Attachment 1

Results of the "1,000-hour Test" after SPDS

Implementation for Confirmatory Review

NPPD SITE AVAILABILITY TEST REPORT

07 April 1986

1.0 Purpose

The purpose of this report is to describe the results of the 1000 hour Availability Test. Included with this Test Report will be the following Attachments:

a. Revised Availability Test Plan (2/20/86)
b. Test Logs
   i. PMIS Availability Test Log (PATL)
   ii. PMIS Availability Test Problem Report (PATPR)
c. Problem reports written during Availability
d. A list of spare parts used
e. A list of accumulated outage time (included on the PMIS Availability Test Log)
f. A list of accumulated hold time (included in the PMIS Availability Test Log)
g. A calculation of system availability.

The Availability Test took place on 21 February 1986 through 04 April 1986 at Cooper Nuclear Station (CNS) Brownsville, Nebraska.

2.0 Test Objectives

The objective of the NPPD Availability Test was to have at least 99.5 percent system availability for the 1000 hour test. The purpose of the Availability Test is to demonstrate that the system, as installed, provides a high degree of availability in a normal plant operating environment.

3.0 Test Environment

The Availability Test was performed at the Cooper Nuclear Station, using the DEC Computers and other associated hardware in their final configuration.

4.0 Test Tools

No special tools or test equipment were used during the Availability Test.

5.0 Test Results

During the Availability Test, the total run time was 1005.73 hours. This includes 5 hours 11 minutes of accumulated hold time and 33 minutes of accumlated outage time. Two problem reports were written during the test. These are PATPR 1 and PATPR 2 which are attached to this test report.

The System Availability Test was completed successfully on 04 April 1986 with an availability of 99.945%.

6.0 Spare Parts

No spare parts were drawn from the DISTRICT's inventory; however Digital Equipment Company provided two disk packs under the maintenance agreement.

Disks DUL0 and DUL1 were replaced on the "B" system.

7.0 Attendance

The following is a list of personnel who were directly involved in the NPPD Availability Test:

Mike Culjat	NPPD
Leo Parks	NPPD
Mel Hawkins	NPPD (I&C)
Pete Sukup	NPPD
Jeff Jones	NPPD
Paul Ballinger	NPPD
Ray Perterson	NPPD
Jay Scheuerman	NPPD
Control Operator Personnel	NPPD
Daniel Pate	SAIC (HSV)
David Chandler	SAIC (HSV)
Allen Massey	SAIC (ALT)

ATTACHMENT A

AVAILABILITY TEST PLAN

(REVISED 2/20/86)

1. INTRODUCTION

This test plan defines the conduct, rules, and record keeping requirements associated with the availability test for the SAIC supplied PMIS system installed and operational at NPPD's Cooper Nuclear Station.

The purpose of this availability test is to demonstrate that the system, as installed, provides a high degree of availability in a normal plant operating environment.

This test plan concentrates on the definition and record keeping requirements associated with the conduct of this Availability demonstration. No special tools or test equipment is required and the intent is to minimize impact on DISTRICT personnel in their day to day plant operations consistent with obtaining the data required to clearly document whether or not the Availability objectives have been successfully achieved.

Previous system testing, including both Factory and Site Acceptance Tests, have demonstrated that the supplied system is in compliance with the requirements of the Contract Statement of Work. As such, this availability test does not attempt to reverify individual program or component accuracies. Any problem of this type that is detected during the Availability Test will be expeditiously addressed and resolved by SAIC but will not in any way impact the conduct or successful completion of the availability test. During this test SAIC will support NPPD requested data base changes per the existing Site Procedures. NPPD will be allowed normal access to the backup system, but no program development activity will be allowed on the primary system. Only those items as defined under "Accumulated Outage Time" of this test plan will count against SAIC in the completion of availability statistics to meet the availability test requirements. ~~Those items as defined under "holdtime" have specific provisions where considerable amounts of holdtime may result in the accumulation of small amounts of Accumulated Outage Time.~~ CNP 2/20/86 Dmf

2. SPECIFIC RULES FOR THE AVAILABILITY TEST

This test plan is governed by the existing NPPD Statement of Work. During the evolution of this test plan, certain SOW provisions, such as the definition of downtime for hardware maintenance, have been specifically modified and agreed to by both parties to represent a "practical" realization of the S.O.W. requirements.

Test CNP 2/20/86 Dmf

A. This availability will start at a time and date that is mutually agreeable to SAIC and NPPD, but in no case will be initiated until the following requirements have been met. SAIC will not be held liable for NPPD's readiness to initiate this Availability Test.

   1. All SAIC supplied personnel training associated with this contract will be complete (except SAIC 201/501).

   2. All SAIC supplied spare parts associated with this contract will have been delivered to CNS.

   3. All SAIC supplied software and system documentation associated with this contract will have been delivered to CNS as specified in Part 1, Paragraph 5.3 of the SOW.

~~B. No minimum time shall be charged against any occurrence except as defined under "holdtime" in this test plan.~~ CNP

Dmf

2/20/86

C. Alteration to SAIC supplied software shall not be permitted unless required to correct an error. These alterations must be approved by SAIC prior to implementation.

D. Alterations to the hardware shall not be permitted unless required to correct a failure, or in the opinion of SAIC, such changes will improve system reliability.

E. Availability test logs and records as defined in this test procedure will be maintained by DISTRICT personnel.

F. During the availability test the DISTRICT or its authorized agents will operate and maintain the PMIS system in accordance with SAIC supplied documentation and procedures. The DISTRICT or its authorized agents will supply qualified service engineers or agents to perform all required system maintenance, both preventative and remedial.

G. SAIC shall support the DISTRICT by providing a service representative on-call 24 hours/day, 7 days/week for duration of the availability test.

H. Outages resulting from causes external to the computer system, caused by negligence, misoperation, or misuse or abuse of the computer system by employees or agents of NPPD, or due to exceeding environmental and input specifications applicable to the equipment, shall not be charged as accumulated outage time but shall be accrued as holdtime.

I. All accumulated outage time, holdtime; and system operating time shall be mutually agreed upon by the DISTRICT and SAIC.

J. All spare parts used during the availability test will be drawn from the DISTRICT inventory purchased with the system. SAIC will repair or replace all spares used during the test. If a part is required which is not in inventory, due to the failure of SAIC to recommend appropriate spare parts, the system will be considered down until the part is obtained. The part will be repaired/replaced and an additional unit placed into the inventory at no cost to the DISTRICT.

