LEAD ENGINEER: TOM OTT

I. GENERAL DESCRIPTION OF CHANGE/ORGANIZATION OF DCP:

1.0 <u>Introduction</u>

This is the final DCP in a series of six DCP's which are replacing the core protection calculator system (CPCS). The previous DCPs have built a new CPC room, installed fire protection and air conditioning systems, and installed cabinets containing the new CPC hardware. This DCP will disconnect the old CPCs in 2C15 and make permanent connections to the new system. This DCP is organized into 13 sections as follows:

1. HIGH TEMP ALARMS
2. ANNUNICATORS
3. CPC OPERATOR'S MODULE
4. CEA/CAPS/SPDS CRT
5. STARTUP TEST INSTALLATION PATCHBOARD
6. CEA'S
7. CPC POWER
8. RCP SPEED SIGNALS
9. PRESSURIZER PRESSURE SIGNALS
10. RX HOT AND COLD LEG TEMP SIGNALS
11. CPC TO CAPS DATA LINKS
12. CPC TO PPS INTERFACE
13. NUCLEAR PWR-DNBR MARGIN, LPD MARGIN & PHICAL

The CPCS consists of four redundant channels. The old system is presently located in 2C15. Separate termination cabinets and equipment cabinets are provided for each channel of the new system. The cabinet assignments for the new system are as follows:

2C395 Channel A CPU Cabinet
2C394 Channel A Termination Cabinet
2C397 Channel B CPU Cabinet
2C396 Channel B Termination Cabinet
2C398 Channel C CPU Cabinet
2C399 Channel C Termination Cabinet
2C400 Channel D CPU Cabinet
2C401 Channel D Termination Cabinet

This is a single discipline DCP and Tom Ott (EIC) is the lead engineer. Carl Honeysuckle (MSC) provided design input for seismic mounting of the operator's modules in 2C03. Cabinet drawings for 2C03 have been revised and are included with this DCP. Harold Hughes (MSC) reviewed the seismic test report/analysis for the new CPC cabinets and prepared calculations to document the seismic qualification. All remaining work was performed by a design team in the EIC Section. The principal contributors on the design team were Keith Nichols, Mike Zuber, Eric Allen, and Danny Tarkinton. Lee Puckett and Al Caine assisted by reviewing various calculations. Gary Sullins performed the independent review.

1.1 HIGH TEMP ALARM

The CPC room temperature is required to be monitored per technical specification 4.3.1.1.6. It states "The core protection calculator system shall be subjected to a channel functional test to verify operability within 12 hours of receipt of a valid high CPC room temperature alarm." The annunciator procedure 2203.12 delineates that a functional test must be performed on all CPC channels if the existing CPC room #2150 exceeds a temperature of 85°F and any one CPC cabinet exceeds a temperature of 95°F.

In the new CPC room 2098C, the individual CPC cabinet temperatures will not be monitored. The room temperature will alarm at two set points: a "high" temperature and a "high-high" temperature. These temperature setpoints will be determined by calculation #85D-2075-19 with input from testing in section G of this DCP. The purpose of the testing in Section G is to determine a Delta T between the room temperature and the cabinet temperatures. The Delta T along with the calibration tolerance will be used to select setpoints that will ensure that if the cabinet temperatures exceed their operating range, corrective action will be taken. Procedure 2203.13 will be revised to reflect this. In addition to the temperature alarms, there will also be a fan fail alarm for the CPC room HVAC units. HVAC units 2VUC-37 A&B supply air to the CPC cabinets at a rate of 725 CFM (ref: Calculation 85D-2075-10). Only one of these HVAC units will be running at any given time. The HVAC units are redundant in that if one unit stops, the other unit will automatically start. The fan switches are connected so that an annunciator will alarm if both units stop.

The high-high temperature alarm will be the technical specification alarm. The high temperature alarm will be used in conjunction with the fan fail alarms to provide a pre-alarm to the technical specification alarm (high-high temperature). The monitoring of both air flow and temperature will ensure that a CPC room cooling problem is detected before any damage to the CPCS occurs.

This DCP will remove the existing wall temperature switch in room 2150. A new two stage temperature switch, with the same instrument number 2TS-8538, will be installed in the new CPC room 2098C. Two flow switches 2FS-8538 A&B will be installed in the new CPC room HVAC units 2VUC 37 A&B, one in each unit. Two annunciator windows in 2C33 (2K09) will be utilized in this modification. One window for the CPC room temp HI-HI and one window for 2VUC 37 A&B high temp/fan fail.

The installation of this DCP should be coordinated with DCP 86-2113 (Annunciator Package) because this DCP relocates windows that DCP 86-2113 locates. The selection of the annunciator window locations was coordinated with DCP 86-2113.

1.2 ANNUNCIATORS

This portion of DCP 85-2075D will revise connections to annunciators in cabinets 2C16, 2C17, and 2C32. Listed below is a brief description of the changes that will be made to each annunciator:

ANNUNCIATOR 2K04 (2C16) REF: E2454-2

Three annunciator windows (DNBR/LPD bypass selected channel 4-2K04 K6, CPC sensor failure channel 4-2K04 K7, CPC failure channel 4-2K04 K8) will be disconnected from the old CPC cabinet, 2C15-4, and reconnected to the new channel D CPC termination cabinet 2C401.

ANNUNCIATOR 2K05 (2C16) REF: E2454-3

Six annunciator windows (DNBR/LPD bypass selected channel 2-2K05 K1, CPC sensor failure channel 2-2K05 K2, CPC failure channel 2-2K05 K3, CEA sensor failure CEAC 1-2K05 D4, CEA failure CEAC 1-2K05 E4, CEA deviation CEAC 1-2K05 F4) will be disconnected from the old CPC cabinet 2C15-2 and reconnected to the new channel B CPC termination cabinet 2C396.

ANNUCIATOR 2K06 (2C17) REF: E2455-2

Three annunciator windows (DNBR/LPD bypass selected channel 1 - 2K06 K6, CPC sensor failure channel 1 - 2K06 K7, CPC failure channel 1 - 2K06 K8) will be disconnected from the old CPC cabinet 2C15-1 and reconnected to the new channel A CPC termination cabinet 2C394.

ANNUNCIATOR 2K07 (2C17) REF: E2455-3

Six annunciator windows (DNBR/LPD bypass selected channel 3 - 2K07 K1, CPC sensor failure channel 3-2K07 K2, CPC failure channel 3 - 2K07 K3, CEA sensor failure CEAC 2-2K07 D4, CEA failure CEAC 2-2K07 E4, CEA deviation CEAC 2-2K07 F4) will be disconnected from the old CPC cabinet 2C15-3 and reconnected to the new channel C CPC termination cabinet 2C399.

