UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SEP 25 1985

Docket No.: 50-528

MEMORANDUM FOR: Raymond F. Fraley, Executive Director
Advisory Committee on Reactor Safeguards

FROM: Thomas M. Novak, Assistant Director for Licensing, DL

SUBJECT: STARTUP EXPERIENCE ON PALO VERDE UNIT 1

In its letter report on Palo Verde, Units 1, 2 and 3, dated December 15, 1981, the ACRS requested that the staff keep the Committee informed of the startup experience on Unit 1 prior to fuel loading on Unit 2. The following two documents are provided in response to that request.

1. Letter from D. F. Kirsch to the Arizona Nuclear Power Project, dated August 6, 1985, transmitting Inspection Report No. 50-528/85-12 on the enhanced operational inspection conducted on Palo Verde Unit 1 during initial startup and low power testing.

2. Memorandum from Dennis F. Kirsch to Hugh L. Thompson, dated July 30, 1985, providing a review of the startup experience for Palo Verde Unit 1 (up to 50% power operation).

As indicated in the above documents, no significant problems were experienced during the startup testing of Palo Verde Unit 1. The areas where difficulties were encountered and appropriately handled by the licensee included several reactor trips, unidentified leakage in the reactor coolant system, and leaking tubes in the condenser. In addition, operability of the post-accident sampling system under postulated accident conditions required licensee attention.

After an extended outage during parts of July and August 1985 to correct the above difficulties, Palo Verde Unit 1 is back to 50% power. Additional testing at this level and at the 80% level is planned before commercial operation is achieved (scheduled for the end of 1985).

Contact: E. Licitra, NRR
x27200

8510010042 XA 2pp

The applicant's current schedule for Palo Verde Unit 2 is to load fuel in November 1985 and achieve initial criticality in January 1986. The staff will continue to keep the Committee advised on the startup experience of Unit 1, as you requested.

Thomas M. Novak, Assistant Director
for Licensing
Division of Licensing

Enclosures:
As stated

cc: H. Denton
D. Eisenhut
H. Thompson
F. Miraglia

Enclosure

AUG 06 1985

RSB.

Docket No. 50-528

Arizona Nuclear Power Project
P. O. Box 52034
Phoenix, Arizona 85072-2034

Attention: Mr. E. E. Van Brunt, Jr.
Executive Vice President

Gentlemen:

Subject: NRC Enhanced Team Inspection of Palo Verde Unit 1

This refers to the enhanced operational inspection conducted by J. L. Crews, others of this office and our consultants on May 23 - June 5 and July 16, 1985, of activities authorized by NRC Operating License No. NPF-34, and to the discussion of our findings held with members of your staff at the conclusion of the inspection and on July 16, 1985.

Areas examined during this inspection are described in the enclosed inspection report. Within these areas, the inspection consisted of selective examinations of procedures and representative records, interviews with personnel, and observations by the inspection team.

No violations of NRC requirements were identified within the scope of this inspection.

In accordance with 10 CFR 2.790(a), a copy of this letter and the enclosure will be placed in the NRC Public Document Room.

Should you have any questions concerning this inspection, we will be glad to discuss them with you.

Sincerely,

Original Signed By
D. F. Kirsch

D. F. Kirsch, Acting Director
Division of Reactor Safety & Projects

Enclosure:
Inspection Report No. 50-528/85-12

cc w/enclosure:
J. Bynum, ANPP
S. R. Frost, ANPP
T. D. Shriver, ANPP
W. E. Ide, ANPP
C. N. Russo, ANPP
Ms. Jill Morrison, PVIF
Lynne Bernabei, GAP
Duke Railsback, ACC
Arthur C. Gehr, Esq., Snell & Wilmer

bcc: RSB/Document Control Desk(RIDS); Mr. Martin; R.I., LFMB; Greg Cook

CREWS/dot	CHAFFEE	KIRSCH
8/6/85	8/6/85	8/6/85

1/1
1E01

U. S. NUCLEAR REGULATORY COMMISSION
REGION V

Report No. 50-528/85-12

Docket No. 50-528

License No. NPF-34

Licensee: Arizona Public Service Company

Facility Name: Palo Verde Nuclear Generating Station, Unit 1

Inspection at: Palo Verde Site

Inspection conducted: May 22 - June 5, 1985 and July 16, 1985

Inspectors:

J. L. Crews, Senior Reactor Engineer and Team Leader — Date Signed 8/6/85

R. D. Pate, Acting Chief, Reactor Safety Branch — Date Signed 8/6/85

L. H. Miller, Chief, Reactor Projects Section 2 — Date Signed 8/6/85

S. E. Bryan, Acting Director, Tech. Spec. Improvement Proj., NRR — Date Signed 8/6/85

J. H. Eckhardt, Senior Resident Inspector, Rancho Seco — Date Signed 8/6/85

B. H. Huey, Senior Resident Inspector, San Onofre — Date Signed 8/6/85

T. J. Polich, Resident Inspector, Diablo Canyon — Date Signed 8/6/85

G. Fiorelli, Resident Inspector, Palo Verde — Date Signed 8/6/85

C. J. Bosted, Resident Inspector, Palo Verde — Date Signed 8/6/85

Other Accompanying Personnel:

L. R. Peterson, Consultant, Lawrence Livermore National Lab.
B. F. Gore, Consultant, Pacific Northwest Laboratories
J. W. Upton, Jr., Consultant, Pacific Northwest Laboratories
A. J. Boegel, Consultant, Pacific Northwest Laboratories

Approved By: A E Chaffee — 8/6/85
A. E. Chaffee, Chief, Reactor Projects Branch — Date Signed

Summary:

Inspection on May 22 - June 5, 1985 (Report No. 50-528/85-12)

Areas Inspected: Enhanced Team Inspection of the operating crews and operational support activities during initial startup and low power testing. This inspection involved 447 inspection hours by nine NRC personnel and 210 inspection hours by four NRC consultants.

Findings: No violations of NRC requirements resulted from ths inspection. Observations by the Special Inspection Team were discussed with licensee management for their consideration, and actions were taken, and are expected to continue, to improve operational activities. These observations are discussed throughout the report; and relate principally to needed improvements in the control room environment (e.g., reduction in noise levels, operator alertness, and communications), retrieval of information for post-event evaluation, and reactor engineering support for operations.

DETAILS

1. Persons Contacted

*E. E. Van Brunt, Jr., ANPP Executive Vice President
**G. Haynes, Vice President Nuclear Production
(Announced as Vice President on May 30, 1985)
*D. B. Karner, ANPP Assistant Vice President Nuclear Production
*J. R. Bynum, ANPP Plant Manager
*W. E. Ide, ANPP Director, Corporate QA/QC
J. E. Allen, ANPP Operations Manager
*L.A. Souza, ANPP Assistant Director Corporate QA/QC
*O. J. Zeringue, ANPP Technical Support Manager
*R. C. Younger, ANPP Unit I Operations Superintendent
*D. F. Hoppes, ANPP Reactor Engineering Supervisor
*W. W. Montefour, ANPP Quality Assurance Engineer
F. Philpott, CE Lead Engineer
L. Briner, Shift Advisor (Southern California Edison Company)
R. Gouge, Day Shift Supervisor
C. N. Russo, Manager QA Audit and Surveillance

Discussions were also held with numerous other personnel, including shift supervisors, reactor operators, QA/QC engineers and inspection/surveillance personnel, during the inspection.

*Present at Site Exit Interview on June 5, 1985.
**Present at Corporate Office Exit Interview on July 16, 1985.

2. Enhanced Inspection Team Composition and Pattern of Inspection

The inspection was carried out be senior members of the Region V and NRC headquarters staffs, Senior Resident and Resident Inspectors assigned to operating power reactors in Region V, and four NRC consultants from the Lawrence Livermore National Laboratory (LLNL) and Battelle Pacific Northwest Laboratories (PNL). The latter consultants (three individuals) from PNL currently provide contract assistance to the NRC staff in the conduct of operator license examinations for PWR (Combustion Engineering supplied) power reactor facilities. The consultant from LLNL is an experienced reactor physicist, and has previously served as a consultant to the NRC staff in the area of human factors evaluation of control room layout and design as well as inspections of the type of the current inspection.

To evaluate the performance of the operating crews, members of the Enhanced Inspection Team were assigned to around-the-clock coverage of shift operations commencing on May 22, 1985, when plant heatup in preparation for initial criticality was started. This around-the-clock coverage continued through initial criticality (on May 25, 1985) and until June 5, 1985.

The above pattern of inspection permitted members of the inspection team to observe the performance of each of the six operating crews as well as the conduct of portions of all of the zero power physics tests.

3. Assessment of Operating Crew Performance

Operating crew performance was assessed based upon the inspection team's observation of (1) the conduct of scheduled plant evolutions during initial criticality and zero power physics tests, (2) crew response to unplanned events, and (3) through discussions with individual operating crew members. Particular emphasis was given to the extent to which Shift Advisors (individuals under contract to the licensee to provide on-shift experience in the operation of similar licensed power reactor facilities) were integrated into the shift operations.

The overall performance of the operating crews was judged by the Special Inspection Team to be average to above average in plant knowledge and in the conduct of operating duties (including the use of and adherence to operating procedures) when compared to operators of power reactor facilities of similar type during the initial plant startup and early operating period.

