equipment has been analyzed by APS and has been shown to be within the bounds already allocated for the analog-to-digital converter of the legacy CPCS. Therefore, there is no change to the analyses.

Digital/Processing Uncertainty
The processing uncertainties of the Upgrade CPC, defined as those resulting from the differences in machine precision between CPCS and the more accurate CPC/CEAC Fortran Simulation, continue to be bounded (as was the case with the legacy CPCS) by those used in the safety analysis as demonstrated in Table B.5-1 below :

Table B.5-1
Processing Uncertainty Comparison

PVNGS Safety Analysis Assumptions	Upgraded CPCS Uncertainties*
DNBR +/- 0.0093	DNBR -0.00030, +0.00022
LPD +/- 2.204%	LPD -0.053%, +0.079%

* These values have been updated based on the most current information from Westinghouse which is different than that provided by APS to the NRC Reactor Systems Branch on July 10, 2003 (Ref. 3). In either case, both sets of data are bounded by the PVNGS Safety Analysis.

NRC Request #B.6:

Is software documentation as specified in procurement spec complete and correct?

APS Response to Request #B.6:

APS considers the software documentation supplied by Westinghouse to meet the intent of the procurement specification, and is complete and correct. This conclusion is reached as follows:

1. Westinghouse has provided to APS the required types of software documentation, such as System Requirement Specifications, Software Requirements Specifications, Software Design Descriptions (SDD), V&V documentation and Software Testing/Analysis documentation.

2. The format and generic content of each of the documents is consistent with the expectations within APS. It was not the intent of the PO Spec to require Westinghouse to follow exactly any of the sample document formats described in any of the IEEE documents.

3. APS reviews of the individual documents and an APS lead SQA surveillance audit conducted at Westinghouse has provided APS with confidence that the specific content of individual documents and Westinghouse compliance with SQA requirements has been met. Reviews were typically conducted by the responsible engineering group within APS. This included OCS Engineering, Nuclear Fuels Management (NFM), Equipment Qualification (EQ), and EMI/RFI experts. The NFM department was primarily responsible to ensure that the new CPCS algorithms were functionally identical to the legacy system algorithms. The OCS engineering group was primarily responsible to ensure the hardware and its interfaces would be compatible. When there were discrepancies, comments would be submitted to Westinghouse. Typically, responses to the comments would be provided by Westinghouse to development an agreement, and then the document would be revised to reflect the final understanding. The personnel most knowledgeable in the area, plus others conducted these reviews. For example, NFM personnel would review all SDDs, since they were knowledgeable of the CPC algorithms. OCS Engineering and Maintenance would review the Hardware Design Descriptions (HDDs). EQ and EMI/RFI personnel would review qualification reports.

4. APS also conducted four Critical Design Reviews (CDRs) with Westinghouse. These CDRs looked at the overall hardware and software design of the system, helped guide the design, and provided action items to both APS and Westinghouse to ensure the system to be provided was the system that was both specified and desired.

5. APS also observed three FATs. The first two were primarily APS personnel observing the conduct of the formal FAT procedures. The third FAT was time set aside for APS to send a cross-functional team to insert different failures, and conduct tests outside of the scope of the formal FAT procedures. Knowledgeable APS personnel created a set of potential failures or off normal conditional that were then placed in the four channel hardware. The response was documented and compared against expected behavior where requirements existed.

6. Concerning the last section of 9.5 in the procurement specification, this can not be validated as complete at this time. The contract with Westinghouse will be closed after the last milestone payment is made, which is planned for late in 2004. The forward-looking statements concerning providing additional design documentation in case of discontinued support are more of an agreement of intent.

7. Concerning the level of effort being done to verify the requirements of Section 7.0 and 9.0 of the procurement specification are being met, there is not a report documenting compliance with any specific IEEE standard. Reports are not created by APS to verify and document that each individual procurement specification section is met. However, reviews of various levels have been performed. Concerning Section 7.0, Qualification Requirements, APS has had EQ and EMI engineers as active members of the APS CPC Replacement project.

   The EQ engineer has provided the following support:

   - Provided the input to create section 7.0 of the Procurement Spec, as well as providing the RRS.
   - Reviewed and provided comments on EQ related documents provided by Westinghouse, including test plan and test results.
   - Traveled to Huntsville to observe one of the seismic tests. A second, non-EQ engineer also traveled to Huntsville to observe a different seismic test for Common-Q.

   The EMI engineer has provided the following support:

   - Reviewed and provided comments on EMI related documents provided by Westinghouse, including test plans and test results.
   - Traveled to Pittsburgh to support Palo Verde specific supplemental EMI testing.
   - Supported plant specific EMI testing at Palo Verde.

<u>NRC Request #B.7:</u>

Has timing analysis completely considered all aspects of timing delay in a 2 out of 4 digital system?

<u>APS Response to Request #B.7:</u>

The timing analysis takes into consideration the cross channel delays of the CEA data and other assumptions for timing delays (i.e., just missing a program cycle). The scope of the CPCS replacement is the CPCS computer system only, and not the input sensors nor the RPS and its 2-out-of-4 relay logic. Therefore the scope of the timing analysis is for the CPCS replacement only.

NRC Request #B.8:

Appendix 2 of the topical mentions 4 algorithms running in a CPC processor, the SysRS has five...which is correct?

APS Response to Request #B.8:

Based on discussion with the NRC on July 17, 2003, no further response to this request by APS is required.

NRC Request #B.9:

If the CPCS is part of a digital plant protection system, why is the performance of overall time response testing not considered as discussed in APS response to PSAI 6.12?

APS Response to Request #B.9:

Based on discussion with the NRC on July 17, 2003, no further response to this request by APS is required.

NRC Request #B.10:

FMEA reviewed focuses on field device failures and failures at the card and communication link level, has a software hazards analysis been performed?

APS Response to Request #B.10:

A Preliminary Software Hazards Analysis was performed as required by the Software Program Manual (SPM) Software Safety Plan. All potential software safety hazards were addressed in the design.

C. JUNE 5, 2003 RAIs

NRC Request #C.1:

Requirements Traceability Matrix - discussion to clarify its use.

APS Response to Request #C.1:

The Requirements Traceability Matrix (RTM) was primarily used by Westinghouse as part of the formal V&V effort. APS has reviewed the RTM during an SQA audit in 2002 and while conducting informal thread audits for implementation of requirements and completion of open software life cycle process items.

NRC Request #C.2:

Describe the connections that exist between the CPCS channels in the CEAC processors. How is channel independence maintained?

APS Response to Request #C.2:

Based on discussion with the NRC on June 5, 2003, no further response to this request by APS is required.

NRC Request #C.3:

The system event log holds up to a certain number of events, is there an LCO for types of events that may be present in the system event log and explain why/why not.

APS Response to Request #C.3:

There are no specific LCOs for types of events that may be present in the System Event Log. The System Event Log serves as an operational aide in providing a visual display of the alarmed condition. CPC or CEAC failures can also be indicated by alarms on the Operator's Module. Indications on the System Event Log may lead to channel inoperability after further evaluation and testing. However, numerous redundant components preclude the requirement to declare a channel inoperable based on a given failure without further evaluation.

NRC Request #C.4:

What events or errors have occurred on the legacy system during its operation and how were these corrected?

APS Response to Request #C.4:

Based on discussion with the NRC on July 17, 2003 only a summary of applicable CPCS LER events and how the issues were addressed in the Common Q CPCS is required. This summary is provided below:

- LER 2001-001-00 - CPC Aux Trip Actuation
  Unit 3 tripped on a CPC Axial Shape Index (ASI) Aux Trip while the plant was being reduced in power due to Main Turbine vibration problems. The operating crew did not recognize that CPC ASI trip values were being approached in time to take action to prevent the trip. There is no graphical trend of CPC calculated ASI in the legacy CPCS.

  Trend displays for ASI have been developed and will be part of the replacement system. Operations will have a visual display of CPC calculated ASI. In addition, pre-trip alarms have been developed by APS to warn operators of pre-trip conditions for a number of CPC Aux trips (ASI included). Aux trip pre-trip alarms have been previously discussed in response #A.6 of this letter.

- <u>LER 94-006-00 - CEAC Caused Reactor Trip</u>
  CEAC 1 Unit 2 sent erroneous DNBR penalty factor information to all four CPC's. The incident was caused by a calculational failure in the CEAC. Normally the CEAC will "catch" an error such as this and set a bit that declares the data to invalid (failed CEAC bit), but in this case the bit was not set. The CPC's interpreted this error as valid data and all four CPC channels conveyed this to the Plant Protection System resulting in a trip.

  The replacement system utilizes 2 CEAC's per CPC. If a similar event with a failed CEAC should occur, this would result in tripping only the associated CPC channel. Additionally, the replacement system has on-board diagnostics running concurrently with the operational software and the likelihood of an undetected internal CEAC failure that will allow the CEAC to continue to function is negligible. Should a CEAC failure be detected, this failure will be annunciated on the OM, MTP, and control board annunciator system. System Health displays on both the Operator Module and Maintenance Test panel will indicate the location of the failed CEAC module. (LERs 89-004-00 and 99-005-00 also document similar CEAC failures and plant trips. This response applies to both events.)

- <u>LER 91-008-00 - RPCB Algorithm Anomaly</u>
  This LER is discussed in APS' original submittal of November 7, 2002 (Ref. 4).

- <u>LER 86-047-00 - CPC Caused Reactor Trip</u>
  CPC Channel C Unit 2 performed an auto restart and tripped during a power ascension test when CPC Channel D was in bypass and CPC Channel A was in a trip condition until the test could be completed. Due to the one-out-of-two trip logic that resulted from the other two channels being out of service, this condition resulted in a reactor trip. It was determined that an invalid floating point fault occurred in CPC Channel C resulting in the auto-restart and subsequent trip. The computer board responsible for this failure was replaced.

  With the exception of the Channel C failure, this event demonstrated the proper operation of the CPCS, whether legacy or Common Q. In normal configuration, the CPCS functions as a two-out-of-four trip logic to initiate a DNBR/LPD trip to the PPS. The system will function as a one-out-of-two trip logic if one channel is bypassed and the other tripped and will respond conservatively if one channel provides a DNBR/LPD trip.

<u>NRC Request #C.5:</u>

The drawing given in the FMEA shows TCP/IP connections from the OMs (in addition to the connection from the MTP discussed previously) to what appears to be a LAN and LAN printer. Discuss how the existence of this connection does not permit inadvertent changes to addressable constants. What addressable constants can be changed from the OM?

APS Response to Request #C.5:

APS response to NRC Request #B.1 applies. The addressable constants are additionally protected by Cyclic Redundancy Checks (CRCs). If an addressable constant is inadvertently changed causing the CRC to change, the OM or MTP will flag the CPC so as not to rely on that flat panel device for constant values.

NRC Request #C.6:

Has an FMEA been performed for the interposing relay panel?

APS Response to Request #C.6:

No failure modes effects analysis (FMEA) has been performed specifically for the interposing relay panel (IRP). However, the IRP failure has the same effect on the system as the Digital Output (DO) module failure in the FMEA. A failure of the DO module or DO channel will result in either energizing or deenergizing an IRP relay. The IRP relay contact is the interface to the plant and used to drive annunciators or provide a trip signal to the PPS. A failure of the DO module channel output can not be detected by the AC160 diagnostics. Likewise a failure of the IRP relay is not seen by the AC160 diagnostics. In either case the failure is detected external to the CPCS by an annunciator not actuating when expected, an annunciator inadvertently actuating, an inadvertent trip signal received by the PPS, etc. Whether the DO module channel output fails or the associated IRP relay fails, the plant indications and affects on the PPS are the same. The FMEA contains analyses on the DO and IRP relay failures.

NRC Request #C.7:

The RCPSSS (Rx coolant pump shaft speed sensor) converts signals from the RCP shaft speed for use by the DP acquisition cards in each CPCS channel. Is the RCPSSS new? If not has is been approved by the staff? Why are there not two DP cards (for RCP) as there are two AI cards for other analog inputs such as Th, Tc and Pressure?

APS Response to Request #C.7:

Based on discussion with the NRC on June 5, 2003, no further response to this request by APS is required.

NRC Request #C.8:

WDTs can be implemented in different ways in the Common Q, describe their configuration for CPC. How will the WDTs be tested?

APS Response to Request #C.8:

The only watchdog timer (WDT) output that causes a channel trip is the CPC WDT. Should the WDT go off, power is cut off from the contact outputs causing the LPD

and DNBR trips, pretrips and CWP output to be de-energized, resulting in a channel trip. In the case of the CEACs, the WDT will cause the CEAC FAIL contact output to de-energize. For the Aux CPC and CPPs, the WDT will cause their associated trouble contact outputs to de-energize. The WDTs were tested by resetting the processors and observing the contact outputs of the CPC, AUXCPC, CEACs and CPPs.

NRC Request #C.9:

The SPM, section 3.4 discuss SW safety. Under the section, *Sequences of actions that can cause the system to enter a hazardous state*, it states that "A...hazards are identified in the Software Requirements Specification". Please identify where in the SRS for the CPCS these are located?

APS Response to Request #C.9:

The CPC replacement project is a unique application of the SPM Software Safety Plan. This is a digital-to-digital safety-related replacement system. The potential for software safety hazards was evaluated and all potential software safety hazards were already addressed in the SRS. This evaluation is documented in the Preliminary Software Hazards Analysis that was performed in accordance with the SPM.

NRC Request #C.10:

FDR for a CPC discusses interlocks and permissives in section 3.7. A $<10^{-4}$% reactor power trip and pretrip bypass (with the ability to change the setpoint) is discussed. Please discuss for the Common Q, how the failure of this bypass or the failure of the bypass to be automatically removed if reactor power is greater than the setpoint, does not present a single or common mode failure to the CPCS.

APS Response to Request #C.10:

Based on discussion with the NRC on July 17, 2003, no further response to this request by APS is required.

NRC Request #C.11:

In the SysRS, a reliability goal of $5x10^{-3}$ failures / channel is mentioned. Is this for the hardware only? Is there a reliability block diagram, fault tree or other analysis methodology identified to support this value?

APS Response to Request #C.11:

This goal is for hardware only, not software. The Common Q CPCS unavailability is more than a factor of 13 better that the current value for the CPCS. The $5x10^{-3}$ failures / channel is the assumed availability for the CPCs in the PRA in CEN 327-A, RPS/ESFAS Extended Test Interval Evaluation. This is strictly a hardware value and software availability is not included in the formulation of this number.

D. JULY 17, 2003 RAIs

<u>NRC Request #D.1:</u>

Discuss changes in the CPC Channel Functional Tests that differ as a result of implementing the Common Q CPCS.

<u>APS Response to Request #D.1:</u>

A general description of the changes to the CPC functional test as a result of the implementation of the Common Q CPC is provided below:

- A test cart is no longer required. Testing will occur using the installed maintenance test panel (MTP).
- The CEAC functional test procedures will now be rolled into the CPC functional test procedures as a result of having CEACs in each CPC channel.
- Auto restarts will not be checked since the new system fails in a HALT condition rather than auto-restarting.
- Testing will include verifying IRP performance along with the CPC. As previously performed, test signals generated from the excore drawers (external to the CPCS cabinet) will be used to verify that the CPC channel generates DNBR and LPD trip signals to the Plant Protection System (PPS) cabinets. This can only be accomplished through the IRP. (The PPS trips are placed in bypass before this test.)
- Software tests that the online diagnostics already monitor continuously will no longer be checked.
- All addressable constants (ACs) and reload data block (RDB) constants will be checked via the CRC and system load page.
- There will be no testing of the CEA Position Isolation Amplifiers which are part of the legacy system and not the Common Q.
- Steps will be added for checking CPCS system health (e.g., using miscellaneous displays on the FPD).

<u>NRC Request #D.2:</u>

Clarify PSAI 6.11 response.

<u>APS Response to Request #D.2:</u>

Based on discussions with the NRC staff on July 17, 2003, further clarification was requested regarding APS' response to Plant Specific Action Item (PSAI) 6.11. The following clarification is provided to assure that diversity and defense in depth is maintained with the installation of the Common Q CPCS:

1. There are no plans at this time to replace any other "safety" or non-safety plant control systems with similar computer technology.

2. The backup alarm and indications to warn operators of a CEA misoperation event (CEA insertion) are still available and will not be changed upon implementation of the Common Q CPCS.

3. The response time for operator action during a CEA misoperation event (Single Full-Length CEA Drop Event) is 900 seconds (15 minutes) as stated in section 15.4.3 of the PVNGS UFSAR. Only the CEA insertion event is considered for CEA misoperation since a CEA withdrawal event is backed up by a high pressurizer pressure trip whereas a CEA insertion event has no backup automatic trip.

References

1. APS letter 102-04931-GRO/SAB/TNW, "Response to Request for Additional Information to Proposed Amendment to Technical Specification 3.2.4, Departure From Nucleate Boiling Ratio (DNBR), 3.3.1, Reactor Protective System (RPS) Instrumentation – Operating, 3.3.3, Control Element Assembly Calculators (CEACs)", dated April 25, 2003, from C.D. Mauldin, APS to USNRC

2. CENPD-396-P, Rev. 01, "Common Qualified Platform" Topical Report, dated May 2000

3. APS letter 102-04964-CDM/SAB/DWG, "Response to Request for Additional Information to Proposed Amendment to Technical Specification 3.2.4, 3.3.1, and 3.3.3", dated July 10, 2003, from C.D. Mauldin, APS to USNRC

4. Letter 102-04864-CDM/TNW/DWG, "Request for Amendment to Technical Specifications: 3.2.4, Departure From Nucleate Boiling Ratio (DNBR), 3.3.1, Reactor Protective System (RPS) Instrumentation - Operating, 3.3.3, Control Element Assembly Calculators (CEACs)" , dated November 7, 2002, from C.D. Mauldin, APS to USNRC

Attachment 1

13-JN-1000

Engineering Specification For The Core Protection Calculator/Control Element Assembly Calculator (CPC/CEAC) System For Palo Verde Nuclear Generating Station

ENGINEERING SPECIFICATION

FOR THE

CORE PROTECTION CALCULATOR /

CONTROL ELEMENT ASSEMBLY CALCULATOR

(CPC/CEAC) SYSTEM

FOR

PALO VERDE NUCLEAR GENERATING STATION

ARIZONA PUBLIC SERVICE COMPANY

PALO VERDE NUCLEAR GENERATING STATION

OPERATIONS COMPUTER SYSTEMS ENGINEERING

PURCHASE SPECIFICATION

Specification For: CPC/CEAC SYSTEM

Specification No.: 13-JN-1000 **Rev:** 2

Project Title: CPC/CEAC SYSTEM REPLACEMENT

WBS Number: CD3GT123

Quality Class: Q

Location: Palo Verde Nuclear Generation Station

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Attachments

1.0 SCOPE

1.1 It is the intent of this Scope to require all Services (Engineering), Procurement of Equipment and Services necessary to design, fabricate, test, deliver, and startup a new Core Protection Calculator / Control Element Assembly Calculator (CPC/CEAC) system for the Palo Verde Nuclear Generating Station (PVNGS). The CPC/CEAC system shall consist of the NRC approved, safety related, microprocessor-based, "Standard Platform" system to be installed in all three PVNGS units, the two plant training simulators and the Operations Computer Systems (OCS) development center. The system shall be provided complete with all accessories, documentation and support services necessary to meet the requirements of this specification.

2.0 WORK NOT INCLUDED

The following work and services will be furnished by APS:

2.1 Replacement of DNBR and LPD meters.

2.2 Provide design reviews and comments of major system components, design documents and schedules. APS will perform design reviews and project oversight to ensure the design meets this specification and the project is being conducted satisfactorily.

2.3 Labor for unloading, handling, inspection, storage and installation of Contractor's Equipment at the installation locations.

2.4 Heated/Cooled, dust and humidity controlled rooms for equipment located in the control room area. Field located and remote area equipment conditions are defined in section 7.3.

2.5 Foundation and anchor bolts for equipment mounting in accordance with Contractor's drawings.

2.6 All conduit, cables and wiring external to the equipment furnished, internal cabling from the field side of the existing field terminal boards.

2.7 Electrical power to the equipment enclosures, rated at 120 VAC +/- 10%, 60 Hz +/- 5%, ungrounded.

2.8 Installation labor, craft support for field testing, and overall supervision at the site.

2.9 All tools required for installation, except special tools and equipment furnished by Contractor.

2.10 All equipment and material, including calibration and installation, specifically listed as being supplied by APS.

2.11 A connection to the Power Plant Ground grid.

2.12 Field painting for all APS supplied field equipment. Minor touch up painting on Contractor furnished equipment can be accommodated. Contractor shall provide all appropriate painting materials for touch up painting.

2.13 Modification of existing equipment cabinets to facilitate installation of contractor's equipment.

2.14 Performance of the setpoint engineering and analysis work. Also see section 5.4.5.

2.15 A NQR CPC to PMS Data Link will serve as an interface between the new CPC system and the PMS. This interface is required to translate the data from a format sent by the CPCS to a format that the PMS computer can accept. The CPC to PMS Data Link will also provide additional functions that will be difficult or costly to implement in the Q CPC system. These functions will include Pre-Trips for CPC Auxiliary Trips and other abilities as outlined in a separate specification.

3.0 DEFINITIONS AND ABBREVIATIONS

DEFINITIONS

Class 1E - The safety classification of the electronic equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or otherwise essential in preventing significant release of radioactive material to the environment.

Active Component - A component in which mechanical movement must occur in order to complete the component's intended nuclear safety function. A failure occurs when the component does not complete its intended nuclear safety function upon demand. Spurious action of a powered component originating within its actuation system is regarded as an active component failure unless specific design features or operating restrictions prelude such spurious action. Examples of active component failures include the failure of a powered or manual valve to move to its correct position, the failure of an electrical breaker or relay to respond or the failure of a pump, fan, or emergency generator to start.

Anticipated Operational Occurrences – Those conditions of normal operation that are expected to occur one or more times during the life of the plant. In particular, the occurrences considered include single operator errors or single component or control system failures resulting in transients which could lead to a violation of acceptable plant and fuel design limits if protective action were not initiated.

Contractor - The company contracted to furnish the computer system defined by this specification. Westinghouse Electric Company LLC was awarded this contract 12/20/00, and is the Contractor.

Departure From Nucleate Boiling Ratio (DNBR) - DNBR is the ratio of Critical Heat Flux to actual heat flux. Critical Heat Flux is that value of heat flux at which DNB occurs. It is assumed that when DNB occurs in the limiting coolant channel, the cladding fails since the differential temperature across the film layer adjacent to the cladding becomes very large.

Design Basis Accident - Those assumed accident conditions that, if uncontrolled, could result in radiological releases from the power plant.

Factory - contractor's facility used to integrate the computer system.

Field Proven - System hardware and software that is in operation at an operating nuclear plant.

Firmware - The combination of software and data that resides in read-only memory.

Fuel Design Limits - The DNBR, in the limiting coolant channel in the core, shall not be less than a preset minimum value. The peak local power density (LPD), in the limiting fuel pin in the core, shall not be greater than a preset value, which corresponds to the onset of centerline fuel melting.

HMI - Human-Machine Interface consisting of a color graphics monitor, a display processor and input device(s).

HMI Response Time - The time interval from the request of a new HMI screen display to the completion of the display.

Human Factors - A coherent, integrated set of activities aimed at an engineering program improving human-plant interface designs in a cost-effective manner.

Local Power Density (LPD) – A calculated core peak power expressed in linear heat rate (KW/ft) in the limiting fuel pin in the core.

On-Site (or Site) - Locations within the Palo Verde Nuclear Generating Station that are controlled with respect to access by the general public.

Operating Basis Earthquake - That earthquake which, considering the regional and local geology and seismology and specific characteristics of local subsurface material, could reasonably be expected to affect the plant site during the operating life of the plant. It is that earthquake which produces the vibratory ground motion for which those features of the nuclear power plant necessary for continued operation without undue risk to the health and safety of the public are designed to remain functional.

Operating Environment - The hardware and software which is needed to support the use of a software application or system. (e.g., operating system software, communications software/hardware, compiler, etc.).

Passive Component - A component in which mechanical movement does not occur in order for the component to perform its intended nuclear safety function. A failure is the structural failure or plugging of a passive component so that it does not perform its intended nuclear safety function. For fluid pressure boundary components, a passive component failure results in a break of, or crack in, the pressure boundary. Passive components include piping, and cables. (During the period of design for the safety injection system, a check valve failure is also considered a passive failure).

Plant Units - Palo Verde Nuclear Generating Station.

Power Susceptibility Profile - An AC power susceptibility profile is defined by a curve showing Voltage Deviation vs. Disturbance Duration. The curve shall show both over voltage and under voltage situations.

Purchaser - APS, as agent for the Owners of Palo Verde Nuclear Generating Station.

Quality Assurance - All those planned and systematic actions necessary to provide adequate confidence that a system or component will perform satisfactorily in service.

Quality Class Q - Any structure, system, or component which, as a result of being defective, could cause or increase the severity of a nuclear incident that would impose undue risk to the health and safety of the public, shall be designated Quality Class Q. All engineered safeguard systems fall within this classification. For items in this classification, the requirements of 10 CFR 50, Appendix B, as interpreted by ANSI N45.2-1971 shall be met to ensure the highest quality standard.

Quality Class QAG - Those items not included in Quality Class Q, which perform no safety function, but on which APS has made a regulatory, management directive, or UFSAR commitment to include them within the scope of the APS NA Program. The quality requirements of Quality Class QAG items may be similar to those for Quality Class Q except that 10 CFR 50, Appendix B is not applicable.

Quality Class NQR - Any structure, system, or component not included in Quality Class Q or QAG shall be designated as Quality Class NQR. In general, the quality requirements for equipment in Quality Class NQR will be the industry standard.

Response Time - The design basis for reactor protective system response times are the values assumed in the plant safety analysis used to establish reactor protective system trip setpoints. Initial values for time response and uncertainty are determined from test and analysis of the RPS and its associated instrumentation. These values are then used as input values to the transient analysis described in Chapter 15 of the UFSAR. A value is calculated for each setpoint such that the protective function of the system will be met if the sensor and processing system time delays and inaccuracies are maintained within the maximum values assumed in the analyses. The values for time delay and uncertainty then form the basis for values of response time and accuracy documented in

the Plant Technical Specifications and Periodic Test, Surveillance and Calibration Procedures and then become a requirement for the system.

Safe Shutdown Earthquake/Design Basis Earthquake - That earthquake which is based upon an evaluation of the maximum earthquake potential considering the regional and local geology and seismology and specific characteristics of local subsurface material. It is that earthquake which produces the maximum vibratory ground motion for which certain structures, systems, and components are designed to remain functional.

Safety Systems - Those systems that are relied upon to remain functional during and following design basis events to ensure (i) the integrity of the reactor coolant pressure boundary, (ii) the capability to shut down the reactor and maintain it in safe shutdown conditions, or (iii) the capability to prevent or mitigate the consequences of accidents that could result in potential off-site exposures comparable to the 10 CFR Part 100 guidelines.

Seismic Category I - Structures, systems, and components which are important to safety and are designed to remain functional in the event of a Safe Shutdown Earthquake (SSE), are designated as Seismic Category I. In addition, Seismic Category I structures, systems, and components are designed to remain functional and within applicable stress and deformation limits (elastic range of materials) when subjected to the effects of the vibratory motion of the Operating Basis Earthquake (OBE) in combination with normal operating loads.

Seismic Category II - Seismic Category II structures, systems, and components are those non-seismic Category I structures, systems, and components which are essential to power generation or whose failure could cause a safety hazard to station personnel.

Seismic Category III - Seismic Category III structures, systems, and components are those not designated as Category I, II or IX structures, systems, and components. Floor or wall-mounted Seismic Category III components shall be designed to withstand an equivalent static seismic load of 0.05g times the mass of the equipment in any direction applied to the center of gravity of the component, and not experience any structural failure of that part of the component that is secured to the foundation. Seismic Category III tanks and structures shall meet the Uniform Building Code for Seismic Zone 2.

Seismic Category IX - Seismic Category IX structures, systems, and components are those non-seismic Category I, II, or III structures, systems, and components including the associated supporting structure that must be designed to retain structural integrity during and after a

seismic event, but do not have to retain operability for protection of public safety. The basic requirement is prevention of structural collapse and damage to equipment and structures required for protection of the public safety.

Simulator - Palo Verde Control Room Training Simulators.

Software - Sequence of instructions suitable for processing by a computer, along with procedures, rules and associated documentation and data pertaining to that processing.

Software Configuration - A collection of software elements treated as a unit for the purposes of control.

Standard Platform - The COMMON QUALIFIED PLATFORM as defined by Westinghouse Electric Company LLC, in CENPD-396-P, Rev. Latest; CENPD-396-P, Appendix 1, Rev. Latest; Appendix 2, Rev. Latest; Appendix 3, Rev. Latest; Appendix 4, Rev. Latest; and CE-CES-195, Rev. Latest.

Specification - This document, including all attachments.

System - The entire assembled equipment, including all operating system and application software.

Train - The designation applied to a given system or set of components that enables the establishment and maintenance of physical, electrical, and functional independence from other redundant sets of components.

Validation - The process of evaluating the system at the end of the development process to ensure compliance with its requirements.

Verification - The process of determining by review and/or alternate calculations and testing (when possible) whether or not the products of a given phase of the system development cycle fulfill the requirements established during the previous phase.

Acronyms/Abbreviations

AC	Alternating Current
ANS	American Nuclear Society
ANSI	American National Standards Institute
APC	Auxiliary Protection Cabinet
ARC	Auxiliary Relay Cabinet
ARO	After Receipt of Order
ASGT	Asymmetric Steam Generator Transient
CD-ROM	Compact Disc – Read Only Memory
CEA	Control Element Assembly
CEAC	Control Element Assembly Calculator
CEAPDS	Control Element Assembly Position Display System
CEDM	Control Element Drive Mechanism
CFR	Code of Federal Regulations
CP	Control Panel
CPC	Core Protection Calculator
CPCS	Core Protection Calculator System
CPU	Central Processing Unit
CRT	Cathode Ray Tube
DC	Direct Current
DNBR	Departure from Nucleate Boiling Ratio
ESFAS	Engineered Safety Feature Actuation System
FAT	Factory Acceptance Test
FPD	Flat Panel Display
HMI	Human-Machine Interface
HSL	High Speed Link
I/O	Input/Output
IEEE	Institute of Electrical and Electronics Engineers
IRP	Interposing Relay Panel
ITP	Integrated Test Processor

LPD	Local Power Density
MCB	Main Control Board
MTP	Maintenance and Test Panel
NA	Nuclear Assurance
NI	Nuclear Instrumentation
NRC	Nuclear Regulatory Commission
NUREG	Nuclear Regulation
OM	Operators Module (new)
PC	Personal Computer
PCI	Personal Computer Interface
PMS	Plant Monitoring System
PPC	Process Protective Cabinet
PPS	Plant Protection System
PVC	Polyvinyl Chloride
QA	Quality Assurance
RCPSSS	Reactor Coolant Pump Speed Sensing System
RDB	Reload Data Block
REG	Regulation/Regulatory
REV	Revision
ROM	Remote Operators Module (old)
RSPT	Reed Switch Position Transmitter
SAT	Site Acceptance Test
STD	Standard
TCP/IP	Transmission Control Program/ Internet Protocol
UFSAR	Updated Final Safety Analysis Report
USNRC	United States Nuclear Regulatory Commission
V&V	Verification and Validation
VAC	Volts Alternating Current
VME	Virtual Memory Extension
VOPT	Variable Overpower Trip
WDT	Watch Dog Timer

4.0 CODES AND STANDARDS

This section describes those regulatory documents, codes and standards, and regulatory commitments which are directly applicable to the design, procurement, manufacture, installation, testing, operation, modification and maintenance of the system and its components and constituent parts.