ANNUNCIATOR 2K08 (2C33) REF: E2456-1

DCP 86-2113 will relocate window 2K08 F3 (El Equip RM Unit Cooler 2VUC-25A Fan Air Flow Low) to window 2K08 D5 and rename it to "CPC room 2VUC-25A Fan Trouble". This DCP (85-2075D) will override that change and move the 2VUC-25A fan alarm to 2K08 K5 along with the existing name tag. This change should be coordinated with DCP 86-2113 so that window F3 is moved directly to K5 and is not relocated twice. The details for this move are in the high temp alarm portion of this package.

ANNUNCIATOR 2K09 (2C33) REF: E2456-2

DCP 86-2113 will relocate window 2K09 F4 (El Equip room unit cooler 2VUC-25B fan air flow low) to window 2K09 D5 and rename it to "CPC room 2VUC-25B fan trouble". This DCP (85-2075D) will override that change and move the 2VUC-25B fan alarm to 2K09 K5 along with the existing name tag. This change should be coordinated with DCP 86-2113 so that window F4 is moved directly to K5 and is not relocated twice. DCP 86-2113 will also move the CPC room high temperature alarm from annunciator 2K10 F6 to annunciator 2K09 D4. This DCP (85-2075D) will not alter the new location of the CPC room high temp alarm but the connections will be changed to the new 2TS-8538, two-stage temperature switch, in the new CPC room 2098C instead of the old 2TS-8538 temperature switch (to be deleted) in the old CPC room 2150. The name tag of window 2K09-D4 will be changed to "CPC room temp HI-HI". Window 2K09 D5 will be utilized as a pre-alarm to the CPC room high-high temp alarm. The high temperature alarm portion of this DCP gives specific details for the changes to annunciator 2K09.

ANNUNCIATOR 2K10 (2C33)

DCP 86-2113 will remove the CPC room high temp alarm from 2K10 F6 and relocate it to 2K09 D4. This DCP (85-2075D) will not make any changes to this annunciator. The connections for the high CPC room temp pre-alarm will pass through this annunicator's terminal blocks on the way to 2K09 to be consistent with the new routing of the CPC room high temp alarm. Details for these connections are contained in the high temp alarm portion of this DCP.

ANNUNCIATOR 2K20 (2C32) REF: E2463

Two annunciator windows for the CPIA test will be deleted. Upon receipt of this alarm, the action required by Procedure 2203.12 is "insure that proper personnel are testing this equipment and that all operators are aware of the condition." The new CPCS requires a hard key to place the CP01A (equivalent to CP1A in old CPCS) in test. The first step of the test procedure is to set the CEAC INOP light of the operators module to the on position. Based on these initial steps it was agreed upon with Operations that these annunciators would not be required for the new CPCS. These two windows, 2K20 E1 and 2K20 E5 will be spared.

Four new CPC door open alarms will be added at windows 2K20 G1, 2K20 G2, 2K20 G5 and 2K20 G6. A door open alarm for each channel was provided so that Operations would be able to detect if someone inadvertently entered the wrong channel while performing maintenance or testing. These alarms were requested by Operations.

The phical signal from the new CPC's will be tied into the nuclear power deviation alarms in another portion of this DCP.

1.3 CPC OPERATOR'S MODULES (REF: E2205-1)

Four existing operators modules (2JC-9051-1, 2, 3, & 4) will be removed from cabinet 2C03. Four new operators modules will be installed in the same locations in 2C03 from which the existing operator's modules were removed. These new modules will have the same component tag numbers as the existing modules.

The existing cables from each operator's module to the old CPC cabinets (2C15) will be removed. A new 20/C #20 cable and a 2/C fiber optic cable will be installed and connected from each new operator's module to the new CPC cabinets. One spare 2/C fiber optic cable will also be pulled to each operators module.

1.4 CEA/CAPS/SPDS CRT (REF: E2205-13)

This portion of DCP 85-2075D will revise the connections to the CRT scheme in Cabinet 2C03 so that the CRT will no longer display CEA positions. This function will be performed by the new CPC operator's modules.

In 2C03, handswitch 2HS-9810 will be revised so that position 3(CEA display) has no function. Handswitch 2HS-9058 (CEAC 1/CEAC 2 select) will be removed and the hole plugged.

In 2C32, the CRT display generator (2QY-9058) will be completely disconnected. The cables that connect 2QY-9058 to 2C15 and 2C03 will be removed.

1.5 STARTUP TEST INSTALLATION PATCHBOARD (REF: E2517-11)

A new terminal box (2TB41U) will be installed in the new CPC Room 2098C for startup testing. An 8-conductor cable will be pulled from the existing startup testing terminal box 2TB934 in the old CPC Room 2150 to the new startup testing terminal box 2TB41U in the new CPC Room 2098C. This new cable will be laid down on terminals in 2TB41U. In 2TB934 the cable will be rolled up and left unconnected.

Two short runs of conduit will be required to tie in the existing and new terminal boxes resulting in one penetration in Room 2150 (South end-floor). This penetration is neither a Tech. Spec or ANI barrier therefore no penetration number is required.

1.6 CEA'S (REF: E2258-3,4,5)

Presently the CEA position signals are transmitted to the old CPC cabinets (2C15-1, 1, 2, 3 & 4). This portion of DCP 85-2075D will disconnect these signals from the old CPCs and reconnect them to the new CPCs in cabinets 2C394 through 2C401.

New cables will be pulled between the old CPC cabinets and the new CPC cabinets. Twenty 3/C cables will be pulled from 2C15-1 to 2C394. Sixty-one 3/C cables will be pulled from 2C15-2 to 2C396. Sixty-one 3/C cables will be pulled from 2C15-3 to 2C399. Twenty 3/C cables will be pulled from 2C15-4 to 2C401.

In the 2C15 cabinets, the internal wiring for the CEA positions will be removed and these new cables will be laid down in their place so that the CEA position signals feed straight through 2C15 and on to the new CPC cabinets 2C394 through 2C401.

The CEA isolation amps (channels A&D) and the CEAC's (channels B&C) in the old CPC cabinets will be completely disconnected in this portion of DCP 85-2075D.

1.7 CPC POWER (REF: E2437-1,2)

A disconnect switch, transformer and distribution panel were installed in DCP 85-2075C to supply temporary power to the new CPCs. This temporary power will be disconnected and the temporary disconnect switch, transformer and panel removed. The new CPC system consists of 4 channels with 2 cabinets each (8 total). Each cabinet will have a new power circuit from the associated RS panel. The new power cables will be 2/C #10. The old CPC system is located in cabinet 2C15, which is divided into 4 channels. Each channel presently has 2 power circuits from the associated RS panel. One power circuit is being removed from each channel of 2C15 by this DCP. The remaining power circuit will feed the non-CPC loads which will stay in 2C15. Internal wiring in 2C15 will be removed between the old CPC equipment chassis and the internal fuse blocks. Fuse block jumpering is being modified so that all fuses are fed from the single remaining power circuit in each channel of 2C15.

1.8 RCP SPEED SIGNALS (REF: E2731)

The RCP speed signals are presently input to the old CPCS in cabinets 2C15. These signals will be disconnected from the old CPCS and routed to the new CPCS in cabinets 2C394 through 2C401.