K. SAIC will have ready access to the DISTRICT's Availability Test log at all times.

3. TEST DEFINITIONS

A. SYSTEM AVAILABILITY - The system availability shall be at least 99.5 percent for the 1000-hr test. Availability is calculated as follows:

$$\text{AVAILABILITY (PERCENT)} = ((TDT-AOT)/TDT)*100$$

B. TEST DURATION TIME (TDT) - Total elapsed time from start of test to completion of test excluding holdtime. This time shall be a minimum of 1000 hours.

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TDT = Tt - Th

Tt = time the PMIS system is undergoing the test
Th = time declared as holdtime

C. ACCUMULATED OUTAGE TIME (~~ADT~~ AOT) - Accumulated Outage Time occurs whenever any system function, hardware or software, is unavailable in the Control Room, TSC or EOF. AOT is not accumulated when the function unavailability is caused by holdtime except as defined in this test plan. In the event of multiple failures, the total elasped time required for the DISTRICT or its authorized agents to repair all problems, ~~per the definition in Item 5 of this Section~~, will be counted as AOT regardless of the number of maintenance personnel available.

AOT will ~~only~~ accumulate under the following circumstances and as defined in section "D"

1. Loss of any "critical inputs" required for SPDS displays due to the failure of any SAIC-specified equipment.

   Critical inputs are defined to include:

B000	F085	N026	N038	N079	N797
B001	G032	N027	N040	N082	N798
B002	G033	N028	N041	N083	N799
B003	N011	N029	N042	N084	N800
B004	N012	N030	N043	N085	N801
B005	N013	N031	N061	N276	N802
B021	N014	N032	N062	N277	N803
D530	N017	N033	N063	N627	N804
D531	N018	N034	N065	N628	N806
D554	N023	N035	N069	N629	N807
D555	N024	N036	N073	N630	
F084	N025	N037	N074	N631	
	N019	N021		N632	
	N020	N022		N633	

2. Loss of entire multiplexor, both IRCU's not communicating with Host Computer.

3. Loss of both host processors or data concentrators. The loss of a single processor or data concentrator will not require downtime since automatic failover of all functions and peripherals is provided.

4. Loss of the ability for an operator or engineer to be able to access the system from at least one terminal in either the Control Room, Technical Support Center, or Emergency Operations Facility due to failure of a disk drive or other peripheral device. This item is further amplified in Item 6, below.

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5. Loss of SPDS functions due to a peripheral switch failure.

6. Loss of all CRT displays and printer at one or more locations: Control Room, TSC and the EOF.

As a minimum, one CRT and the printer will be operable in the Control Room and the TSC, and the CRT or printer in the EOF will be operable in order to avoid accumulation of AOT per the definition given below.

AOT will start to accumulate from the time that the DISCTICT's qualified service man or its authorized agent starts to correct the failure.

AOT will not accumulate for any period of time that a qualified service man is not actively working on problem correction.

Any repairs requiring call-out for SAIC service shall not be counted as outage time until the SAIC representative has arrived or 24 hours have elasped, whichever occurs first.

AOT will not be accumulated for the brief periods of time when a system failover is taking place if failover is successful.

The time between equipment failure detection and initiation of corrective action by the qualified DISTRICT service man or its authorized agent will be counted as holdtime. In the event of SAIC call-out, this holdtime may be up to twenty-four hours in duration.

All times will be recorded to the nearest minute.

In the event that the accumulated outage time (AOT) exceeds 5 hours, the test start time shall be shifted to delete some of the previous outage until the accumulated outages during the 1000-hour test no longer exceeds 5 hours. The shifted start time shall be mutually agreed upon between the DISTRICT and SAIC.

In order to establish that all failures have been satisfactorily repaired no AOT will have occurred within the last 240 hours of the conclusion of the test. The test may have to be extended to satisfy this requirement.

Any time the system is down due to a noncomputer-related event, such as power failure, this time will not be counted as outage time. See the section on availability run "holdtime".

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D. HOLDTIME - During a test of this nature, certain contingencies may occur which otherwise would cause the system to be accumulating outage time (AOT), but which are not valid for the purpose of measuring system availability. Such periods of AOT may be declared "holdtime" by mutual agreement of the DISTRICT and SAIC. These periods will not be considered in availability statistics for acceptance purposes. Specific instances in which a holding period may be declared are:

1. POWER INTERRUPTION/ENVIRONMENTAL EXCURSION: Loss of power or manual shutdown in the event of loss of environmental control will be considered holdtime. If the system is operated during the periods of power or environmental conditions beyond those specified, any resultant outage time will not be counted.

2. INTERMITTENT FAILURE: Periods during which an intermittent, recurring software or hardware failure is experienced will be considered holdtime, providing SAIC is actively engaged in remedial action and normal functions can be restored by a partial system restart whenever the failure occurs. In lieu of accounting for the actual intermittent outage time which might occur during such a period, one hour of AOT will be counted for each 101 hours of otherwise successful operation while the problem persists.

3. CORRECTED DESIGN DEFECT: Holdtime may be declared by mutual agreement, if a failure occurs due to a defect in the hardware design for which SAIC defines and implements corrective measures to ensure against similar future occurrences. In such cases, holdtime will be allowed in increments of 120 hours so as to effectively extend the test period to allow verification of the corrective action.

4. LOGISTICS DELAYS: In the event of delays in completing repairs which would otherwise accumulate AOT due to lack of SAIC recommended spare parts in the DISTRICT inventory, holdtime may be declared by mutual agreement if the delay is beyond the control of either party and if SAIC is pursuing replacement parts in an expeditious fashion. One hour of AOT and ~~operating time~~ will be counted for each 25 hours of holdtime under these circumstances. Total Test Time (T_T) this DMF

5. SCHEDULED SHUTDOWN/PERVENTATIVE MAINTENANCE: During scheduled shutdowns, preventative maintenance, or if an equipment failure occurs while its backup device is scheduled out of service, the resulting system outage will be considered holdtime, providing that service can be restored according to SAIC procedures within 60 minutes. RE CH DMF If holdtime exceeds 60 minutes ~~than the whole time is~~ considered AOT. CH DMF

6. FAILURE OF DISTRICT SUPPLIED SOFTWARE: Time during which the system is down due to failure of software written by the DISTRICT will be considered holdtime. ~~(Note that the DISTRICT Integrated Software by SAIC does not apply to this test provision.)~~ DMF Such periods will be kept as short as possible so as not to interfere with the availability test. If a failure in such software cannot be overcome by a system restart, execution of the failed program will be suspended.