The contractor will comply with the codes and standards applicable to the provided equipment.

4.1 Nuclear Regulatory Commission (NRC).

USNRC Reg. Guide 1.152	Criteria for Digital Computers in Safety Systems of Nuclear Power Generations Stations.
USNRC Reg. Guide 1.168	V&V, Reviews, and Audits for Digital Computer Software Used in Safety Systems of Nuclear Power Generation Stations.
USNRC Reg. Guide 1.170	Software Test Documentation for Digital Computer Software Used in Safety Systems of Nuclear Power Generating Stations.
USNRC Reg. Guide 1.171	Software Unit Testing for Computer Software Used in Safety Systems of Nuclear Power Generating Stations.
USNRC Reg. Guide 1.172	Software Requirements Specifications for Computer Software Used in Safety Systems of Nuclear Power Generating Stations.
USNRC Reg. Guide 1.173	Developing Software Lifecycle Processes for Computer Software Used in Safety Systems of Nuclear Power Generation Stations.
USNRC Reg. Guide 1.75	Physical Independence of Electrical Systems.
10CFR20	Standards for Protection Against Radiation.
10CFR21	Reporting of Defects and Noncompliance.
10CFR50 Appendix A	Licensing of Production and Utilization Facilities, General Design Criteria for Nuclear Power Plants.

10CFR50 Appendix B	Quality Assurance Criteria for Nuclear Power Plants.
10CFR50 Appendix I	Numerical Guides for Design Objectives and Limiting Conditions for Operation.
NUREG-0737	Requirements for Emergency Response Capability.

4.2 American National Standards Institute (ANSI) Standards.

ANSI/ANS 3.5-1998	Nuclear Power Plant Simulator for Use in Operator Training and Examination.

ANSI/ANS 7-4.3.2-1993 Standard Criteria for Digital Computers in Safety Systems of Nuclear Power Generating Stations

ANSI C37.90.1 1989	Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
ANSI/ANS N45.2.2-1972	Packaging, Shipping, Receiving, Storage and Handling of Items for Nuclear Power Plants.

4.3 Institute of Electrical and Electronic Engineers (IEEE) Standards.

279-1971	Criteria for Protection Systems for Nuclear Power Generating Stations.
308-1974	Criteria for Class 1E Electrical Systems for Nuclear Power Generating Stations.
323-1983	Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.
338-1975	Standard Criteria for the Periodic Testing of Nuclear Power Generating Station Protection Systems.
344-1975	Guide for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations.

383-1974	Guide for Type Test of Class IE Electric Cables, Field Splices and Connections for Nuclear Power Generating Stations.
379-1972	Trial-Use Guide for the Application of the Single Failure Criterion to Nuclear Power Generating Station Protection Systems.
384-1974	Trial-Use Standard Criteria for Separation of Class 1E Equipment and Circuits.
610.12-1990	Standard Software Engineering Terminology.
730-1994	Software Quality Assurance Plans.
802.3 Part 3:	Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications.
828-1990	Standard for Software Configuration Management Plans.
829-1983	Standard for Software Test Documentation.
830-1998	Recommended Practice for Software Requirements Specifications.
1008-1987	Standard for Software Unit Testing.
1012-1986	Software V&V Plans.
1016-1987	Recommended Practice for Software Design Descriptions.
1016.1-1993	Guide to Software Design Descriptions.
1028-1988	Standard for Software Reviews and Audits.
1044-1993	Standard Classification for Software Anomalies.
1063-1987	Standard for Software User Documentation.
1074-1995	Software Lifecycle Process.

1233-1996	Guide for Developing System Requirements Specifications.

4.4 Other

UL 910	Underwriter's Laboratory Fire & Smoke Test.
NEI/NUSMG 97-07	Nuclear Utility Year 2000 Readiness.
Addendum - A-01	General Drawing and Data Requirements.
Addendum - A-02	Project Classification System.
Addendum - A-05	Supplier Quality Class Q and QAG Program Requirements.
Addendum - A-13	Instrumentation For Package Systems.
Addendum - A-14	Surface Preparation and Coating Requirements for Ferrous Metal Surfaces to Be Installed Outside the Containment Building.
Addendum - A-21	Instruction Manuals And Spare Parts List For Equipment.

4.5 Compliance with Codes and Standards

4.5.1 The contractor shall comply with the above list of codes and standards.

4.5.2 The contractor will design the replacement CPCS in accordance with Reg. Guide 1.153, which endorses IEEE 603-1991, "IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Plants", as augmented by the new Branch Technical Positions HICB-1, 2, 3, 6, and 9-12 of the new Standard Review Plan.

4.5.3 In addition to the standards and regulatory guides described above, the contractor shall provide to the purchaser a replacement Core Protection Calculator System that will meet all standards as listed in the Common Q Topical Report, CENPD-396-P, Rev. Latest. The draft 10CFR 50.59 evaluation that shall be developed by the contractor to determine whether or not this modification can be implemented without prior NRC approval, will provide a detailed description to the standards, regulatory guides and NRC licensing positions that define the requirements for the existing system.

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5.0 CONDITIONS OF SERVICE AND GENERAL REQUIREMENTS

The replacement systems will replicate the functions of the existing systems. Each of these items being provided under this Purchase Specification is described in the following section.

The CPCS system in each unit shall be replaced with four Quality Class Q / Seismic Category I channels of equipment (channels A, B, C, and D) which acquires and processes four channels of inputs. The four channels of equipment are located inside the Auxiliary Protection Cabinet (APC) in which each channel is physically separated and isolated from each other. A Human-Machine interface (HMI) will be located on the Main Control Board (MCB) in the Control Room, and also in each APC. The replacement of CPCS shall be based on a "Standard Platform". This "Standard Platform" and its Class 1E applications must pass the review and approval of the USNRC.

The CEA Display shall be replaced with a Quality Class QAG / Seismic Category IX CEA Position Display System (CEAPDS). The Palo Verde CEAPDS will be located at the Main Control Board (B04) and will be connected to the CPC system through fiber optically isolated Ethernet links. A color FPD shall be provided for mounting in B04 and displaying the CEA rod positions. The FPD viewing area should be between 18" and 21".

5.1 The CPCS portion of the Palo Verde CPCS replacement described herein provides the following replacement systems:

5.1.1 Three Safety Related Core Protection Calculator Systems (one system per unit, four channels per system, including an Operators Module (OM) and Maintenance and Test Panel (MTP) per channel).

5.1.2 Safety Related Control Element Assembly Calculators (two per channel).

5.1.3 Three Non-Safety related, QAG and Seismic IX Control Element Assembly Position Display Systems (one channel per unit).

5.1.4 Each channel shall also include the following hardware:

- Three AC160 Racks (CPC, CEAC 1 and CEAC 2) including all processor and I/O modules.
- A Common Q Power Supply Assembly including chassis, RSPT, Auxiliary power supply modules and cooling fans.
- Two cabinet temperature sensors.
- AF100 fiber optic modems for interfacing with the control room mounted OMs.
- HSL fiber optic modems for isolation between channels.

- Fiber optic cables for those links between channels within the APCs
- Miscellaneous support items (relays, termination assemblies, staging racks, and mounting hardware for the APCs and the staging racks, etc.)

5.2 The Palo Verde CPCS replacement described herein also provides the following new equipment:

5.2.1 One Safety Related "Standard Platform" Single Channel System, with OM, MTP, CEAPDS (the CEAPDS is Non-Safety related, QAG and Seismic IX) which includes the following hardware.

- Three AC 160 Chassis including all processor and I/O modules.
- One Common Q Power Supply Assembly, including chassis, RSPT, Auxiliary power supply modules and cooling fan assembly.
- Two cabinet temperature sensors.
- AF100 fiber optic modems for interfacing with the OMs.
- fiber optic cables for the AF100 FO modems
- HSL fiber optic modems.
- HSL fiber optic cables.
- One two bay staging rack for mounting the single channel equipment.
- Termination interface to allow the connection of the I/O simulator.

5.2.2 Four Non-Safety Related Common Q I/O Simulator Systems (one system per unit to be used for surveillance testing, and one system for the Single Channel Development System) which include the following hardware.

- One rack with casters for mounting the equipment.
- I/O chassis for the I/O and processor cards needed for simulating the CPCS signals.
- One FPD
- One keyboard and mouse/trackball assembly.
- Connector interface for easy connection of cables between the I/O simulator and the CPCS.
- Cable assemblies of sufficient length for connection between the I/O simulator and the CPCS.

5.3 The Palo Verde CPCS replacement described herein also provides for the following new equipment for the plant training simulators:

5.3.1 Eight Non-Safety Related Operator Modules (four per plant training simulator).

5.3.2 Two Non-Safety Related Control Element Assembly Position Display Systems (one per plant training simulator).

5.3.3 The same software provided to the actual plant system will be provided and used in the simulator, with one exception. Existing CPC/CEAC codes that are written in Fortran shall be provided for simulator use. The contractor has no responsibility for interfacing the provided hardware and software with the plant training simulator, except to provide documentation of data formats and protocols of the information flow for these devices and the communication software (AF100 for the OMs and Ethernet for the CEAPD).

5.4 CPC/CEAC system overall performance requirements.

5.4.1 The system contractor shall provide a replacement CPC/CEAC system with, at minimum, the same functionality of the existing system.

5.4.2 The safety related CPCS Replacement system time response will meet or be faster than the time response requirements of the existing system.

5.4.3 The CPC Power Indication Calibration shall be automated on all channels of the OM. This calibration is described in Palo Verde procedure 40ST-9NI01. This shall include the following characteristics:

- The ability for the operator to manually enter CAL PWR using the OM touch screen.
- The routine would smooth the CPC input data by averaging the last 10 values for TC1, TC2, PHICAL, BDTD and M.
- The routine would display all input data, intermediate calculations and final results, displaying new addressable constants next to old addressable constants. Old and new calculated power would also be displayed.
- The routine would update addressable constants after confirmation by the operator.
- A data file with the information associated with the above calibration (except the smoothed values) would be broadcast to the PMS computer via the Ethernet link to the APS provided CPC to PMS Data Link (reference section 2.15).

5.4.4 The CPC/CEAC algorithms shall remain functionally identical to the existing algorithms to eliminate the need for a NRC review. However, the following changes shall be made.

Enhance the RPCB bit flag in the RPCB module (in the CEAC algorithm) so that it has the ability to discern a rod slip.

- A means shall be provided to re-set the correct CEA position after a rate-of-change error has cleared. Note – this is not considered an algorithm change.

5.4.5 All components and equipment replaced under this modification, including the CPCS, shall be designed to meet or exceed the instrumentation uncertainty and display resolution of the original equipment being replaced. Formal calculation of hardware and processing uncertainty for the new CPCS equipment shall be provided by the contractor consistent with ISA S67.04 methodologies and station procedures. Also see section 2.14.

5.4.6 All interfaces to other plant systems shall be compatible with the current system capabilities and requirements, including field inputs, output to board mounted indicators, trip relay contacts, power supplies and plant annunciator system contacts, unless specifically addressed elsewhere.

5.4.7 To aid in ease of system use by operators, the replacement system shall provide English descriptors for all Point IDs and shall not require any hexadecimal decoding by the users. The definition of Point ID is: a number that can be used to call up a tag name (database variable) using the standard display.

5.4.8 Modify DNBR Margin analog output to increase the Operators ability to read DNBR. Modify the output to be 0.0 to 2.0 DNB for a full scale range of output voltage of 0 – 10 VDC.

6.0 CPCS DESIGN, MATERIALS AND CONSTRUCTION OVERVIEW

6.1 The CPC System shall be installed into the existing APC. The existing CPC/CEAC cabinet equipment will be removed and the new equipment installed in its place. Modifications to the cabinet to install the new system shall be minimized. Contractor shall provide the design to modify the existing Auxiliary Protection Cabinets (APCs) to accept the new CPC/CEAC system. This shall include any analysis or testing required to support the Seismic Category 1 re-qualification in accordance with IEEE 344-1975. The design shall utilize the existing rails, attaching the chassis to the rails using clip nuts (or an equivalent) or by attaching a standard mounting rail to the existing rail. The design shall accommodate the existing field terminal boards. The equipment currently in the cabinets that is not replaced by this modification shall remain installed as is, so as to not require removal, reinstallation and retest. The exception to this requirement is the IRIS, which shall be moved to accommodate the new equipment.

6.2 In order to minimize the installation time and to test the system as completely as possible, the contractor shall build staging/shipping racks that reflect and emulate the design of the existing APC. These racks shall be designed with mounting rails and terminal blocks located in the same position as the existing APC. This will allow the contractor to assemble and wire each rack of equipment in the same position as it will be installed in the plant. The CPCS shall be wired such that the wire bundles in the staging racks can be easily removed and placed in the APC with minimal effort. The replacement design shall reuse existing field cabling and field wire connections.

6.3 The contractor shall build all four channels of equipment into staging racks. For the Factory Acceptance Test, the contractor will connect the four channels together as they would be connected in the plant. All four channels of input signals shall be simulated, thus providing a complete system-testing platform for the FAT. In this way, the contractor can assemble and test the system in the configuration in which it is to be installed and operated. This will provide a high level of confidence on the operation of the system prior to installation.

6.4 The CPCS shall consist of four CPC channels per Palo Verde unit and two CEACs per channel. Each channel shall receive all of the Reed Switch Position Transmitter (RSPT) signals thus allowing each channel to perform a CEAC 1 and CEAC 2 calculation. The target rod position information for each channel will be received by the CPC processor via High Speed Link (HSL) from the CEACs. The CEACs will receive the RSPT signals via the HSL via global memory from the CPPs. The RSPT

signals are input to the I/O chassis where they are converted to a digital value via the CPPs. The digital values are then transmitted to all four channels using a HSL. These links shall be fiber optically isolated between channels to meet the separation criteria of IEEE-384. The fiber optic cable is a medium that is not susceptible to EMI noise and provides separation between channels as is required for a safety system. There shall be two high-speed serial links provided between each channel. The links shall be wired such that the primary and the backup links are terminated to two different processor modules so that a failure of one module would not prevent receiving information from the transmitting channel.

6.5 Each CPCS channel shall receive two HSL data links, a primary link and a backup link, from each channel (a total of six links). The CPC/CEAC shall first check to see if the primary link is active and if not, then uses the backup link for those RSPT signals. The data received across the HSLs result in each channel receiving all of the RSPT1 and RSPT2 signals so that each channel can perform a CEAC1 and CEAC2 calculation. The penalty factor outputs of CEAC1 and 2 shall be input to the channelized CPC calculation.

Since all of the RSPT signals are available, the new CPCS shall have the capability to allow some signal substitution or bypass to occur (administratively controlled). The signal substitution shall be manually initiated from the Operators Module or the Maintenance and Test Panel. This will make it easier to handle the failure of an RSPT (RSPT 1 or RSPT 2). This feature is not believed to require the approval of the NRC before implementation is allowed.

6.6 There are four existing CPCS Remote Operator's Modules (ROM), one for each channel, mounted in the main control room. The new CPCS Operator's Module shall be implemented using a "Standard Platform" Flat Panel Display System. The CPCS shall talk to its Operator's Module through a fiber optically isolated "Standard Platform" field bus interface. The Operator Module shall have the following characteristics:

6.6.1 Replace the existing Remote Operators Module with a color touch screen Flat Panel Display.

6.6.2 The ability to view CPC and CEAC information a page at a time versus one value at a time.

6.6.3 All PIDs shall also have appropriate English descriptions or tag names.

6.6.4 The ability to view a minimum of 10 addressable constants on a single display page.

6.6.5 The ability to list the last twenty (20) sensor failures with a Time of Day and date stamp.

6.6.6 An improved Trip Buffer Report that contains three copies of the Trip Buffer; two copies before the trip, and one copy when the trip occurred.

6.6.7 The ability to display the Trip Buffer Report, providing for paging through the report a page at a time.

6.6.8 Allows the user to select which PIDs to display on a PID groups page.

6.6.9 Provides an emulation of the existing Remote Operator's Module keypad and displays on the screen what would be shown on the Point ID Display.

6.6.10 Provides the ability for signal substitution of up to 3 RSPT signals per channel.

6.6.11 The OM/MTP shall have a "pop up" LCO alarm text box for the alarm buttons displayed on the screen.

6.6.12 Shall not require the operator to manually re-enter Type 1 or 2 addressable constants for any of the following conditions: loss of power and restoration, preventative maintenance, surveillance testing or functional testing (if this specific testing is required).

6.6.13 A standard CEAC page should display penalty factors.

6.6.14 Display pages specifically designed to provide channel health status shall be provided.

6.6.15 An updating display page shall be provided that illustrates a block diagram of the system for system health determination.

6.6.16 The OM shall be designed so that Maintenance and Software loading shall be conducted from outside the control room horseshoe (i.e. behind the OM, preferable from a CD-ROM).

6.6.17 The OM should fit in the panel cut out of the existing ROM with as little modification of the cut out as possible. Zeus fasteners or

their equivalent are recommended, using the same bolt holes, if possible. Unless required for seismic qualification, there is no need to use all 12 of the existing bolt holes.

6.6.18 A total of at least 25 display pages should be created for the OM. These pages shall be approved by the purchaser, and shall include the following pages:

- ASI plot page (canned and calculated ASI values).
- Alarm status indication shall be present on every page.
- View addressable constants.
- Change addressable constants when Function Enable Keyswitch is enabled (always showing PIDs 406 and 179).
- Display sensor failures, including the time and failure mode of at least the last twenty sensor failures.
- Display the CPC trip buffer report or snapshots for CEAC 1 or 2.
- User PID group display page that allows the displaying of a minimum of 40 online operator selectable dynamic point ID values and English descriptors on multiple pages (at least ten at a time). A user interactive display will be used to define point IDs to be displayed on each page.
- 11 fixed PID group display pages as defined by APS.
- A page to emulate the old ROM, but with additional English descriptors for point ID values, to minimize training required to use the new displays.
- ST Automation page for NI01 Surveillance Test. This page will allow the operator to input the calorimetric power and have the OM or MTP calculate and update the new addressable constants for the CPC.
- A page that shows in graphical form a block diagram of the channel.
- Channel health page for Module Failures/errors, including a historical display of at least the last thirty system diagnostic failure conditions.
- Display directory.

  (item deleted)
- A display page with CEAC 1 and 2 information displayed side by side.
- A DNBR and LPD trending page used when COLSS is out of service. Reference PVNGS procedure 72ST-9RX03.
- A Technical Specification Channel Check display consisting of a single page of dynamic data, with English descriptors or tag names, to facilitate periodic CPC/CEAC related Technical Specification channel checks.

- Each page will have a "Print Screen" icon. Depressing this icon will save the screen as a bitmap file and transmit this file across the Ethernet to a printer where it will be printed.

6.7 The Maintenance and Test Panel (MTP) shall also be implemented using a "Standard Platform" Flat Panel Display System, for diagnosing the system and displaying the same information as the Operator's Module. The MTP shall have the following characteristics:

6.7.1 The MTP shall have all the same characteristics of the OMs, except as modified below.

6.7.2 Provide a color touch screen Flat Panel Display in the APCs for initiating testing for each of the four channels.

6.7.3 Used off-line for loading software to the CPCS processor modules.

6.7.4 Shall have the same display pages as the OM, with the addition of pages for maintenance and testing functions, and can be used as a backup for the Control Room OM.

6.7.5 The MTP will have a menu driven Surveillance/Test Mode or addressable constants page that supports the following activities.

- CPCS Surveillance Test
- CEAC/CPP Surveillance Test
- Save Addressable Constants to MTP Removable Media
- Load Addressable Constants from MTP Removable Media
- Save the CPC Trip Buffer to MTP Removable Media
- Save the CEAC Snapshot to MTP Removable Media
- Load RDB

6.8 The CEA Position Display (CEAPD) shall have the following characteristics:

6.8.1 Replaces the existing CEAPD with a color 18-21" FPD (with a mouse/trackball, and not a keyboard).

6.8.2 Provides a screen display to be able to see all CEAs on a single display page, i.e., the same functionality as the current system.

6.8.3 At least 4 other displays shall be provided. These should consist of CEA groups, such as, shutdown groups, regulating groups, part length groups, CEAC1 and CEAC2 data displayed on a

single display page, Cross Channel Comparison data and System Health and Alarm information.

6.8.4 The CEAPD shall be designed so that Maintenance and Software loading shall be conducted from outside the control room horseshoe (i.e. behind the CEAPD, preferable from a CD-ROM).

6.8.5 The CEAPD should fit in the panel cutout of the existing CEAPD with as few changes to the panel as possible. Zeus fasteners or equivalent are recommended. The FPD shall be installed so that routine replacement can be performed from the back.

6.9 The MTPs shall also provide the interface to the PMS computer and the CEAPDS. Each MTP will send the RSPT information to the CEAPDS via a fiber optically isolated connection. The PMS computer information shall also be transmitted across this Ethernet connection. The actual Ethernet bus to which these devices will be connected shall be located outside of the APC, possibly in the computer room, or the main control room. The CPCS to PMS Data Link shall have the following characteristics:

6.9.1 All CPC data currently provided to the Plant Computer, for such PMS functions as the CPC Report, the CEAC report and the CECOR snapshot, will be provided via an Ethernet link at a period of once per second.

6.9.2 Additional data, such as calculated variables VOPT and ASGT and the current values of Type I and II addressable constants will be provided. This shall be accomplished by sending all values displayed in the CPC trip buffer (~114 points), CEAC trip buffer (~97 points) and addressable constants list (~49 points) to the Plant Computer via an Ethernet link at a period of once per second.

6.9.3 Three copies of the Trip Buffer Report will be sent to the Plant Computer all the time. When the channel is not tripped, this is the live values, and the two previous values. When tripped, this information is frozen and not updated until the trip buffer/snapshot is cleared.

6.10 Each channel of the APC shall contain a CD drive to be used for loading software into the CPCS. The CD drive will be connected to the MTP. The operator will use the MTP to perform necessary functions to load the software, configure the processor modules, and load reload data block information into the CPCS.

6.11 Each channel of the CPCS shall contain a Watchdog Timer (WDT). The WDT module interfaces with an interposing relay panel (IRP). The CPCS DNBR and LPD trip and pretrip outputs from the processor module shall drive the IRP, which interfaces with the Plant Protection System (PPS). If the processor fails to refresh this module or on a loss of power, the module will cause the CPCS to generate a trip by opening the DNBR and LPD IRP contacts to the PPS. This provides a failsafe condition should the CPCS computer system fail. Internal system diagnostics shall be contained within the processor.

6.12 The replacement CPC system shall be designed with redundancy to improve system reliability and shall be designed to provide a channel trip under all failure conditions that would prevent the CPCS from performing their intended trip functions. Failures of the computer, power supply, multipliers, or sensor shall by design, initiate a channel trip upon detection thereby preventing a Functional Failure (FF) error from occurring. If a failure were to occur that prevents the system from initiating a valid channel trip, then the system shall fail in a fail safe channel trip condition.

6.13 Parameters, which could be indicative of system degradation such as power, supply voltage, cabinet temperature, cooling fan failure, and others need to be transferred through the data link to the PMS Computer.

6.14 Contractor will provide spare parts for any energized component. The quantity shall be 15% of the total components of each model provided. All quantities shall be rounded up to the next highest whole number. Contractor shall supply a complete list of recommended spare parts, with part numbers, required for assembly, reassembly and repair of all components of the Equipment. The spare parts ordered by APS shall be supplied in separate containers suitable for long-term indoor storage. The containers shall be marked with the purchase order number and WBS number and shall also show that the parts are for Arizona Public Service Company, PVNGS CPC/CEAC Replacement Project. Contractor shall provide prices for all spare parts listed in this section. Fiber optic cables shall be provided with twice the amount of required fiber for use as spares.

The contractor shall have a parts obsolescence support plan to achieve a 20-year obsolescence support goal from 10/31/2000. The plan shall include commitments for the following:

- Full production (for new systems) for 7 years w/o requalification costs to APS.
- Spare parts production for an additional 5 more years w/o requalification costs to APS.
- Contractor pooled inventory spares stocking for an additional 8 more years as a minimum.

6.15 All components, test jacks and adjustment settings shall be easily accessible for routine monitoring and adjustments without moving equipment or cables to gain access.

6.16 Since equipment degradation is related to the elevated temperatures, cabinet temperature shall be monitored. The temperature switches shall be replaced with temperature transducers (RTDs) that will be input to the CPCS equipment. The CPCS shall monitor the temperature transducers and generate an alert/alarm condition(s) should a temperature setpoint be exceeded. Incipient failures resulting from elevated temperature can then be corrected before elevated temperature related problems occur.

6.17 Power Supplies

6.17.1 The power supply assembly shall be based on a 19" rack assembly. Various modules shall be available to accommodate the different output voltages anticipated.

6.17.2 The power supply shall be designed for use by the processor, digital logic, relays, and reed switch position transmitter circuits. Separate power supply modules may be used for different functions.

6.17.3 The power supply assembly shall be designed as a series of modules to facilitate easy maintenance. Power supply assemblies shall consist of AC line filters, Surge protection, Holdup capacitor block, and Ripple filter (as needed per application).

6.17.4 Redundancy shall be available using a diode auctioneering or current sharing scheme, except for the RSPT power supplies, which must be current sharing. The intent is that the good power supply will pick up the load upon loss of the faulted one to prevent relays from dropping out or the processor from halting. Fault in one half of a redundant supply shall not affect the other from operating normally. Capability shall exist for replacing the faulted power supply on line. Turning off the affected side power supply while the unaffected side powers the entire load to keep the channel functional is acceptable.

6.17.5 The power supply shall have over voltage and over temperature protection. Under voltage and over voltage will be indicated.

6.17.6 The power supply shall be configured so that it is not near its maximum loading to extend its life. Supplemental cooling shall be provided to assure the highest reliability available.

6.17.7 Each of the power supply modules will provide a digital signal to the CPC for failure indication. The RSPT auctioneered output voltage shall be monitored and read by the CPCS. All fans used in the CPCS shall provide indication of failure and shall be selected for the maximum reliability, such as including use of sealed ball bearings and ensuring adequate margin on power supply thermal derating curves. An external precision voltage for verifying that various cards are functioning within specifications is not required if the cards have an internal precision voltage source for their self-calibrating feature.

6.17.8 Sufficient hold up time (approximately 20 milliseconds) shall be provided to allow momentary loss of external power due to bus transfer.

6.17.9 Soft start shall be provided so those external sources powered by inverters will not be adversely affected.

6.17.10 The power supply shall have a power factor greater than 0.9.

6.17.11 To extend power supply life, the power supplies shall be configured so that they are not near their maximum loading. Supplemental cooling shall be provided to also extend the life of components. Power supply detailed design documentation shall be provided as part of the technical manual to facilitate periodic rebuilding in order to account for electrolytic capacitor life.

6.17.12 The new systems requirements for cooling shall be greatly reduced with the reduced number of heat generating components and more efficient power supplies. The system shall use muffin or platter fans strategically placed. Fans shall be easily accessible for operability determination and for ease of replacement. Sufficient redundancy shall exist to protect the system from heat related failures as a result of a single fan failure.

6.18 Calibration adjustments, test points, meter readings, and other maintenance related activities shall be made easily accessible, without the need to remove equipment to gain access.

6.19 The replacement CPC/CEAC shall use an Ethernet connection to the PMS computer to transmit data.

6.20 A data point file with the capability to select 30 addressable constants using the RDB shall be created to archive the CPC/CEAC data for

passthrough to the PMS. This data point file shall have the ability to be configurable by the Operations Computer Systems personnel for their use.

6.21 To improve the life of new CPC/CEAC hardware, improved methods of equipment cooling will need to be provided. Methods selected shall minimize ambient noise to the control room environment. Redundancy in cooling shall be provided, and cooling fan failures shall be alarmed along with high cabinet temperatures.

6.22 The CPCS shall provide an indication of test or bypass conditions or removal of any channel from service by means of status lights and annunciators. Where plant-operating requirements necessitate the automatic or manual bypass of a complete protective function, the design shall be such that the bypass will be automatically removed when required.

6.23 Addressable Constants

6.23.1 The CPCS shall be designed with addressable constants where it is necessary to change to a more restrictive setpoint to provide adequate protection for a particular mode of operation or set of operating conditions.

6.23.2 Each addressable constant shall have programmed in its change-value function an upper and a lower limit to minimize the range of values that can be entered.

6.24 The single channel "Standard Platform" for the CPC/CEAC and the I/O Simulator

6.24.1 As part of this specification, a Class 1E "Standard Platform" Single Channel CPC/CEAC/CEAPDS system shall be provided. This system shall be used for training and troubleshooting by plant personnel. The I/O simulator system shall provide the capability to simulate all inputs and monitor the outputs of the "Standard Platform" Single Channel CPC system. The MTP shall allow an interface to the "Standard Platform" Single Channel CPC system and to perform surveillance testing such as CEA Drop Testing, Time Response Testing, etc.

6.24.2 An I/O simulator to be used for testing the four-channel plant CPCS in each unit and a fourth I/O simulator for the CPCS single channel shall be provided.

6.24.3 The I/O simulator shall provide signals that include RSPT inputs, process inputs, pump speed inputs, and PPS contact inputs. The I/O simulator shall be designed to simulate all of the

signals necessary to make the CPC Single Channel appear as an operational CPC Channel system. The I/O simulator shall allow the Operator to select how the input changes. The Operator can choose to have the output respond as a step change or as a RSPT ramp. Under normal conditions, the RSPT ramp changes the signal at a rate not to cause a rate of change error in the CPCS. The Operator shall be able to select different ramp rates so that the rate of change error can be tested or to see how the system responds. The I/O simulator shall also receive and display the outputs of the Single Channel System. These will include the annunciator outputs, inter-channel high-speed links, the plant computer data links, and the analog outputs.