New cables (type 4P6) will be pulled from 2C15-1, 2, 3 & 4 to 2C394, 2C396, 2C399 and 2C401 respectively.

The speed sensor signal processor chassis are located in the 2C15 cabinets, one in each channel. The internal wiring that connects the signal processors to the old CPC chassis will be disconnected and the new cables will be connected to carry the speed signal outputs to the new CPCS.

1.9 PRESSURIZER PRESSURE SIGNALS (REF: E2703-5)

The pressurizer pressure signals are presently input to the old CPCS in cabinets 2C15-1, 2, 3 & 4. This portion of DCP 85-2075D will disconnect these signals from the old CPCS and reconnect them to the new CPCS in cabinets 2C394 through 2C401.

New 2/C cables will be pulled from 2C15-1, 2, 3 & 4 to 2C394, 2C396, 2C399 and 2C401 respectively.

These new cables will pick up the pressure signal from a terminal block in 2C15 and transmit them to the new CPCS.

1.10 RX HOT AND COLD LEG TEMP SIGNALS (REF: E2701-1,2,3,4,7,8,9,10)

The reactor hot and cold leg temperature signals are presently input to the old CPCS in cabinets 2C15. The internal wiring that carries these signals to the old CPCS will be disconnected and removed.

New cables (Type 2P6) will be pulled from 2C15-1, 2, 3 & 4 to 2C394, 2C396, 2C399 and 2C401 respectively. These new cables will be connected to a terminal block in the 2C15 cabinets where they will pick up the temperature signals and carry them to the new CPCS.

1.11 CPC TO CAPS DATA LINKS

This portion of DCP 85-2075D will disconnect and remove the coax cables presently used for data links between 2C15 (old CPC cabinet) and 2C93 (CPU - Computer Cabinet). New fiber optic cables will be installed from each channel of the new CPC cabinets to 2C84 in the computer room (EL 404). Each CPC and CEAC will have one data link, for a total of six.

A 286 based PC with 8 serial ports will be installed in 2C84. Two serial links to the CAPS computer will be installed. The procurement installation, connection and programming of the PC and CAPS equipment will be performed by the computer support group.

The connections made to CAPS in DCP 85-2075E for temporary signals to the new CPC will be disconnected.

1.12 CPC TO PPS INTERFACE

In this section the cables that carry the DNBR Trip, DNBR Pre-Trip, LPD Trip, LPD Pre-Trip and CWP Signals from the old CPCS to PPS will be disconnected and removed. New cables will be routed from the new CPCS to PPS for these signals.

The cables that carry the Excore signals from the PPS to the old CPCS will be disconnected and removed. New cables will be routed from the new CPCS to PPS for these Excore signals.

In 2C15, BG-Chassis 0 will be completely disconnected and miscellaneous internal wiring removal will be performed in this section.

1.13 NUCLEAR PWR - DNBR MARGIN, LPD MARGIN & PHICAL

The cables that presently carry the DNBR Margin and LPD Margin signals from 2C15 to 2C03 will be disconnected and removed. New cables will be pulled directly from the new CPCS to the 2C03 cabinets for these signals.

In 2C15, the internal wiring for the phical signal will be disconnected and removed. New cables will be pulled from the 2C15 cabinets to the new CPCS for these signals.

In 2C15, BH-Chassis 1 will be completely disconnected in this portion of DCP 85-2075D.

II. DESIGN BASIS DISCUSSION/DESIGN CONSIDERATIONS:

The principle design consideration throughout the course of the CPC project has been to provide a replacement for obsolete CPC hardware and to maintain an identical functionality of the system. Enhancements have been made to the system in areas of reliability, maintainability and operator interface in order to satisfy the goal of improving these areas.

Combustion Engineering designed and assembled the new CPC hardware. The following regulatory criteria and design standards which were applied to the original CPCS design were also used for the replacement CPCS design: 10CFR50 - Appendix A, 10CFR50 - Appendix B, IEEE-279-1971, IEEE-323-1971, IEEE-338-1971, IEEE-344-1971, IEEE-379-1972, USNRC R.G.1.47 and USNRC R.G.1.22. The qualifying tests performed on the original CPC hardware were duplicated on the new CPC hardware by Combustion Engineering. These tests include the seismic qualification test, EMI susceptibility testing, environmental testing and software qualification tests. It should be noted that the CPCS is not an "EQ" system and it does not have a post accident function.

The CPCS is a "Q", class IE system and this DCP is classified as such. Certain portions of this DCP can be treated as Non-Q since there are some Non-Q components installed. These are identified in the Design Change Summary.

The general approach to making permanent connections to the new CPCS is described as follows. Field cables between the various sensors and 2C15 are left intact. Internal wiring to the old CPC hardware is being removed. New cables are installed from the outgoing terminal blocks (OTBs) in 2C15 to the new CPC cabinets for field input signals. Outputs from the old CPCS are disconnected from the OTBs in 2C15 and the external cables are removed. New cables are installed from the new CPC cabinets to the control room and to the computer room for the various CPC outputs.

Separate termination cabinets are provided for the new CPCS. All cabinets (CPU and termination) are designed for both top entry and bottom entry of cables. External cables will enter through the tops of the cabinets and inter-cabinet cables will enter through the bottoms of the cabinets. This is not a hard and fast rule, and exceptions are made for the annunciator and power cables which enter the bottoms of the cabinets.

Existing raceway will be used as much as possible for cables installed by this DCP. Old cables which are being disconnected will be removed where practical to make room for new cables. Raceway loadings were examined in detail and are documented in the CIS Impact Report and Attachment A. With only one exception, all cable tray loadings are below 30%. The loading for 2TFJ035 changed from 41.3% to 42.3% due to this DCP. This is deemed acceptable since this is an instrumentation cable tray and heating effects are negligible. All tray loadings are well below the 50% and 74% guidelines used for fire protection and seismic considerations.

A key consideration in this DCP is the separation/isolation between redundant channels and between safety systems and non-safety systems. Through the use of existing channelized raceway, separation is maintained. For the limited amount of new conduit to be installed, separation is also addressed. Where interchannel connections are made in the new system, isolation is improved by the use of fiber optic devices. The channels are connected by non-conducting fiber optic cable so that a fault in one channel cannot propagate to the other channel. Fiber optic cable is also employed for isolation between the new CPCS and the CAPS computer. Currently a Technical Specification governs testing of the isolation devices on the old CPCS. The testing prescribed by this Technical Speci cation is not practical for the new isolation devices. Therefore, a change to the Technical Specification is being requested. This change is justifiable on the basis of the superior isolation characteristics of the new devices.

The power circuits for the new CPCS are designed to be equivalent to those provided for the old system. Each channel of the new CPCS will have two power circuits from the respective channel of the 120 VAC safety related power distribution system. Calculations have been prepared to document that there is no adverse impact on the station batteries and diesel generators. The net effect of the power circuit modifications is a reduction in load on the RS panels. The circuit coordination was reviewed and determined to be acceptable.