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7. SERVICE RESPONSE TIME: A maximum 24 hours holdtime will be allowed for SAIC to respond to each call for maintenance support. The time between the detection of a failure and the start of diagnostic procedure, when performed by the DISTRICT personnel, will also be considered holdtime.

E. TEST SATISFACTION - After 1000 hours of cumulative test time have elapsed, the test records will be examined to determine conformance with the availability criteria. If the test objectives have not been met, the test will be extended until the specified availability is achieved.

F. AVAILABILITY TEST LOG - SAIC will supply the Availability Test Log Notebook. DISTRICT personnel will maintain the Availability Test Log which will include, at the minimum, a listing of all system problems/failures that are potential candidates for accumulating AOT or holdtime. Each entry will include:

1. Problem description in adequate detail that DISTRICT or SAIC personnel could effectively troubleshoot.

2. Time problem "detected."

3. Time corrective action initiated by qualified DISTRICT personnel.

4. Any subsequent time span time during which qualified DISTRICT personnel were not actively engaged in solving the problems.

5. Identification of DISTRICT personnel working on the problem resolution.

6. Identification of all corrective action taken, i.e.: diagnostics run, boards replaced, etc.

7. Identification of all spare parts used, replaced, or added to the spare parts inventory.

8. Time problem corrected or system restored to service whichever occurs first.

9. Room for SAIC concurrence with AOT/Holdtime declaration.

G. TEST REPORT - SAIC will prepare a test report at the conclusion of the availability test that will include:

1. The availability test plan.

2. DISTRICT maintained Availability Test Log signed by the DISTRICT and SAIC.

3. A listing of all failures and problems encountered during the test, and the resolution of same.

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4. A list of all spare parts used, replaced or added to the spare parts inventory.

5. A list of all AOT, with causes and resolutions.

6. A listing of all holdtime, with causes and resolutions.

7. A calculation of system availability.

TEST PLAN CONCURRENCE:

SAIC: Daniel M. Pate

DISTRICT: C. M. Michel

DATE: 2/20/86

The changes in the body of the availability Test Plan were made and agreed to during the Telephone conversation of 2/19/86 between the following people:

Jim Murphy – NPPD
Roy Peterson – NPPD
Mike Hooker – NPPD
Curt Goeke – NPPD-CNS
Dan Pate – SAIC
John Skinner – SAIC
Paul Buck – SAIC

2/20/86

ATTACHMENT B

PMIS AVAILABLITY TEST LOG (PATL)

COOPER NUCLEAR STATION (CNS)

DATE (MM/DD/YY)	START TIME (HH:MM)	STOP TIME (HH:MM)	TIME CODE* (SEE BELOW)	AMOUNT HT THIS OCCUR (MIN)	AMOUNT OT THIS OCCUR (MIN)	AMOUNT SOT THIS OCCUR (HR)	AMOUNT AHT TO DATE (HR)	AMOUNT AOT TO DATE (HR)	AMOUNT SOT TO DATE (HR)	CONCURRENCE		COMMENT OR PATPR NUMBER
										SAIC	CNS	
2-21-86	08:00	24:00	SOT	—	—	16:00	—	—	16:00	Dmf	TWC	
2-22-86	00:00	24:00	SOT	—	—	24:00	—	—	40:00	Dmf	TWC	
2-23-86	00:00	24:00	SOT	—	—	24:00	—	—	64:00	Dmf	TWC	
2-24-86	00:00	24:00	SOT	—	—	24:00	—	—	88:00	Dmf	TWC	
2-25-86	00:00	24:00	SOT	—	—	24:00	—	—	112:00	Dmf	TWC	
2-26-86	00:00	12:30	SOT	—	—	12:30	—	—	124:30	Dmf	TWC	
2-26-86	12:30	12:33	OT	—	:03	—	—	:03	124:30	Dmf	TWC	#1
2-26-86	12:33	13:00	HT	:27	—	—	:27	:03	124:30	Dmf	TWC	#1
2-26-86	13:00	24:00	SOT	—	—	11:00	:27	:03	135:30	Dmf	TWC	
2-27-86	00:00	24:00	SOT	—	—	24:00	:27	:03	159:30	Dmf	TWC	
2-28-86	00:00	24:00	SOT	—	—	24:00	:27	:03	183:30	Dmf	TWC	
3-1-86	00:00	24:00	SOT	—	—	24:00	:27	:03	207:30	Dmf	TWC	
3-2-86	00:00	24:00	SOT	—	—	24:00	:27	:03	231:30	Dmf	TWC	
3-3-86	00:00	08:00	SOT	—	—	8:00	:27	:03	239:30	Dmf	TWC	

PATL = PMIS AVAILABILITY TEST LOG

PATPR = PMIS AVAILABILITY TEST PROBLEM REPORT

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SOT = SYSTEM OPERATING TIME

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COOPER NUCLEAR STATION (CNS)

DATE (MM/DD/YY)	START TIME (HH:MM)	STOP TIME (HH:MM)	TIME CODE* (SEE BELOW)	AMOUNT HT THIS OCCUR (MIN)	AMOUNT OT THIS OCCUR (MIN)	AMOUNT SOT THIS OCCUR (HR)	AMOUNT AHT TO DATE (HR)	AMOUNT AOT TO DATE (HR)	AMOUNT SOT TO DATE (HR)	CONCURRENCE		COMMENT OR PATPR NUMBER
										SAIC	CNS	
3-3-86	08:00	08:30	OT	-	30	-	:27	:33	239:30	Dmf	mjc	#2
3-3-86	08:30	10:15	HT	105	-	-	2:12	:33	239:30	Dmf	mjc	#2
3-3-86	10:15	14:46	SOT	-	-	4:31	2:12	:33	244:01	Dmf	mjc	
3-3-86	14:46	14:52	HT	6	-	-	2:18	:33	244:01	Dmf	mjc	#2
3-3-86	14:52	24:00	SOT	-	-	9:08	2:18	:33	253:09	Dmf	mjc	
3-4-86	00:00	24:00	SOT	-	-	24:00	2:18	:33	277:09	Dmf	mjc	
3-5-86	00:00	24:00	SOT	-	-	24:00	2:18	:33	301:09	Dmf	mjc	
3-6-86	00:00	24:00	SOT	-	-	24:00	2:18	:33	325:09	Dmf	mjc	
3-7-86	00:00	24:00	SOT	-	-	24:00	2:18	:33	349:09	Dmf	mjc	
3-8-86	00:00	24:00	SOT	-	-	24:00	2:18	:33	373:09	Dmf	mjc	
3-9-86	00:00	15:04	SOT	-	-	15:04	2:18	:33	388:13	Dmf	mjc	
3-9-86	15:04	15:07	HT	3	-	-	2:21	:33	388:13	Dmf	mjc	#1
3-9-86	15:07	24:00	SOT	-	-	8:53	2:21	:33	397:06	Dmf	mjc	
3-10-86	00:00	24:00	SOT	-	-	24:00	2:21	:33	421:06	Dmf	mjc	