6.24.4 By acquiring these signals, the I/O simulator can provide a user-friendly interface for viewing all of the inputs and outputs from the single channels system.

6.24.5 Additionally the capability to input test cases shall be provided. The user first generates a test file containing various input states and values. This file is read into the I/O simulator where the I/O simulator then sets the outputs to this state.

6.24.6 The capability to ramp inputs at various user selected speeds shall be provided for use by the user. More than one input shall be ramped at a time.

6.24.7 The I/O simulators shall be housed in a rack approximately 3 feet tall containing a monitor, keyboard, mouse, and the I/O hardware. The rack shall be on casters for portability. The I/O simulator shall contain various cables and connectors that will allow for the connection to the "Standard Platform" Single Channel CPC system or one channel of the CPCS. The I/O simulator and I/O hardware shall be designed using cards that interface to a standard backplane architecture such as VME or Compact PCI. The application software shall be written to run on a *x*86 processor.

6.25 The system ground shall be completely isolated from power and chassis grounds. All ground connections shall be a single, low potential tie to the site ground grid system. All ground cables shall be #4/0 AWG or larger insulated copper wire. Contractor's system shall be designed to be unaffected by ground potential fluctuation and transients.

6.26 Contractor's Equipment shall be supplied with provisions for protecting against system errors, erroneous data and hardware damage resulting

from electrical transients on power or signal wiring. These transients include those generated by switching large electrical loads, by power line faults, and due to lightening strikes which induce surges on power or signal cables. Contractor shall describe the method it intends to use to provide this protection.

6.27 Special Tools and Consumables

6.27.1 Contractor shall not use special nonstandard tools, test equipment, calibration fixtures, and any other equipment required for testing, troubleshooting, calibration or maintenance without APS approval.

6.27.2 Contractor shall include appropriate nonstandard tools and accessories, as well as adequate consumables necessary for start up of Contractor's Equipment.

6.27.3 Contractor shall supply a complete list of recommended consumables, with part numbers, for all components of the equipment. This list shall include all consumable items such as printer, plotter and recorder paper; printer ribbons; pen ink; fuses; jumpers; maintenance kits; filters; terminal screws; wire lugs; connector pins; jumpers; etc. Quantities recommended shall reflect the number required to maintain all equipment supplied under this specification for approximately 2 year of operations. Contractor shall provide prices for all consumables, special tools and equipment listed in this section.

6.27.4 Contractor shall provide, from the list in Section 6.27.3, a minimum one year supply of all consumable items which are required to operate and maintain the systems (filters, floppy diskettes, data tapes, etc.)

6.28 System Description of the Reactor Protection System

6.28.1 The protection system shall, with precision and reliability, automatically initiate appropriate protective action whenever a trip setpoint or preset level is achieved. The system must remain functional during and after a design basis event. The Plant Protection System (PPS) includes the mechanical and electrical devices as well as the circuitry (from sensors to actuation device input terminals) involved in generating the signals associated with various reactor protective functions. The RPS initiates protection signals needed to protect the core and RCS pressure boundary for defined anticipated operational occurrences (AOOs).

The PPS is comprised of several unique systems that are physically located in different enclosures and locations and which are integrated to provide and support the Reactor Protection and Engineered Safeguards functions.

The individual systems that are integrated to provide support for the Reactor Protection functions of the PPS include: Core Protection Calculator (CPC) System, Process Protective Cabinets (PPC), Excore Nuclear Instrumentation (NI), Plant Protection System (Reactor Protection Portion), and Reactor Trip Switchgear (RTSG). This modification is to replace the CPC.

The RPS is that portion of the PPS which generates signals that actuate the reactor trip. The RPS consists of sensors, calculators, logic and other equipment necessary to monitor selected Nuclear Steam Supply System (NSSS) and containment conditions and to effect reliable and rapid CEA insertion (reactor trip) if any or a combination of the monitored conditions approach specified safety system settings. The RPS uses inputs from Process Protective Cabinets (PPC), the CPCS, and the safety–related excore nuclear instrumentation drawers. These input signals are processed to generate outputs to the RTSG, control annunciators and to the PPS remote control module.

The PPS is designed utilizing four (4) independent measurement channels of instrumentation that are electrically and physically separate. Four separate and independent channels of trip signals are generated by the CPCS. With all four channels in operation, a 2 out of 4 coincidence of like trip signals is required to generate a reactor trip signal. Bypassing of one channel is allowed for testing, maintenance, etc., while maintaining a two out of three system.

The reactor trip signal de-energizes the CEDM coils by actuating the RTSG, allowing all CEAs to drop into the core. Once initiated, the protective action goes to completion. Return to operation requires operator action. A manual reactor trip capability is also provided.

6.28.2 Core Protection Calculator:

The CPC System shall provide automatic protective action signals to assure that acceptable fuel design limits are not

exceeded during specified AOOs. Using setpoint values provided by APS, the CPC System shall assure that the DNBR of the most limiting fuel assembly in the reactor core is greater than or equal to minimum required (current value 1.30, which will change to 1.34). The CPC system shall also assure that the Local Power Density of the most limiting fuel assembly in the core does not exceed a value at which fuel centerline melting would occur for the list of design basis anticipated operational occurrences (current value 21 kW/ft).

The CPC utilizes primary pressure, reactor coolant pump speed, hot leg and cold leg temperature, CEA position, and excore neutron flux signals to calculate a value for DNBR and Local Power Density from these measurements. The calculated values are compared to predetermined setpoints to determine whether a reactor trip signal should be generated to the Plant Protection System (PPS) Cabinet RPS Logic to initiate a reactor trip.

In the existing design, the CPC monitors reactor parameters via the four redundant CPCS and the two redundant CEACs. Calculations are performed on these variables by each channel. The CPC provides control interlocks to the CEDM Control System to prevent CEA withdrawal when certain protective system limits are approached. If an unsafe condition is found to exist, the channel sends a reactor trip signal to the RPS. The RPS circuitry will shut down the reactor upon receiving trip signals from two of four CPC channels. The channels are physically and electrically isolated from each other and receive AC power from four redundant vital instrument buses.

Four independent CPCS are provided, one in each protection channel. Calculation of DNBR and LPD is performed in each CPC. Two independent CEA calculators (CEACs) are provided as part of the CPCS to calculate individual CEA deviations from the position of the other CEAs in their subgroup.

Each calculator is mounted in the auxiliary protective cabinet (APC) with an operator's display and control module located on the main control board. From the four OMs, an operator can monitor all calculators, including specific inputs or calculated functions. In the existing design, the ROM for channels B and C is able to access either the CPC or CEAC in its respective channel.

The CPC System calculates DNBR and LPD under the control of software programs developed outside the system and then disk-loaded into the CPC System. These programs include the instructions and data values necessary to perform the calculations and the setpoint values which determine when a reactor trip signal is generated. The software design basis is derived from the requirements and transients described in Chapter 15 of the UFSAR. The NRC has imposed additional requirements on the design modification and on-site control of the software programs for the CPC System, as described in the Palo Verde Safety Evaluation Reports. Topical Reports describe the detailed requirements for the design, modification, testing and documentation for the software. In addition, the topical and its reference documentation provides the detailed description of the hardware configuration necessary for proper functioning of the software.

For the purposes of this description, the CPCS includes the CPC calculators, the CPC I/O chassis, the CPC Analog Input Multiplexer cards, the Analog-To-Digital Converter cards, the Digital-To-Analog Converter cards, Relay Output cards, Digital Output cards, Digital Input cards, Digital Output (DO) Data Link cards, the Discrete Input Pulse Counter and Watchdog Timer card, the CPC I/O Chassis Power supplies, the CPC Trip Bypass key switch on the OM located in the MCB, and other interfacing components. The CPCS shall provide displays, alarms, and status indications to permit the operator to monitor all trip system inputs, outputs, and calculations. The CPCS shall be designed to permit periodic testing of its functions while the reactor is in operation. The testing must be capable of being performed on an independent channel basis to determine failures and loss of redundancy. The CPC shall provide the capability for performing cross channel comparisons of system inputs, outputs, and calculations for confirming the proper operation and functionality.

6.28.3 Reactor Coolant Pump Speed Sensor System (RCPSSS):

The Reactor Coolant Pump Speed Sensor System (RCPSSS) is used to monitor reactor coolant pump speed. Proximity devices scan slotted discs on the reactor coolant pump motor shaft. The signal is transmitted to the RCPSSS signal conditioning drawers located in the APC. The conditioned signals are then transmitted to the CPCS where the reactor coolant flow rate is computed. The speed of each reactor coolant pump motor is

measured to provide a basis for calculation of reactor coolant flow through each pump.

6.28.4 Excore Nuclear Instrumentation:

The excore nuclear instrumentation includes neutron detectors located around the reactor core and signal conditioning equipment located within the containment and the Auxiliary Building. Signal conditioning is also provided within the PPS Cabinet. The linear safety channels provide neutron flux information from ~1 to 200 percent of rated power. All channels have an associated signal-conditioning drawer in the PPS cabinet. These channels feed the RPS and provide information for rate of change of power display, DNBR, LPD, and overpower protection.

6.28.5 Auxiliary Protection Cabinet (APC):

The APC consists of the RCPSSS, CEAC, APC Multiplexer, and the CPCS.

In the existing design, two independent CEACs are provided as part of the CPCS to calculate individual CEA deviations from the position of the other CEAs in their subgroup. The existing CEAC design is an exception to the general four-channel redundancy of the PPS. The CEACs are two channel redundant. The CPCS, which receive CEA detection information from the two redundant CEACs, use the most conservative of the two data values from the CEACs, which is, in effect, one out of two logic coincidence which satisfies the single failure criteria. In the new design four-channel redundancy is required.

In the existing design, the CPCS are also allowed to be operated with one CEAC channel out of service. This mode of operation is restricted in duration by the Plant Technical Specifications since this mode does not satisfy the single failure criterion. The CPCS are also permitted to be operable with both CEAC channels bypassed by use of the CEAC Inoperative function of the CPCS. This mode of operation is restricted for certain power levels of the plant by means of the Plant Technical Specifications.

For the purposes of this description, the CEAC includes the CEAC calculators, the CEAC I/O chassis, the CEAC Analog Input Multiplexer cards, the Analog-To-Digital Converter cards,

Relay Output cards, Digital Output cards, Digital Input cards, Digital Output (DO) Data Link cards and Watchdog Timer card, the CEAC I/O Chassis Power supplies and other interfacing components.

6.28.6 Design Requirements - Single Failure:

The criterion for single failure is that any single failure within the Protection System shall not prevent proper protection action at the system level when required. The Plant Protection System is designed with sufficient independence and redundancy to assure that: no single failure results in the loss of a protective function, the removal from service of any component or channel does not result in loss of the minimum redundancy, and the environment resulting from design basis events and natural phenomena do not result in the loss of the protective function.

The Plant Protection System has been designed with four redundant channels. The PPS requires a coincidence of two channels of the four channels to initiate a protective function. The four-channel design accommodates the single failure criterion in the following modes of Plant Protection System Operation.

Four Channels Operable – The PPS can sustain a single failure and still have three channels available to satisfy the two channel coincidence. The system will initiate action on a coincidence of two of the three operable channels.

One Channel Out of Service – In this mode there are initially three redundant channels operable. Application of the single failure criterion leaves two channels available for initiation which satisfies the two-channel coincidence requirement. The PPS is designed with a channel bypass feature that bypasses the inoperable channel.

If there is more than one channel of a PPS trip function inoperable, one of the inoperable channels must be bypassed and the second channel must be placed in the tripped condition to satisfy the single failure criterion.

In the existing design, the Core Protection Calculator System contains a subsystem, the CEA Calculators, which is an exception to the general four-channel redundancy of the PPS. The CEACs are two channel redundant. The CPCS, which receives CEA detection information from the two redundant

CEACs, uses the most conservative of the two data values from the CEACs, which is, in effect, one out of two logic coincidence which satisfies the single failure criteria.

In the existing design, the CPCS is also allowed to be operated with one CEAC channel out of service. This mode of operation is restricted in duration by the Plant Technical Specifications since this mode does not satisfy the single failure criterion. The CPCS is also permitted to be operable with both CEAC channels bypassed by use of the CEAC Inoperative function of the CPCS. This mode of operation is restricted for certain power levels of the plant by means of the Plant Technical Specifications.

The four-channel redundancy of protective action initiation at the PPS must interface with a two-train redundancy for the actual components of the Engineered Safety Features Systems. The Auxiliary Relay Cabinet (ARC) is designed with a two-train division which coincides with the two trains of the Engineered Safety Features System components. Each train of the ARC receives a four-channel initiation signal from the PPS. Each train is activated on a two out of four coincidence of PPS initiation signals.

The independence of the redundant channels of the PPS are maintained by physical separation of sensors and interconnecting cabling, by mechanical and thermal barriers between channels contained in a single cabinet, and by electrical isolation for signals that interconnect the redundant channels and for signals that interconnect the PPS to non-safety related equipment. The isolation devices shall be qualified such that credible failures at the output of the isolation device can not propagate to the PPS and prevent it from performing its protective function.

7.0 QUALIFICATION REQUIREMENTS

7.1 The CPC/CEAC system is safety related, designated Class 1E. The Quality Class of this equipment is "Q", Seismic Category 1. Equipment which is not safety related is designated as non-safety related. Non-safety related equipment shall be physically separated and electrically isolated from Class 1E, safety related equipment, in accordance with NRC Reg. Guide 1.75-1975. In instances where electrical signals are used as inputs to the CPC/CEAC System, the non-safety related signals are electrically isolated from the CPC/CEAC system. In instances where CPC/CEAC signals are used as inputs to non-safety related equipment, such as annunciators and operator display devices, the CPC/CEAC signals shall be electrically isolated from the non-safety related equipment. The non-safety related equipment shall be qualified as Quality Class QAG, Seismic Category IX components so not to interact with adjacent safety related equipment.

7.2 The contractor shall seismically qualify all of the safety related (Seismic Category 1) equipment in accordance with IEEE 344-1975. All other equipment and structures shall be qualified to meet the requirements of a Seismic Category IX component or structure. The seismic qualification of Class 1E equipment (replacement CPCS) located within the support structure (racks, cabinets) shall be determined by either test or analysis. Qualification of electrical equipment using IEEE Std. 344-1975 is accepted, with conditions, by the NRC in Regulatory Guide 1.100. Qualification tests for seismic shall be performed for both the OBE (minimum of 5 events) and SSE (1 event). The tests shall demonstrate both structural integrity and functional operability. As stipulated in this Purchase Specification, the performance characteristics shall be maintained before, during and after each test, in order to achieve satisfactory qualification of equipment. Additionally, the PVNGS Required Response Spectra (RRS, provided in this spec for both OBE and SSE) shall be enveloped buy the Test Response Spectra (TRS) at an equal or conservative structural damping values. The envelope shall have a minimum margin of 10 percent.

7.3 The CPC/CEAC system shall be environmentally qualified for the environmental conditions that result from accidents and transients for which it must operate. Only the sensors that provide input signals to the CPC/CEAC system are located in areas which experience extreme environmental conditions that result from accidents. The CPC/CEAC system shall be designed to minimize, consistent with other safety requirements, the probability and effect of fires and explosions. The provided equipment shall operate in the following temperature range without degradation of functionality or accuracy.

Table 1 – Environmental Design Requirements inside the Cabinet

Environmental Parameter	Normal			Abnormal		
	Min.	Max.	Duration	Min.	Max.	Duration
Temperature	65F	104F	Continuous	55F	122F	8 Hours
Humidity	40% RH	60% RH	Continuous	20% RH	90% RH	8 Hours
Pressure	Atmospheric	Atmospheric	Continuous	Atmospheric	Atmospheric	Continuous
Radiation	Negligible	Negligible	Continuous	Negligible	Negligible	Continuous

7.4 The contractor will conduct the overall qualification test program consistent with Reg. Guide 1.89, which endorses the requirements of IEEE 323-1983, "Qualifying Class 1E Equipment for Nuclear Power Generating Stations".

7.5 Copies of test data and qualification reports as required shall be submitted for acceptance by the PVNGS prior to acceptance of the equipment for shipment.

7.6 In addition to the seismic and environmental qualification of the CPCS, conducted and radiated EMI testing shall be performed by the contractor to identify and correct these types of problems. The extended burn-in period where the replacement CPCS will run in the actual plant environment can also be utilized to identify and correct these types of problems.

8.0 PURCHASER RECOMMENDATIONS

8.1 Provide an option to automatically update system time and date with a purchaser provided time synchronization signal, such as an IRIG-B signal.

8.2 To reduce the CPCS sensitivity to electrical noise, external field wiring shall contain twisted pairs and be shielded all the way to the I/O chassis. This work will be the responsibility of the Contractor for all provided equipment.

8.3 Optical isolation, noise filters and ANSI C37.90.1 high voltage surge protection circuits shall be utilized where appropriate.

8.4 Self-testing devices shall be utilized where available.

8.5 Self-monitoring devices (e.g. Watchdog timers, etc.) shall be utilized to detect functional failures and force the system to fail-safe.

8.6 Unpowered analog input gate cards shall have high impedance to avoid loading down RSPT inputs to the CEAC during maintenance of the associated CPCS.

8.7 The pre-existing CPC/CEAC cabinets will be used.

8.8 Coordinate the system design with RF frequencies in use at the site to minimize interference, i.e. test the system for EMI susceptibility and correct the design or change the RF frequencies in use as required.

8.9 Maintain the necessary signal isolation characteristics.

9.0 SOFTWARE REQUIREMENTS

9.1 For the CPC software, the contractor will conform to the requirements of the NRC Regulatory Guide 1.152, Rev. 01, "Criteria for Digital Computers in Safety Systems of Nuclear Power Plants", November 1996 which endorses IEEE 7-4.3.2-1993.

9.2 Deleted.

9.3 A software requirement specification shall be provided to the purchaser by the contractor per IEEE-STD-830-1993 and NRC Reg. Guide 1.172, Rev 0 as described in the Common Q Software Program Manual.

9.4 A software design description shall be provided to the purchaser by the contractor IEEE-STD-1016-1987 following the recommended format provided in the Appendix to IEEE-STD-1016-1987.

9.5 The source code and program documentation shall be procured by the contractor and provided to the purchaser, via electronic files and (or) hardcopy printout manual(s). In the event that the contractor discontinues support for the code or either goes out of business, or transforms into another business entity, any additional design documentation shall be provided by the contractor to APS to allow maintenance of the system for 20 years as defined in the proposal, and shall be available for NRC inspection upon request. A statement of conformance to the contractor's software design specification and the contractor's internal QA program shall be included.

9.6 The contractor shall procure and/or supply the software in accordance and adherence to 10CFR50, Appendix B. The services specified herein perform a safety-related function in a Nuclear Power Generating Station licensed under regulations of the United States Nuclear Regulatory Commission (USNRC) and shall be performed in accordance with the Contractor's Quality Assurance Program, as provided by APS QA Manager. The provisions of 10CFR21 shall apply. It is understood that 3rd party software is typically commercial off the shelf, and alternative actions may be taken to verify the software is appropriate for its intended use. For example, commercial grade dedication reports may be created to qualify a commercial off the shelf operating system per ANSI/IEEE 7-4.3.2 and the Common Q Software Programming Manual.

9.7 The contractor shall provide documentation of the software reviews and audits as recommended by IEEE STD 1028 1988 for both safety related and non-safety related software, in accordance with the requirements of the Common Q Software Program Manual.

9.8 Software Validation and Verification shall be performed and documented by the contractor, in accordance with the requirements of the Common Q Software Program Manual as augmented by the Westinghouse APS CPC Project Plan. The contractor shall provide the V&V Plan and the V&V Final Report to the purchaser. Validation and Verification activities shall include documentation of testing and evaluation performed per the Common Q Software Program Manual as augmented by the Westinghouse APS CPC Project Plan. Validation and Verification activities shall be performed to assure the adequacy and compliance to this specification for each phase of the software development process.

9.9 Anomalies detected during the Validation and Verification activities shall be documented by the contractor along with corrective action taken. The software contractor shall develop and perform all activities recommended in IEEE STD 1012 1986, excepting the purchaser approval of the "Final Approval" and "Program Acceptance" documentation.

9.10 Final approval and program acceptance will be performed by the purchaser following contractor certification that all Verification and Validation recommendations have been met. The Validation and Verification plan, along with sufficient documentation to demonstrate the acceptability of the Verification and Validation activities (sample run outputs, discussion of results, and conclusions) shall be provided with the contractor's certification.

9.11 A software safety analysis shall be provided as defined in the Common Q Software Program Manual.

9.12 All software testing required by the Common Q Software Program Manual. shall be performed by the contractor with the purchaser personnel in attendance. Software testing shall be documented as required by the Common Q Software Program Manual. Factory acceptance testing shall be performed by the contractor with the purchaser personnel in attendance to verify and validate the reliability of the code, to ensure it correctly represents the intended design, and that the design correctly represents the intended mathematical models utilized. Checks shall include inspection of benchmark output and comparison of that output with the results of hand calculations, verified calculations, and measured data. The results of the test cases executed against the expected result shall be provided to the purchaser to verify the successful execution of software.

9.13 A Software / Operators User's Manual shall be provided by the contractor which includes all of the features required by the Common Q Software Program Manual, focusing on the expected interactions intended by the

software's man-machine interface. This manual shall not include detailed design and programming information.

9.14 Software documentation shall be provided by the contractor as defined in the Common Q Software Program Manual. The contractor shall also provide software documentation received from third party vendors (i.e. Microsoft NT, QNX, etc.) that is used by the CPCS.

9.15 Controls shall be established to permit authorized and prevent unauthorized access to a computer program.

9.16 The contractor shall report software anomalies per the Common Q Software Program Manual to the purchaser including the classification code and associated classification code description. The contractor shall also report any anomalies in the hardware, testing, or documentation identified following shipment. These reports shall be prompt, written, and include an evaluation of the impact of the anomaly, provisions to avoid the anomaly, and any recommended corrective action.

9.17 The contractor shall analyze, design, implement, test, and deliver changes to the software consistent with the Common Q Software Program Manual.

9.18 The contractor shall provide the information recommended by NUREG-0800 in the NUREG-0800 format describing the supplied system (hardware, software, and interfaces with plant systems). The information not applicable to Palo Verde shall be removed from the provided description.

9.19 The software shall be based on a Software Life Cycle model consistent with IEEE-STD-1074-1995 and NRC Reg. Guide 1.173, Rev 0. The software shall be developed, acquired, procured, controlled, and maintained in accordance with the Common Q Software Program Manual.

9.20 The contractor shall provide software that fully complies with IEEE-STD-730-1989 for all phases of the software life cycle. The contractor shall develop and provide to Palo Verde the contractor's Quality Assurance Plan, as follows:

9.20.1 Software Quality Assurance Plan shall be provided that implements the requirements and recommendations contained in ASME NQA-2a-1990 Part 2.7 with the exception of sections 7 and 10.2, and IEEE Std. 730-1989. The contractor shall provide certification of compliance with the Software Quality Assurance Plan in accordance and adherence to 10CFR50, Appendix B.

9.20.2 Hardware Quality Assurance Plan shall be provided that implements the requirements and recommendations contained in ASME NQA-1-1989 and IEEE-STD-603-1991. The contractor shall provide certification of compliance with the Hardware Quality Assurance Plan in accordance and adherence to 10CFR50, Appendix B.

9.21 The software configuration shall be controlled and documented throughout the entire software life cycle as required in the Common Q Software Program Manual.

9.22 Contractor shall provide three (3) copies of all CPCS and I/O simulator software. This includes the application and source code for CPCS (CEAC1, CEAC2, CPC, etc.), MTP, OM, and the I/O simulator. This is to be provided on the highest speed media compatible with Contractor's equipment. Contractor shall provide a licensed copy of third party vendor software for each application used within the CPCS Replacement scope.

10.0 GENERAL DRAWING AND DATA REQUIREMENTS

10.1 The contractor shall generate a set of requirements to implement the mandatory features, and any optional features. The System Requirements Specification shall conform to IEEE-STD-1233-1996.

10.2 For all documentation, approximately six weeks shall be provided for the purchaser review and comment. The contractor shall correct documentation and resolve all comments before final payment. As a minimum, documentation shall include the documents specified in sections 10 through 12 and hardware documentation for the system, components, and subcomponents provided. Two electronic copies of the documents specified in sections 10 through 12 shall be provided. For text documents, these shall be provided in Microsoft Word ©97 or Adobe Acrobat .pdf format on CD-ROM. For drawings, these shall be converted to Microstation, version J7.1 and verified upon completion of the contract.

10.3 Contractor shall furnish, as a minimum, the following arrangement drawings.

- Operator and engineering console arrangement drawings.
- Cabinet arrangement drawings.
- Equipment arrangement drawings.

10.4 Interconnection wiring diagrams for each separate component and sub-system, including field diagrams for Contractor's Equipment, complete and suitable as working drawings for installation and connection of Equipment in the field and for maintenance troubleshooting. Diagrams shall identify all devices and shall include but not be limited to, the following:

- APS cable numbers, points of origin or destination (i.e. component or sub-system name and drawing number).
- Internal conductor color codes and connection points to pigtail leads, terminal blocks, etc.
- Control Wiring Diagrams (CWD) drawing numbers associated with each component and sub-system.
- Identification of all devices and a complete device index with catalog numbers for each device (i.e. a Bill Of Material)
- All grounding requirements and details.
- Any other information required to interpret drawings and follow routings of cables with ease from one drawing to the next.

10.5 Wiring diagrams shall be submitted for review of the terminal locations, wiring numbers, cable connections and wiring arrangement. At this time APS' Design Engineering personnel will supply circuit designations, cable numbers, descriptions, etc., to be added to the diagrams by Contractor. Approval of the diagrams will not relieve Contractor of its responsibility to furnish correct diagrams or to furnish correctly operating systems.

11.0 INFORMATION REQUIRED WITH CONTRACTOR'S PROPOSAL

11.1 A description of the proposed equipment (hardware and software) with a statement of conformance and with a list of exceptions to this Specification.

11.2 Preliminary site preparation information, including power conditioning requirements (AC voltage, frequency tolerances, harmonic distortion, estimated load Equipment will place on APS' AC source, and AC power susceptibility profile), grounding requirements, radio frequency and electromagnetic interference precautions and requirements for all the equipment to be supplied.

11.3 Detailed functional system and cabling diagrams depicting the topology of the contractor's proposed design and proposed equipment layouts.

11.4 Preliminary weight and dimensions for all equipment suitable for arranging space.

11.5 Preliminary power, ventilation requirements and heat dissipation outputs.

11.6 A description of options that may be available to Palo Verde including price. A description of the training program for Palo Verde personnel with an example of the course material.

11.7 A schedule of the contractor's document submissions and Palo Verde provided documents.

11.8 A schedule of milestones and invoicing. The essential attributes of IEEE-STD-1058.1-1987 for a software project management plan are recommended for consideration.

11.9 The shipment date of equipment and instruction manuals.

11.10 Pricing of basic equipment including the price of the basic software and an engineering statement of the hardware and software warrantee practice.

11.11 Discounts that may be applied for Palo Verde including comparable upgrades at other sites.

12.0 DELIVERABLES AND SCHEDULE REQUIREMENTS

12.1 The contractor shall provide up to 320 man-hours of support for the licensing of the CPC/CEAC system. This support is in addition to any support required to complete Common-Q phase III activities. Phase III work to be completed includes the second NRC submittal to address the new configuration with an increased number of processors, the new PM 646 processor, the follow-up items on EMI/RFI and the follow-up items on seismic qualifications. APS would be responsible for the NRC submittal to address plant specific implementation, including any phase IV scope additions.

12.2 The contractor shall provide 160 man-hours for Installation and Start-up Support and Site Acceptance Test Support for each unit. Additional support beyond the man-hours specified in sections 12.1 and 12.2, or in other areas, may be requested by APS. This will be provided under a Time and Material basis.

12.3 The Contractor shall provide a total of 240 hours of training. This training will consist of three 40-hour sessions, each conducted twice. The training shall be provided at Palo Verde or a Contractor location, as determined by APS. The training shall consist of a mix of classroom and hands on training in the following three areas.

- CPC/CEAC configuration and operation overview. Targeted to operations, engineers and technicians. Up to 16 seats for each class shall be available. This class is intended as a prerequisite for the next two items.
- Performance of surveillance tests and recommended PMs. Targeted to technicians. Up to 8 seats each class shall be available.
- Advanced CPC/CEAC design and troubleshooting. Targeted to technicians and engineers. Up to 8 seats per class shall be available.

12.4 The contractor shall support a maximum of 4 formal design reviews with APS at the PVNGS site.

12.5 Schedule of Deliverables

Deliverables will be provided by the scheduled months ARO. The dates are provided for convenience and assume the order is received by 1/1/2001. If there is any conflict between this schedule and the actual contract, the contract will prevail.

4 Months ARO – 5/1/2001

- CPC/CEAC and I/O Simulator requirements documents issued.

6 Months ARO – 7/1/2001
- I/O Simulator Design Documents Issued

8 Months ARO – 9/1/2001
- CPCS Design Documents Issued

10 Months ARO - 11/1/2001
- Beta version of Single channel and 1st I/O simulator with beta version of all software.
- One additional OM with FPD building tools, AF100 communication and Ethernet communication software that broadcasts data to FPDs and PMS.
- Existing CPC/CEAC codes that are written in Fortran for simulator use.
- Price list for spare parts (all active components).

12 Months ARO - 1/1/2002
- Draft 50.59
- CPC/CEAC FAT issued.

18 Months ARO - 7/1/2002
- Instrument uncertainty calculation.
- 1st simulator hardware.
- First unit 4-channel CPCS staged. (7/15/02)

19 Months ARO - 8/1/2002
- Draft procedure for performing all recommended/required calibrations or PMs.
- The basis for all recommended/required calibrations or PMs.
- Software for Time Response Testing.
- Form, fit and function spec for all subcomponents in FPD
- P1 testing complete.

20 Months ARO - 9/1/2002
- Construction/modification drawings for installing 19" racks in existing cabinets.
- Seismic test reports for the major seismically qualification components
- Provide all drawings for all supplied components and structures including the modified Auxiliary Protection Cabinets, and schematics for all supplied equipment.
- RDB loading tool. Software to change RDB.
- Detailed Engineering Installation Instructions.

22 Months ARO – 11/1/2002
- Software for Rod Drop Timing Test.
- Requirement and Design Phase Interim V&V reports issued.