A fire protection and Appendix R review has been performed and it is concluded that no unanswered Appendix R concerns exist. The only safe shutdown components or cables being modified by this DCP are the RS power panels. These changes were determined to be acceptable. Various changes to the SSCA and the FPPM were identified as a result of this DCP. Many of the changes are being made to reflect as-built conditions as a result of DCP-85-2075A. That DCP created a new fire ne for the new CPC room in what was once part of the cable spreading room. The new room is now considered separate from the cable spreading room and has its own halon fire suppression system.

The existing process instruments which provide inputs for the old CPCS will be reconnected to the new CPCS by this DCP. Since these instruments will stay the same, any measurement error or uncertainty associated with them will be unchanged. CE has performed analyses and testing to account for measurement errors and calculational uncertainties for the entire system. The uncertainties for the system are treated in a manner such that any transients in the NSSS parameters that affect the fuel design limits are accommodated in a conservative fashion.

Seismic design criteria have been applied for components installed by this DCP. The seismic analysis for cabinet 2C03 has been revised for the mounting of the new operator's modules.

The new room for the CPCS and the supporting systems were provided by a previous DCP (85-2075A). The new HVAC system is non-Q whereas the HVAC system for the old CPC room is Q. This deviation from the original design is justifiable for several reasons. During the initial CPCS licensing process, emphasis was placed on having a redundant and reliable HVAC system. The new HVAC system satisfies this goal. The new system is 100% redundant and is designed for highly reliable operation. Multiple alarms are to be installed by this DCP for detection of any HVAC problems. One of these alarms is governed by an existing Technical Specification. The CPCS has design features which will cause it to generate a trip signal on credible failures. The CPCS is not a post accident system. For any design basis event, the CPCS will perform its function within seconds of the initiation of the event. Once the reactor trip occurs, no further action is required from the CPCS.

A comprehensive testing program has been laid out for the new CPCS in order to satisfy the intent of the various tests which were performed on the original CPCS. This program includes system qualification tests and site commissioning tests. The qualification tests have been performed by CE and adequately demonstrate that the system is capable of performing its safety function. The site commissioning tests will be completed prior to placing the new CPCS in operation. In a few cases, operating experience has shown that the concerns originally addressed by the tests are no longer valid. In these cases, the tests on the new system will either be eliminated or abbreviated since they are no longer necessary.

The response time test software supplied with the new CPCS employs a different method of measurement than what is presently used. The new method only measures the hardware response time, whereas the old method measures the total time response including hardware and software delay times. In order to demonstrate compliance with ANO-2 Technical Specifications, it will be necessary to manually add the software delay time to the hardware delay time measured for the new system. A Technical Specification change is likely to be requested in the future so that the measured time response can be compared directly to the values in the Technical Specification. This change is not required for implementation of the new system.

III. OPERATING MODES & FUNCTIONAL REQUIREMENTS:

The CPCS is a subset of the RPS. Four redundant channels monitor NSSS parameters and generate trip signals for low DNBR (departure from nucleate boiling ratio) and high LPD (local power density). The function of the CPCS is to prevent specified allowable fuel design limits from being exceeded. The CPCS also functions to assist the ESFAS during certain accidents by promptly tripping the reactor upon initiation of these accidents. The CPCS does not have a post accident function.

The CPCS is required to be operable during modes 1 and 2 in accordance with technical specifications. When rated thermal power is below 10^{-4}%, the CPC trips may be bypassed. During other modes, when the CPCS is not required, the system is likely to be energized and in a tripped condition.

An operator interface to the CPCS is provided in the control room via operator modules, panel meters and annunciators. These components allow the operator to assess the condition of the CPCS and to monitor certain parameters. CEA position can be graphically displayed on the B and C channel operator modules. While the operator interface provides important information, the CPCS will perform its intended safety function without operator intervention.

Post-trip information is provided by the CPCS via the CAPS computer data links. The CPCS maintains an internal buffer containing values which represent field input parameters and calculational results. This buffer is periodically transmitted to the CAPS computer. When a CPC generated trip occurs the values in the buffer are frozen and transmitted to the CAPS computer. This information can be used to assess conditions leading up to the trip and to determine the actual cause of the trip.

Upon loss of offsite power, the HVAC units in the new CPC room will cease operation. If the CPC room temperature alarms are received, consideration should be given to de-energizing the CPCS to prevent CPC damage due to overheating. The CPCS should never be de-energized if the plant is not tripped.

IV. FAILURE MODES AND EFFECTS:

Combustion Engineering performed a detailed failure modes and effects analysis on the entire plant protection system (PPS), including the CPCS, when the system was originally designed. This FMEA is documented in Table 7.2-5 of the SAR. CE reviewed this FMEA in light of the CPCS hardware replacement and, as reflected in the proposed SAR changes, concluded that it is still valid for the new system. A subsequent in-house review has reached the same conclusion.

On a block diagram level, the new CPCS is identical to the old. The protection algorithms from the old system were recompiled for the new, software compatible, computers. Software qualification tests were performed on the new system to demonstrate its ability to respond to transient conditions and generate a trip when conditions warrant. The new system is designed to function identically to the old CPCS.

The inherent compensating provision which is built into the CPCS (both old and new) is its four channel redundancy. Any failure which prevents one channel from tripping or causes one channel to spuriously trip is compensated by the remaining three channels. Other failures of lesser consequence can result in mis-operation of alarms and indicating devices. The presence of four channels allows cross channel checks to be made in order to assess the situation. The methods of detecting any failures include various alarms and indicators as well as periodic tests.

The failure modes and effects for the modifications made by this DCP are addressed in detail in the Design Change Summary. In many instances, the changes made by this DCP result in more reliable operation of the system. In all cases, it can be concluded that the failure modes and effects are acceptable for one or more of the following reasons:

1) the failure is of little consequence
2) the failure is readily detectable
3) the failure is not likely to occur
4) the failure does not prevent the CPCS from performing its safety function.

1.	ALARA REVIEW REQUIRED:	YES X	NO ___	If "NO" Provide Justification:
2.	FIRE PROTECTION REVIEW REQUIRED:	YES X	NO ___	If "NO" Provide Justification:
3.	HUMAN FACTORS REVIEW REQUIRED:	YES X	NO ___	If "NO" Provide Justification:
4.	ENVIRONMENTAL QUALIFICATION REVIEW REQUIRED:	YES ___	NO X	If "NO" Provide Justification: The CPCS is not a post accident system and is not located in a harsh environment. This DCP does not affect plant environmental conditions.

ATTACHMENT 2

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1.0 Introductory Summary

Arkansas Power and Light is upgrading the Core Protection Calculator System to replace obsolete equipment and to improve overall system reliability, availability and operability.

A major goal of the upgrade effort is to accomplish these improvements while minimizing the impact of changes on the licensing basis of the system.