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DATE (MM/DD/YY)	START TIME (HH:MM)	STOP TIME (HH:MM)	TIME CODE* (SEE BELOW)	AMOUNT HT THIS OCCUR (MIN)	AMOUNT OT THIS OCCUR (MIN)	AMOUNT SOT THIS OCCUR (HR)	AMOUNT AHT TO DATE (HR)	AMOUNT AOT TO DATE (HR)	AMOUNT SOT TO DATE (HR)	CONCURRENCE		COMMENT OR PATPR NUMBER
										SAIC	CNS	
3-11-86	00:00	24:00	SOT	-	-	24:00	2:21	:33	445:06	Dmf	mrc	
3-12-86	00:00	13:15	SOT	-	-	13:15	2:21	:33	458:21	Dmf	mrc	
3-12-86	13:15	16:05	HT	170	-	-	5:11	:33	458:21	Dmf	mrc	#1
3-12-86	16:05	24:00	SOT	-	-	7:55	5:11	:33	466:16	Dmf	mrc	
3-13-86	00:00	24:00	SOT	-	-	24:00	5:11	:33	490:16	Dmf	mrc	
3-14-86	00:00	24:00	SOT	-	-	24:00	5:11	:33	514:16	Dmf	mrc	
3-15-86	00:00	24:00	SOT	-	-	24:00	5:11	:33	538:16	Dmf	mrc	
3-16-86	00:00	24:00	SOT	-	-	24:00	5:11	:33	562:16	Dmf	mrc	
3-17-86	00:00	24:00	SOT	-	-	24:00	5:11	:33	586:16	Dmf	mrc	
3-18-86	00:00	24:00	SOT	-	-	24:00	5:11	:33	610:16	Dmf	mrc	
3-19-86	00:00	24:00	SOT	-	-	24:00	5:11	:33	634:16	Dmf	mrc	
3-20-86	00:00	24:00	SOT	-	-	24:00	5:11	:33	658:16	Dmf	mrc	
3-21-86	00:00	24:00	SOT	-	-	24:00	5:11	:33	682:16	Dmf	mrc	
3-22-86	00:00	24:00	SOT	-	-	24:00	5:11	:33	706:16	Dmf	mrc	

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										SAIC	CNS	
3-23-86	00:00	24:00	SOT	—	—	24:00	5:11	:33	730:16	Dmf	mjc	
3-24-86	00:00	24:00	SOT	—	—	24:00	5:11	:33	754:16	Dmf	mjc	
3-25-86	00:00	24:00	SOT	—	—	24:00	5:11	:33	778:16	Dmf	mjc	
3-26-86	00:00	24:00	SOT	—	—	24:00	5:11	:33	802:16	Dmf	mjc	
3-27-86	00:00	24:00	SOT	—	—	24:00	5:11	:33	826:16	Dmf	mjc	
3-28-86	00:00	24:00	SOT	—	—	24:00	5:11	:33	850:16	Dmf	mjc	
3-29-86	00:00	24:00	SOT	—	—	24:00	5:11	:33	874:16	Dmf	mjc	
3-30-86	00:00	24:00	SOT	—	—	24:00	5:11	:33	898:16	Dmf	mjc	
3-31-86	00:00	24:00	SOT	—	—	24:00	5:11	:33	922:16	Dmf	mjc	
4-1-86	00:00	24:00	SOT	—	—	24:00	5:11	:33	946:16	Dmf	mjc	
4-2-86	00:00	24:00	SOT	—	—	24:00	5:11	:33	970:16	Dmf	mjc	
4-3-86	00:00	24:00	SOT	—	—	24:00	5:11	:33	994:16	Dmf	mjc	
4-4-86	00:00	5:44	SOT	—	—	5:44	5:11	:33	1000:00	Dmf	mjc	

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ATTACHMENT C

PMIS AVAILABILITY TEST PROBLEM REPORT (PATPR) NO. 1 PAGE 1 OF 3

NOTE: ALL times to be in 24 hour format - use PMIS time if available. Use continuation sheet if necessary.

DATE & TIME DETECTED 2-26-86 12:30 DETECTED ON Disks

DETECTED BY (NAME) D Pate PRIMARY = / BACKUP = ____

DESCRIPTION OF PROBLEM: System was up and running but response was slow and getting worse. At 12:30 there was virtually no response. We initially thought the system disk or B was lost investigation showed both disks on B communicating. We have seen this problem before. Either something of extremely high priority grabs the disk or there is a hardware problem.

SPARE PARTS USED: RA81 Disks or DUL0: DUL1: were replaced by DEC.

PROBLEM CORRECTED AND SYSTEM RETURNED TO NORMAL (DATE & TIME)

OUTAGE TIME :07
HOLD TIME 3:20

NPPD CONCURRANCE (NAME / DATE) M T Pulpit / 3-20-86

SAIC CONCURRANCE (NAME / DATE) Daniel M. Pate / 3-24-86

START/STOP TIME & DATE	INITIALS	CORRECTIVE ACTION TAKEN
12:30 2-26-86	MTC	Immediately identified problem as one we had seen before once we saw both disks communicating. Since the system would have to be manually "failed over" to get it into a useful state we declared 3 minutes down time.
12:33 2-26-86	MTC	
12:17 2-26-86	MTC	Could not get the system to a failover was found at 12:17. The power to B disks was cycled several times. B was brought back up. The system was returned to

PMIS AVAILABILITY TEST PROBLEM REPORT (PATPR) NO. 1 PAGE 2 OF 7
(Continuation Sheet)