23 Months ARO – 12/1/2002

- CPC/CEAC FAT for first unit 4 channel CPCS ready for test start
- Seismic test reports for all seismically qualification components and structures
- Qualification testing/evaluation paperwork for installing 19' racks in the existing cabinets.
- Seismic test reports for all components and structures that are seismically qualified to Seismic Category IX requirements.
- P2 testing complete.
- Implementation Phase Interim V&V report issued.

25 Months ARO - 2/1/2003

- CPC/CEAC FAT for first unit 4 channel CPCS complete.

26 Months ARO - 3/1/2003

- V&V Report and Code Certificate.
- Technical Manual

27 Months ARO - 4/1/2003

- Draft procedure for performing all recommended/required STs.
- Unit 2 hardware and final version of all software, delivered, FAT complete.
- Final version of CPC Single Channel (with SR hardware) and IO Simulator hardware

33 Months ARO - 10/1/2003

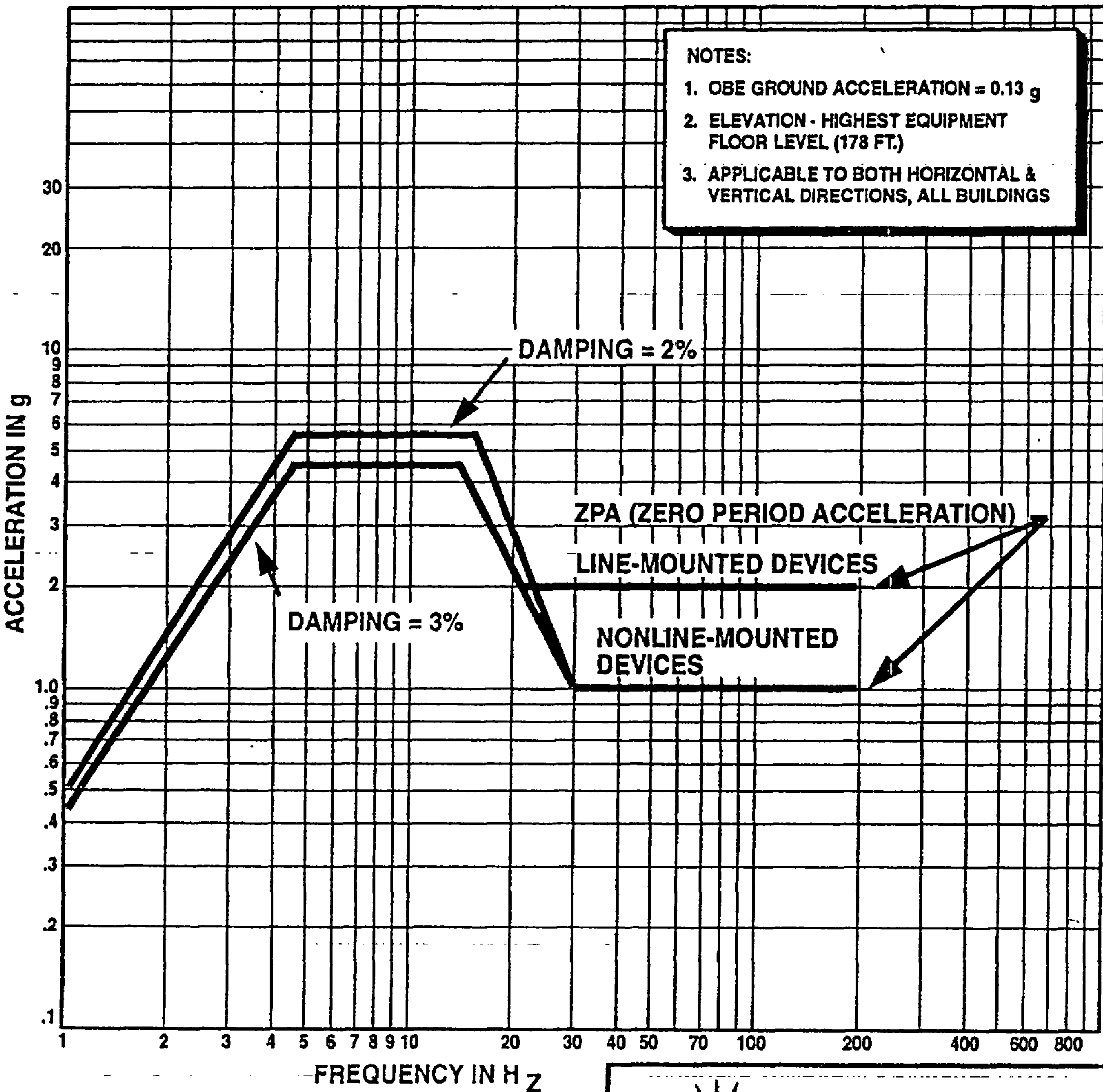
- Unit 1 hardware and final version of all software, delivered, FAT complete.

39 Months ARO - 4/1/2004

- Unit 3 hardware and final version of all software, delivered, FAT complete.
- 2nd plant simulator hardware.

EQ PROGRAM MANUAL

TITLE		REVISION
EQ - Equipment Qualification		6
	Lead Discipline - Nuclear Engineering Analysis (EQ)	



Palo Verde
NUCLEAR GENERATING STATION

SOURCE. SQRT (Fig 3.7-7)
Spec Std Addendum (4T-3, DXVII-3)

Required Response Spectrum (RRS) for OBE Class IE for Control and Instrumentation Devices for PVNGS

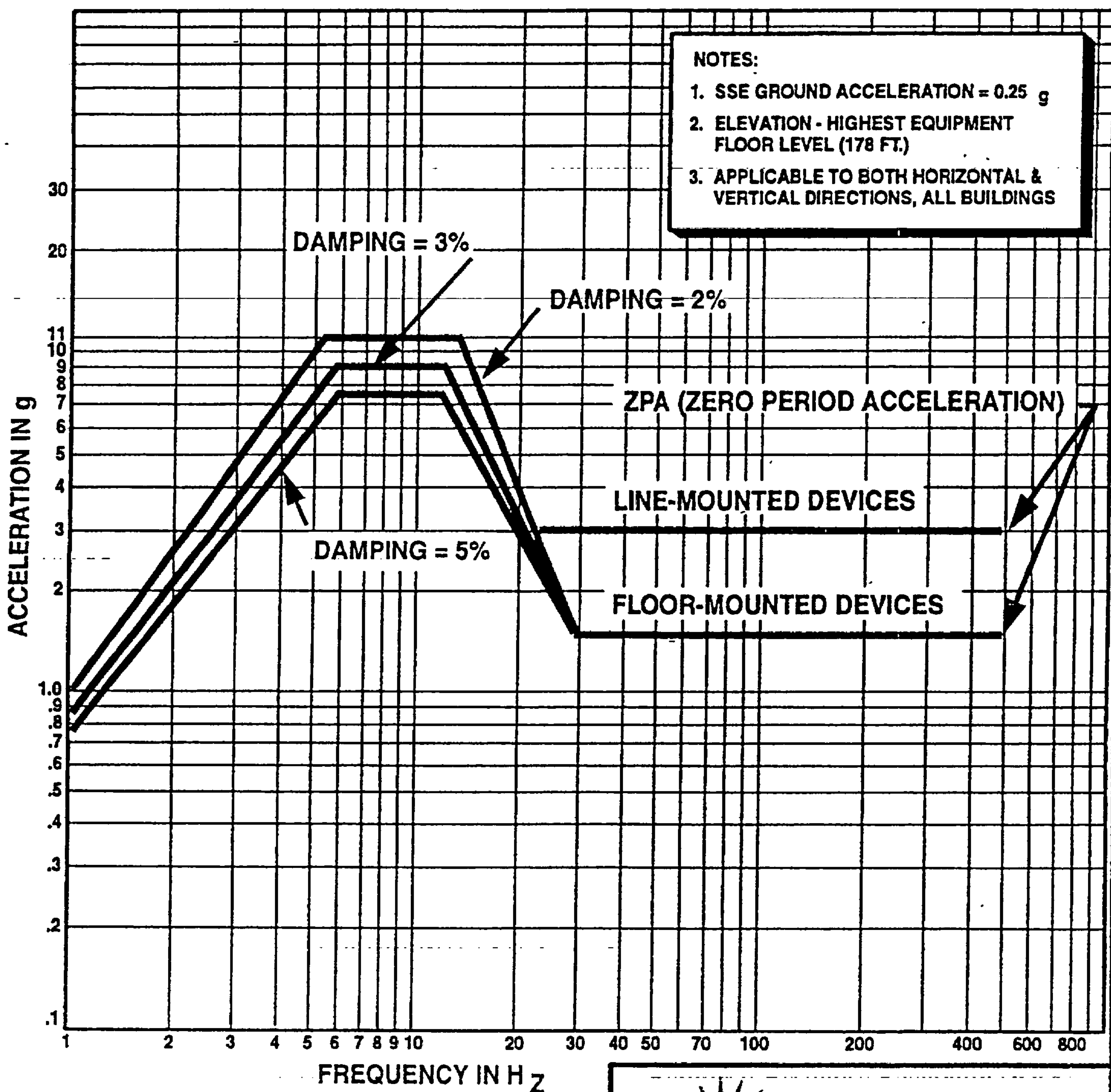
EQ PROGRAM MANUAL

TITLE

EQ - Equipment Qualification

REVISION
6

Lead Discipline - Nuclear Engineering Analysis (EQ)



SOURCE: SQRT (Fig 3.7-8)
Spec Std Addendum (4T-4, DXVII-4)

Palo Verde
NUCLEAR GENERATING STATION

Required Response Spectrum (RRS) for SSE for Class 1E for Control & Instrumentation for PVNGS

ADDENDUM A-01

GENERAL DRAWING AND DATA REQUIREMENTS

FOR THE

ARIZONA PUBLIC SERVICE COMPANY

PALO VERDE NUCLEAR GENERATING STATION

QUALITY CLASS Q, QAG, NQR

ADDENDUM A-01

GENERAL DRAWING AND DATA REQUIREMENTS

TABLE OF CONTENTS

ATTACHMENTS

ADDENDUM A-1
GENERAL DRAWING AND DATA REQUIREMENTS

1.0 GENERAL REQUIREMENTS

The Supplier/Contractor shall submit originals or reproductions of all drawings, data, procedures, and/or engineering quality verification documents in accordance with the following requirements.

1.1 Engineering documents and quality verification documents requiring Arizona Public Service (APS) review shall be transmitted to APS via Supplier/Contractor letterhead paper, referencing the Design Change Package (DCP) number and listing document number, revision, title and amount of copies for each document transmitted.

1.2 The Supplier/Contractor shall be instructed in the specification to transmit the specified documents to APS Design Configuration Control (DCC).

1.3 All correspondence with APS shall be sent to:

Palo Verde Nuclear Generating Station
P.O. Box 52034, Mail Station 1706
Phoenix, Arizona 85072-2034

Attention: NIRM/Design Configuration Control (DCC)

2.0 REVIEW OF SUPPLIER/CONTRACTOR DRAWINGS

2.1 Documents, which include drawings, when submitted by the Supplier/Contractor, will be processed by APS after receipt, review and approval, and returned with status marked as follows:

Status 1 [ ] WORK MAY PROCEED

Indicates that information delineated on the document has been reviewed by APS without comment. Status 1 documents must be free of notes or comments.

Status 2 [ ] REVISE AND RESUBMIT. WORK MAY PROCEED SUBJECT TO INCORPORATION OF CHANGES INDICATED

Indicates that information delineated on the document is in accordance with the specification, purchase order or contract. However, APS changes or comments have been noted; therefore, the Supplier/Contractor must resolve the indicated changes or comments and resubmit accordingly.

Documents which have hold areas, or which are marked substandard for microfilm quality, should also receive this status and the document shall be stamped with the following:

THIS DOCUMENT WAS REVIEWED
FOR MICROFILM QUALITY AND
FOUND SUB-STANDARD. PLEASE
UPGRADE AND RESUBMIT.

ENCLOSED PRINT HAS AREAS
CIRCLED IN RED THAT ARE
SUB-STANDARD.

All comments must appear on the document or on an attachment to the document.

Status 3 [ ] REVISE AND RESUBMIT. WORK MAY NOT PROCEED

Indicates that information delineated on the document is not acceptable to APS and, therefore, work may not proceed. All comments must appear on the document or on a sheet attached to the document. The Supplier/Contractor must resolve the APS comments and revise and resubmit this document.

2.2 Supplier/Contractor shall incorporate changes as required by comments on the document and resubmit the revised document within 30 calendar days. All changes which are made or requested by the Supplier/Contractor after a document has been accepted shall be resubmitted. Resubmittals are not required on any Status 1 document unless revisions are made.

2.3 Should the Supplier/Contractor choose to reply to APS' comments by letter, each letter should preferably cover only one document. However, if the Supplier/Contractor covers more than one document per letter, each item must be clearly identified with APS' log number.

2.4 Permission to proceed does not constitute acceptance or approval of design details, calculations, analyses, test methods, or materials developed or selected by the Supplier/Contractor, and does not relieve Supplier/Contractor from full commence with contractual obligations.

2.5 The Supplier/Contractor shall not proceed with changes resulting from comments which affect cost or schedule without prior written approval from APS that the specific cost and/or schedule impacts are acceptable.

3.0 GENERAL DRAWING REQUIREMENTS

3.1 Use of standard drawings to satisfy a general type design presentation for equipment having slight deviations is acceptable if the information is specific and options are clearly noted or deleted. Each particular equipment type shall have its own drawing and each drawing shall have its own title and number. It is recognized that identical units of apparatus have many probabilities of duplication; however, it shall be required that the intent of this paragraph be met.

3.2 APS will consider the Supplier/Contractor's reasonable request for restriction of proprietary information. However, it may become necessary to make disclosures to the NRC, and other regulating government agencies or bonafide intervenors.

3.3 Each drawing or document shall have a revision number, including the first submittal. When a drawing is revised, revision numbers must be clearly legible, easily distinguishable from the drawing number, and should be in or as close as possible to the title box. A short description of the revision must be included and affected areas on

drawing shall be circled and identified with the revision number.

On resubmittals, any revised drawing or document shall contain APS' Log Number which was placed on the drawing or document during the initial review.

3.4 Drawing List

A Supplier/Contractor drawing list (Attachment 1) will be submitted to APS. The list shall be updated periodically during the course of work, as required. This list is to include all the Supplier's/Contractor's drawings, and other documents to be submitted in accordance with the specification and/or appendices.

4.0 TYPE OF DRAWING SUBMITTALS

4.1 APS has standardized drawing reproduction techniques that use 35mm microfilm aperture cards for all in-house and field distribution. All submitted drawings or data must be of sufficiently high quality drafting to permit microfilming by APS. It is preferable that originals be submitted when possible. If reproductions of the originals are submitted, they must be full size, rolled, direct-reading type, first generation, on photographic mylar either 3 or 4 mil thickness, having sharp, clean, well-defined lines with a line density equal to or better than the original. Folded drawings cannot be accepted. The reproducible must maintain an evenly high contrast between image and background over the surface of the drawing and shall be capable of maintaining clarity so as to produce a rough generation copy and still be clearly visible/readable on the fourth generation copy using the same machine and material. Reproducers must be of a quality that will ensure microfilming on 35mm film to produce clearly legible/readable copies (normally 50% of the original on "D" size and larger) when blown back from film base. Reproducibles with low contrast or heavy background density with thin, weak lines and lettering are not acceptable. Drawings drafted to the National Micrographics Association Drafting Standards, Information Monograph No. 3 "Modern Drafting Techniques for Quality Microreproductions", generally meet the requirements and are nationally accepted. Copies of this standard are available from the National Micrographics Association (NMA), 8728 Colesville Road, Silver Springs, Maryland, 20910.

4.2 NMA Standards are referenced as minimums; upgrading of these or use of standards specifying heavier line weights or larger letter sizes are acceptable.

4.3 Drawings submitted and not conforming to the above standards will not be accepted, and will be returned to the Supplier/Contractor for correction and resubmittal 7 days after receipt of the unacceptable drawing(s). The Supplier/Contractor will upgrade or redraft the non-standard drawing at the Supplier's/Contractor's expense.

4.4 Drawings produced by Computer Aided Drafting (CAD) shall be on the Intergraph system. Upon completion of contract, the Supplier/Contractor shall furnish APS the tape and one hard copy of each drawing produced by CAD.

4.5 Drafting Practices

4.5.1 Drafting Materials

a. Drawing Media and Sizes

1) All original engineering and architectural drawings shall be on polyester (mylar) base drafting film in either 3 or 4 mil thickness coated for drafting on one side, or on Computer Aided Drafting (CAD) type for CAD produced drawings.

2) Drawing sizes shall be USA standard as follows:

"A" size = 8-1/2" x 11"
"B" size = 11" x 17"
"C" size = 17" x 22"
"D" size = 22" x 34"
"E" size = 34" x 44"
"EE" size = 34" x 88"

3) The title block format shall include the signature blocks specified in Attachment 3. (Ref. 81DP-0C009, Appendix E.)

b. Ink

1) Ink shall be used for the body of all drawings to ensure consistent, high quality suitable for reproduction and microfilming. Plastic graphite leads may be used only when authorized by the Responsible Supervisor (RS).

2) Ink shall be used when manual drafting changes or additions are made to computer aided drafting (CAD) prepared drawings.

c. Erasers

1) Use only erasers made specially for drafting film. Gritty or abrasive erasers such as "Pink Pearl", or similar type erasers shall not be used.

2) Plain water and cotton swabs are a good eraser for plastic leads, and repeated erasings with this method will not destroy the "tooth" on the drawing surface.

3) Electric erasing machines, if used, should have the correct eraser "stick" for plastic leads and mylar drafting film and be used with extreme care to prevent a heat melt "hole" in the coated drafting surface

4.5.2 Scales

a. Drawing scales shall be selected which maximize the utilization of drawing size and anticipate drawing reductions. Common scale advantages between disciplines shall also be considered in the selection of drawing scales.

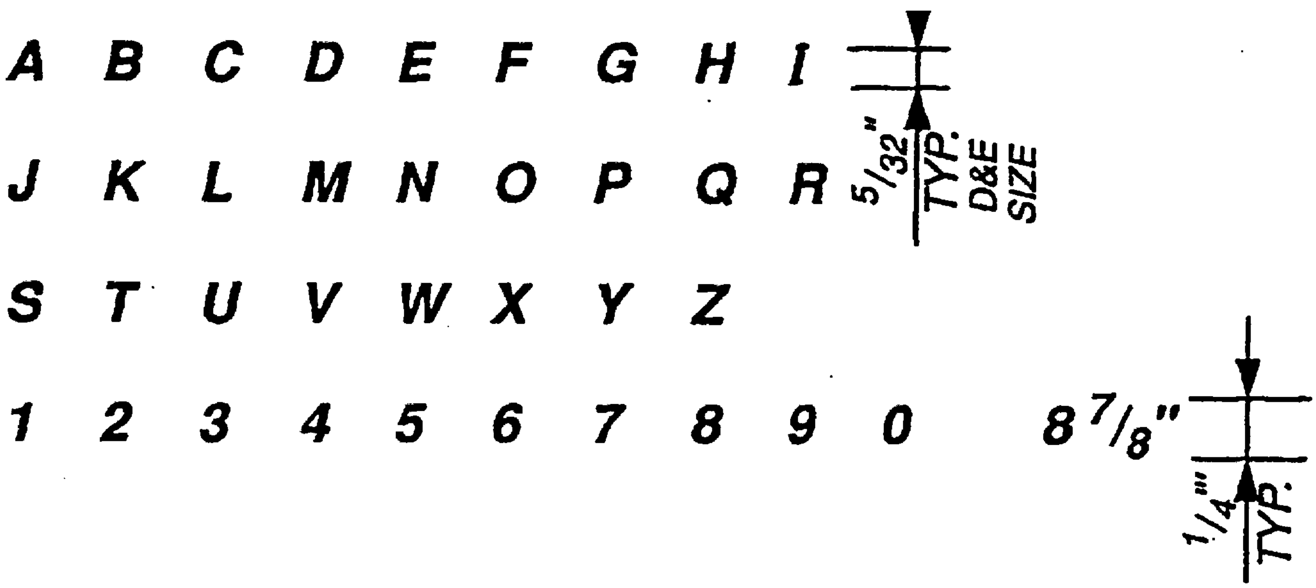
b. Only standard engineering and architectural scales may be used.

c. A graphic scale should be included on all dimensioned drawings to ensure proper blow back capabilities from microfilm.

4.5.3 Lettering

a. Letters and numerals shall be clear, clean, opaque (black) and uniform in weight and density so that constant contrast with the background is provided.

b. All lettering shall be upper case only, inclined (with the exception of architectural lettering which shall be vertical) and



c. General lettering drawn by CAD shall be approximately 1/8" (3 mm) high for A, B and C size drawings and approximately 5/32" (4 mm) high for D and E size drawings. Otherwise, general lettering drawn by hand shall be approximately 1/8" (3 mm) high for A, B and C size drawings and approximately 3/16" (4 mm) high for D and E size drawings.

d. Title lettering shall be approximately 1/4" (6 mm) high.

e. Overall height of fractions shall be approximately 1/4" (6 mm).

f. Minimum space between characters shall be approximately 1/16" (1.6 mm).

g. When manual drafting changes or additions are made to CAD prepared drawings, lettering shall be similar to CAD lettering.

h. Lettering shall be applied in a manner that prevents the characters from making contact with lines, symbols, figures, or other characters.

i. Care should be taken to keep characters open so the legibility will not be affected on reduced size copy, regardless of the reduction ratio.

4.5.4 Linework

a. Sharp, solid, dense opaque (black) lines with a uniform density which provides

constant contrast with the background are critical microfilming requirements. Linework shall be limited to three widths as follows:

Thin = .01" (Minimum)	Dimension Lines Leader lines, Background, etc.
Medium = .02"	Primary Object
Thick = .03" (1/32)	Diagrammatic, reinforcing steel, etc.

b. Minimum open space between lines shall be 1/16" (1.6 mm).

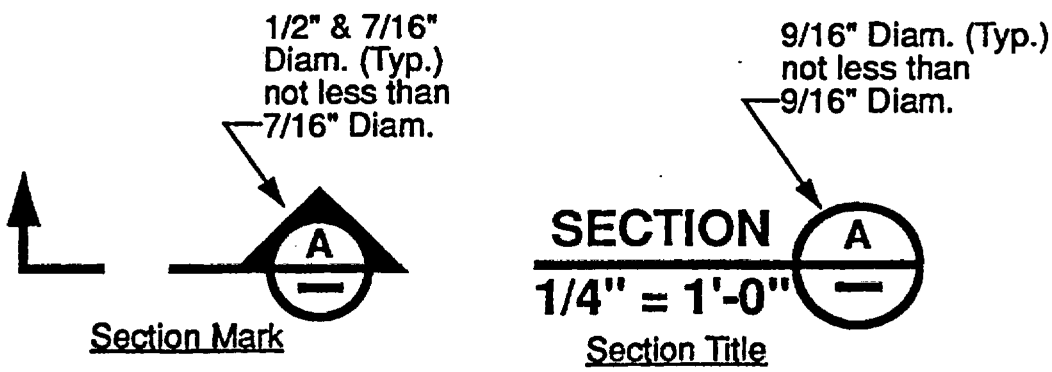
c. Weight of lines shall be constant in thickness so that after reduction they will not diminish, but will remain clear and legible.

4.5.5 Sections

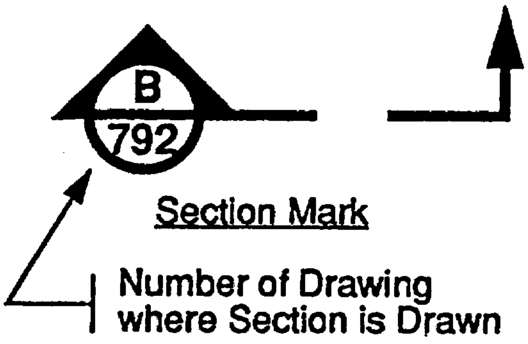
a. Sections shall be taken in the direction which will give the most functional view. Sections looking to the top and left of the drawing are preferred.

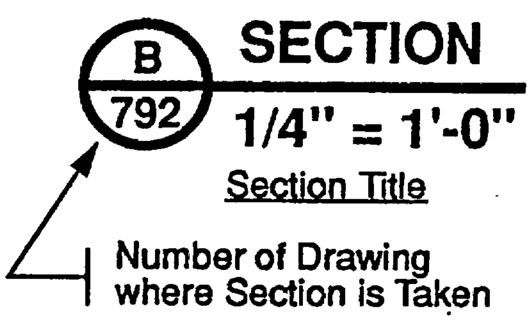
b. Sections shall be designated by letters in alphabetical order, i.e., "A", "B", "C". Do not use the letters "I" or "O" to designate sections.

c. When a section is taken and drawn on the same drawing, the section mark and rifle shall appear as follows:

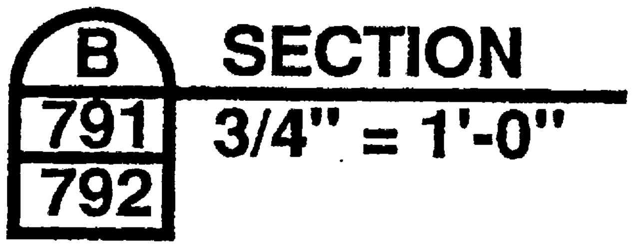


d. When a section is taken on one drawing and drawn on another drawing, the section mark and title shall appear as follows:





e. When identical sections are taken on more than one drawing, the section title shall appear as follows:



f. Letters used for section marks may be duplicated on the same drawing if the reference drawing number is different. However, letters used for section titles shall not be duplicated on the same drawing.

4.5.6 Elevations

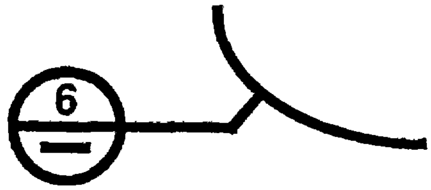
a. Elevations shall be indicated in the same manner as sections except the word "Elevation" shall be substituted for "Section".

b. When exterior wall elevations are noted by compass direction (e.g., North Elevation) elevation marks are not required.

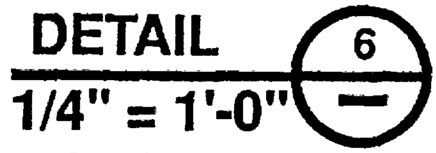
4.5.7 Details

a. Details are blown-up views drawn in the same plane and to the same orientation as the smaller original view. Details are designated by numbers in numeric order, i.e., 1, 2, 3.

b. When a detail is taken and drawn on the same drawing, the detail mark and title shall appear as follows:



Detail Mark



Detail Title

c. The procedure for indicating detail reference drawing numbers shall be the same as for sections.

d. Numbers used for detail marks may be duplicated on the same drawing if the reference drawing number is different. However, numbers used for detail titles shall not be duplicated on the same drawing.

4.5.8 Dimensions and Drawing Scales

a. The most efficient and suitable drawing scales to use shall be determined on the basis of maximum utilization of drawing size, anticipated drawing reductions, and common scale advantages between disciplines. Only standard engineering and architectural scales are to be used.

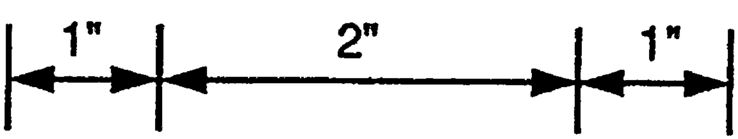
b. Dimensions and/or elevations shown on Electrical, Instrumentation and Control, Mechanical, Structural and Architectural drawings shall be in feet and inches. Dimensions under 1 ft-0 in. and over shall be shown in inches. Dimensions 1 ft-0 in. and over shall be shown in feet and inches. Feet and inch marks shall be used with all dimensions.

c. Dimensions and/or elevations shown on Civil drawings shall be in feet and decimals of a foot when applicable. Dimensions and/or elevations on structural plans, sections, elevations, and details shown on Civil drawings shall be in feet and inches.

d. Individual dimensions "not to scale" shall be noted with the notation "NTS" directly under the dimension. If the entire drawing is "not to scale" the notation "NTS" shall be placed near or in the title block, or the sections, details and elevations.

e. Repetitious dimensioning shall be avoided.

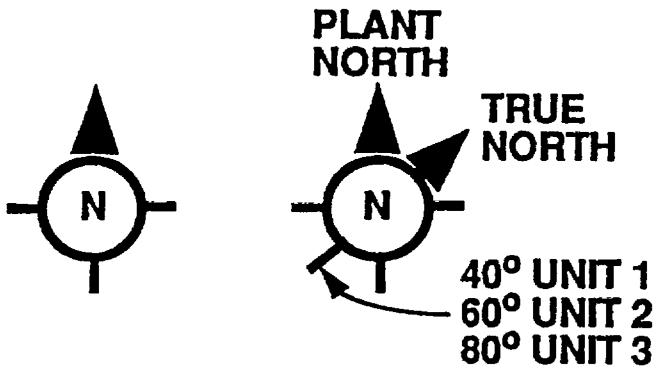
f. Arrowheads shall be used on all dimension lines.



g. Dots shall not be used in lieu of arrowheads.

4.5.9 North Arrows

Plan drawings shall be oriented either by a true north or plant north arrow, as appropriate, located in the key plan or in the upper left corner of the drawing. North arrows are illustrated below. North shall be to the top or left of the drawing whenever possible.



4.5.10 Key Plans

a. Key plans shall be designed in a simple form and readable when the drawing is reduced.

b. Key plans shall be located in the upper right hand corner of all plan drawings and oriented with their own north arrow.

c. Key plans may be the decal type and applied to the front of the drawing as needed or printed on the drawings with the original title block format.

d. Key plans should clearly denote the use of State or USGS Coordinate Systems.

4.5.11 Notes

a. When possible, notes should be located on the right side of the drawing, above the title block, and may be hand lettered. However, extensive notes shall be typewritten on a transparent mylar pressure sensitive applique material and applied to the face of the drawing.

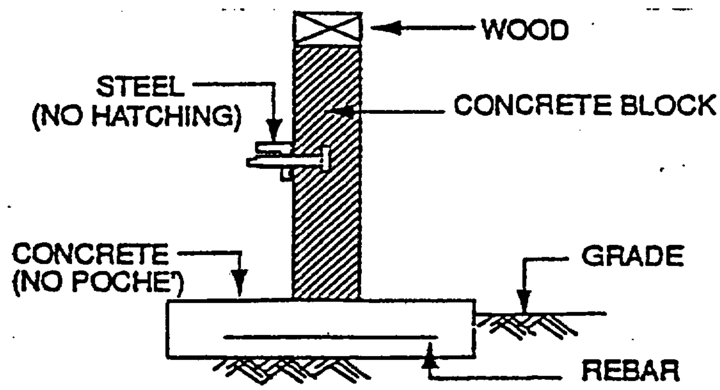
b. Specification information shall not be duplicated by drawing notes except where the information facilitates interpretation of the drawings. When possible, refer to notes on other drawings, to avoid repetition.

c. Drawing cross referencing shall be done by note when appropriate.