To meet this goal, the upgrade is being accomplished by component replacement while preserving the original equipment design bases and functions.

This document describes the component changes and evaluates each change against the design basis of the equipment and the licensing basis of the system. The evaluation criteria utilized is that described in Arkansas Power and Light Company Policy Statement on Application of 10CFR50.59.

The evaluation has resulted in the following findings:

A change to the technical specifications is required to support the Core Protection Calculator Upgrade. Specifically a change is required to T.S. 3/4.3.1 concerning isolator testing as described in Appendix B, page B-11. The change is justifiable in terms of superior compliance with design criteria governing the separation of redundant channels inherent in the new CPC design. The technical specification change does not raise any unreviewed safety questions and can be considered as a separate issue apart from the overall upgrade.

A change to the same technical specification is likely to be requested in order to more readily accommodate response time testing. A different method of testing is employed in the response time test software supplied with the upgraded CPCS. Compliance with the existing technical specification can be demonstrated without any change to it. However, the change would make it easier to demonstrate compliance and would be consistent with the other utilities which are using a CPCS.

The Core Protection Calculator Upgrade does involve a change to the ANO Unit 2 Facility because information contained in the Licensing Basis Documentation would be rendered inaccurate. In accordance with the AP&L 10CFR50.59 Policy, a 50.59 evaluation is required.

The analysis provided in this document indicates that the proposed changes will not result in an unreviewed safety question. The bases for this recommendation are contained in Sections 4 and 5 of this document.

2.0 Purpose and Scope

The purpose of this document is to describe the proposed modifications to the Arkansas Nuclear One Unit 2 Core Protection Calculator System and evaluate the modifications for their impact on the Licensing Basis Documents, Regulatory Criteria and Positions, and the Engineering Design Bases of the original system. This discussion is contained in the main body of this document. The scope of the review includes the non-CPC components and modifications installed by this DCP such as alarm switches for annunciators.

Appendix A contains proposed revisions to sections of SAR Chapter 7. This chapter was rewritten to provide information on the new Core Protection Calculator System equivalent to that contained in the current SAR. It is proposed to delete SAR Chapter 7A because of its proprietary nature. Revised Chapter 7 will contain references to various C-E topical reports which will contain the proprietary information. The goal of the SAR revision is to remove unnecessary component detail and proprietary information while preserving the necessary functional information.

Appendix B contains a summary of the review of the licensing basis documents. The impact of the Core Protection Calculator Upgrade on these documents is assessed in this section.

Appendix C is a comprehensive list of the licensing basis documents reviewed for this evaluation.

3.0 Evaluation Criteria

The review provided in this document consists of two separate steps:

a. The determination if a change to the Licensing Basis Documents or Technical Specifications is required.

b. The evaluation if an unreviewed safety question is involved in the change.

The criteria for this evaluation is contained in the Arkansas Power and Light Company Policy Statement on Application of 10CFR50.59.

Specific criteria that represent detailed interpretations of these general criteria are presented below. The analysis shall address both the general criteria and the detailed criteria.

These specific criteria are:

1. Functional Equivalent

The protective functions of the Core Protection Calculator (CPC) and the CEA Calculator (CEAC) will be performed in a manner equivalent to the present system. The basic hardware structure will be retained in the new system, with an equivalent counterpart for each major component as it now exists in the present system. A function will be considered to be equivalent if the software algorithm associated with that function is executed without change to the mathematics, with a response time equal to or better than the current implementation and with an overall accuracy (including addressable constants) that is equal to or better than the present implementation.

2. Reliability

The Core Protection calculator shall be designed such that the probability of a hardware failure that does not result in a protective channel trip shall be equal to or less than the probability of this occurrence in the present system.

3. Qualification

The Core Protection Calculator hardware shall be designed to operate within the seismic, temperature, humidity, and electromagnetic interference (EMI) environment established as the design bases for ANO-2. IEEE Std 323-1971 and IEEE Std 344-1971 shall be utilized for specific criteria and documentation of suitability. The test methods and procedures for EMI evaluation utilized for the current system shall serve as criteria and guidance for the upgraded system.

4. Physical Interfaces and Isolation

The Core Protection Calculator design shall provide for physical separation and electrical isolation of redundant channels equivalent to or better than the present system. Isolation between the Class 1E Core Protection Calculator equipment and non-Class 1E equipment shall be equal to or better than the present system.

5. Operator Interface

The operator interface functions shall be implemented in a manner such that

a) the human-machine interaction capability is equal to or better than the present system.

b) the functions required for operator surveillance, test and calibration can be accomplished efficiently.

6. Design Bases and Configuration

The Core Protection Calculator design shall satisfy the requirements of applicable sections of standards and regulatory guides, the NRC positions and engineering design bases.

These detailed requirements are described in:

a) IEEE-279-1971

b) IEEE-323-1971

c) IEEE-344-1971

d) IEEE-338-1971

e) IEEE 336-1971

f) IEEE-379-1972

g) Regulatory Guide 1.47

h) Regulatory Guide 1.22

i) The 27 NRC Positions on the original CPC design

j) The ANO-2 SAR, Chapters 7 and 7A

k) The ANO-2 SER and SER Supplements

4.0 Evaluation

This section compares the design features of the Core Protection Calculator Upgrade to the design features of the original system.

Each design feature that has changed is evaluated to determine if a change to the LICENSING BASIS DOCUMENTS is required. If a change is required, a further evaluation if an unreviewed safety question exists will be made in accordance with the criteria of Section 3.0.

The evaluation will encompass the entire Core Protection Calculator System including:

a. Computer Component Changes

b. Input/Output Equipment Changes

c. Operator Interface Equipment Changes

d. Changes required in the cabinet enclosing the equipment and the interface cabling.

e. The impact of changes on the system interfaces including environment (temperature, electrical noise, humidity and seismic), physical and electrical isolation, and 120 V.A.C. electric power.

f. Software Changes

g. Single Channel Changes

h. Licensing Basis Document Changes

4.1 Computer Equipment Changes

General

The current CPC computer is an Interdata model 7/16 with High Speed ALU. Since the date of the original hardware installation, the model 7/16 has been superseded by a Concurrent Computer Corp. Model 3205 (same vendor, different name).

The model 3205 has an upward compatible instruction set such that the CPC and CEAC application programs can be converted to run on it without software redesign.

The model 3205 utilizes current electronic technology and as such provides for more effective equipment maintenance. The model 3205 also provides for improved performance in the speed of program execution and the accuracy of mathematical operations.

A comparison of the features of the model 3205 and model 7/16 are provided in Table 1.

4.1.1. Central Processing Unit

The central processing unit of the model 3205 is functionally similar to that of the model 7/16, with superior performance.

The architecture of the CPU has been changed from 16 bit to 32 bit. The increased word length provides the ability to address a larger main memory.

The CPU of the model 3205 uses integrated circuit chips of larger scale integration than the model 7/16, thus reducing the number of components and improving the inherent reliability of the CPU.