START/STOP TIME & DATE	INITIALS	CORRECTIVE ACTION TAKEN
		the B machine. Everything was again working properly. Called DEC in Canada to ask about possible HSC problems. DEC made several calls back to CNS + passed to their Colorado Support Center. They have a set of diagnostics they can run from Colorado if problem returns. This will require the machine be left in its "locked up" condition while they do their troubleshooting. Contact Ernie Babis
12:30 2-26-86	MTC	of Canada DEC Office (530-5710) for help.
15:04 3-9-86	MTC	System response again became unacceptable. A Pats failed over to B machine. Problem went away. Brought B up as backup. (2 min of Held Time)
15:07 3-9-86	MTC	
09:00 3-11-86	MTC	Called DEC about problem after checking a terminal on the B machine. Problem did not appear to be line. Can down error report from terminal on B Disks/HSC 50's to DEC. They feel it may be a simple alignment problem with the heads. They will come down and troubleshoot
10:00 3-11-86	MTC	
14:00 3-11-86	MTC	DEC performed diagnostics on B HSC 50 + DUA0: A hardware problem has been identified with DUA0: disk drive. It must be replaced. It will take (at) 2 days for the new one to arrive
16:00 3-11-86	MTC	

PMIS AVAILABILITY TEST PROBLEM REPORT (PATPR) NO. 1 PAGE 3 OF 3
(Continuation Sheet)

START/STOP TIME & DATE	INITIALS	CORRECTIVE ACTION TAKEN
13:15 3-12-86	MRC	DEC arrived around 11:00 today to replace the
↑		disks on "B" side. In order to accomplish this
		the "A" side had to be brought down also in
		order to back-up the "B" user disk (i.e. "A" had
		it open for read). Therefor, hold time was
		declared at 13:15 to facilitate this. At
		16:05 "A" CPU had been restarted and
		was up as primary stand alone.
		Shortly there after "B" was brought
		up as backup. It looks as if the
↓		new disks on B were properly backed
16:05 3-12-86	MRC	up. This should solve the problem

PMIS AVAILABILITY TEST PROBLEM REPORT (PATPR) NO. 2 PAGE 1 OF 3

NOTE: ALL times to be in 24 hour format - use PMIS time if available. Use continuation sheet if necessary.

DATE & TIME DETECTED 3-2-96 0900 DETECTED ON SPDC Displays

DETECTED BY (NAME) C. Siebel PRIMARY = / BACKUP = ____

DESCRIPTION OF PROBLEM: At 0900 S. Dunlap informed C. Siebel various points on the SPDC displays were not updating. We were later informed this had been going on for several hours. Using "Point Value" showed how to find "Bad" quality but no change in input signal value. At the DC the same points were shown to have a changing count rate.

SPARE PARTS USED: None

PROBLEM CORRECTED AND SYSTEM RETURNED TO NORMAL (DATE & TIME)

OUTAGE TIME 1:30
HOLD TIME 1:51

NPPD CONCURRANCE (NAME / DATE) M T Pulgar / 3-20-96

SAIC CONCURRANCE (NAME / DATE) Daniel M. Pate / 3-24-96

START/STOP TIME & DATE	INITIALS	CORRECTIVE ACTION TAKEN
0900 3-2-96	MTC	Checking the console output showed the following:
↑		The backup had gone down on 3-1-96 at 22:20:00.11.
		We were not informed of this. Also A+B DC had
		been marked off-line several times over the
		weekend. B DC was presently in control. It
↓		was decided at 0900 a failover to A DC would
0900 3-2-96	MTC	probably correct the problem for now. (30 Min. OT)
0930 3-2-96	MTC	(Two common factors in all non-updating
↑		points appeared to be Link 1, Concept point
		we found not updating was on this link

PMIS AVAILABILITY TEST PROBLEM REPORT (PATPR) NO. 2 PAGE 2 OF 3
(Continuation Sheet)

START/STOP TIME & DATE	INITIALS	CORRECTIVE ACTION TAKEN
		We made several calls to Huntsville (AIC supports the HI) about the new boards used in B DC. Shortly after 10:00 we swapped from B to A DC while watching a point that was not updating. The point began responding properly. We then switched back to B and the point no longer updated. At 10:15 we swapped back to A DC and called the system up and operating. The Global Firmware Board was removed from B DC for inspection. If A DC fails now we will have more system Outage Time.
		This item will remain open till some resolution is reached for the HI boards.
		Other items we had noted were:
		1) The Event state was Auto for one known reason. The checkpoint file showed it was activated on 3-2-86 at 05:40:40:01.
		2) The TM monitor display showed 60% CPU usage but the # of processing cycles each second ranged from 8 to 10. Also, the number of points processed was much lower than expected (see attached).
		3) A VAX was brought up as backup at OPSO.
10:15 3-3-86	TMC	
14:46 3-3-86	TMC	At 14:46 we declared HT for trouble shooting

PMIS AVAILABILITY TEST PROBLEM REPORT (PATPR) NO. 2 PAGE 3 OF 3
(Continuation Sheet)

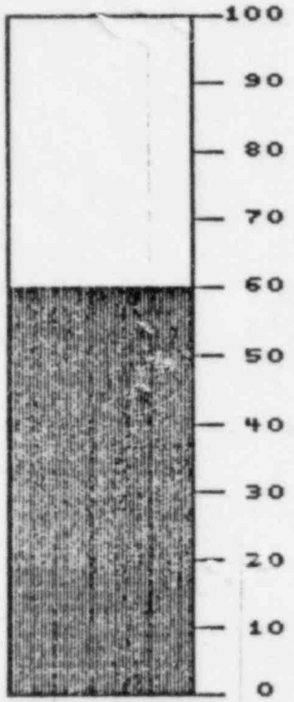
START/STOP TIME & DATE	INITIALS	CORRECTIVE ACTION TAKEN
		I Parks forced BDS to become primary in
1452 2-2-96	JMC	order to observe findings + report to SAIC.
0900 3-5-96	JMC	Just before investigators closed the
		problem to be switch 2 of switch
		bank S1 on the System Monitor Board
		in the position. The switch was reset,
		system tested and the problem was
09:00 3-5-96	JMC	considered solved around 09:00.