4.5.12 Abbreviations

Abbreviations should conform to those set forth in ANSI Y1.1-1972, Abbreviations for Use on ASME Drawings and in Text. Only common abbreviations should be used.

4.5.13 Material Indications



Material indications shall be used only when necessary to differentiate between materials not called out on the drawings. Emphasis is placed on limiting the material indication to maintain an efficient drawing appearance. Some common material indications are as follows:

4.6 Drawing Revisions

4.6.1 The assignment of drawing revision letters and numbers is described in Attachment 4.

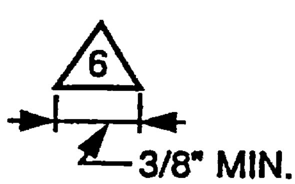
4.6.2 Whenever possible, changes to drawings should be made by the originator or as a minimum, the lettering style should be similar.

4.6.3 The procedure for indicating a revision on the drawing shall be as follows:

a. Note the specific revision description in the revision block.

b. Indicate the revised area(s) on the back of the drawing by enclosing the area(s) with a "Cloud" or irregular line enclosing the changed portion(s). It's preferred to use a black crayon type marker.

c. Draw a triangle inside or attached to the "cloud" indicating the changed area. The revision letter or number shall be indicated inside the triangle as follows:



4.6.4 Prior to revising the drawing, the previous number or letter, circles or triangles, and the revision number adjacent to drawing number and clouds shall be removed

from the drawing.

4.6.5 When all available space in the revision block and space for extending the block has been used and another revision is required, Revision 1 revision information and number are removed and the new revision information and number are inserted in its place. Succeeding revisions remove Revision 2, 3, etc. information and reuse the space.

4.6.6 Releasing a hold area of a drawing shall be treated the same as a revision.

4.7 Use of a Project Classification System on Drawings

4.7.1 General Information

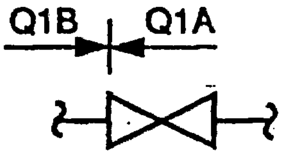
On all drawings, a Q, QAG or NQR shall be placed in the block adjacent to the title block (Attachment 2) depending on the highest class depicted on the drawing. If the drawing (except general arrangement) contains items of a lower quality class, then these items shall be properly identified for clarity. General arrangement drawings only require that the highest quality class identification be placed adjacent to the title block.

4.7.2 Piping and Instrumentation Drawings (P&ID)

a. Sketches A, B, and C are representative examples of how to identify boundaries between different quality, seismic and code classes on P&ID's.

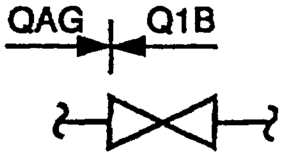
Boundary Defined

Sketch A



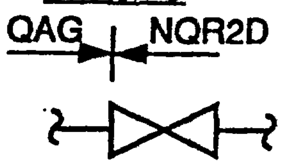
Between ASME B&PV Code, Section III, Class 1 and Class 2

Sketch B



Between Quality Class Q and QAG, between Seismic Category 1 and 2, and between ASME B&PV Code, Section III, Class 2 and ANSI B31.1

Sketch C

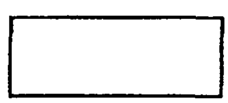


Between Quality Class NQR and QAG and between Seismic Category 2 and 3

b. Quality, seismic, and code class boundaries for instrument lines and instrumentation will not be shown on the P&ID's. These classifications will be shown on the applicable instrument installation detail.

c. Major equipment such as pumps, tanks, and heat exchangers shall be identified on P&IDs using the project classification system's triple alphanumeric designator in proximity to (preferably below) the equipment or component as shown in sketch D.

Sketch D



Equipment Name
Equipment Number
Project Classification - Q1C

4.7.3 Equipment Location Drawings

Major equipment such as pumps, tanks, and heat exchangers shall be identified on equipment location drawings using the project classification system's triple alphanumeric designator in proximity to (preferably below) the equipment or component as shown in sketch E.

Sketch E

Equipment Name
Equipment Number
Project Classification - Q1C

4.7.4 Logic Diagrams

Logic diagrams for Class 1E systems shall be identified per IEEE Standard 494-1974, Method for Identification of Documents Relating to Class 1E Equipment and Systems for Nuclear Generating Stations, using the words "NUCLEAR SAFETY RELATED" adjacent to the title block (Attachment 2).

4.7.5 Elementary Drawings

a. Elementary drawings for Class 1E systems shall be identified per IEEE Standard 494-1974, Method for Identification of Documents Relating to Class 1E Equipment and Systems for Nuclear Generating Stations, using the words "NUCLEAR SAFETY RELATED" adjacent to the title block (Attachment 2).

b. Circuits of a lesser quality class will be identified by notes. When contacts from a lower quality class circuit are indicated as going to a higher quality class drawing, the lower class drawing shall not be upgraded, but will remain the lower class. The contacts will, however, be identified as going to a higher quality class drawing.

4.7.6 Single Line Diagram

a. The higher class areas will be blocked out with a dotted line enclosure and clearly identified by notes for the main single line diagram.

b. Individual single line drawings for Class 1E system shall be identified per IEEE Standard 494-1974, Method for Identification of Documents Relating to Class 1E Equipment and Systems for Nuclear Generating Stations, using the words "NUCLEAR SAFETY RELATED" adjacent to the title block (Attachment 2).

c. Electrical Drawings

Electrical layout drawings for Class 1E equipment and systems shall be identified per IEEE Standard 494-1974; Method for Identification of Document Relating to Class 1E Equipment and Systems for Nuclear Generating Stations, using the words "NUCLEAR SAFETY RELATED" adjacent to the title block (Attachment 2). Conduit and trays for Class 1E and non-Class 1E systems shall be identified by numbering and notes.

5.0 DEFINITIONS AND ABBREVIATIONS

Abbreviations used in this addendum are defined at the first point of use. There are no special definitions.

6.0 REFERENCES

6.1 Implementing References

6.1.1 ANSI Y1.1-1972, Abbreviations for Use on ASME Drawings and in Text

6.1.2 IEEE Standard 494-1974, Standard Method for Identification of Documents Relating to Class 1E Equipment and Systems for Nuclear Power Generating Stations

6.2 Developmental References

6.2.1 81PR-0CC01, Rev. 1, Configuration Management Program

6.2.2 81AC-0CC06, Classification of Structures, Systems, and Components

6.2.3 81DP-0CC09, Drawings

6.2.4 USNRC Regulatory Guide 1.64, Rev. 2, June 1976, Quality Assurance Requirements for Design of Nuclear Power Plants

6.2.5 Updated Final Safety Analysis Report (UFSAR) Section 1.8 and Section 17.2.

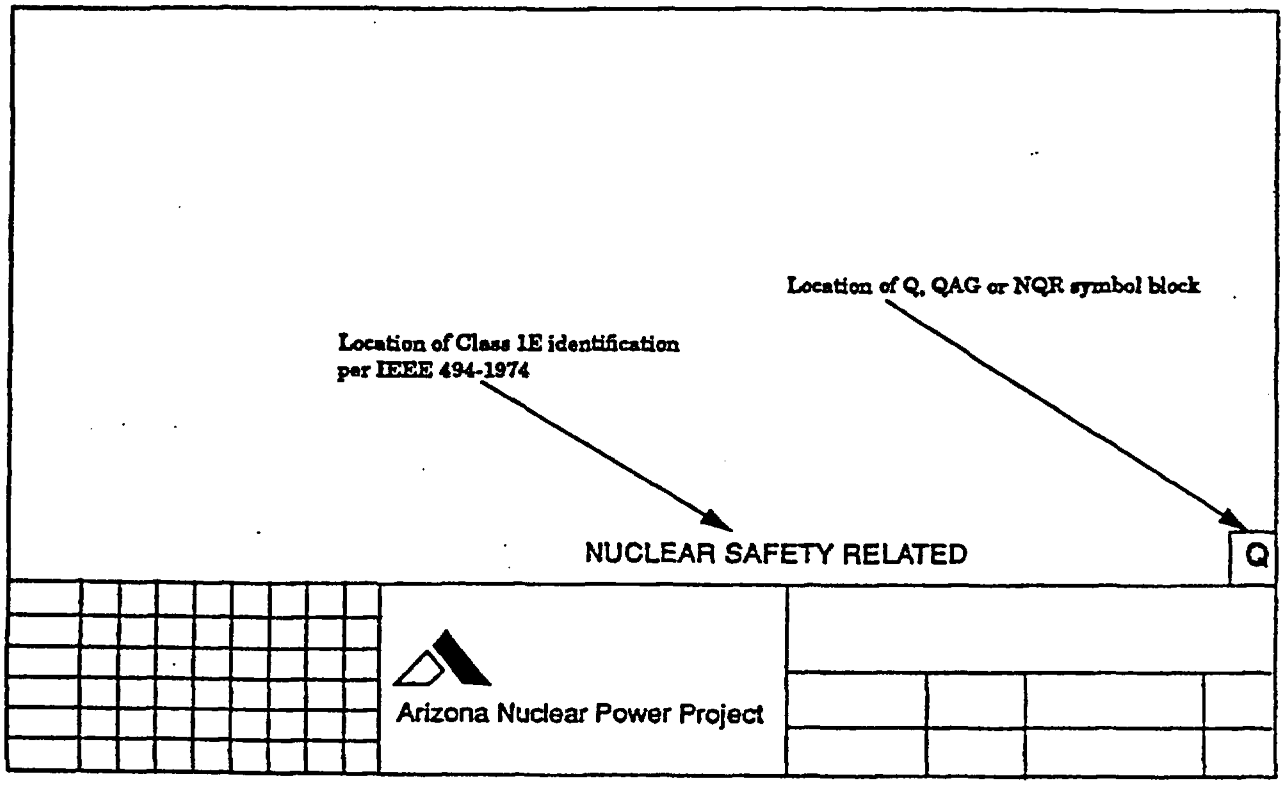
Attachment 1

DRAWING LIST

Drawing No.	Revision

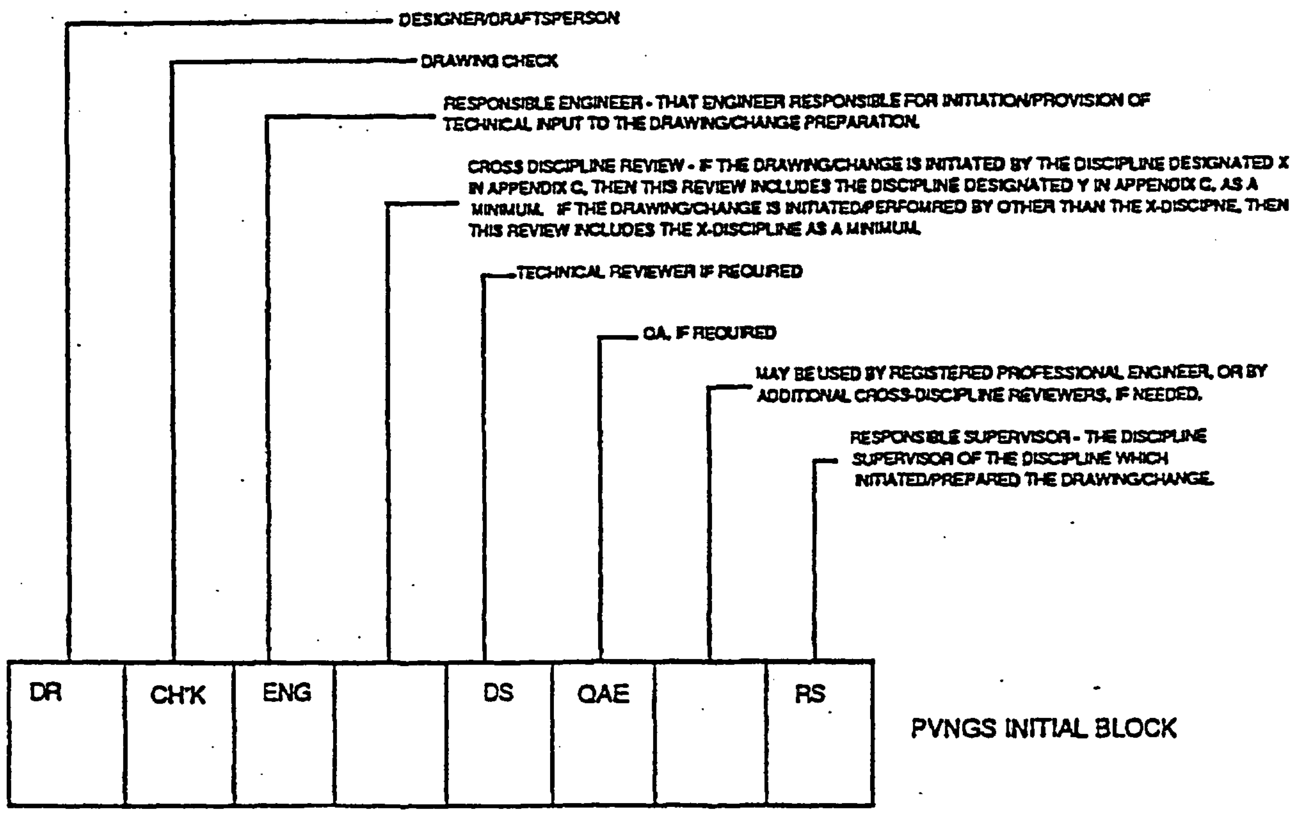
Attachment 2

QUALITY CLASS IDENTIFICATION ON DRAWINGS
(Sample)



ATTACHMENT 3

DRAWING SIGNATURE REQUIREMENTS



ATTACHMENT 4

Revision Classifications

1. Design and other technical documents shall be classified by revision as either "Preliminary" or "Final".

   Preliminary documents are those which are still, technically speaking, in preparation and which, therefore, may not be used for activities, including fabrication, construction or operation. Documents in this category are those normally awaiting verification of design inputs and assumptions.

   Final documents are those which are considered complete and ready for use in any activities.

2. Preliminary documents, with the exception of specifications, may only be issued for one of the following reasons:

   "Issued For Renew"
   "Issued For Information Only"
   "Issued For Bid"

   Preliminary specifications may not be "Issued For Bid".

3. Revisions of preliminary documents shall be designated by letters (starting with A). The revision block shall also include a description of the revision, i.e., "Issued For _specify_".

4. Final documents may only be issued for one of the following reasons:

   "Issued For Use/Implementation"
   "Issued For Bid"
   "Issued For Award"
   "Issued For Fabrication"
   "Issued For Construction/Installation"
   "Issued As-Built"
   "Issued For Information Only"

5. Revisions of final documents shall be designated by numbers (starting with 0). The revision block shall also include for Rev. 0 a description of the revision, i.e., "Issued For _specify_".

   If the purpose for issue changes with future revisions (e.g., drawings issued for construction revised to reflect as-built configuration), the revision description block should be used to describe the nature of the revision made.

6. Document revisions or change notices shall be reviewed and approved in accordance with the same requirements applicable to the original document.

7. The revision date for documents shall be the date of issue.

ADDENDUM A-02

PROJECT CLASSIFICATION SYSTEM

FOR THE

ARIZONA PUBLIC SERVICE COMPANY

PALO VERDE NUCLEAR GENERATING STATION; UNITS 1, 2 AND 3

QUALITY CLASS Q, QAG, NQR

ADDENDUM A-02

PROJECT CLASSIFICATION SYSTEM

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ADDENDUM A-2
PROJECT CLASSIFICATION SYSTEM

1.0 PURPOSE

The purpose of this addendum is to define and explain the Arizona Public Service (APS) Project Classification System, as utilized in the Technical Specifications. This system provides the method of identifying the quality class, seismic category, and code classification of structures, systems and components, so that Suppliers/Contractors will readily understand the various references.

The Supplier Quality Program Requirements and Seismic Category I and II Requirements are contained in other Addenda. Section 4.3 contains the requirements of Seismic Category III.

2.0 DESCRIPTION

The project classification system utilizes a three-element alpha-numerical identification scheme. The first element consists of a single letter or a group of letters designating the quality classification, the second element consists of a number or a symbol to designate seismic category, and the third element consists of a letter designating the applicable code classification.

The quality classes are indicated by the letters Q, QAG, and NQR in compliance with their importance to nuclear safety or reliable plant operation. The quality classes are defined in Section 3.0.

The seismic category is indicated by the numbers 1, 2, 3, and 9 representing Categories I, II, III, and IX, respectively, of seismic design requirements. When no seismic requirements apply, the symbol "#" is used. The seismic categories are defined in Section 4.0.

The last letter of a project classification indicates the code or standard applicable to the design and construction of the component. These codes are defined in Section 5.0.

3.0 QUALITY CLASS DEFINITIONS

3.1 Quality Class Q (See Addendum 5)

Any structure, system, or component which, as a result of being defective, could cause or increase the severity of a nuclear incident that would impose undue risk to the health and safety of the public, shall be designated Quality Class Q. All engineered safeguard systems fall within this classification.

For items in this classification, the requirements of 10 CFR 50, Appendix B, as interpreted by ANSI N45.2-1971 shall be met to ensure the highest quality standard.

3.2 Quality Class QAG

Those items not included in Quality Class Q, which perform no safety function, but on which APS has made a regulatory, management directive, or FSAR commitment to include them within the scope of the APS QA Program.

The quality requirements of Quality Class QAG items may be similar to those for Quality Class Q except that 10 CFR 50, Appendix B is not applicable. The purpose of the quality program for "QAG" listed items is to assure reliable operation and individual personnel safety.

3.3 Quality Class NQR

Any structure, system, or component not included in Quality Class Q or QAG shall be designated as Quality Class NQR. In general, the quality requirements for equipment in Quality Class NQR will be the industry standard. Any specific requirements will be included in the equipment specification.

4.0 SEISMIC CATEGORY DEFINITIONS

4.1 Seismic Category I

Structures, systems, and components which are important to safety and are designed to remain functional in the event of a Safe Shutdown Earthquake (SSE), are designated as Seismic Category I. In addition, Seismic Category I structures, systems, and components are designed to remain functional and within applicable stress and deformation limits (elastic range of materials) when subjected to the effects of the vibratory motion of the Operating Basis Earthquake (OBE) in combination with normal operating loads.

4.2 Seismic Category II

Seismic Category II structures, systems, and components are those non-seismic Category I structures, systems, and components which are essential to power generation or whose failure could cause a safety hazard to station personnel.

4.3 Seismic Category III Requirements

Structures, systems, and floor or wall-mounted components not designated Seismic Category I or II are designated Seismic Category III. Floor or wall-mounted Seismic Category III components shall be designed to withstand an equivalent static seismic load of 0.05g times the mass of the equipment in any direction applied to the center of gravity of the component, and not experience any structural failure of that part of the component that is secured to the foundation. Seismic Category III tanks and structures shall meet the Uniform Building Code for Seismic Zone 2."

4.4 Seismic Category IX Requirements

Seismic Category IX structures, systems, and components are those non-seismic Category I, II, or III structures, systems, and components including the associated supporting structure that must be designed to retain structural integrity during and after a seismic event, but do not have to retain operability for protection of public safety. The basic requirement is prevention of structural collapse and damage to equipment and structures required for protection of the public safety.

5.0CODE CLASSIFICATION DEFINITIONS

Code Classification	Applicable Code and Standard
A	ASME B&PV Code, Section III Class 1
B	ASME B&PV Code, Section III Class 2
C	ASME B&PV Code, Section III Class 3
D	ANSI B31.1, Power Piping
E	Electrical Industry and IEEE (Institute of Electrical and Electronics Engineers) Standards
F	National Fire Protection Association (NFPA)
G	National or Applicable Plumbing Code
H	ASME B&PV Code, Section I
I	API (American Petroleum Institute)
J	AWWA (American Water Works Association)
K	CMAA (Crane Manufacturers Association of America
L	ASME B&PV Code, Section VIII
M	ASHRAE (American Society of Heating,Refrigerating and Air-Conditioning Engineers)
	AMCA (Air Moving and Conditioning Association)
	ARI (Air Conditioning and Refrigeration Institute)
N	TEMA (Tubular Exchanger Manufacturers Association), Heat Exchange Institute Standards
0	Recognized Industry Standards
P	SMACNA (Sheet Metal and Air Conditioning
	Contractors National Association, Inc.)
Q	ASME B&PV Code, Section III Class MC
R	Hydraulic Institute Standards
S	DEMA (Diesel Engine Manufacturers Association) Standard Practices

Code Classification	Applicable Code and Standard
T	CAGI (Compressed Air and Gas Institute) Standards
U	ASME B&PV Code, Section X

6.0 PROJECT CLASSIFICATION DESIGNATION - EXAMPLES

Project Classification

Component	Quality Class	Seismic Category	Code Classification
Reactor Vessel	Q	1	A
Diesel Generator	Q	1	E
Reactor Drain Tank	NQR	3	L
Electrical Cable	QAG	#	E
Reinforcing Steel	Q	#	O
Cement	QAG	#	O
Auxiliary Building	Q	1	O
Administration Bldg.	NQR	3	O
Auxiliary Bldg HVAC Ductwork	QAG	9	P

If two or more code letters apply, both should be indicated using the project classification, i.e., QIM, Q1P.

ADDENDUM A-05

SUPPLIER QUALITY CLASS Q PROGRAMS

FOR THE

ARIZONA PUBLIC SERVICE COMPANY

PALO VERDE NUCLEAR GENERATING STATION

UNITS 1, 2, AND 3

QUALITY CLASS Q

ADDENDUM A-05

SUPPLIER QUALITY CLASS Q AND QAG PROGRAMS

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ADDENDUM A-5
SUPPLIER QUALITY CLASS Q AND QAG PROGRAMS

1.0 SCOPE

This addendum provides the Quality Assurance requirements for the Quality Class Q and QAG equipment, material, or services as specified in the Purchase Order, Technical Specifications, or material requisitions.

This Addendum does not delete or revise (but is in addition to) those requirements defined by the Technical Specification. If a Supplier/Contractor believes that an inconsistency exists between this Addendum and the Technical Specification and referenced codes and standards, the Supplier/Contractor shall immediately notify the APS CPC Project Lead for resolution.

Quality Class Q

The Project Quality Assurance Program is governed by NRC Regulation 10 CFR 50 Appendix B and 10 CFR Part 21, Quality Assurance Criteria for Nuclear Power Plants. To satisfy this requirement, the Supplier/Contractor shall maintain a Quality Assurance Program that conforms to the applicable provisions of ANSI N45.2, Quality Assurance Program Requirements for Nuclear Power Plants, and to the other codes and standards as cited in the Technical Specifications.

Quality Class QAG

Quality Class QAG applies to those items not included in Quality Class Q, which perform no safety-related function, but on which APS has made a regulatory or FSAR commitment to include them within the scope of the APS QA Program due to their importance to plant reliability or the safety of station personnel.

It is not the intent to specify herein all details of the required Supplier/Contractor Quality Program. However, it shall be the responsibility of the Supplier/Contractor to implement a Quality Program, the detailed requirements of which are established by the codes and standards specified by the nature of the work, and by this Addendum.

Supplier/Contractor is a generic term synonymous with seller, vendor, architectural/engineer and engineering/design consultant.

2.0 SPECIFIC REQUIREMENTS

2.1 Control of Purchased Material, Equipment and Services

The Supplier/Contractor shall establish and implement a Quality Assurance Program that conforms to the applicable codes and standards as cited in the Technical Specification. These Quality Assurance requirements shall apply to all aspects of the work necessary for carrying out this Purchase Order/Contract, including but not limited to, design, procurement, fabrication, inspection, installation, delivery and testing.

2.2 Quality Surveillance

The term Surveillance, here, may include inspection, survey, and/or audit.

All designing, procuring, manufacturing, processing, assembling, testing, examination, and inspection operations performed by the Supplier/Contractor and its suppliers/contractors are subject to surveillance by APS or its authorized agents. This surveillance shall in no way relieve the Supplier/Contractor of any contractual responsibilities.

The APS Inspector(s), or its designated representative, shall be given free access to the Supplier's/Contractor's and its supplier's/contractor's facilities to inspect and report on the work in all phases of design, manufacturing, and testing.

The Supplier/Contractor shall give APS Inspector at least 5 working days prior notice of all tests, and other check points in the manufacturing program specifically requested by the Inspector, after a joint review of Supplier's/Contractor's work plan(s) and the Purchase Order/Contract. Such check points may be designated as Witness Points or Hold Points. Work shall not proceed beyond a designated Hold Point without the permission of APS or its authorized agent.

If the requirements of the Purchase Order/Contract have not been fulfilled, the APS Inspector has the authority to refuse acceptance of the work.

2.3 Audits

APS may conduct audits of the Supplier/Contractor and its supplier's/contractor's quality programs, procedures, records and activities to assure compliance with the Purchase Order/Contract.

2.4 Vendor Access

APS or its authorized agent reserves the right to access the Supplier's/Contractor's lower-tier supplier's/contractor's facility and records for verification activities (surveillance, inspection and audit) as appropriate to assure conformance of procured items and services to identified requirements. Supplier/Contractor will be notified in advance of such visit.

All design, procuring, manufacturing, processing, assembling, testing, examination, and inspection operations performed by the Supplier/Contractor and its lower-tier suppliers/contractors are subject to surveillance by APS or its authorized agents. This surveillance shall in no way relieve the Supplier/Contractor of any contractual responsibilities.

2.5 10CFR21 Reportability (Q Classification Only)

Reporting Defects and Noncompliance

The Supplier/Contractor shall comply with the provisions of 10CFR21 "Reporting of Defects and Noncompliances". Should the Supplier/Contractor notify the NRC concerning defects or noncompliances covered by 10CFR21 which are related to items or services covered by this agreement, concurrent notification shall be made to:

Vice President Nuclear Production
Palo Verde Nuclear Generating Station
P.O. Box 52034 - Station 7602
Phoenix, Arizona 85072-2034

If the item being procured from lower-tier suppliers/contractors is considered safety-related, then the requirements of 10CFR21 apply.

3.0 DRAWING AND DATA REQUIREMENTS

Refer to Addenda 1 and 2.

ADDENDUM A-13

INSTRUMENTATION FOR PACKAGE SYSTEMS

FOR THE

ARIZONA NUCLEAR POWER PROJECT

PALO VERDE NUCLEAR GENERATING STATION

UNITS 1, 2, AND 3

ADDENDUM A-13

INSTRUMENTATION FOR PACKAGE SYSTEMS

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ADDENDUM A-13
INSTRUMENTATION FOR PACKAGE SYSTEMS

1.0 SCOPE

This Addendum defines the technical requirements for furnishing instrumentation components, cabinets, piping, and wiring associated with package systems. These requirements are imposed to ensure a high quality level and design uniformity. In the text of the Addendum, the word "Specification" is used to reference the equipment package Technical Specification. This Addendum is an integral part of the Technical Specification, but in cases of conflict, the Technical Specification shall prevail over the Addendum. Instrumentation and controls supplied under the provisions of this Addendum shall be subject to the approval of APS.

2.0 ABBREVIATIONS

2.1 Organizations

ANSI	-American National Standards Institute
API	-American Petroleum Institute
ASME	-American Society of Mechanical Engineers
ASTM	-American Society for Testing and Materials
IEEE	-Institute of Electrical and Electronics Engineers
ICEA	-Insulated Cable Engineers Association, Inc.
ISA	-Instrument Society of America
MSS	-Manufacturer's Standardization Society of the Valve and Fitting Industry, Inc.
NACE	-National Association of Corrosion Engineers
NEMA	-National Electrical Manufacturers Association
SAMA	-Scientific Apparatus Makers Association
SSPC	-Steel Structures Painting Council
UL	-Underwriters Laboratories, Inc.

2.2 Descriptors

DPDT	Double pole, double throw
NC	Normally closed
NO	Normally open
NPT	National pipe thread
Ro	Ice-point resistance
RTD	Resistance temperature detector
SPDT	Single pole, double throw
PTFE	Polytetrafluoroethylene

3.0 CODES AND STANDARDS

Design, materials, manufacture, examination, testing, inspection, stamping, certification, and documentation shall conform to applicable portions of the following adopted or tentative specifications and their addenda:

ANSI B1.20.3	Pipe Threads, General Purpose (Inch)
ANSI B16.5	Pipe Flanges and Flanged Fittings

ANSI B16.11	Forged Steel Fittings, Socket-Welding and Threaded
ANSI/FCI 70-2	Control Valve Seat Leakage
ANSI B31.1	Power Piping
ANSI B147.1	Commercial Seat Tightness of SafeW Relief Valves with metal-to-Metal Seats
ANSI C37.20	Switchgear Assemblies Including Metal-Enclosed Bus
ANSI/MC96.1	Temperature Measurement Thermocouples
ANSI N101.2	Protective Coatings (Paint) for Light Water Nuclear Reactor Containment Facilities
IEEE 315-75	Graphic Symbols for Electrical and Electronic Diagrams
ASME B&PV Code Section II	Material Specifications
ASME B&PV Code Section III Division I	Rules for the Construction of Nuclear Power Plant Components
ASME B&PV Code Section IX	Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators
ASME Publication	Fluid Meters - Their Theory and Application
ASME PTC 25	Safety and Relief Valves
ASME SA-182	Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASME SA-213	Seamless Ferritic and Austenitic Alloy-Steel Boiler, Superheater, and Heat-Exchanger Tubes
ASME SA-479	Stainless and Heat-Resisting Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
ASTM B 43	Steamless Red Brass Pipe, Standard Sizes
ASTM B 68	Seamless Copper Tube, Bright Annealed
ASTM E 235	Thermocouples, Sheathed, Type K, for Nuclear or for Other High Reliability Applications
ICEA S-19-81 (NEMA WC3-80)	Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
ISA RP7.1	Pneumatic Control Circuit Pressure Test

ISA S5.1	Instrumentation Symbols and Identification
MSS SP-25	Standard Marking System for Valves, Fittings, Flanges and Unions
NEMA ICS	Industrial Controls and Systems
SAMA PMC 20.1	Process Measurement and Control Terminology
UL 83	Standard for Safety Thermoplastic Insulated Wires and Cables
UL 467	Standard for Safety Grounding and Bonding Equipment
UL 486	Standard for Safety Wire Connectors and Soldering Lugs for Use with Copper Conductors

This Addendum is based on the codes and standards in effect at date of award of purchase order. If subsequent revisions or case rulings for these codes and standards come to the Supplier's/Contractor's attention, APS shall be informed of the revisions for resolution of applicability.