The CPU of the 3205 utilizes hardware processing of floating point instructions as contrasted to firmware floating point capability. This permits faster and more accurate processing of floating point instructions.

The format and type of the 7/16 instructions have been retained in the model 3205 thus permitting the transfer of 7/16 programs to the model 3205 without major reprogramming. The Concurrent Common Assembler Language (CAL) Assembler restructures the model 7/16 instructions into 3205 compatible instructions.

TABLE 1

Computer Hardware Comparison

	Feature	Model 3205	Model 7/16
1.	Memory Technology	Metal Oxide Semiconductor volatile with battery backup.	Ferrite Core, Non-Volatile
		32-bit word length	16-bit word length
		5-bit Error Correction and Detection	1-bit parity
		400 nanoseconds cycle time	1000 nanoseconds cycle time
2.	CPU Technology	VLSI, LSI, MSI	LSI
		8 Sets of Sixteen 32-bit general purpose registers	Sixteen 16-bit general purpose registers
		Floating Point Hardware	Floating Point Firmware
		Eight 32-bit Single Precision Registers	
		Eight 64-bit Double Precision Registers	

The correct translation of model 7/16 instructions to model 3205 instructions has been verified in Phase One and Phase Two software tests performed in accordance with NRC approved software Change Procedure CEN-39(A)-P. These tests also verify the adequacy of processing speed and arithmetic accuracy of the model 3205. The 3205 software was subjected to the same testing as the existing 7/16 software.

4.1.2. Semiconductor Memory

The model 7/16 utilizes ferrite core memory technolcgy. This technology allows the retention of stored data for long periods of time when all a-c power is lost. The ferrite core technology has become obsolete due to the relatively slow speed and large operating power consumption typical of this technology.

In the model 3205, Metal Oxide Semiconductor (MOS) memory technology has replaced ferrite core technology due to its improved speed and lower power consumption. Because the memory elements are semiconductors rather than magnets, the memory is volatile; that is if power is removed from the memory, the stored data is lost. To prevent inadvertent loss of data, MOS memory systems utilize a built-in battery back-up to maintain data if main a-c power is lost.

For the 3205, a 40 minute battery back-up is provided. Also, a function has been implemented into the system which will allow automatic reload of the software from a Programmed Read Only Memory (PROM) on loss of power.

The combined function of battery back up and PROM reload accomplish the functional equivalent of the model 7/16 core memory.

The model 3205 memory error detection scheme is greatly improved over the model 7/16. The single parity bit check of the model 7/16 could only detect single bit errors. The 5 bit error correction scheme incorporated in the model 3205 can detect and correct all single bit errors and can also detect all double bit errors. Thus, the original diagnostic scheme has been retained and improved in the model 3205 memory.

The model 7/16 utilizes a hardware, key switch activated memory protect feature that prevents the CPU from writing into designated protected areas in memory.

In the model 3205, the memory protection is at all time under the control of the executive program. This eliminates the need for the key switch on the operator's module. The new memory protect has improved capability such that it can detect and prevent invalid read and execute faults in addition to the invalid write of the current system. The benefit of this modification is that it allows the use of standard computer hardware thus improving maintainability and useful life. The 3205 scheme is functionally superior to the software based memory protect scheme utilized for C-E's System 80 CPC's licensed and operating at Palo Verde Unit-1.

Since no safety credit was given to this function by the NRC, and since the NRC has accepted the concept at Palo Verde and there are substantial benefits to the change, the change is functionally equivalent and is acceptable.

4.2 Input/Output Equipment

The model 7/16 based CPC accomplished a variety of input/output functions through the "Multipurpose Acquisition and Control System" (MACS) built by Systems Engineering Laboratories. The functions include:

analog signal input
analog signal output
digital signal input
digital signal output
pulse signal input
data link input
data link output
watchdog timer
CRT display generator output

In the model 3205 based design, the MACS has been replaced because it is obsolete and is no longer manufactured.

4.2.1 Plant Signals

The plant signal input/output functions for the 3205 are accomplished by a Computer Products, Inc. Nuclear Equipment Qualified (NEQ) input/output subsystem. This subsystem is designed to accommodate:

analog signal input
analog signal output
digital signal input
digital signal output
pulse signal input
watchdog timer

Table 2 provides a comparison of specification values for the MACS and the NEQ. As can be seen from the table, the accuracy and noise immunity of the NEQ system are equivalent or superior to the existing MACS equipment.

The NEQ equipment has been qualified for other applications as Class 1E and has been field proven in numerous applications.

Based upon this operating history, the reliability of the input/output equipment is expected to be equivalent to or superior to the MACS, especially when the maintainability of the two systems is considered.

4.2.2 CEAC to CPC Data Links

In the MACS, the CEAC to CPC data links are accomplished through the use of 16 bit parallel, optically isolated, digital output cards at the CEAC, interfaced to 16 bit, optically isolated, digital input cards at the CPC.

In the 3205 based CPC system, the data links are accomplished by converting the data to a serial bit stream at the CEAC. The serial bit stream is then transmitted to the CPC across a fiber optic data link. At the CPC, the serial bit stream is converted back to a byte format. The serial fiber optic link concept has been implemented, licensed and is operating at C-E's System 80 Palo Verde Unit 1.

The serial fiber optic design has several major advantages over the current 16 bit, optically isolated, parallel links:

1. Standard Communication Link Hardware

   The use of standard RS-232 compatible hardware greatly improves the maintainability and useful life of the 3205 system.

2. Superior Isolation

   The use of a non-conducting fiber optic transmission medium in lieu of wire provides no possible path for electrical faults from channel to channel.

3. Improved Reliability

   The reliability of the 3205 based CPC is improved because the fiber optic design uses fewer components and eliminates the fusible resistors required to limit fault energy with the optical isolators.

Table 2

		MACS	CPI NEQ
Analog Input	Format	12 bits	14 bits
	Speed	10 K Samples per second	12 K Samples per second
	Noise Immunity	None	Surge protection per IEEE STD. 472-1974
Digital Input	Format	16 bit input word	16 bit input word
	Type	Opto-coupled	Opto-coupled
	Input protection & Noise Immunity	Input fuses	5 msec. filters & Surge protection per IEEE STD. 472-1974
Analog Output	Format	12 bit D/A converter	12 bit D/A converter
	Settling Time	100 microseconds	50 microseconds
	Full Scale Output Voltage	± 10 Volts	± 10.24 Volts
	Accuracy	± 0.25% Full Scale	± 0.025% Full Scale
Digital Output	Format	16 bit word	16 bit word
	Type	Electronic switch	Opto-coupled
Digital Output (Relay)	Format	9 Relays per card	16 Relays per card
	Contacts	8-SPST-dry reed 1-SPST-dry reed	SPST-dry reed
Pulse Input (from RCPSSS)	Type	16 bit counter	16 bit counter

4.2.3 Plant Computer Data Link

The existing plant computer interface utilizes a 16 bit optically isolated digital output card that is interfaced to a 16 bit optically isolated digital input card at the plant computer.