Early in the inspection period, on May 23, 1985, the inspection team observed that an annunciator, CEA Deviation - Tech Spec Violation, was activated during a period following manipulation of the control element assemblies (control rods). At the time a licensed operator was in attendance at the CEA controls adjacent to the panel where the annunciator was located. Also present was an operator trainee, who on occasion manipulated the annunciator acknowledge button to silence audible annunciators as they were activated. After a period of several minutes, the inspection team leader questioned the two operators present as to their knowledge of the conditions causing this annunciator to be activated. Neither had an immediate explanation. After some prompting by the NRC inspector, the operators referred to the annunciator response procedures manual located on the front of the control panel nearby. Still there was not an explanation by either operator for a period of several minutes, after which a third individual (an STA) was asked of his knowledge of the conditions accounting for the annunciator's activation. It was only after a period of more than 30 minutes that sufficient attention and actions were taken by the operating crew to satisfactorily understand and explain the reasons and significance of the annunciator's being activated. It was determined that one or more CEA's were out of position in two different rod groups sufficiently to cause the deviation alarm condition. The deviation was not, however, sufficiently great to constitute a violation of the technical specifications.

This observation by the inspection team was discussed the following morning with senior site and corporate management, and characterized as unacceptable attentiveness and alertness on the part of the control room operators involved. Steps were taken by licensee management to assure the alertness of control room operators such that this circumstance was not repeated during the balance of the inspection period. There were numerous occasions during the inspection when control room operators were asked about actuated annunciators and other system and component status.

On these occasions, except for the instance discussed above, the operators demonstrated an exceptionally good level of knowledge of plant instrumentation and equipment status.

The inspection team observed shift turnover practices on frequent occasion. The shift turnover of plant and equipment status, particularly within the control room - including thorough "walk down" of instrument and control room panels was judged to be of exceptional quality.

There were instances where the inspection team observed circumstances within the control room warranting attenbion by licensee management and/or supervision, particularly with regard to reducing noise levels or potential distraction of control room operating personnel. An example where licensee corrective action was prompt in correcting the condition involved shift briefings by the test director at the beginning of each shift. Initially these briefing were conducted adjacent to the "horseshoe" area of the control room. The numbers of people involved plus discussion among those involved in the briefing created potential distractions to the operators. When this observation was brought to the attention of supervision steps were taken to relocate such briefings in the computer room immediately adjacent to the control room.

Two other observations by the inspection team regarding the control room environment were (1) the location of telephones for calls from outside the plant and (2) the background noise level resulting from the control room normal air conditioning system. In the first instance, it was observed on numerous occasions that calls received in the horseshoe area, generally answered by the reactor plant operator, were for individuals in the opposite end of the control room. This necessitated rather loud verbal paging, without the aid of an intercom or buzzer system, to transfer the call to the individual for whom it was intended.

Regarding the control room air conditioning noise level, apparently generated by the high velocity air exiting the ceiling vents, the inspection team, particularly on the non-day shift periods, observed substantial annoyance due to this condition over a period of an eight hour shift.

Licensee management committed to give further attention to these conditions. In the case of the control room air conditioning, the condition had been previously identified for further evaluation by the licensee.

The relatively low numbers of control room annunciators actuated (or lit) during plant operations was a particularly positive observation by the inspection team. This circumstance had resulted from a comprehensive and effective effort by the licensee to reduce substantially the number of unnecessary and nuisance alarm conditions.

Not withstanding the need for licensee management to give continuing attention to those areas discussed above to enhance the control room environment and the alertness of plant operators, the inspection team found the performance of the operating personnel to be good. Their overall attitude was observed to be very positive toward "doing the job

right the first time". Few personnel errors were observed; this being in large part the result of substantial utilization of the plant specific simulator to train operators in the testing procedures and operations involved.

Attachments 1 through 4 provide additional observations and comments by consultant members of the special inspection team regarding the performance of the operating crews.

4. Initial Criticality and Zero Power Testing

Members of the Enhanced Inspection Team witnessed initial criticality and portions of all low power tests. Details regarding the conduct and results of these tests are discussed in Attachment 4.

5. Engineering Direction and Support of Operations and Testing

The technical direction and of initial criticality and low power testing activities was provided by individuals within the Reactor Engineering Section of the licensee's onsite Technical Support staff. This staff is composed currently of approximately 12 engineers, half of whom are employees under contract from the NSSS (Combustion Engineering - CE) contractor. Approximately an equal number of contract CE technical personnel are also available to the Reactor Engineering staff, when needed.

The licensee's staff within Reactor Engineering is relatively inexperienced with regard to the startup and operation of commercial nuclear plants - thus the need for the presence of contract personnel in this part of the organization.

The Inspection Team observed that the licensee's Reactor Engineering personnel were noticeably dependent upon the advice of the more experienced CE representatives during the initial approach to criticality and low power physics tests. The licensee's current plans are to retain CE representatives through completion of the power ascension testing on Unit 1.