4.0 GENERAL

4.1 Conditions of Service and Environment

4.1.1 Instrumentation for package systems will generally be located in the vicinity of the equipment it controls or serves and will generally be subjected to similar environmental conditions. When special consideration of environmental conditions is necessary, the Specification shall provide the environmental design parameters.

4.1.2 Instruments for service within the containment shall be of stainless steel construction or coated in accordance with Addendum 17, "Surface Preparation and Coating Requirements for Ferrous Metal Surfaces to be Installed in 'Q' and 'QAG' Areas" and shall not contain polyvinyl chloride, mercury, zinc, or aluminum. Instruments for service in radiation fields shall not contain teflon or other materials which may deteriorate in this type of service. Selection of materials not specified by APS shall be the responsibility of the Supplier/Contractor. Material shall conform to requirements specified in applicable codes, standards, and regulations and shall be subject to approval by APS.

4.2 Permanent Plant Utilities

The available plant utilities are listed below. The Supplier/Contractor shall indicate the need for any additional or special utility service required for the operation of the package system instrumentation.

a. Dry, oil free instrument air delivered to the Supplier's/Contractor's outboard connection at 80 to 125 psig (Dew point - minus 40 °F).

b. Interruptible service air delivered to the Supplier's/Contractor's outboard connection at 80 to 125 psig.

c. 480 Vac, three phase, 60 Hz, grounded.

d. 120 Vac, single phase, 60 Hz, grounded (Non-Class 1 E).

e. 120 Vac, single phase, 60 Hz, ungrounded (Class 1E).

f. 120 Vac, single phase, 60 Hz, grounded; for lighting, heaters (up to 3 kW rating), and receptacle outlets only.

g. 125 Vdc nominal, 105 to 140 Vdc range, ungrounded.

h. Demineralized and potable water.

4.3 Measurement Reference Data

a. Normal barometric pressure base: 14.7 psia.

b. Pressure base for gas-flow measurement: 14.7 psia.

c. Temperature base for gas-flow measurement: 60 °F.

d. Temperature base for liquid-flow measurement: 60 °F.

4.4 Indicated Units

a. Positive gauge pressures: inches H20 or psig.

b. Vacuum: inches Hg or inches H20.

c. Absolute pressure: inches Hg (abs) or psia.

d. Temperature: degrees Fahrenheit.

e. Liquids: gal/min.

f. Steam and vapors: lb/hr.

g. Gases: sf3/hr or sf3/min.

h. Solids: lb/hr.

i. Slurries: gal/min.

j. Level: feet or percent

k. Radiation: mrem/h or counts/minute

5.0 TECHNICAL REQUIREMENTS

5.1 Instruments

5.1.1 General

a. Standardization of instrumentation in total plant design is desired. Supplier/Contractor shall offer its standard instrumentation package and shall offer comparable Foxboro instrumentation as an option. Tracor Westronics recorders, or equivalent, shall be offered as an option to Supplier's/Contractor's standard package recorders.

b. Control systems shall include all equipment necessary to perform the required measuring and controlling operations. Instruments shall be furnished and installed prior to shipping to jobsite when practical. All necessary accessories, such as five-valve manifolds, primary elements, and individual air sets, shall be included in the installation. Instruments shall be mounted in a manner that precludes deterioration of performance due to vibration of instruments or connecting lines.

c. Supplier/Contractor shall determine sensitivity, accuracy, repeatability, and deadband of instruments and instrumentation systems to be supplied. This data, in addition to complete instrument specifications, shall be provided by the Supplier/Contractor.

d. The use of electrical systems is preferred. This does not preclude the use of local pneumatic loops where adequate performance can be achieved at reduced cost. Pneumatic instrument loops shall not be utilized within the containment or in Seismic Category I service.

e. Calibration and alignment of all instruments shall be performed prior to shipment. Calibration data shall be traceable to documentation required by Addendum 3, "Technical Proposal Data." All calibration standards shall be traceable to the National Bureau of Standards (NBS).

f. Instrument scales shall be calibrated to read directly in engineering units, and to be linear when practical.

g. Supplied instrumentation shall be designed to fail-safe on loss of power; i.e., pneumatic or electrical, to provide personnel protection first; then process protection, with equipment safety last.

h. nstrument lines shall transmit neither process media nor pneumatic signals to the control room. Signal transmission to the control room shall be electrical only.

i. Control instruments shall be provided with bumpless transfer from automatic-to-manual and manual-to-automatic.

j. Pneumatic or electronic field-mounted instrument internal adjustments shall not be accessible without removing covers, plates, or plugs.

k. Instruments shall be line mounted only on approval of APS.

l. All liquid level indication shall be of the electronic type; e.g., electronic transmitter and indicator. All instruments shall be provided with shutoff valve(s) and test tee(s).

5.1.2 Electronic Instruments

a. The standard analog electrical signal is 4 to 20 mA dc. Two wire transmitters shall be employed for electronic control loops. Electronic equipment shall be of solid state modular design that operates at supply voltages ranging from + 10 percent of rated voltage.

b. Electronic components, when supplied, shall be selected to reliably and safely perform the function intended during the 40 year design plant life giving consideration to environmental conditions in which they must operate.

c. Printed circuit cards that are used to mount electronic components shall be rugged and free from warping or cracking under normal handling in the operational environment. The cards shall be spaced and/or supported to prevent contact between adjacent cards when being withdrawn or inserted. Plug-in cards shall have gold plated contacts and connectors.

d. Thermocouple burn-out protection shall provide upscale indication unless specified otherwise by APS.

e. Electronic field mounted instruments shall be supplied with NEMA 4 or APS approved equivalent weatherproof housing with integral junction box, wiring terminals, and 3/4-inch conduit connection. Mounting features of these instruments shall be either surface bracket or 2-inch pipe bracket for horizontal or vertical pipe.

f. Instruments shall have individual ac power disconnect features other than removal of conductors from terminals to facilitate maintenance.

5.1.3 Pneumatic Instruments

a. The standard analog pneumatic signal is 3 to 15 psig. There shall be no exceptions without prior approval by APS.

b. Instruments shall be suitable for operation from the dry plant instrument air source of 80 psig minimum without requiring lubrication.

c. Each instrument shall be furnished with mounted Fisher Controls Type 67FR Filter/Regulator or APS approved equivalent and 2-inch pressure gauges indicating supply and transmitted output pressure. Inlet and outlet connections shall be 1/4-inch NPT.

d. Pneumatic field-mounted instruments shall be supplied with NEMA 4 or APS approved equivalent weatherproof housing. Mounting features shall be as specified in 5.1.2.e.

e. All flow gauges, pressure gauges, and pressure switches shall be provided with shutoff valve(s) and test tee(s).

5.1.4 Panel-Mounted Instruments

a. Instruments shall be nominally 3-inches wide by 6-inches high except miniature recorders which shall be a minimum of 6-inches wide by 6-inches high. Instruments shall be mounted flush or semi-flush in the panel and shall include all necessary mounting hardware including shelves. Non-glare glass shall be provided on instruments which have glass facings.

b. Electronic instruments shall be provided with quick connect/disconnect features and a cable harness which permits the withdrawal of the instrument from the panel-mounted shelf without removing the instrument from service.

c. Engineering units, identification legends, and scaling factors shall be provided for each instrument.

d. Instrument bezel color shall be black.

5.1.5 Miscellaneous Instruments and Hardware

The following are miscellaneous instruments and hardware, so defined because they are not specifically covered by any of the previously defined categories. However, they may be part of many package systems and therefore must meet the following requirements.

5.1.5.1 Level, Pressure, Temperature, and Flow Switches

Switches shall be DPDT, provided in NEMA 4 or APS approved equivalent housings, and shall have independently adjustable set points. Switches shall be rigidly fastened to panel, rack, or cabinet so that removal of tubing, piping, and wiring can be accomplished without dismounting the instrument. All field connections shall be to terminal blocks. Minimum switch contact ratings shall be O. 5 ampere (inductive), 125 Vdc and 5.0 amperes (inductive), 120 Vac.

Paddle type flow switches shall not be used.

5.1.5.2 Indicating Lights

Indicating lights shall be Master Specialties Series 90K or APS approved equivalent. Refer to the electrical requirements of the Specification and Figure 5, Control Position Color Indications.

5.1.5.3 Pressure Gauges

Pressure gauges, except those specified in 5.1.3.c, shall have a 4-1/2 inch diameter dial, stainless steel case, white dials with black graduations, and blowout protection. All instruments used for handling viscous liquids, liquids with suspended solids or corrosive chemicals shall have diaphragm seals. Each pressure gauge shall have a plugged test tee.

5.1.5.4 Thermometers

Bimetallic thermometers shall be used for local temperature indication unless excessive vibration or radiation prohibits use. Thermometers shall have 5-inch nominal diameter indicating scales enclosed in corrosion and weatherproof housings.

Glass stemmed thermometers shall not be used.

5.1.5.5 Flowmeters

Flowmeter installations shall comply with ASME publication Fluid Meters: Their Theory and Application (1971).

Supplier/Contractor shall submit flowmeter calculations to APS for review and approval in accordance with Addendum 3, "Technical Proposal Data."

5.1.5.6 Thermocouples

Thermocouples shall be Chromel-Alumel, ASTM E 235, Type K for service to 2400 ° F.

Thermocouple extension wire shall be No. 16 AWG, Type KX, solid conductor, twisted pair, flame-resistant insulation, and shielded with a No. 20 AWG drain wire attached to shield.

5.1.5.7 RTDs

Resistance Temperature Detectors (RTDs) shall be platinum with an Ro = 100 ohms and a temperature coefficient of 0.00385 ohms/ohm-C to be utilized in three wire circuits.

5.1.5.8 Thermocouple and RTD Assemblies

Thermocouple and RTD heads shall be weatherproof. Covers shall be threaded and gasketed with retainingchain to body. Terminal blocks shall be arranged to permit removal of elements without removing terminal blocks. Conduit connections shall be 3/4-inch NPT.

When the output of a thermocouple or RTD is used for two devices, such as both for a multipoint recorder input and a computer input, duplex elements shall be provided (two independent elements in the same swaged tube).

5.1.5.9 Recorders

Multipoint records shall be the null-balance type with regulated power supply, Tracor Westronics DDR10 or APS approved equivalent.

Single, dual, and three pen recorders shall be the null-balance type with regulated power supply, 4-inch strip chart, Tracor

Westronics Series 2000 or APS approved equivalent.

Recorder chart drives shall be 120 Vac, 60 Hz. Chart speeds shall be l inch/hour unless process variable characteristics require otherwise.

5.1.5.10 Gauge Glasses

Level gauge glasses for nonradioactive service shall be flat glass, transparent or reflex type. Reflex glass shall be used only for clean services; transparent glass shall be used for acid, caustic, dirty, or liquid interface services. Steam, hot water service at temperatures in excess of 200°F, and caustic service shall require mica gauge glass shields. Gauges shall be equipped with quick-closing, back-seated, offset isolation valves fitted with internal ball check valves for automatic shutoff in the event of glass breakage. Gauge glasses shall be installed to cover not only the working range, but the entire vessel liquid level range.

5.1.5.11 Annunciators

The local annunciators are self-contained units located on local control panels. The windows, logic and power supply system shall be located in a single annunciator assembly for panel mounting.

a. Annunciators shall be RIS AN3100, Beta Products Series 1000, or APS approved equivalent. Windows, lamps, and logic cards shall be front removable. Windows shall be constructed of white translucent materials with black engraved lettering. Engraving shall be approved by APS prior to fabrication. Annunciators shall be powered by 125 Vdc. Alarm initiating contacts shall be normally closed and shall open to indicate alarm. Sequence of operation shall be in accordance with Figure 1 for sustained alarm and Figure 2 for momentary alarm.

b. Continuous ringing 6-inch bells shall be provided for installation in the local control panels. The audible sound shall be silenced automatically after approximately 15 seconds (adjustable) since the panels are not continuously attended.

c. Auxiliary contacts shall be provided to open while any window is flashing and also when the power has been lost for more than two seconds. In addition, twenty percent of the windows shall have auxiliary contacts which shall follow the window contacts. These contacts shall be electrically isolated and wired for connection to the plant annunciator system.

5.1.5.12 Control Valves

The Supplier/Contractor shall be responsible for sizing and determining flow characteristics of control valves, subject to APS approval. Control valves shall be suitable for the full range of process conditions, and meet any safety related requirements stipulated in the specification.

a. End connections, body material, and pressure rating shall comply with the line classification and piping code requirements. Butt-weld valves shall have APS' standard weld end preparation in accordance with Addendum 15. Butt-weld control valves with alloy bodies shall be furnished complete with pipe stubs of the same material as the adjoining pipe specified by APS.

b. Control valves shall be provided with bypass and isolation valves, unless otherwise specified by APS. The bypass for pressure reducing service shall have capacity no greater than the control valve unless the downstream relief is sized to full open bypass capacity or if the downstream piping and equipment is designed for upstream pressure.

c. Valve trim shall be of materials suitable for the process conditions. Trim shall be capable of replacement without removing the valve from the line.

d. Valve packing box construction shall consist of a bolted packing gland follower with dimensions to facilitate easy change of the packing. Packing sleeves and lantern rings shall be stainless steel. Packing shall be per APS Specification 13-PN-220. When control valves are included with package systems, a copy of 13-PN-220 will be included with this Addendum. Double PTFE V-ring packing shall be used for non-radioactive vacuum service. Weld-end valves shall be packed after welding.

e. For valves carrying a radioactive fluid, a leak-off connection shall be provided at the lantern ring and shall be 1/2-inch by 6-inches long, Schedule 160 pipe nipple, socket welded into the bonnet with depth as specified in ANSI B16.11. Pipe nipple shall be temporarily capped.

f. A lubricator connection shall be furnished on all bonnets where a leak-off connection is not required. A plug shall be provided when a lubricator is not used and shall be stainless steelonly. Lubricant, where required, shall be furnished by the Supplier/Contractor and

packaged separately in a bag tied to the valve yoke. Supplier/Contractor shall indicate type and manufacturer of lubricant furnished.

g. A flow direction arrow shall be permanently displayed on the valve body in the form of a casting, stamping, or plate. The plate shall conform to ASME Section III, Material Requirements.

h. Supplier/Contractor shall submit valve sizing calculations to APS for review in accordance with Addendum 3, "Technical Proposal Data."

5.1.5.13 Valve Actuators

Actuators shall satisfy the following requirements:

a. Cast iron yokes shall not be used on control valves supplied under the provisions of this Addendum.

b. All valve actuators shall be furnished with stem travel indicators and scales readable from a distance of 25 feet.

c. Diaphragm actuators shall be removable screwed or bolted topworks. The valve topworks shall be constructed to minimize friction and hysteresis.

d. Supplier/Contractor shall provide individual lubricators for actuators requiring a lubricated pneumatic supply.

e. Requirements for electric actuators are specified in Addendum 16, "Valve Electric Motor Actuators."

5.1.5.14 Valve Accessories

Position switches and handwheels shall satisfy the following requirements.

a. Position Switches

1. On-off control valves shall be furnished with position switches to indicate valve open and closed conditions.

2. Position switches and the associated apparatus shall be installed on the valve by the Supplier/Contractor prior to shipment of the valve to the jobsite.

3. The switches shall be National Acme Company, "Snap-Lock" heavy duty series EA-170 or APS approved equivalent with 3/4-inch conduit opening for service outside the containment. Switches for service in the containment shall be National Acme Company,

"Snap-Lock", EA-740, or APS approved equal. Switches shall be provided with two normally open and two normally closed contacts.

4. The switches shall be installed in a manner that will not interfere with the normal operation or installation of the apparatus. The mounting brackets and switch actuating mechanism shall be of sufficient rigidity and strength to ensure operation without distortion. The installation shall be such that the conduit and cable connections to the switches can be installed easily without causing misalignment or incorrect operation. The switch actuating mechanism shall have provisions for adjusting the operating point to allow accurate switch operation at the apparatus position specified.

5. Drawings showing the details of switch mounting and actuating devices shall be provided in accordance with the specified drawing requirements. The switch manufacturer and model number and provisions for conduit entry shall be shown on the drawings.

b. Handwheels

When handwheels are supplied, the manual operating force of the valve handle shall not exceed 80 lb for on-off service and 50 lb for modulating service. Handwheels shall have arrows to indicate direction to open or close valve. Handwheels shall be smooth finished and free of burrs.

5.1.5.15 Solenoid Valves

Solenoid valves shall satisfy the following requirements.

a. Solenoid valves shall be Automatic Switch Company (ASCO), universal construction or APS approved equal. Where three-way solenoid valves are furnished, connections shall be piped to provide the required failure mode.

b. Solenoids designated as ac shall be suitable for continuously energized operation from 108 to 132 Vac power source, single phase, 60Hz. Solenoids designated as dc shall be suitable for continuously energized operation from 105 to 140 Vdc power source, battery powered. Supplier/Contractor shall advise APS of the power consumption and inrush current ratings for solenoid valves supplied.

c. Solenoid enclosures shall be NEMA 4 or better with 3/4-inch conduit hubs. Enclosures shall meet the area electrical classification as specified in the

Specification. Solenoid pigtail leads shall be terminated at terminal blocks to eliminate splicing and to facilitate field wiring.

d. Solenoid coils shall be Class H with an insulation rating of 600 volts for both ac and dc service.

e. Solenoid valve bodies shall be stainless steel for use within the containment and brass for use outside the containment. Solenoid valves shall be of packless construction and 1/4-inch NPT connections. The Supplier/Contractor may provide a solenoid valve with larger orifices and/or connections if valve actuator response would be unreasonably slowed by a 1/4 inch NPT solenoid valve.

5.1.5.16 Safety and Relief Valves

The design, materials, and construction of safety and relief valves shall comply in all respects with the latest revision on the applicable codes. APS shall specify the required safety and relief valve material and shall review and approve the Supplier's/Contractor's valve sizing method.

a. Leakage tests for liquid service are to be performed at 90 percent of the set pressure except for valves set at 50 psi or below, in which case the pressure shall be held at 5 psi below the set pressure. Allowable seat leakages shall comply with the following requirement:

   Leakage rate - limited to 2 cc/hr/inch of nominal valve inlet size (10 cc for non-nuclear service)

b. Gas and vapor leakage tests shall be performed in accordance with "Commercial" tightness standards and ANSI B147.1, "Commercial Seat Tightness of Safety Relief Valves With Metal-to-Metal Seats." Supplier/Contractor shall provide leak test procedure and test data in accordance with Addendum 3 "Technical Proposal Data."

c. Test gauges shall be supplied for all safety and relief valves adaptable to these devices to facilitate field hydrostatic testing.

5.2 Equipment Arrangement and Fabrication

Equipment layout and arrangement shall conform to the Supplier's/Contractor's standard practice, subject to APS approval of all layout drawings prior to fabrication.

Equipment shall be arranged to prevent hazard to personnel or damage to major equipment in the event of mechanical failure or loss of power.

Adequate spacing shall be provided for personnel performing operation or maintaining, removing, and replacing components. Instruments shall be located in accessible areas, but must not obstruct aisles or walkways.

Local instrument centerlines shall be mounted between 4 feet 6 inches to 5 feet 6 inches above grade or platform elevation; then located as close to the primary taps as practical. Dial orientation must be readily seen and read by an operator passing within 10 feet of the instrument.

5.2.1 Control Panels, Cabinets, and Racks

All enclosed panels shall be NEMA 12 for indoors and NEMA 4 for outdoors. Panels shall be freestanding unless provided as an integral part of a pre-wired, wall-mounted, or skid-mounted package. Panels, cabinets, and racks shall be completely tubed, wired, and assembled with all instruments, devices, and controls installed so that the assembly is an operating unit ready for installation.

5.2.1.1 Dimensions

The control boards or cabinet shall be of sheet steel not less than 1/8-inch thick. Wall-mounted control cabinets shall not exceed 48 inches in height. Cabinets greater than 48 inches in height shall be designed as free-standing floormounted units. Free-standing control boards or cabinets shall not exceed 90 inches in height.

5.2.1.2 Construction

Control board and cabinet enclosures shall be constructed of smooth finished sheet steel, with sufficient structural reinforcement to ensure a plane surface, to limit vibration, and to provide rigidity.

5.2.1.3 Tolerance

Control boards and cabinets shall have the following flatness tolerance which is defined as the maximum allowable deflection of a steel panel from a plane surface in one direction, but not both:

- Width up to 24 inches - 1/16 inch tolerance
- 24 inches to 32 inches - 3/32 inch tolerance
- 32 inches and larger - 1/8 inch tolerance

5.2.1.4 Removal and Replacement

Each piece of equipment shall be so mounted that removal and replacement may be accomplished individually without interruption of service to adjacent equipment not in the same electrical circuit. All piping shall be arranged for maximum accessibility and allow for instrument removal without disturbing other operating instruments or disfiguring tubing or wiring.

5.2.1.5 Cable Access and Separation

Control boards and/or cabinets shall be designed for both top and bottom access of cables. Openings shall be in strict accordance with Supplier's/Contractor's drawings or in locations specified by APS. The openings shall be separated according to cable functions (power, control, and low level signal). Cable entry clear space and terminal block wiring space shall be in accordance with Figure 7, Requirements for Wiring Space at Terminal Blocks.

Enclosure component wiring shall be separated from instrument piping to the maximum extent possible and utilizing barrier panels when necessary.

Equipment which requires redundant wiring for channel separation shall be identifiedin the Specification, by APS, when applicable.

5.2.1.6 Forced Ventilation

Forced ventilation shall be required when heat dissipated from equipment within the cabinet would cause excessive temperatures or unsatisfactory operation of equipment with only natural ventilation under ambient conditions. Rack top-mounted drip-proof exhaust fans with thermostatic control and manual-off-automatic selector switches shall be furnished.

5.2.1.7 Space Heaters

Space heaters shall be furnished in boards and cabinets where condensation is possible and could cause system malfunction. APS will provide specific requirements in the Specification for space heaters, when required.

5.2.1.8 Lighting and AC Service

Each freestanding control panel/cabinet shall be provided with sufficient interior switchable lighting and duplex, grounded type 120-volt ac convenience outlets. A three-way switch and 120-volt ac convenience outlet shall be provided at each door for walk-in cabinets with two or more personnel entry doors.

5.2.1.9 Surface Preparation and Painting

Surface preparation and coating requirements for panels, racks, and cabinets located within the containment and in nuclear areas outside the containment shall be in accordance with ANSI N101.2, Protective Coatings (Paint) for Light Water Nuclear Reactor Containment Facilities, Specifications, Addendum 17, and this section.

The following surface preparation and coating requirements apply to panels, racks, and cabinets located outside of nuclear areas:

a. All surfaces shall be sandblasted, pickled, phosphic acid etched, ground, or sanded as required to produce a smooth, clean surface free of scale, grease, and dirt.

b. After cleaning, all surfaces shall be given one coat of red oxide or yellow chromate primer.

c. Following priming, all surfaces shall be finish sanded, exterior indentations filled, and a full coat of sand glazer or surfacer applied.

d. Exterior surfaces shall be wet sanded smooth with No. 280 wet or dry paper, followed by two coats of finish paint of 1.0 to 2.0 mils dry film thickness. Inside surfaces shall be given one coat of white finish paint.

e. Finish paint color for external surfaces shall be specified by APS in the Specification, when required.

f. Supplier's/Contractor's surface preparation, materials, and techniques must be approved by APS.

g. Internal piping components such as air headers and other nonferrous piping shall not be painted.

h. Nameplates, tags, or other component identifiers shall not be painted.

i. The Supplier/Contractor shall furnish a sufficient quantity of touch-up paint. The touch-up paint shall be from the same batch of paint as that used to paint the enclosures. The Supplier/ Contractor shall indicate the type and quantity of touch-up paint to be furnished.

j. Paints and/or other applied surface preparation shall contribute minimally relative to the total combustible potential of materials or components in or on the enclosures. No preparation or material shall release toxic gases or dense smoke or propagate flames when heated or exposed to open flame.

5.2.1.10 Design and Workmanship

Design, material selection, and workmanship shall be such as to result in a neat appearance outside and inside, with all exterior surface true and smooth.

5.2.2 Wiring

5.2.2.1 Device Wiring

All cabinet, panel, or control device wiring for connection to external circuits shall be wired to terminal blocks. Unused contacts or control devices shall also be wired to the terminal blocks for future connection to external circuits as required. Wiring shall be free of abrasions and tool marks. Wiring shall be supported to prevent sagging and breakage caused by vibration when equipment package is in transit.

5.2.2.2 Wiring Type

The following requirements apply to instrumentation wiring only:

a. Wiring shall be 600 volt stranded copper wire, with heat and flame resistant insulation capable of passing the vertical flame resistance test as specified in UL 83, Class FR-1 or paragraph 6.19.6 of ICEA S-19-81. Insulations such as polyvinyl chloride shall not be used for internal wiring. The wire size shall be suitable for the application, but in no case smaller than No. 16 AWG unless specifically approved by APS. For the Common Q CPCS project 18 AWG 300 V shielded twisted pair (analog signals) or multiconductor with OAS (digital signals) for connection to the internal side of the field terminal blocks. Single conductor wire from 20 AWG – 12 AWG 600V shall be used for any AC or DC power wiring to the terminal blocks. Size of this wire will be based on design needs and will be documented on the APC cabinet wiring diagram. Wiring crossing hinged joints shall be flexible hinge type wire.

b. All insulation and clearances to ground shall be designed so that the energized parts will withstand a high potential test specified in 6.0.

c. Instrumentation with low level signal wiring (100 mV and under), which is designated as having twisted and shielded field wiring, shall also have twisted and shielded wiring internal to the boards. Each shield shall be connected to a separate terminal point immediately adjacent to the signal wires. Connection to the instrument ground bus, when required, shall be made with insulated No. 12 or 14 AWG wiring.

5.2.2.3 Non-Conduit Connections

Groups of field-mounted control devices which do not have individual provisions for conduit connectors shall be wired to terminal blocks in one or more NEMA 4 terminal boxes or APS

approved equivalent weather-proof housing for connection to external circuits using watertight conduit and fittings. All conduit entrances shall be 3/4 inch threaded.

5.2.2.4 Terminal Blocks

Terminal blocks shall be of the molded plastic multi-terminal barrier type. Pressure or clamp type terminals are also acceptable. Terminal blocks and installed wiring space shall be in accordance with Figure 6 and Figure 7. Where Supplier's/Contractor's equipment prohibits utilization of terminal blocks specified, alternate types proposed will be evaluated by APS to ensure adequate wiring interface and to preclude field installation problems.

5.2.2.5 Compression Type Terminals

Compression type ring tongue terminals with insulation ferrules shall be used for termination of all wiring at the terminal blocks. Terminals shall be sufficiently strong to prevent their breakage under the conditions of vibration inherent in the equipment in which they are installed. No solder or "quick" type connectors shall be used in connection with any wiring, except solder type will be acceptable for indicating light resistors.

Not more than one wire shall be connected to one terminal block point in the control board internal wiring except where jumper wires are needed. A maximum of two wires per terminal is permitted. Wires shall not be terminated on adjacent terminal points if accidental short circuiting of the wires can cause tripping or closing of a breaker.

Permanent markings shall identify each terminal in accordance with the wiring diagram. Each conductor shall be identified at each terminating point with a sleeve-type, smear-proof, non-conductive, embossed wire marker or APS approved equivalent.

5.2.2.6 Auxiliary Relays

All auxiliary relays shall be rated at 600 volts. Acceptable types of auxiliary relays are as follows:

- General Electric Types HGA and HFA
- Westinghouse Type SG and MG-6
- Agastat Types 7012, 7022, 7014, and 7024
- Machine type relays will be acceptable provided that they are rated at 600 volts.

5.2.2.7 Control Switches

Switches for control circuits shall be Microswitch Types PTS and PTK in accordance with the following selection criteria:

Operating Equipment	Switch Type	Switch Location
480-V Load Center Motors (Greater than 50 hp)	PTS	Local Panels
480-V Load Center Motors (50 hp and below)	PTS PTK (key lock)	Local Panels Local Panels

5.2.2.8 Grounding

Grounding requirements are as follows:

a. Facility/Power Ground - This system comprises the structural steel in the plant buildings, the facility ground grid beneath the plant, and all the grounds connected to the facility power equipment, switchgear, enclosures, racks, and panels.

1) Each instrument and control panel, rack, or cabinet which is supplied electrical power shall be provided with a power ground bus.

2) The power ground bus shall be constructed of a copper bar with connecting lug suitability sized for connection to a 4/0 AWG bare copper wire which connects to Plant/Facility ground.

3) The power ground bus shall be properly sized in relation to electrical load.

4) The power ground bus shall horizontally traverse the applicable enclosure bottom and shall be brazed to the enclosure structure.

5) Should section breaks be required for shipping enclosures, adequate means shall be provided to ensure ground continuity when the equipment is reassembled.

b. Main Instrument Ground - The main instrument ground shall be a large insulated copper bus bar to which all I&C system analog and digital instrument grounds attach. This bus will be connected by the plant constructor to the facility ground grid.

1) Each instrumentation and control panel, rack, or cabinet which contains analog and/or digital instrumentation wiring shall be supplied with a grounding system insulated from the power ground which provides for the individual removal of each instrument from ground to facilitate testing and maintenance.

5.2.3 Instrument Piping/Tubing

Design, materials, manufacture, examination, testing, inspection, identification, certification, shipping, documentation, and ANSI primary pressure rating of instrument piping components shall conform to the applicable portions of the latest issue of industry specifications, codes, and standards, including addenda. Material selection shall be the responsibility of the Supplier/Contractor and shall be suitable for the intended service.

5.2.3.1 Instrument piping requirements are applicable at a point immediately downstream of the main piping process root valves and are governed by the following codes:

- Nuclear Service - ASME B&PV Code, Section III, Rules for Construction of Nuclear Power Plant Components, Class 2

- Non-nuclear Service (Service Outside the Containment) - Power Piping, ANSI B31.1

5.2.3.2 Instrument piping for Nuclear Service shall satisfy the following minimum requirements:

- Steel tubing for ANSI primary pressure rating of 1500 psig shall be seamless, 3/8-inch O.D. by 0.065-inch wall thickness, but not greater than 1-inch O.D., with appropriate wall thickness; ASME SA 213, Grade 304 or 316, Hardness of 70 to 74 Rockwell B and not exceeding 80.

- Steel tube fittings for ANSI primary pressure rating of 1500 psig shall be stainless steel 6000 lb @ 100F socket weld, Forged ASME SA 182, Barstock ASME SA 479, Grade 304 or 316, Swagelok/Cajon.