The new system will interface with the CAPS computer instead of the plant computer. CAPS is comprised of redundant systems which make it more reliable and more readily available for receipt of data from the CPCS.

Similar to the change made for the CEAC data links, the 3205 based system replaces the existing design with a serial data link utilizing fiber optic transmission to the CAPS computer. This concept has been designed, implemented and licensed and is operating at C-E's Palo Verde Unit 1 Nuclear Generating Station.

The change to the data link improves the isolation characteristics, reliability, maintainability and useful life of the new system as discussed above in the CEAC data link analysis.

4.2.4 CEA Position Optical Isolation Assembly

The 7/16 based system uses conventional analog isolation modules to isolate CEA position signals between redundant channels of the CPCS. Signals are transmitted between channels via wire conductors.

Due to obsolescence of the existing isolator assemblies, the 3205 based CPCS uses a fiber optically coupled system of receivers and transmitters. The transmitter takes a voltage signal input and converts it to a frequency modulated light signal. On the receiving end, the process is reversed with the light signal being converted back to a voltage. The use of a non-conduting fiber optic transmission medium in lieu of wire provided no possible path for electrical faults from channel to channel.

The change in isolation devices improves the isolation characteristics, reliability, and useful life of the new system.

4.3 Man-Machine Interface Equipment

The CPC man-machine interface supports the following operator and technician functions:

- Trip Channel Surveillance and Status Indication
- Calibration
- Periodic Test
- CEA Position Display

4.3.1 Operator's Module

In the 7/16 based CPC system, a custom designed, discrete circuit module was manufactured for mounting in the Main Control Room. This module interfaced to the computer by means of digital inputs and outputs from the MACS I/O System. There are four modules, one for each channel.

The 3205 system replaces this custom module with an operator's module designed around a standard touch screen Plasma Display Device that interfaces to the computer via a standard RS 232 serial data link, and to the input/output subsystem.

All of the current operator functions of the original operators module have been retained with the exception of the memory protect switch. Additional display functions that exploit the expanded capability of the plasma display have been added to improve the operator interface capability.

The security function provided by the memory protect switch has been implemented at the computer equipment location to improve maintainability and system security.

The numerical key pad, function buttons and digital display have been replaced with the touch screen, switch functions and display capability of the Plasma Display.

This implementation improves the module reliability, maintainability and useful life of the system because it uses standard components, standard interfaces and fewer components.

The proper functioning of the new Operator's Module will be verified during system tests including the NRC required tests in the phase 2 tests of CEN-39(A)-P.

The acceptability of the human factors elements of this design has been verified by a human factors evaluation.

The graphic display capability of the Plasma Display allows it to also provide the CEA position display function originally performed by means of the a CEA CRT. This design feature provides improved display capability while also increasing reliability and maintainability of the system by eliminating equipment associated with the CRT display.

4.3.2 Test and Maintenance

The CPC equipment is being relocated to a new room with improved personnel access and improved environmental control.

The test support equipment, previously consisting of floppy disks and a teletype, is being replaced and upgraded to a cartridge disk, CRT and hard copy terminal. These will be mounted on a maintenance support cart to improve the ease of maintenance. These devices are temporarily connected to the new CPCS test panels whenever maintenance testing is performed. At all other times, they are disconnected so they will not have any adverse impact on the operating system.

These modifications improve system reliability, maintainability and testability while providing the equivalent test and maintenance capability required in the original system.

4.3.3 CEAC Position Display

In the current 7/16 based CPC system, CEA positions are provided to the control room operators by the use of a Cathode Ray Tube (CRT) driven by a non-safety grade display generator. The display generator is controlled by one of the two CEA calculators (switch selectable) through a 16 bit optically isolated digital output card from the MACS.

For the new design the display CRT, display generators, wiring and output interface are eliminated. CEA position is now provided on the channels B & C CPC/CEAC operators modules utilizing Plasma Display Panels.

This design change improves the system reliability, maintainability and isolation by the elimination of the present equipment. The man-machine interface considerations of the new CEAC display are discussed above in Section 4.3.1.

4.4 <u>Cabinets and Cabling</u>

The 3205 CPC system will be enclosed in a new cabinet structure in a new building location. The new location was selected to improve access and environmental control.

The cabinets have been redesigned to reduce cable congestion and improve cooling air flow capability. Separate equipment and termination cabinets are provided for each channel, thereby keeping the majority of cables away from components that need to receive cooling.

Only CPC system equipment will be mounted in the new cabinet with the balance of the equipment remaining in the current 2C15 enclosure.

External cabling has been designed for separation of redundant channels. The same raceways used for the old system are employed for new cabling to a great extent.

These modifications will result in improvement to reliability and maintainability.

4.5 Environment and Interfaces

The 3205 based CPC system has been qualified to the Arkansas Nuclear One Unit 2 criteria and environment in accordance with the appropriate regulatory guides and IEEE standards. Test reports and analyses have been developed to document the acceptability of the new system.

4.5.1 Seismic Evaluation and Tests

The CPC equipment including the new enclosures and operator's modules has been tested and qualified consistent with the requirements of IEEE-STD-344. These are the same criteria used for the original system.

4.5.2 Temperature and Humidity Tests

An environmental testing program, comparable to that performed on the original system, has been performed on the new CPCS. The environmental conditions used as a design basis remain as stated for the new equipment location.

4.5.3 Electrical and Physical Isolation

The 7/16 based CPC system utilized 120 VAC fault testing to demonstrate the acceptability of the optical isolators for the data links.

In the 3205 based CPC, analysis of isolation will be utilized in lieu of tests due to the superiority of the non-conducting fiber optic cable to provide isolation. This approach was utilized for Palo Verde CPC's and was acceptable to the NRC. This approach is superior to the 7/16 based system.

4.5.4 120 VAC Electrical Power

The 120 VAC power interface to the new CPC equipment is equivalent to that provided for the old system. Channelized power circuits from the safety related 120 VAC power distribution system are connected to the new CPCS channels. Separation of channels is maintained.

4.5.5 Shielding and Grounding

The new CPCS employs a shield ground bus which is isolated from the rest of the system. A dedicated ground cable makes the connection to the plant ground grid. Signal shields are terminated so as to minimize the coupling of noise onto the signal wires. The new CPCS cabinets are electrically connected to the plant ground system for personnel protection. These features are equivalent to those in the existing system.

4.5.6 Radiated and Conducted Electromagnetic Noise

The CPC immunity to ambient noise has been verified by running equipment susceptibility tests and site surveys similar to those performed on the original system. The new cabinets have RFI/EMI gasketing around the doors to provide addition shielding from noise.

4.5.7 Process Noise

A formal process noise test program will not be performed on the new CPCS. The features and tests described in 4.5.5 and 4.5.6 make this unnecessary. The operating experience with the CPCS has demonstrated that system performance has not been adversely affected by signal noise. The performance of the new system will be monitored during startup to confirm this.