SELECT PANC. KEY OR TURN-ON CODE PM

3-MAR-1986
08:34:12 E

PMIS PERFORMANCE MONITOR

CPU UTILIZATION



ARCHIVE FILE STATUS

ARCHIVE FILE IS 22. % FULL

REMOTE SYSTEM STATUS

	YES	NO
THE BACKUP SYSTEM HAS FAILED	☑	☐
FAILOVER HAS OCCURED	☑	☐

POINT PROCESSING SUMMARY

NUMBER OF ANALOG PTS/SEC	462.
NUMBER OF DIGITAL PTS/SEC	928.
NUMBER OF PULSE PTS/SEC	2.
NUMBER OF PA PTS/SEC	15.
NUMBER OF BOOLEAN PTS/SEC	9.
NUMBER OF TRANSFORM PTS/MIN	0.
NUMBER OF AO PTS/SEC	0.
NUMBER OF DO PTS/SEC	0.
NUMBER OF ARCHIVE TRAN LAST SEC	48.
NUMBER OF ALARM TRAN GEN LAST SEC	2.
NUMBER OF SOE'S PROC LAST SEC	0.
TOTAL NUMBER PTS PROC LAST SEC	1416.
NUMBER OF PROCESSING CYCLES/SEC	8.
DATA CONCENTRATOR "A" STATUS	NORMAL
DATA CONCENTRATOR "B" STATUS	NORMAL

CPU M | REACTIVITY CONTROL | CORE COOLING | COOLANT SYSTEM INTEGRITY | CONTAINMENT INTEGRITY | RADIOACTIVE RELEASE

F1=CLEAR PREV CANC ↑ ↓ F2= F3=MENU HARDCOPY=BUSY F4= CONSOLE=PRIMARY F5= MODE=RUN F6= EVENT=AUTO

ATTACHMENT D

SPARE PARTS

No spare parts were drawn from the District's inventory. Digital Equipment Company replaced two disk packs (DUL0 & DUL1) under the Maintenance Agreement.

ATTACHMENT E

SYSTEM AVAILABILITY

TDT = Test Duration Time = Total elapsed time from start to completion of test excluding holdtime

Tt = Time the PMIS System is undergoing the test I.E. System Operating Time (SOT) + Acc. Hold Time (AHT) + Acc. Outage Time (AOT).

AOT = Accumulated outage time - This occurs whenever any system function, hardware or software, is unavailable in the control room, TSC or EOF.

TH = Time declared as hold time

Tt = 1000 + 5.183 + .550
Tt = 1005.733 Hours
TDT = Tt - TH
TDT = 1005.733 - 5.183
TDT = 1000.55

Availability (Percent) = ((TDT-AOT)/TDT) * 100
((1000.55 - .55)/1000.55) * 100
(1000/1000.55) * 100
(.99945 X 100)

Availability = 99.945%

Attachment 2

Documentation that the information displayed on Cooper SPDS is readily perceived and does not mislead the operator(s) (Man-In-The-Loop Testing).

SAIC-86/3006

MAN-IN-THE-LOOP TESTING FOR THE SAFETY PARAMETER DISPLAY SYSTEM AT THE COOPER NUCLEAR STATION

January 17, 1986

Prepared by:

Science Applications International Corporation

1. INTRODUCTION

This document describes the procedures used and results of the man-in-the-loop testing for the Safety Parameter Display System (SPDS) at the Cooper Nuclear Station, owned and operated by the Nebraska Public Power District (NPPD). The SPDS is an integral segment of the Plant Management Information System (PMIS) recently installed at the Cooper Station, and is intended to function as an aid to control room personnel during abnormal, and emergency conditions in determining the safety status of the plant. The PMIS and SPDS were designed and built by Science Applications International Corporation (SAIC). The SPDS is described in detail in SAIC document no. 503-8500000-78 (Ref. 1)

A considerable amount of attention has gone into the design of the SPDS to ensure consistency with accepted human factors principals and maximum usefulness to control room personnel. An extensive human factors plan was prepared and used in designing the system (Ref. 2). Also, input from NPPD operators was solicited in the early phases of the project, and incorporated into the design of the SPDS displays. The purpose of man-in-the-loop testing is to serve as an additional check to ensure a smooth integration of the SPDS with the rest of the control room environment, the Emergency Operating Procedures (EOPs), and the training of control room personnel.

2. METHOD

2.1 PROCEDURE

Man-in the loop testing of the Cooper SPDS consisted of having plant operating crews view and evaluate the SPDS displays under simulated operational conditions. Taped, time-dependent transient data was utilized to drive the displays in a real time mode, with the transient data displayed on the actual SPDS terminals installed in the Technical Support Center (TSC) at the Cooper nuclear station. The transient scenario is described in greater detail later.

During the evaluation, each operating crew completed a two page "Display Characteristics Questionnaire" for each display they observed (not all crews observed every display). This questionnaire solicited operator opinions regarding the usefulness of the display, as well as any observed deficiencies, and recommendations for improvement. A copy of the questionnaire is provided as Attachment A. A copy of the test procedure, and the instructions to the operators is provided as Attachment B.

Five operating crews (including a training crew) were involved in the testing, generating five sets of questionnaires. Test sessions were conducted over the period of November 7, 1985 through December 3, 1985. Questionnaire responses were quantified and reviewed by SAIC human factors staff during January, 1986.

2.2 TRANSIENT SCENARIO

The transient scenario utilized to exercise the SPDS displays was a "loss of cooling accident" (LOCA), which lasts approximately 22 minutes. During the transient, the following malfunctions occur:

1. Loss of feedwater flow
2. Reactor core isolation cooling trip
3. High radiation in reactor building
4. Turbine bypass valves fail shut
5. Core spray trip
6. Residual heat removal trip
7. Loss of coolant (recirculation pump suction line break)

This transient scenario tape was compiled from transient data previously obtained from the Brown's Ferry (BWR) simulator as part of the BWR Graphics Display System Dynamic Screening Program (Ref. 3) which was conducted by SAIC for the BWR Owner's Group, the EPRI Nuclear Safety Analysis Center, and the U.S. Department of

Energy. The data was subsequently modified by SAIC specifically for the purpose of man-in-the-loop testing at the Cooper Nuclear Station. A graph of the RPV water level instrument readings depicting the transient scenario is provided as Attachment C.

3. RESULTS

Questionnaire responses from the five operating crews were summarized and reviewed in order to obtain overall ratings of the displays, identify problem areas, and identify potential system/display enhancements. A summary of the questionnaire responses is provided below.

3.1 DISPLAY DESIGN

Operating crews were asked to evaluate each display in terms of five specific design criteria. In every case, display design was rated favorably by the majority of the operating crews. In no case did any display receive an unfavorable rating from more than one (out of five) crews for a given design related category. Approximately 92% of all crew responses related to display design were positive.

3.2 AMOUNT OF INFORMATION

Operating crews were asked to evaluate the adequacy of the amount of information presented in each display. For 22 of 24 displays, the majority of operating crews rated the amount of information provided as being appropriate. In two instances, the majority of responders indicated that they would like additional information provided. No displays were rated as providing too much information. Eighty percent of all crew responses received indicated that displays provided the appropriate amount of information.