- Steel tube fittings for ANSI primary pressure rating of 900 psig shall be stainless steel, compression type. Forged ASME SA 182, Barstock ASME SA 479, Grade 316, Swagelok.

- Supplier shall furnish certificates of compliance with material specifications in accordance with Subarticle NC-2130 of the ASME B&PV Code, Section III and Addendum 3 "Technical Proposal Data."

5.2.3.3 Instrument piping for Nonnuclear Service (outside the containment) and Instrument Air Service shall satisfy the following minimum requirements:

- Steel tubing for ANSI primary pressure rating of 1500 psig shall be seamless, 3/8-inch O.D. by 0.065 inch wall thickness, ASME SA 213, Grade 304 or 316, Hardness of 70 to 74 Rockwell B and not exceeding 80; for general nonnuclear service.

- Steel tube fittings for ANSI primary pressure rating of 1500 psig shall be stainless steel 6000 lb @ 100F socket weld, Forged ASME SA 182, Barstock ASME SA 479, Grade 304 or 316, Swagelok/Cajon; for general nonnuclear service.

- Steel tube fittings for ANSI primary pressure rating of 900 psig shall be stainless steel, compression type. Forged ASME SA 182, Barstock ASME SA 479, Grade 316, Swagelok, for general non-nuclear service.

- Copper tubing shall be seamless, annealed, 1/4-inch O.D. by 0.030-inch wall thickness, and 3/8-inch O.D. by 0.049-inch wall thickness, ASTM B 68, soft drawn, ANSI primary pressure rating of 125 psig for instrument service outside the containment.

- Copper tube fittings for ANSI primary pressure rating of 125 psig shall be brass, Swagelok, compression-type.

5.2.3.4 Instrument piping and tubing fabrication for instruments and control panels shall be in accordance with the Supplier's/Contractor's standard practice with APS approval of fabrication and layout drawings prior to equipment fabrication.

5.2.3.5 All tubing runs within enclosures shall be carefully formed, fitted, and supported at regular intervals. Tubing shall be arranged for maximum accessibility and ease of tracing lines.

Incoming and outgoing pneumatic lines within enclosures shall terminate at tubing bulkhead connections mounted on the enclosure bulkhead bar to provide an interface between the enclosure and field instrumentation. Connections shall be located such that adequate space is available for leak tests and replacement of tube fittings without disturbing adjacent tubing connections. Each tubing terminal shall be identified by a stainless steel tag.

5.2.4 Air Systems

5.2.4.1 Small Systems

If instrument air consumption to the package system is less than 600 scfh, individual combination filter/reducers (Staynew APH or APS approved equal) shall be used with each instrument or with a panel board header using less than 600 scfh for the complete panel.

5.2.4.2 Large Systems

On large systems (systems with instrument air consumption greater than 600 scfh) the Supplier/ Contractor shall provide a

dual instrument air regulator filter station to reduce the nominal 100 psig instrument air to the nominal header pressure required for instrument operation. Large air supply systems shall have the following additional features:

a. The valving and manifold arrangement shall permit removal of one reducing valve and one filter from service without disturbing the other or affecting its operation.

b. A 4-1/2 inch diameter pressure gauge with the proper scale range shall be provided downstream of each reducing regulator, but ahead of manifold valves.

c. If instruments requiring air pressures different from those described here are furnished, the Supplier/Contractor shall provide an additional filter/reducing station for each different system.

d. All filter/reducing stations shall be furnished with a separate relief valve downstream of the reducing valve.

e. On air headers, individual air supply takeoffs for each instrument shall be made from the top of the air header through 1/4-inch brass packless valves (Dahl Demi G or approved equal) attached to 1/4-inch Schedule 40, ASTM B 43 brass nipples brazed into the header. Each valve shall be tagged with the number of instruments it serves.

f. The Supplier/Contractor shall furnish 20 percent extra valved branches on each header installed.

g. Air headers shall slope 1 inch/foot of run and shall be provided with low point drain valves at header termination points.

5.2.5 Component Identification

5.2.5.1 Panel Nameplates

Nameplates shall be provided for each board or panel-mounted device in accordance with Supplier/ Contractor itemized lists. Nameplates shall be furnished for all control/selector switches, pushbuttons, relays, control circuit fuses, instruments, and auxiliary circuit breakers. Nameplates shall be three-ply laminate, black face, white core, unless specified otherwise in the Specification, fastened to panel front surface with self-tapping rust resistant screws in accordance with Figure 4, Nameplate Standards.

APS will provide device numbers for the Supplier/ Contractor. Supplier/Contractor shall provide an inscription list for each nameplate for APS' approval prior to nameplate fabrication.

5.2.5.2 Component Tagging

Each instrument, control valve or other ISA designated device shall be identified with a stainless steel tag in accordance with the requirements of Figure 3, Instructions for Instrument Tagging.

APS will provide Supplier/Contractor with instrument numbers as required.

5.2.5.3 Equipment Identification

Nameplates with APS' Purchase Order Number, Purchase Order item number, and equipment number shall be provided for each equipment package. Nameplate shall be three-ply laminate, colored face, white core, fastened to front surface of equipment with self-tapping rust resistant screws in accordance with Figures 3 and 4, Nameplate Standards. The following color code is to be applied:

Color	Designations
Black face - white core	Non-essential
Red face - white core	Train A
Green face - white core	Train B

APS will provide equipment numbers for the Supplier/Contractor. Supplier/Contractor shall provide an inscription list for such nameplates for APS' approval prior to nameplate fabrication.

5.3 Protection, Packing, Shipping, and Storage

a. Packing, shipping, and storage requirements for packaged systems shall be determined by the Specification. However, particular attention should be directed to the instrumentation components; e.g., switches, solid state devices, printed circuit boards and similar components to determine if more stringent or separate provisions for storage and handling of these items are justified.

b. Ferrous metals shall be suitably coated or protected to prevent rusting and corrosion during transit and storage. Protection materials shall be readily removable and shall not contain materials which may contaminate process fluids. Cleaning and protection of instruments shall be compatible with the process fluid or intended service as described in the Specification.

c. Disconnected piping and tubing ends and connectors shall be capped or taped to prevent entry of foreign material and to protect threaded components. Open valve ends shall be taped or shall have wooden cutouts bolted to the valve flanges.

6.0 TESTS AND INSPECTIONS

Instrumentation and control portions of packaged systems shall be tested by the Supplier/Contractor to provide adequate assurance that all supplied equipment will reliably and safely perform its designed function. Tests and inspections shall include electrical, pressure, operational, or other nondestructive examination and testing as required.

a. Electrical and functional/passive pressure retaining devices shall be tested in accordance with applicable ANSI, IEEE, or ASME codes and standards.

b. APS shall approve test procedures prior to tests when required and shall exercise the right to witness any or all portions of Supplier/Contractor tests.

c. The Supplier/Contractor shall provide all test and measuring equipment and the necessary qualified personnel to perform the required tests.

d. Test and measuring equipment for tests specified herein shall be properly calibrated and traceable to the U.S. National Bureau of Standards and shall comply with applicable standard criteria.

e. Documented proof for all tests performed and the results thereof shall be provided in accordance with 7.0.

6.1 Pressure Tests

6.1.1 Piping/Tubing Assemblies

Assemblies shall be leak tested at 150 percent of the equipment normal working pressure in accordance with ISA RP7.1, Pneumatic Control Circuit Pressure Test, or equivalent, and the following conditions:

a. If the working medium is a liquid; clean low-chloride (200 ppm) water shall be used, after which the device shall be suitably air dried.

b. If the working medium is a gas; dry, oil free air or nitrogen shall be used.

c. Leak-Tec or an equivalent proprietary nonresidue, bubble forming solution shall be used.

d. Soap solutions shall not be used.

e. Contaminate gas leakage detection is an acceptable alternate.

f. Components shall not be disassembled after final leak testing.

6.1.2 Control, Safety and Relief Valves

Nondestructive examination and testing, including hydrostatic tests, shall be performed by the Supplier/Contractor in accordance with the applicable

piping code.

6.2 Electrical Tests

Electrical wiring tests shall be conducted to ensure that the assembled package system is properly wired prior to energization and shall include, but not be limited to the following:

a. Each circuit shall be given a point-to-point continuity test

b. Each circuit shall be given electric insulation tests in accordance with the requirements of ANSI C37.20, Section 5.3.4 and NEMA ICS 1971, Section 1-109.05, except that megger or other high voltage tests shall not be applied to any coaxial and triaxial cables. Solid state components shall be tested in accordance with NEMA ICS-1971, Section 1-109.05, paragraphs .01 through. 10.

6.3 Operational Tests

Simulated signals which closely approximate actual operation conditions shall be applied to completed equipment to prove equipment functional adequacy.

7.0 DOCUMENTATION

Supplier/Contractor shall furnish required engineering documents during design and construction of the package system in accordance with Addendum 3. Documentation shall consist of detailed drawings, descriptions, set-point and interlock data, procedures, and any additional information necessary for installation, calibration, testing, protection, maintenance and operation of the package system instrumentation. Supplier/Contractor shall provide quality verification documents in the form of reports, certificates of compliance, and other documents required by Addendum 3 to verify and/or certify that the material manufacture, assembly, and test complies with applicable codes and the provisions of the Specification.

7.1 Physical Drawings

Physical drawings, to scale, of control boards or cabinets shall be furnished for the following:

a. Layout of front and rear panels complete with Bills of Material for all mounted items.

b. Overall construction drawings showing section views, details, sills, framing, bracing, total weights, plus size and location of the ground bus.

c. The front views shall also contain panel cutouts, dimensions for maintenance and operating clearances, details for escutcheons, and nameplates (with exact lettering).

d. Outline drawings shall also contain size and location of internal lights, switches, heaters, and other components.

7.2 Elementary Drawings

Elementary drawings shall be furnished by the Supplier/Contractor to include the

following:

a. Contact developments of control and selector switches.

b. Each device shall be correlated to the physical drawings and wiring diagrams.

c. Each control circuit breaker size and fuse size shall be shown. Control circuit shall be identified as to ac or dc or uninterruptible ac.

d. Terminal block points and device terminals shall be shown and the location of these shall be denoted. If special cables are required for external connections (coaxial, twisted pairs, twisted and shielded), they shall be identified. One-line diagrams of power and control circuits shall also be furnished.

7.3 Piping and Instrument Drawings (P&IDs) shall be furnished by the Supplier/Contractor to show interconnections of instruments, piping and other mechanical equipment. P&IDs shall conform to ISA Standards for instrument designations.

7.4 Control Wiring Diagrams

Control wiring diagrams shall show the interconnection between boards, cabinets, equipment, and other components as to the number of conductors, types of cable, and shall be correlated with the elementary diagrams.

7.5 Internal and External Diagrams

Interconnection and external connection wiring and piping diagrams shall be furnished and shall clearly show any connections to be made in the field.

7.6 Bills of Material

Bills of material shall identify all board mounted components by manufacturer and catalog numbers. The bills of material shall also include wire types used throughout the board.

7.7 Package System Instrument List

Supplier/Contractor shall furnish information required by Attachment 1 for all instruments supplied with the package system. APS assigned tag numbers will be provided during drawing submittal.

ANNUNCIATOR ALARM SEQUENCE

SUSTAINED ALARM

OPERATOR ACTION	FIELD CONTACT	WINDOW LAMPS	AUDIBLE ALARM
–	NORMAL	OFF	OFF
–	ALARM	FLASHING	ON
ALARM RESET	ALARM	FLASHING	OFF
FLASHER RESET	ALARM	ON	OFF
–	NORMAL	SLOW FLASHING	OFF
LAMP RESET	NORMAL	OFF	OFF

ALARM RESET

TURNS OFF AUDIBLE ALARM

FLASHER RESET

CHANGES A FLASHING WINDOW TO ON, OR SLOW FLASHING

LAMP RESET

CHANGES SLOW FLASHING WINDOW TO OFF

TEST

INITIATES ALARM ON ALL WINDOWS

ANNUNCIATOR ALARM SEQUENCE – SUSTAINED ALARM
FIGURE 1

ANNUNCIATOR ALARM SEQUENCE

MOMENTARY ALARM

OPERATOR ACTION	FIELD CONTACT	WINDOW LAMPS	AUDIBLE
–	NORMAL	OFF	OFF
–	ALARM	FLASHING	ON
–	NORMAL	FLASHING	ON
ALARM RESET	NORMAL	FLASHING	OFF
FLASHER RESET	NORMAL	SLOW FLASHING	OFF
LAMP RESET	NORMAL	OFF	OFF

ALARM RESET

FLASHER RESET

LAMP RESET

TEST

A13 - 30 01 30

ANNUNCIATOR ALARM SEQUENCE – MOMENTARY ALARM
FIGURE 2

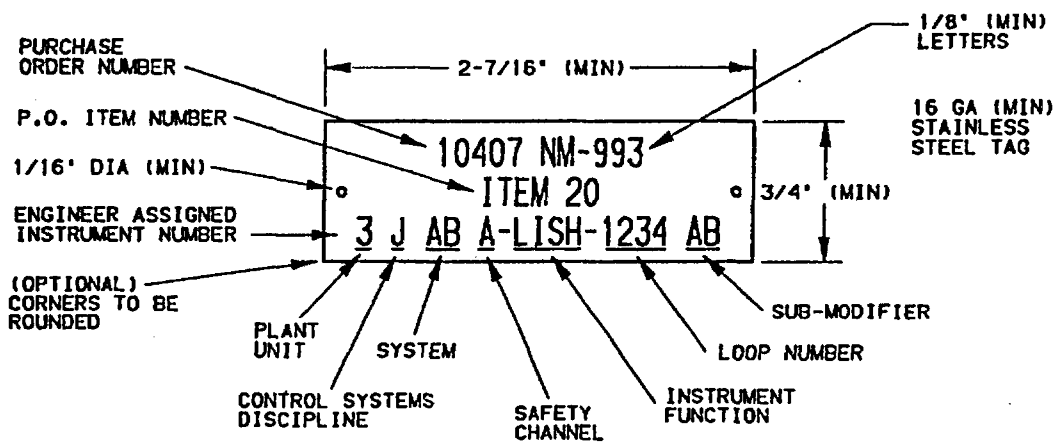
INSTRUCTIONS FOR INSTRUMENT TAGGING

1. Each instrument, control valve, and device designated in accordance with ISA-S5.1-1973, Instrumentation Symbols and Indentification, shall be tagged with a stainless steel tag as shown below. The tag shall be attached to the instrument with stainless steel rivets, screws or wire. Where this is not possible the instrument tags shall be attached to the conduit servicing the device.

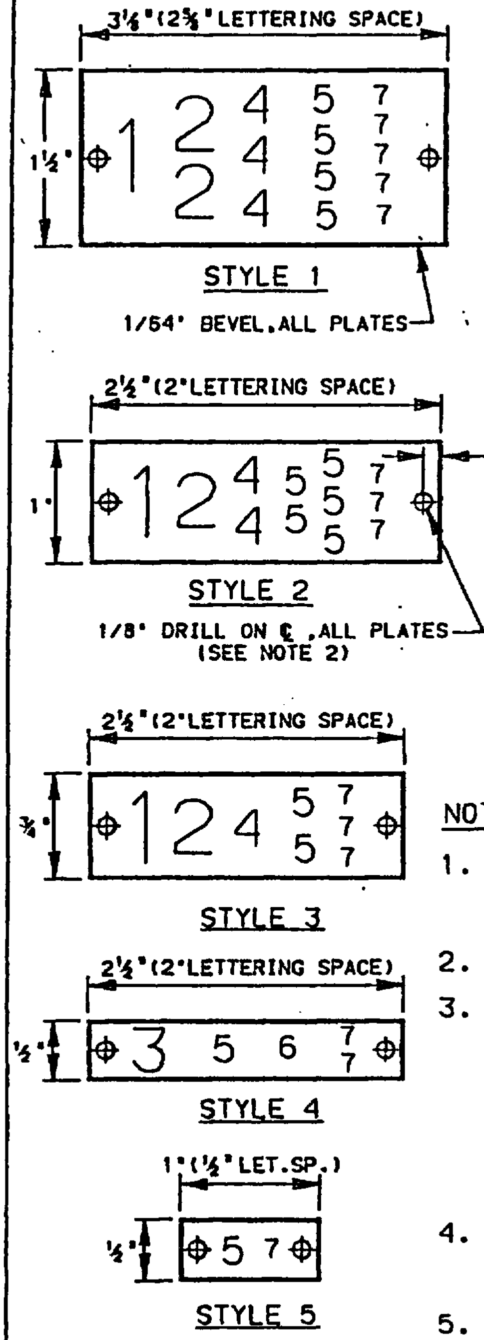
2. Rivets or screws are the preferred means of attachment. Stainless steel wire is the least desired alternate.

3. Wiring of identification tags to components is to be provided when component pressure boundary integrety or device surface contour and size precludes mounting with rivets or screws, Wiring is to be 20 AWG solid stainless steel wire secured at both tag ends.

4. Tagging information shall include the purchase order number, P.O. item number, and instrument number embossed. engraved or impression stamped on the tag as shown on the example below.



INSTRUCTIONS FOR INSTRUMENT TAGGING
FIGURE 3



LETTER SIZE	1	2	3	4	5	6	7
HEIGHT (SEE DET. 'A')	1/2"	3/8"	5/16"	1/4"	3/16"	5/32"	1/8"
NO. PER INCH	2-1/4	3	3-3/4	4-1/2	6-1/2	7-1/2	9-1/2
NO. PER LINE — STY. 1	6	8	10	12	17	19	25
NO. PER LINE — STY. 2,3 & 4	4	6	7	9	13	15	19
NO. PER LINE — STY. 5			1	2	3	3	4
NO. OF LINES MAX. — STY. 1	2	3	3	3	4	4	5
NO. OF LINES MAX. — STY. 2	1	1	1	2	3	3	3
NO. OF LINES MAX. — STY. 3	1	1	1	1	2	2	3
NO. OF LINES MAX. — STY. 4 & 5			1	1	1	1	2

—DETAIL 'A'—

NAMEPLATE STANDARDS

NAMEPLATE MATERIAL:
- NEMA TYPES ES-1 AND ES-3
- TWO OR THREE-PLY LAMINATED ENGRAVING STOCK

COLORS:
- BLACK FACE - WHITE CORE
- WHITE FACE - BLACK CORE
- RED FACE - WHITE CORE
- GREEN FACE - WHITE CORE
- BLUE FACE - WHITE CORE
- YELLOW FACE - BLACK CORE

NOTES:

1. FOR ALL INSTRUMENTS USE STYLES 2,3 OR 4 WHERE POSSIBLE WITH LETTERS NO SMALLER THAN SIZE 5.
2. THICKNESS OF NAMEPLATE IS 1/16".
3. FURNISH PLATES WITH DRILLED HOLES UNLESS SPECIFIED OTHERWISE. DRILLED HOLES MAY BE SPECIFIED 1/16". ATTACHMENT MAY BE WITH MACHINE, SELF-TAPPING OR DRIVE SCREWS. (ALTERNATIVE APPLICATION: ADHESIVES MAY BE USED FOR MOUNTING NAMEPLATES ON THE REAR OF PANELS. IN THIS CASE NO HOLES WILL BE REQUIRED.)
4. ENGRAVE LETTERS THROUGH TO CORE WITH A ROUNDED OR SQUARE END CUTTER. V-SHAPED GROOVES ARE NOT ACCEPTABLE.
5. USE CONDENSED GOTHIC FOR ALL LETTERS.

NAMEPLATE STANDARDS
FIGURE 4

CONTROL POSITION COLOR INDICATIONS

RED General meanings are "operating", "flowing", "increasing"

ON when:
- a. Motor is running
- b. Circuit breaker is closed
- c. Device is energized
- d. Valve is not closed

GREEN General meanings are "not operating", "not flowing", "decreasing"

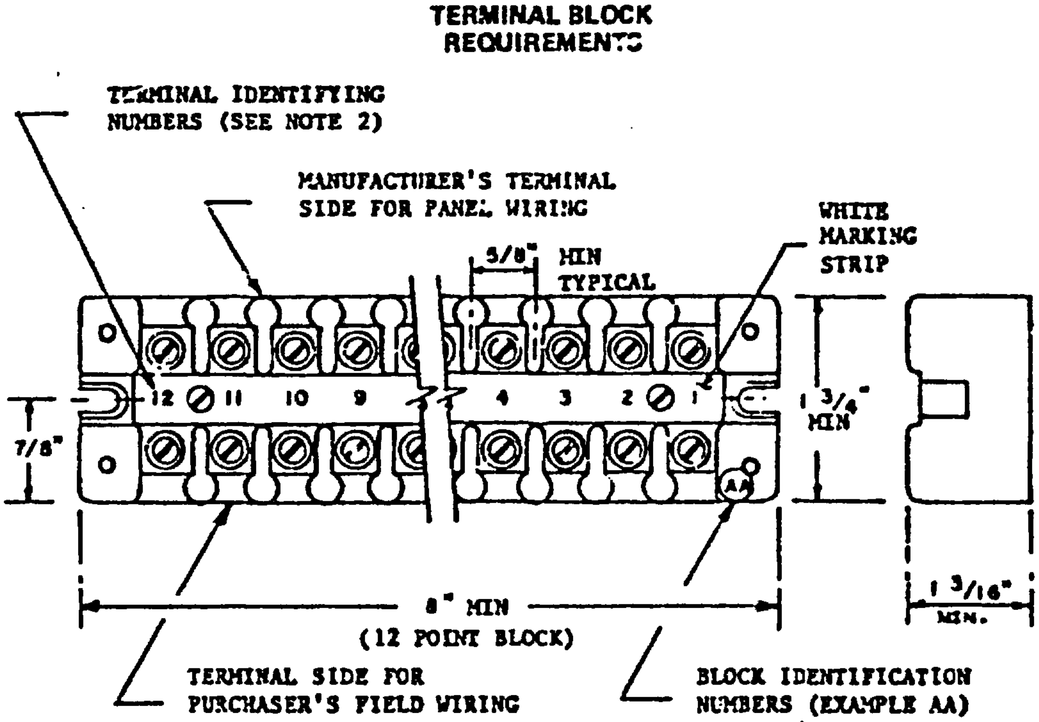
ON when:
- a. Motor is not running
- b. Circuit breaker is open
- c. Device is not energized
- d. Valve is not open
- e. "Extra bright" - used for electrical overload or automatic trip of equipment

AMBER General meanings are Automatic, Standby or Intermediate

WHITE Used for advisory instructions

BLUE Special Functions (Only on approval of Engineer)

CONTROL POSITION COLOR INDICATIONS
FIGURE 5



1. TYPICAL HEAVY DUTY CONTROL CIRCUIT TERMINAL BLOCK WITH STRAP SCREW, METAL TIE DOWN PLATES, REPLACEABLE TIE DOWN PLATES AND MADEUP OF HIGH IMPACT MATERIAL.

2. TERMINAL NUMBERS SHALL BE MARKED ON THE STRIP BY THE SUPPLIER BY SUITABLE MEANS APPROVED BY THE PURCHASER, LETTER HEIGHT TO BE 1/8 INCH.

3. SUPPLIER'S WIRING TO TERMINAL BLOCKS SHALL BE TERMINATED WITH INSULATED CRIMP TYPE RING TONGUE TERMINALS. PVC IS NOT ACCEPTABLE FOR TERMINAL INSULATION.

TERMINAL BLOCK REQUIREMENTS
FIGURE 6

REQUIREMENTS FOR WIRING SPACE AT TERMINAL BLOCKS

NOTES

1. A CLEAR SPACE OF 18" FOR FIELD CABLE ENTRY SHALL BE PROVIDED AT TOP OR BOTTOM OF THE PANEL DEPENDING ON FIELD CABLE ENTRY WITH 6" AT OPPOSITE END. IF ENTRY IS TOP AND BOTTOM, THEN A 12" CLEAR SPACE SHALL BE PROVIDED AT BOTH TOP AND BOTTOM.

2. THE HORIZONTAL CLEAR SPACE REQUIRED BETWEEN THE TERMINAL BLOCKS IS BASED ON THE USE OF 600V MULTICONDUCTOR CABLE WITH A MAXIMUM WIRE SIZE #14 AWG. AND A STANDARD TERMINAL BLOCK AS SHOWN IN DRAWING NO. 43-1-225-004.

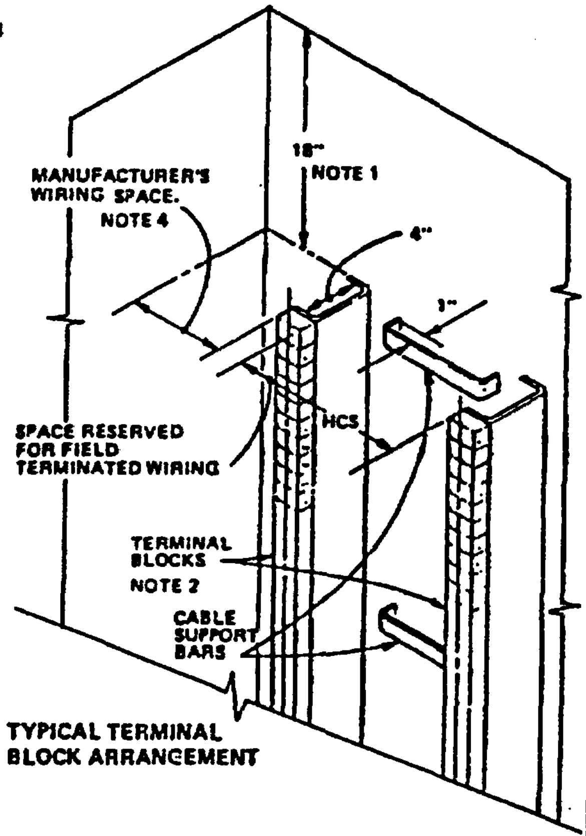
HORIZONTAL CLEAR SPACE (HCS) SHALL BE PROVIDED AS FOLLOWS FOR PURCHASER'S FIELD WIRING:

NO. OF TERM. BLKS. IN VERT STRIP	HORIZONTAL CLEAR SPACE "HCS"	NUMBER OF CABLE SUPPORT BARS
1 TO 3	6" MINIMUM	2
4 TO 10	8" MINIMUM	3 MIN. NOTE 3

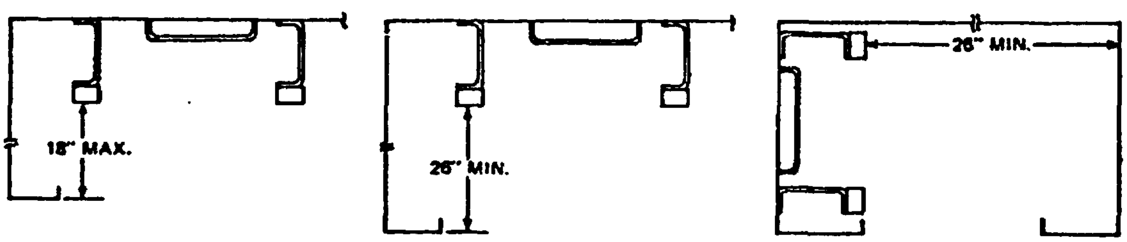
3. NO INTERNAL DUCT OR OTHER INTRUSION IN TO THE CLEAR SPACE IS PERMITTED, WITH THE EXCEPTION OF CABLE SUPPORT BARS. THE VERTICAL SPACING BETWEEN THE CABLE SUPPORT BARS SHALL BE 18" MINIMUM.

4. THIS DOCUMENT IS NOT INTENDED TO SPECIFY SPACE REQUIREMENTS FOR MANUFACTURER'S WIRING.

5. CLEARANCE IN FRONT OF TERMINAL BLOCKS SHALL BE IN ACCORDANCE WITH THE FOLLOWING SKETCHES, AS APPLICABLE:



TYPICAL TERMINAL BLOCK ARRANGEMENT



REAR MOUNTED TERM. BLOCKS (WHERE PANEL CANNOT BE ENTERED) — REAR MOUNTED TERM. BLOCKS (WHERE PANEL CAN BE ENTERED) — SIDE MOUNTED TERMINAL BLOCKS (WHERE PANEL CAN BE ENTERED)

REQUIREMENTS FOR WIRING SPACE AT TERMINAL BLOCKS
FIGURE 7

ATTACHMENT 1

PACKAGE SYSTEM INSTRUMENT LIST

Arizona Nuclear Power Project
10407

PURCHASE ORDER NO. ______
VENDOR'S ORDER NO. ______
VENDOR'S CERTIFICATION ______

SHEET ______
REV. ______
DATE ______

TAG NUMBER		SERVICE	MANUFACTURER	MODEL	RANGE		SET POINT	ADDITIONAL DESCRIPTION	REFERENCES
VENDOR	APS				INPUT	OUTPUT			

ADDENDUM 14

SURFACE PREPARATION AND SHOP COATING REQUIREMENTS

FOR FERROUS METAL SURFACES TO BE INSTALLED

IN "NQR" AREAS

FOR THE

ARIZONA PUBLIC SERVICE COMPANY

PALO VERDE NUCLEAR GENERATING STATION

UNITS 1, 2 AND 3

QUALITY CLASS NQR

ADDENDUM 14

SURFACE PREPARATON AND SHOP COATING REQUIREMENTS FOR FERROUS METAL SURFACES TO BE INSTALLED IN "NQR" AREAS

TABLE OF CONTENTS

ATTACHMENTS

ADDENDUM 14
SURFACE PREPARATION AND SHOP COATING REQUIREMENTS FOR FERROUS METAL SURFACES TO BE INSTALLED IN "NQR" AREAS

1.0 SCOPE

This Addendum states the conditions and requirements for shop coating ferrous metal surfaces of equipment and materials in Quality Class NQR areas at a service temperature of less than 250°F for the Palo Verde Nuclear Generating Station Units 1, 2 and 3.

1.1 Work Included

This work includes the external surface preparation and application of the specified coating system in the shop; on carbon' steel, cast iron, and cast steel equipment and materials, including accessories and associated appurtenances to be installed in Quality Class NQR areas. Type of surface preparation, approved coating materials, number of coats and required dry-film thickness of each coat are specified in Attachment 1 to this Addendum.

1.2 Work Not Included

1.2.1 This Addendum does not include surface preparations and coatings for the following:

- Ferrous metal surfaces for nuclear areas (Containment Building, Fuel Building, Auxiliary Building, Radwaste Building, and Refueling Water Tank Areas).
- Field applied coatings.
- Tank, pipe, valve and equipment linings.
- Surfaces for immersion service.
- Insulated piping, equipment and machinery.
- Underground piping external coating.
- Control boards and instrument racks.