4.5.8 New CPC Room

The old CPCS is located in a room inside the ANO-2 controlled access area. To facilitate access to the new system, a new room has been constructed. The location which was selected is adjacent to the ANO-2 cable spreading room. A new wall which is designed to seismic and fire protection criteria will completely separate the CPC room from the cable spreading room.

To get to the new room, an individual will have to have an appropriate security access level. This will prevent unauthorized personnel from gaining access to the equipment.

The room includes other design features such as a computer room style false floor, halon fire protection and redundant air conditioning which are substantial improvements over the present set-up.

4.5.9 HVAC System

The old CPC room is cooled by a redundant, safety grade HVAC system. While the HVAC system for the new room is not safety grade, there are several reasons why this is justifiable. During the initial CPCS licensing process, emphasis was placed on having a redundant and reliable HVAC system, more so than its being safety grade. The CPCS is designed so it will fail in a tripped state. The CPCS does not have a post accident function. For some of the accidents analyzed in SAR Chapter 15, credit is taken for the CPCS promptly tripping the reactor. In these instances, the CPCS will generate a reactor trip signal in a matter of seconds following the initiation of the event. Once the reactor is tripped, the CPCS performs no further function. The new system has been environmentally tested to demonstrate that the new environment is adequate. Multiple alarms (1 controlled by tech.specs.) are provided for the new room and HVAC system to assure the proper environment is maintained.

The new HVAC system incorporates design features which will result in improvements in reliability. Two redundant, full capacity units, each powered from a diverse source, comprise the new system. Each unit contains redundant components. The false floor in the new room allows cooling air to be forced under the floor and up through the cabinets where it can efficiently remove heat.

4.5.10 Fire Protection

The only provision for fire protection in the old CPC room is the use of portable extinguishers. The new room has a halon suppression system. The area containing the new room was originally protected by the cable spreading room sprinkler system. With the construction of the 3-hour fire wall, the new room can be considered a completely separate area with its own stand-alone fire protection system.

4.6 Software Modifications

A design goal of the upgrade program is to minimize the amount of software changes. Because of the upward compatible instruction set of the 3205 and the capability of the assembler program utility to accommodate either a 16 bit or 32 bit "target" machine, this goal can be realized.

Even though the software design changes are minimized, the entire CPC software system was subjected to the complete range of software testing performed on the original system including phase 1 module tests and phase 2 integrated system tests to validate its correctness.

The CPC system is composed of four (4) types of software. These 4 types are:

1. Executive Software

   Software responsible for managing the computer's resources and program operating environments. It performs input/output operations and handles diagnostics and error conditions.

2. Application Software

   This software contains the algorithms responsible for CPC and CEAC mathematical and logical calculations.

3. Test and Diagnostic Software

   This software is utilized to test and maintain the computer hardware.

4. Utility Software

   This software is utilized to support the generation and test of CPC software.

4.6.1 Executive Software

The design structure of the 7/16 based executive is retained in the 3205 executive. Modifications to the programs are necessary to accommodate the following:

a. Change in Architecture

The CPC executive will be modified to accommodate the machine specific differences between the 7/16 and 3205. These changes include:

1. Low Memory Address Fault Traps
2. Memory Protect/Memory Address Translator
3. Configuration and Memory Addressability
4. Multiple Register Sets

b. Change in Peripheral Equipment

The executive must be modified to accommodate new peripheral equipment including:

1. NEQ Input/Output System
2. Fiber Optic Data Links
3. Plasma Panel Operators Module
4. Cartridge disc replacing floppy disc
5. CRT terminal with hard copy printer replacing teletype
6. PROM Reload Device

c. Change in On-Line Diagnostics

There are no changes to on-line diagnostic functions

To verify the acceptability and correctness of these changes Phase 1 and 2 tests required by CEA-39(A)-P have been performed and analyzed.

4.6.2 Application Software

No modification to the applications programs logic is being made.

The method by which application programs communicate with the executive is changed. Relationships between programs that were formerly implemented with absolute addresses will now be implemented by symbols improving the maintainability of the program.

Phase 1 and Phase 2 tests have been performed in their entirety to verify the correct operation of these programs in the new computer environment.

4.6.3 Test and Diagnostic Software

These off line programs are replaced with the programs pertinent to the new hardware. Periodic test software has been modified to interface with the new hardware. In addition, the executive has an improved interface with the test functions for improved testability and maintainability. The correct operation of the periodic test function has been verified during phase 2 testing.

The response time testing software supplied with the new system employs a different approach to measuring the system response time. The new method measures only the delay time associated with the hardware. The old method accounted for both hardware and software delays. The software response time is determined by CE during the software qualification process. By adding this time to the time measured with the new testing method, the total response time can be determined. Thus, the new method is functionally equivalent to the old method.

4.6.4 Utility Software

Modifications and/or substitutions to the utility programs used in the design, code, assembly, link, load and test have been made to accommodate the new hardware environment and to improve the efficiency and quality of the design process.

These programs have been retested and certified and are reflected in the modified detailed software change procedure.

4.7 <u>Single Channel Facility</u>

A new single channel facility as required by CEN-39(A)-P has been fabricated, tested and certified at C-E's facility.

The test and certification process utilized is functionally identical to that performed for qualification of C-E's CPC facility for System 80 CPCs, which was reviewed and approved by the NRC.

Appropriate changes have been made to design procedures to accommodate the new hardware. These procedures have been documented and verified. The NRC has indicated that these procedures no longer require review as long as the guidelines of CEN-39(A)-P are met.

5.0 CONCLUSION

The description and comparison provided in sections 4.1 through 4.7 above have demonstrated that:

1. The new 3205 based CPC system is functionally identical to the original 7/16 CPC system with improvements in certain areas that do not degrade the safety related functions.

2. The performance, reliability, noise immuni[illegible] maintainability, isolation capability and useful life of the new 3205 based CPC is equal to or superior to the current 7/16 based CPC system.

3. The new CPC system has been completely qualified and tested, both hardware and software, to standards imposed on the original system to verify its performance and physical integrity.

4. The man-machine interface of the new 3205 CPC system is equal to or superior to the original 7/16 based CPC system.

5. The licensing basis review documented in Appendix B demonstrates that the new 3205 based CPC system satisfies the appropriate IEEE Standards, NRC Regulatory Guides, and the 27 NRC Regulatory Positions to an extent that is equal to or superior to the original 7/16 based CPC.

Based upon these analyses it can be stated that:

(i) The change to the CPC system does not increase the probability of occurrence or consequence of an accident or malfunction of equipment previously evaluated in the safety analysis.

(ii) The change to the CPC system does not create the possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report.

(iii) That the change to the CPC system does not reduce the margin to safety as defined in the basis for any technical specification.

Thus, the changes do not constitute an unreviewed safety question as defined by 10CFR50.59 and by the Arkansas Power and Light Policy Statement or Application of 10CFR50.59 dated 7/14/86.