3.3 USABILITY OF INFORMATION

Crews were also asked to evaluate the information provided in the displays in terms of being directly useable versus requiring transformation. In every case, information was determined to be directly useable by the majority of responding crews. Overall, approximately 88 percent of all crew responses were favorable.

3.4 RELATION TO EOPs

Crews were also asked to evaluate displays in terms of how well they related to the new, symptom-oriented EOPs. Approximately 70 percent of the displays were rated as being "related" to the EOPs with the remaining 30 percent rated as being "somewhat related" by the majority of the responding crews. There were three instances in which a single crew (out of five) did not feel the display was related to the EOPs. It should be noted that some SPDS displays were not intended to be closely related to the EOPs. The "Level 2" displays provide information on the five key safety functions identified by the

NRC in NUREG-0737 (Ref. 4). The BWR Emergency Procedure Guidelines (Ref. 5) and the related Cooper EOPs are not closely tied to these safety functions. An additional factor related to the man-in-the-loop test was that information from recently updated EOPs had not yet been incorporated into the displays at the time that man-in-the-loop testing was conducted. This has since been done, which should strengthen the perceived relationship been the SPDS displays and the EOPs.

3.5 USEFULNESS OF DISPLAYS

Operating crews were also asked to rate the usefulness of the displays on a scale from "detrimental" to "very useful". Twenty-three of the twenty-four displays were rated as "useful" by the majority of the responding crews. One display was rated as "not useful", and there were no displays rated as being "detrimental". The single display rated as "not useful" was a static display, and it was recommended that some dynamic features be added to increase its usefulness to the operator.

3.6 OPERATOR COMMENTS

Operators were also asked to provide comments and specific recommendations for improvements to the various displays. Overall, some 60 distinct recommendations were received. The majority of these recommendations suggested minor (potential) enhancements to the system rather than corrective actions that were required due to significant deficiencies. Many of the recommendations (primarily related to inclusion of updated EOP information) had already been incorporated into the system before the questionnaire data had even been reviewed. Other recommendations will be reviewed by SAIC and NPPD for possible future enhancement of the Cooper SPDS.

4. SUMMARY

Overall, the findings of the man-in-the-loop testing were quite positive. No serious deficiencies were observed in the system. The majority of comments and recommendations suggested minor enhancements which are currently being evaluated as to their potential value. It is anticipated that as operators become more familiar with the system, through training and experience, their perceptions of the SPDS system, and the usefulness of individual displays will become even more favorable.

5. REFERENCES

1. "Safety Parameter Display System, Detailed Description" - Revision 2, Science Applications International Corporation (SAIC Doc. No. 503-8500000-78), February, 1985.

2. "Human Factors Plan", Science Applications International Corporation (SAIC Doc. No. 503-8500000-77), April 1984.

3. "BWR Graphics Display System, Dynamic Screening Program", Science Applications International Corporation (SAIC Doc. No. 01381-364LJ), February, 1982.

4. NUREG-0737, Supplement 1 (Generic Letter 82-33), "Requirements for Emergency Response Capability," U.S. Nuclear Regulatory Commission, December 17, 1983.

5. "Draft Emergency Procedure Guidelines," Revision 3G, BWR Owner's Group, November 10, 1983.

ATTACHMENT A

COOPER NUCLEAR STATION
DISPLAY CHARACTERISTICS QUESTIONNAIRE

Display Title _____

1. Is the display

		Yes	No
a.	Understandable?	___	___
b.	Logically organized?	___	___
c.	Uncluttered?	___	___
d.	Readable?	___	___
e.	Updated data at a reasonable rate?	___	___

Suggestions for improvements (if necessary, attach additional sheets with comments).

2. Is the amount of information presented

Too little? _____ Too much? _____ Adequate? _____

Suggestions for improvements.

3. The information in the display

Is directly usable as is _____ Requires transformation _____

Suggestions for improvements.

QUESTIONNAIRE (Continued)

4. Does the information in this display relate well to the information needs of an operator who is using the new, symptom-oriented Emergency Operating Procedures?

   Yes _____ Somewhat _____ No _____ Don't know _____

   Please explain:

5. How do you rate the usefulness of this display?

   Detrimental _____ Not useful _____ Useful _____ Very useful _____

   Please explain:

6. How do the features and data content of this display compare with similar displays?

7. Additional comments.

_____ _____

Reviewer Date

ATTACHMENT B
TEST PROCEDURES

Following the classroom training instruction on the Cooper Nuclear Station (CNS) SPDS, an operator evaluation of all of the CNS SPDS displays should be conducted. All training attendees should participate. The formal procedures follow. During the evaluation, no more than three people should be stationed at an IDT terminal. If necessary, the simulated transient should be repeated a number of times. The two page questionaire used during the evaluation is attached.

1. Instruct the trainees as follows:

   "A twenty-two minute transient will be run using the CVT simulator on the PMIS. During this time, please view all of the 25 SPDS displays in any order or manner you desire. At the end of the transient you will be asked to evaluate each display individually. A two-page questionaire will be filled out for each display. Before starting the transient, you will be given the display questionaire to see what type of information is required from you. The only requirement during the testing is to view each SPDS display at least once during the transient."