1.2.2 The following surfaces shall not be coated:

- Nameplates.
- Surfaces to be embedded.
- Surfaces within 1 inch of edges to be field welded for inorganic zinc coatings.
- Surfaces within 3 inches of edges to be field welded for all other coatings.
- Items made of nonferrous materials, unless otherwise specified.
- Expansion joints.

- Stainless steel surfaces.

- Galvanized surfaces.

2.0 STANDARDS

Surface preparation and coating application shall be in accordance with the most current edition of the following standards as applicable:

a. Steel Structures Painting Council (SSPC)

SSPC Number	Title
SP-1	Solvent Cleaning
SP-2	Hand Tool Cleaning
SP-3	Power Tool Cleaning
SP-5	White Metal Blast Cleaning
SP-6	Commercial Blast Cleaning
SP-10	Near-White Blast Cleaning
Vis-1	Pictorial Standards for Surface Preparation
PA-1	Shop, Field, and Maintenance Painting

b. Coating manufacturer's written instructions and/or recommendations for surface preparation, coating applications, and use of solvents and thinners. In case of conflict between this Addendum and manufacturer's recommendations, APS Nuclear Engineering shall determine the governing document prior to start of any work.

3.0 PROTECTION OF WORK

3.1 The Supplier/Contractor shall be responsible for assuring protection of work to preserve the integrity of the whole, recognizing that some items of work include delicate or prefinished parts which are susceptible to contamination or damage.

3.2 Due to the delicate nature of valves and components, special care shall be exercised. The following items shall be protected when processing valves, instruments, and similar sensitive or rotating equipment.

3.2.1 The following areas are not to be blasted, coated, or painted.

- Valve stem, stem bushing and bearings.
- Packing glands.
- Grease fittings.
- Tags and nameplates.

3.2.2 The following areas listed below shall be properly protected to prevent foreign matter such as abrasive, dust, coating, or paint from entering:

- Gaps between the stem and packing gland and between the packing gland and bonnet.

- Valve stem bearings and bushings.

- All openings in gear operators.
- Motor housings, couplers, gear boxes, bearings.
- Pump housings, couplers, gear boxes, bearings.
- Crane instruments, controls, bearings and gear boxes.

3.2.3 All stainless steel and plated valve and/or components shall not be blasted, coated, or painted and shall be protected.

4.0 SURFACE PREPARATION

All ferrous surfaces to be coated in accordance with this Addendum shall be cleaned and prepared prior to application of coating in the following sequence:

a. Prior to mechanical cleaning, deposits of oil, grease, and crayon marks shall be removed from all surfaces in accordance with SSPC SP-1.

b. Prior to blast cleaning, remove excessive scale, weld spatter, excess weld metal, sharp points and edges.

c. Prepare all surfaces by blast cleaning using dry silica sand, clean steel grit, or shot. The grade of blast cleaning and profile pattern shall be as specified in Attachment 1 to this Addendum.

d. Dry blast cleaning shall not be conducted when the steel surface temperature is less than 5 °F above dew point.

5.0 METAL PATCHING

At the option of APS, all scrapes and gouges on equipment surfaces shall be filled and patched with metal putty and sanded smooth prior to application of paint. This metal putty shall be plastic steel as manufactured by Devcon Corporation, Danvers, Massachusetts, or a similar product if requested by Supplier/Contractor in writing and accepted by APS Nuclear Engineering in writing.

6.0 APPLICATION OF PAINT

a. Application of paint shall conform to SSPC Paint Application Guide PA-1, "Shop, Field, and Maintenance Painting."

b. The abrasive-blasted steel shall be primed within 8 hours or before rusting can occur. If rust becomes visible under visual inspection or if impurities become embedded in the steel surfaces, the steel shall be recleaned to the degree of cleanliness and surface tooth profile as specified in Attachment I to this Addendum.

c. Paint materials shall be applied in a clean and sheltered area, using equipment recommended by the coating manufacturer. Coating manufacturer's written instructions and recommendations shall be followed with regard to the application of the manufacturer's product (Section 2.0.b).

d. Coating shall not be applied if any of the following conditions are expected or evident:

- When relative humidity is higher than 80 percent, except for inorganic zinc primers which may

be applied at relative humidity up to 90 percent.

- When the temperature of metal surfaces is less than 50°F or above 100°F.
- When the steel surface temperature is less than 5 °F above the dew point.
- When there is any moisture detectable on the surface.
- When the lighting is inadequate to fully illuminate the surface being coated.
- If the application equipment is inadequate or not in good operating condition.

e. The coats of paint shall be applied in the sequence and to the dry-film thicknesses specified in Attachment 1 to this Addendum. The primary measuring device shall be a magnetic dry-film thickness (DFT) gauge. In measuring DFT, the reading shall not be less than specified minimum DFT. The wet-film thickness gauge shall be used as a guide during actual coating, with proper correlation to the percent volume of solids in the materials being applied.

7.0 REPAIRS

7.1 Damaged areas of coated surfaces where the metal substrate is exposed, shall be cleaned in accordance with SSPC SP-2 or SSPC SP-3, until rust, damaged coating and contaminants are removed; and a clean toughened surface is obtained. The repair area shall be feather edged into the adjacent sound surface for a minimum of 1 inch.

7.2 Damaged areas prepared utilizing other types of abrasive wheels or abrasive media are acceptable provided the substrate has not been unduly burnished and that the substrate meets the requirements of SSPC-SP3.

7.3 Surfaces which have been hand or power tool cleaned shall be solvent cleaned in accordance with SSPC SP-1 using cleaning solutions as recommended by the coating manufacturer.

7.4 Re-apply the primer and finish, if applicable, as specified in Attachment 1 to this Addendum. This reapplication shall be feather edged onto the adjacent sound surface for a minimum of I inch.

8.0 INSPECTION

All shop coating is subject to inspection and rejection by APS' Inspector, either at the point of delivery or in the Supplier's/Contractor's shop. If the coating work is rejected due to noncompliance with this Addendum, at the option of the APS Inspector, it shall either be removed and reapplied or returned to the Supplier/Contractor for rework at the Supplier's/Contractor's expense, including all incurred costs.

ATTACHMENT 1

SHOP PAINTING OF STEEL SURFACES

1.0 PRIME COAT

1.1 Unless otherwise specified in the Specification/Contract, the items to be coated by Addendum 14 shall receive commercial sandblasting in accordance with SSPC SP-6 and obtain a surface anchor profile of I to 3 mils.

1.1.1 Structural Items

Following blast cleaning' of the structural steel, carbon steel plate, stair stringers, ladders, hatches, and miscellaneous steel, a prime coat shall be applied in accordance with Section 1.1.1.1 for indoors or 1.1.1.2 for outdoors.

1.1.1.1 Indoors

Shop prime the above structural item(s) with one of the following products in accordance with the coating manufacturer's instructions provided the servicetemperature does not exceed 750° F:

Product	Dry Film Thickness
a. Ameron Dimetcote 21-9	3 to 5 mils
b. Carboline Carbo Zinc 11 HS	3 to 5 mils
c. Valspar MZ-7 V13-F-12	3 to 5 mils

Unless otherwise specified, the color shall be similar to Valspar's Palo Verde green as manufactured by the Valspar Corporation in Baltimore, Maryland.

1.1.1.2 Outdoors

Shop prime the above structural item(s) with one of the following products in accordance with the coating manufacturer's instructions provided the service temperature does not exceed 250 ° F:

Product	Dry Film Thickness
a. Ameron Amerlock 400AL	5 to 7 mils
b. Keeler & Long Kolormastic II 1800	5 to 7 mils
c. Valspar Alumapoxy	5 to 7 mils

1.1.2 Electrical and Mechanical Items

Following blast cleaning of cabinets, control panels, motors, cranes, piping, pumps, tanks, valves and associated appurtenances, a prime coat shall be applied in accordance with Section 1.1.2.1 for indoors and 1.1.2.2 for outdoors.

1.1.2.1 Indoors

Shop prime the above electrical and mechanical item(s) with the Supplier's/Contractor's standard protective coating for the service application.

1.1.2.2 Outdoors

Shop prime the above electrical and mechanical item(s) in accordance with Section 1.1.1.2.

2.0 FINISH COAT

2.1 The shop finish coat shall be applied within the coating manufacturer's specified re-coat time interval. The finish coat manufacturer shall be compatible with the prime coat manufacturer.

2.1.1 Structural Items Indoors

Unless otherwise specified in the Specification/Contract, a shop finish coat is not required for indoors application. If the Specification/Contract requires a shop finish coat for aesthetic reasons, apply the shop finish coat with one of the following products in accordance with the coating manufacturer's instructions, provided the service temperature does not exceed 250 °F:

	Product	Dry Film Thickness
a.	Ameron Amercoat 385[(1)]	5 to 7 mils
b.	Carboline 890[(1)]	5 to 7 mils
c.	Valspar 76 Series	5 to 7 mils

2.1.2 Structural Items Outdoors

The shop finish coat shall be applied in accordance with the coating manufacturer's instructions for one of the following products provided the service temperature does not exceed 250 °F:

	Product[(2)]	Dry Film Thickness
a.	Ameron Amershield	4 to 6 mils
b.	Keeler & Long U-1 Series[(3)]	4 to 6 mils
c.	Valspar 54 Series	4 to 6 mils

(1) A "mist" coat is required to prevent bubbling.

(2) This overcoat over primers in Section 1.1.1.2 shall be applied within certain time limits. Consult manufacturer for appropriate time intervals.

(3) Requires two coats

2.1.3 Electrical & Mechanical Indoors

The shop finish coat shall be in accordance with the Supplier's Contractor's standard protective coating for the service application.

2.1.4 Electrical & Mechanical Outdoors

The shop finish coat shall be in accordance with Section 2.1.2.

ADDENDUM 21

INSTRUCTION MANUALS AND SPARE PARTS LISTS

FOR EQUIPMENT

FOR THE

ARIZONA PUBLIC SERVICE COMPANY

PALO VERDE NUCLEAR GENERATING STATION; UNITS 1, 2 AND 3

QUALITY CLASS Q, QAG, NQR

ADDENDUM A-21

INSTRUCTION MANUALS AND SPARE PARTS LIST FOR EQUIPMENT

TABLE OF CONTENTS

ADDENDUM A-21

INSTRUCTION MANUALS AND SPARE PARTS LIST FOR EQUIPMENT

1.0 GENERAL REQUIREMENTS

The instruction manual shall reflect the same high quality appearance and workmanship that goes into the equipment it describes.

The instruction manual shall include all applicable information requested in Section 2.0. The manufacturer's catalogs and brochures shall be supplemented as required by special text, photographs, and drawings so that all data required by this Addendum is included in the final instruction manual.

A recommended spare parts list with unit prices for each item shall be included with Bidder's Proposal. Failure to include this list and prices with the Proposal shall constitute sufficient cause for rejection of the Proposal. This list shall include recommended special tools and/or instruments not included with the equipment. A statement defining the guidelines observed in making the recommendation shall also be included.

When specified on Addendum 3, Technical Proposal Data, Attachment 1, each Bidder shall submit with its Proposal one (1) copy of its standard instruction manual to match the equipment covered by the Proposal for APS' review. The instruction manual will become part of the Proposal and will be evaluated as part of the total Bid Evaluation. As part of the total Proposal, all comments will be resolved prior to Notice of Award.

1.1 Transmittals

Supplier/Contractor shall submit twelve (12) copies of all specialized instruction manuals including twelve (12) copies of the spare parts list for APS' review no later than sixty (60) days prior to shipment of the equipment in accordance with Addendum 1.

1.2 Types of Submittals

1.2.1 Manufacturer's catalog or a combination of catalogs may be utilized in whole or in part if the catalogs meet the requirements of this Addendum. The catalog(s) shall be indexed and describe the specific equipment furnished. All other option(s) shall be deleted or marked out. The instruction manual shall be bound as a single document (multiple volumes are acceptable).

1.2.2 If the instruction manual is to be specially prepared to satisfy the requirements of this Addendum, it shall be arranged and divided as shown in Attachments 1 and 2.

1.2.3 Instruction manuals and spare parts lists may be prepared by subsuppliers or others, but are to be submitted to APS by Supplier/Contractor.

2.0 INSTRUCTION MANUAL STANDARDS

2.1 Theory of Operations

This section shall describe the principles of operation and shall answer the questions of "how" and "why" the equipment/system operates as it does. Schematics, charts, curves, drawings, blueprints, and other descriptive material shall be utilized for clarity.

2.2 Description

This section shall give a detailed description of the individual components: size, rating, power requirements, signal inputs and outputs, and other data. It shall fully describe the function of the controls and indicators. Photographs and drawings shall be used to identify the major components.

2.3 Installation

This section shall cover instructions for unpacking, installing, aligning, checking, and testing prior to operation. Step-by-step procedures for alignment and calibration for the initial installation and for reinstallation after overhaul shall be included. Additional equipment required for these operations, that is not included, shall be identified.

The information should include the approved chemicals and method to be used for cleaning and flushing prior to start-up or after overhaul.

2.4 Operating Instructions

The operating instructions shall include detailed step-by-step procedures for start-up, normal shutdown, emergency shutdown, and normal operations. Limits such as temperature, pressure, voltage, speed, and other parameters shall be clearly indicated and identified as they relate to start-up, shutdown, and normal operations. Special instructions for standby service, short- and long-term layup shall also be included.

Critical limits and procedures, that when omitted or performed out of sequence could result in damage to the equipment or injury to personnel, shall be clearly indicated by a bold CAUTION, NOTE, DANGER, or WARNING note printed on the page.

2.5 Maintenance

This section shall describe the "how," "why," and "when" of the recommended maintenance. It shall include a master table indicating the maintenance to be performed and shall include tests of safety and control devices.

Supplier/Contractor shall provide procedures covering troubleshooting, removal, disassembly, repair, and replacement of component parts. Special emphasis shall be placed on safety and control devices that are utilized for the protection of machinery and personnel, including special instructions for decontamination prior to maintenance.

2.6 Troubleshooting

A master chart shall be used to list areas of probable malfunction giving symptoms, probable cause, and corrective action. Reference shall be made to blueprints, schematics, and tables for alignment procedures, settings, tolerances, dimensions, and other necessary information.

2.7 Spare Parts

All replaceable parts, components, and subassemblies used in the equipment shall be listed. The spare parts numbers shall include the actual manufacturer's part number in addition to Supplier's/Contractor's part number.

a. The recommended spare parts list shall include the following data for each part:

   1. Part Description.
   2. Manufacturer.
   3. Materials of Construction.
   4. Part Number and/or Catalog Number.
   5. Manufacturing Design Standards.
   6. Supplier/Contractor Drawing Reference.
   7. Subsupplier Identificaton Drawing and/or Catalog Number.
   8. Quantity.
   9. Shelf Life, if applicable.
   10. Special Storage Requirements, if applicable.
   11. Cycle and Scope of Preventative Maintenance.
   12. Special Tooling and/or Installation Requirements.
   13. Unit Price.
   14. Recommended Stocking Level, based on anticipated usage, part reliability, and Supplier/Contractor experience.

b. Commodity items, such as fasteners, fuses, cables, and terminal lugs shall be included on the recommended spare parts list. Commodity items shall be identified by the Supplier's/Contractor's part number, as well' as by the commodity manufacturer and manufacturer's part number. In addition, fasteners shall be identified by dimensions and material.

c. Spare parts shall be individually tagged by item number and each shall reference its associated assembly or subassembly.

d. Spare parts shall be boxed separately from original equipment and so identified.

e. Inspection, tests, and documentation for the spare parts shall conform to the requirements as specified in the Technical Specification.1

f. A Certificate of Conformance, as required in Addendum 3, "Technical Proposal Data," shall be included to verify the spare parts conform to the Technical Specification requirements.

g. The list should identify stocked parts and those that must be built or purchased from subsuppliers.

2.8 Special Tools and Instruments

A list of tools and other unattached items furnished with the equipment shall be included. A separate list shall identify special tools and instruments required, but not included. Both lists shall fully identify each item including manufacturer and model number.

2.9 Drawings

This section shall contain a list of all drawings pertaining to the equipment/system including manufacturer's drawings and other supplier's drawings whose components are included in the equipment/system. This section shall also include a reproduction of all blueprints referenced throughout the book and other blueprints such as schematics and wiring diagrams that may be useful for understanding the equipment and for routine operation and maintenance. These blueprints shall be reduced to a convenient size, retaining legibility of all data, and included as pages in the book.

<u>Sample Title Page</u>

INSTRUCTION MANUAL

OPERATION- MAINTENANCE INSTRUCTIONS

AND

PARTS CATALOG

FOR

(Applicable Name of Equipment)
(Model No.)

SUPPLIER/CONTRACTOR

(Name of Supplier/Contractor)
(Address)

(APS Purchase Order Number)

Sample Organizational Format

FRONT MATTER

A. Title Page

B. Foreword - (Brief description of equipment/system)

C. Photograph or isometric drawing of equipment/system - (with major components identified)

D. Equipment serial numbers - (list major components)

E. Contents

	Manufacturer's Catalog	Page No.
1. THEORY OF OPERATIONS		
2. DESCRIPTION		
3. INSTALLATION		
4. OPERATING INSTRUCTIONS		
5. MAINTENANCE		
6. TROUBLESHOOTING		
7. SPARE PARTS		
8. SPECIAL TOOLS AND INSTRUMENTS		
9. DRAWINGS		

Attachment 2

Summary of PVNGS Plant Procedure Changes to Support CPCS Implementation

PVNGS CPCS Related Procedure Changes

Proc #	Title	Description of Change
36DP-9ZZ11	I&C Mode Change Checklist	Delete reference to 36ST-9SB10 for affected unit
36MT-9SB03	PPS B/S INPUT SIMULATION	Revise to reflect new hardware and software.
36MT-9SE06	Log Power Functional Test	Revise to reflect new hardware and software.
36MT-9SE10	Charge Capacitance Test for Excore Safety Channel	Revise to reflect new software. CPC Pt Ids 415-418 will be 471-474. CPC Pt. ID 419 will be 479.
36MT-9SE14	Excore Safety Channel Calorimetric Calib.	Revise to reflect new software. Change name for keyswitch and nomenclature to be consistent with new installation (comment includes table between the steps). CPC Pt Ids 415-418 will be 471-474. CPC Pt. ID 419 will be 479.
36ST-9SB09	PPS RTD Response Time Test	Revise to reflect new software. CPC Pt Ids 415-418 will be 471-474. CPC Pt. ID 419 will be 479.
36ST-9SB10	Control Element Assem Isol Amplifier	To Be Deleted when all three units changed - Equipment not part of new CPCS
36ST-9SB11	CPC Input Loop Calibration	Revise to reflect new software. Change WRAW1 to be W1RPM. Change WRAW2 to be W2RPM, etc.
36ST-9SB41	PPS Transmitter Response Time Test	Revise to reflect new software. CPC Pt. ID 419 will be 479.
36ST-9SB42	PPS Bistable & Bistable Relay Response Time Test	Revise to reflect new software. CPC Pt Ids 415-418 will be 471-474. CPC Pt. ID 419 will be 479.
36ST-9SB44	RPS Matrix Relays To RX Trip Response Time Test	Revise to reflect new software.
36ST-9SB58	PPS Trans Input Calibr. For Parameters 5,6,11,12,14,&15	Revise to reflect new software.
36ST-9SB59	PPS Input Loop Calibr. For ChA Parameters 5,6,11,12,14,&15	Revise to reflect new software. CPC Pt Ids 415-418 will be 471-474. CPC Pt. ID 419 will be 479.
36ST-9SB60	PPS Input Loop Calibr. For ChB Parameters 5,6,11,12,14,&15	Revise to reflect new software. CPC Pt Ids 415-418 will be 471-474. CPC Pt. ID 419 will be 479.
36ST-9SB61	PPS Input Loop Calibr. For ChC Parameters 5,6,11,12,14,&15	Revise to reflect new software. CPC Pt Ids 415-418 will be 471-474. CPC Pt. ID 419 will be 479.
36ST-9SB62	PPS Input Loop Calibr. For ChD Parameters 5,6,11,12,14,&15	Revise to reflect new software. CPC Pt Ids 415-418 will be 471-474. CPC Pt. ID 419 will be 479.
36ST-9SE01	Excore Safety Channel Log Calib.	Revise to reflect new hardware and software. Change all terminology to enable use of touchscreen module. Change name for keyswitch and nomenclature/actions to be consistent with new installation. CPC Pt Ids 415-418 will be 471-474. CPC Pt. ID 419 will be 479.
36ST-9SE02	Excore Linear Monthly Calibration	Revise to reflect new software. CPC Pt Ids 415-418 will be 471-474. CPC Pt. ID 419 will be 479. Program Level names for D1RAW, D2RAW & D3RAW are being changed to D1RAWD, D2RAWD & D3RAW3.
36ST-9SE03	Excore Safety Linear Channel Qtrly Calibration	Revise to reflect new software. CPC Pt Ids 415-418 will be 471-474. CPC Pt. ID 419 will be 479.

Proc #	Title	Description of Change
36ST-9SE06	Log Power Functional Test	CPC Pt Ids 415-418 will be 471-474. CPC Pt. ID 419 will be 479. Change name for keyswitch and nomenclature to be consistent with new installation. Describe new process to bypass. Change name for keyswitch.
36ST-9SF01	CEA Reed Switch Func Test	Revise to reflect new hardware and software (new ops modules, new power supplies, and CEAC 1 and 2 snapshot display/printout)
40AO-9ZZ07	Loss of Condenser Vacuum	Change reflects 4 digit Pt IDs
40AO-9ZZ08	Load Rejection	Change reflects 4 digit Pt IDs
40AO-9ZZ09	RPCB (Loss of Feedpump)	Change reflects 4 digit Pt IDs
40AO-9ZZ10	Condenser Tube Rupture	Change reflects 4 digit Pt IDs
40AO-9ZZ11	CEA Malfunctions	Change reflects 4 digit Pt IDs
40AO-9ZZ13	Loss of Class Instr or Control Power	Change reflects 2 CEACs per channel
40DP-9OP05	Control Room Data Sheets	Change reflects no Auto Restarts
40OP-9PN01	120 AC Class 1E Instru Channel "A"	Change reflects new hardware
40OP-9PN02	120VAC Class 1E Instr Channel "B"	Change reflects new hardware
40OP-9PN03	120VAC Class 1E Instr Channel "C"	Change reflects new hardware
40OP-9PN04	120VAC Class 1E Instr Channel "D"	Change reflects new hardware
40OP-9SB01	CPC/CEAC Operations	Replaces 72OP-9SB02 for new CPCS
40OP-9SF07	Determ of CEA Positions By RSPT Voltages	Change reflects new hardware
40OP-9ZZ02	Intial Reactor Startup Following Refuelings	Change reflects new hardware
40OP-9ZZ03	Reactor Startup	Change reflects new hardware
40OP-9ZZ04	Plant Startup Mode 2 to Mode 1	Change reflects 4 digit Pt IDs
40OP-9ZZ05	Power Operations	Change reflects 4 digit Pt IDs
40OP-9ZZ07	Plant Shutdown Mode 1 to Mode 3	Change reflects new hardware & 4 digit Pt IDs
40OP-9ZZ23	Outage GOP	Change reflects new hardware
40OP-9ZZ24	SNOW Outage	Change reflects new hardware
40ST-9NI01	Adjustable Power Signal Calibrations	Change reflects new software
40ST-9SF01	CEA Operability Checks	Change reflects 2 CEACs per channel
40ST-9ZZM1	Operations Mode 1 Surveillance Logs	Change reflects new Tech Specs
40ST-9ZZM2	Operations Mode 2 Surveillance Logs	Change reflects new Tech Specs
40ST-9ZZ23	CEA Position Data Log	Change reflects 2 CEACs per channel
72AO-9SB01	CEAC Inoperable	Applies only to legacy system
72DP-9SB01	Initiating/Proc Changes to Add Constants	Change to reflect 2 CEACs per CPCs instead of 2 total
72OP-9RJ04	Operations With PMS Out of Service	Change reflects new hardware
72OP-9SB01	CPC/CEAC Addressable Constants	Revise to reflect/optimize use of new system capabilities
72OP-9SB02	CPC/CEAC Operations	Applies only to legacy system

Proc #	Title	Description of Change
72PA-9RX01	Power Calibration	Given new calibration process added to CPCs, procedure may be deleted. If not, revise to reflect/optimize use of new system capabilities.
72PY-9RX01	Low Power Physics Tests	Update for new references.
72ST-9RX03	DNBR/LHR/AZTILT/ASI W/COLSS Out of Service	Revise to reflect/optimize use of new system capabilities
72ST-9RX11	COLSS Margin Alarms	Update for new references.
72ST-9RX13	Monthly Core Performance	Update for new references.
72ST-9SB02	CPC/CEAC Auto Restart Check	Applies only to legacy system
77DP-0CC08	Process changes to COLSS/CPCS Reload Constants	Minor revision to reflect new system (pt IDs, etc)
77DP-0ZZ01	Mode Change Checklist	Revise to reflect new system
77OP-1SB03	CPC System Load and Operations	U1 procedure -No Proc change at present (later)
77OP-2SB03	CPC System Load and Operations	Revise to reflect new system
77OP-3SB03	CPC System Load and Operations	U3 procedure -No Proc change at present (later)
77ST-9RX01	CEA Drop Time	Revise W/statement to exclude unit with mod installed
77ST-9SB01	CPC Channel A Calibration	Revise W/statement to exclude unit with mod installed
77ST-9SB02	CPC Channel B Calibration	Revise W/statement to exclude unit with mod installed
77ST-9SB03	CPC Channel C Calibration	Revise W/statement to exclude unit with mod installed
77ST-9SB04	CPC Channel D Calibration	Revise W/statement to exclude unit with mod installed
77ST-9SB05	CEAC 1 Calibration	Revise W/statement to exclude unit with mod installed
77ST-9SB06	CEAC 2 Calibration	Revise W/statement to exclude unit with mod installed
77ST-9SB07	CPC Channel A Functional Test	Revise W/statement to exclude unit with mod installed
77ST-9SB08	CPC Channel B Functional Test	Revise W/statement to exclude unit with mod installed
77ST-9SB09	CPC Channel C Functional Test	Revise W/statement to exclude unit with mod installed
77ST-9SB10	CPC Channel D Functional Test	Revise W/statement to exclude unit with mod installed
77ST-9SB11	CEAC 1 Functional Test	Revise W/statement to exclude unit with mod installed
77ST-9SB12	CEAC 2 Functional Test	Revise W/statement to exclude unit with mod installed
77ST-9SB43	CPC/CEAC Response Time Test	Revise W/statement to exclude unit with mod installed
77ST-9SB13	CPCS Channel A Calibration	new procedure, replaces 77ST-9SB01 in units w/mod
77ST-9SB14	CPCS Channel B Calibration	new procedure, replaces 77ST-9SB02 in units w/mod
77ST-9SB15	CPCS Channel C Calibration	new procedure, replaces 77ST-9SB03 in units w/mod
77ST-9SB16	CPCS Channel D Calibration	new procedure, replaces 77ST-9SB04 in units w/mod
77ST-9SB17	CPCS Channel A Functional Test	new procedure, replaces 77ST-9SB07 in units w/mod
77ST-9SB18	CPCS Channel B Functional Test	new procedure, replaces 77ST-9SB08 in units w/mod
77ST-9SB19	CPCS Channel C Functional Test	new procedure, replaces 77ST-9SB09 in units w/mod
77ST-9SB20	CPCS Channel D Functional Test	new procedure, replaces 77ST-9SB010 in units w/mod
77ST-9SB21	CPCS Response Time Test	new procedure, replaces 77ST-9SB043 in units w/mod
77ST-9SB22	CEA Drop Time Test	new procedure, replaces 77ST-9RX01 in units w/mod

Attachment 3

Listing of Hardware for Channel A of CPCS

Listing of Hardware for Channel A of CPCS

CPC RF 616 Subrack ▪ RF616 Base Rack ▪ CI631 AF100 Communication Interface Card, twisted pair, config. Control ▪ PM646A Processor Module, Nuclear CC ▪ PM646A Processor Module, Nuclear CC ▪ AI685 Analog Input Card, 16Ch, Nuclear CC ▪ AI685 Analog Input Card, 16Ch, Nuclear CC ▪ DP620 High Speed Counter, 5/24VDC, 100kHz, 5 Ch, Nuclear CC ▪ DI620 Digital Input, 32Ch, Nuclear CC ▪ AO650 Analog Output, 8Ch 12-Bit Isolated/Ch, Nuclear CC ▪ DO625 Digital Output, 16Ch, 24VDC, Isolated, 8 groups, Nuclear CC	**Power Supplies** ▪ 300 VDC Bulk Front End Module, 120 VAC -to 300 VDC ▪ 300 VDC Bulk Front End Module, 120 VAC -to 300 VDC ▪ 24/5 VDC Maxi Module - Chassis Supply ▪ 24/5 VDC Maxi Module - Chassis Supply ▪ 15/0 VDC Mini module - RSPT Power Supply ▪ 15/0 VDC Mini module - RSPT Power Supply ▪ 24/5 VDC Mini Module - Aux & HSL FOM Power Supply ▪ 24/5 VDC Mini Module - Aux & HSL FOM Power Supply
CEAC1 RF 616 Subrack ▪ RF616 Base Rack ▪ CI631 AF100 Communication Interface Card, twisted pair, config. Control ▪ PM646A Processor Module, Nuclear CC ▪ PM646A Processor Module, Nuclear CC ▪ AI685 Analog Input Card, 16Ch, Nuclear CC ▪ AI685 Analog Input Card, 16Ch, Nuclear CC ▪ DO625 Digital Output, 16Ch, 24VDC, Isolated, 8 groups, Nuclear CC	**15" Flat Panel Color Display - Maintenance & Test Panel** ▪ PC Node Box Assembly ▪ IRIG B Fiber Optic Modems ▪ CI527 AF100 bus interface board ▪ Keyboard ▪ Fiber Optic Termination Box
CEAC2 RF 616 Subrack ▪ RF616 Base Rack ▪ CI631 AF100 Communication Interface Card, twisted pair, config. Control ▪ PM646A Processor Module, Nuclear CC ▪ PM646A Processor Module, Nuclear CC ▪ AI685 Analog Input Card, 16Ch, Nuclear CC ▪ AI685 Analog Input Card, 16Ch, Nuclear CC ▪ DO625 Digital Output, 16Ch, 24VDC, Isolated, 8 groups, Nuclear CC	**12.1" Flat Panel Color Display - Operator's Module** ▪ PC Node Box Assembly ▪ CI527 AF100 bus interface board ▪ TC514 AF100 Fiber Optic Modem ▪ TC514 AF100 Fiber Optic Modem ▪ Fiber Optic Termination Box -- ▪ TC514 AF100 Fiber Optic Modem ▪ TC514 AF100 Fiber Optic Modem