2. Start the NUCVTZ simulator on a VT100-compatible terminal. When prompted for a transient name, enter

   LOCA4

3. The transient will last approximately 22 minutes. At the end the output on the terminal will say

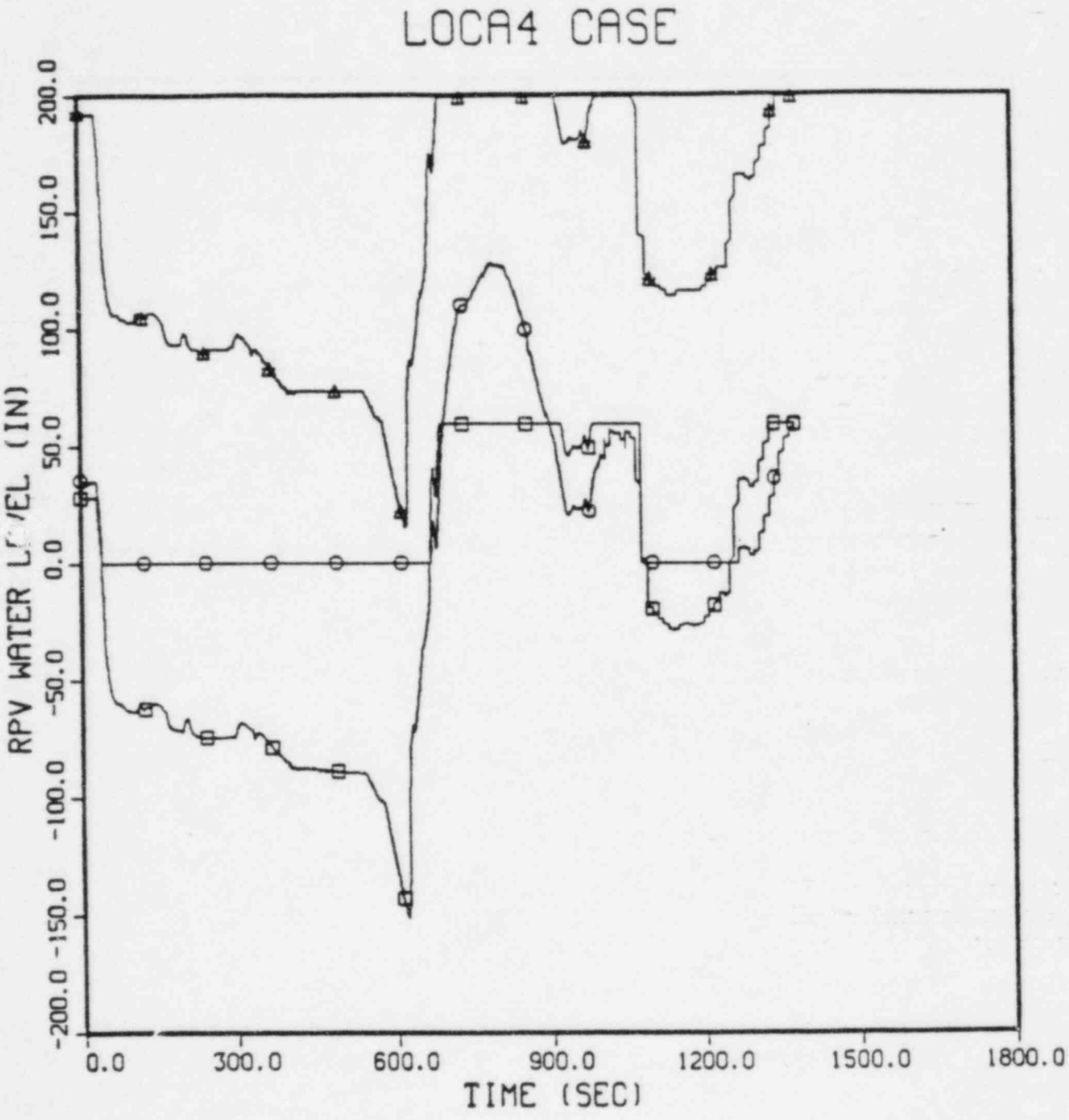
   !END OF LOCA4 TRANSIENT

4. Instruct the trainees as follows:

   "Fill out the two-page display questionaire for each of the 25 SPDS displays. Before filling out the questionaire, call up the appropriate SPDS display on the IDT display. When finished, return the questionaires to the instructor."

ATTACHMENT C

LOCA4 Transient RPV Water Level Readings



SUPPLEMENT TO ATTACHMENT 2

In design and development activities to date, the following measures have been taken to ensure that the information on the CNS SPDS displays will: a) be readily perceived by users of the system, and b) will not mislead the users of the system:

- Incorporating lessons learned in prior BWR SPDS projects.
- Designing the CNS SPDS in accordance with human factors principles.
- Incorporating CNS operating personnel into the SPDS display design review process.

A discussion of each of these points is provided below.

A. Input from Prior BWR SPDS Projects

The CNS SPDS design is an evolutionary development that is built on prior experience gained by SAIC during work on the following BWR SPDS projects:

- BWROG dynamic screening of proposed SPDS displays.
- BWROG prototype SPDS development and testing on the Perry Simulator.
- BWR SPDS design, development, and installation at the Fermi II nuclear power plant.

For example, the CNS SPDS uses the same display hierarchy that was used in all of the above projects. The hierarchy is:

- Level 1: Plant Overview
- Level 2: Safety Functions
- Level 3: EOP Support

Basic display format for bar charts, trend plots, and multiparameter x-y plots can be traced directly to the final formats that were produced by the dynamic screening project. In addition, the use of Safety Function Indicators was introduced in the dynamic screening project and is consistently implemented at CNS and in all BWR SPDS projects listed above.

The CNS SPDS offers significant evolutionary improvements in: a) detailed display format and content, b) communication of data between different levels in the display hierarchy, and c) degree of integration of the SPDS displays with the plant-specific Emergency Operating Procedures. These improvements, coupled with lessons learned by SAIC in prior BWR SPDS projects, help ensure that the CNS SPDS displays are readily perceived and do not mislead the users of the system.

B. Design of SPDS in Accordance with Human Factors Principles

The Human Factors Plan (Document 503-8500000-77) identifies the human factors principles that are implemented in the design and development of the PMIS and SPDS. These human factors considerations help ensure that the CNS SPDS displays are readily perceived and will not mislead the users of the system.

C. Review of the Prototype Displays by CNS Operating Personnel

In March, 1984, SAIC and NPPD personnel met at the CNS site to review the displays from the three projects listed above and to solicit NPPD input on preferred SPDS display features.

A partial set of prototype CNS SPDS displays was provided to NPPD in April, 1984. These static displays were stored on a magnetic bubble and could be viewed on the SPDS terminals, yielding the same visual quality as a real SPDS display. NPPD comments on these prototype displays were incorporated into the first complete set of SPDS displays which was forwarded to NPPD in July, 1984. NPPD operators reviewed these improved static displays on an SPDS terminal set up in the CNS Control Room and provided recommendations for display improvements to SAIC in September, 1984. NPPD recommendations have been implemented in the final display design.

In addition to these reviews of display statics, NPPD personnel have, on several occasions, reviewed the latest CNS SPDS displays. These reviews have resulted in several revisions to the displays to further integrate the EOPs, include the latest vendor data for equipment portrayed on the SPDS displays, and in general, to update and improve the displays in an iterative process with input from plant personnel.

In summary, NPPD input has been instrumental in finalizing the CNS SPDS display design. This input helps ensure that the CNS SPDS displays are readily perceived and do not mislead the users of the system.

Attachment 3

Validation Test Plans and Results.