The lack of experience within the Reactor Engineering staff was also evident during a period of uncertainty regarding the absolute reactor power level below five percent power. A period of several hours was necessary before a satisfactory level of confidence was established in the actual reactor thermal power verses that indicated by the nuclear instrumentation.

At the time of the Management Interviews, this subject was discussed with licensee management in the context of a need to reexamine continued CE presence beyond the completion of Unit 1 startup.

6. Quality Assurance/Quality Control Involvement

The extent of Quality Assurance (QA)/Quality Control (QC) involvement in early operational activities was exceptionally noteworthy during the current inspection. Their presence and substantive involvement in such

activities as low power physics testing, inspection and surveillance of maintenance and troubleshooting (diesel generator apparent malfunction, etc.), health physics activities and housekeeping was readily evident during the inspection. Discussion with QA/QC management revealed plans for greater involvement of the QA/QC staff in operational activities such as independent verification of valving and electrical system lineup.

7. Post-Event Information Retrieval Systems

The inspection team observed rather substantial difficulties in the retrieval and evaluation of information necessary to reconstruct the sequence of events during early operation during the current inspection as compared to similar facilities in Region V. This was particularly the case during the period, discussed in paragraph 5., above, when uncertainty existed on the actual power level.

In response to the inspection team's observation, licensee management indicated that steps, including a reassessment of the amount and type of parameters to be programmed for retrieval by the plant process computer(s), were being taken to improve the utilization of post-trip/event information systems.

8. Management Involvement

During the course of the current inspection particular attention was given by the inspection team to the presence and involvement of site and corporate management in the day-to-day operational activities.

Corporate office management, including the Executive Vice President, Corporate QA/QC Manager, and Assistant Vice President, were observed at the plant on frequent occasion. All were present at the time of initial criticality on May 25, 1985.

The Plant Manager and key managers and supervisors of his staff - including in particular the Reactor Engineering Supervisor, Unit 1 Operations Superintendent, Assistant Operations Superintendent and Technical Support Manager - were observed to be involved extensively in operational activities. Examples of such involvement included unusual efforts to assure operability of the hydrogen monitors and resolution of diesel-generator fuel oil discrepancies.

Overall management involvement was observed to be substantive and effective. The prevailing attitude which seemed to permeate the entire staff associated with operations and operational support activities was one of unusual caution and thoroughness during the approach to initial plant operation and the conduct of each plant evolution.

9. Management Meetings

The results of the current inspection were discussed with those licensee representatives indicated in paragraph 1 at the conclusion of the inspection on June 5, 1985 (onsite) and at the corporate offices on July 16, 1985.

Licensee representatives indicated that particular continuing attention would be given to the following observations of the inspection team.

a. Utilization of post-event information systems (Paragraph 7).

b. Retention of supplemental (contractor) Reactor Engineering staff (Paragraph 5).

c. Enhancement of control room environment and operator alertness (Paragraph 3).

ATTACHMENT 1

Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington U.S.A. 99352
Telephone (509)
Telex 15-2874 375-3755

June 14, 1985

Mr. Jess Crews
NRC Region V
1450 Maria Lane, Suite 210
Walnut Creek, CA 94596

Dear Jess:

SUBJECT: PALO VERDE STARTUP SPECIAL INSPECTION

As a member of the on-shift special Inspection Team at the Palo Verde Nuclear Generating Station (PVNGS) from May 29 through June 5, I monitored the licensee's swing shifts at Unit 1. I monitored the shift-turnover, including the pre-shift-turnover briefings and I made two plant tours to observe operations outside of the control room. I also made a visit to the Chemistry facilities to discuss their measurements of dissolved H2 in the primary coolant. I had a meeting with Mr. Art Ramey, Quality System Supervisor, to discuss the role of the QA Department at PVNGS.

The operating crews (OPS Department) that I observed carried out their duties in a correct and professional manner. As a total perspective, the operating crews exhibited sufficient caution and thoroughness in their handling of initial power ascension operations. See the addendum page, "Specific Items".

As I indicated in our "exit" meeting, my "on-plant" schedule had been the following:

May 29	8 hrs	admin
29	8 hrs	swing
June 1	8 hrs	swing
2	8 hrs	swing
3	8 hrs	swing
4	8 hrs	swing
5	3 hrs	admin

Sincerely yours,

J. W. Upton, Jr.
Senior Research Scientist

JWU:cms

SPECIFIC ITEMS NOTED
PVNGS STARTUP, LOW POWER PHYSICS TESTS AND INITIAL ASCENT IN POWER
MAY 29 THROUGH JUNE 5, 1985

1. The Low Power Physics Test concerning control-rod symetry was conducted proficiently and Reactor Engineering was present in the control room for the tests.

2. The first time that a D/G was declared inoperable (D/G A) and a test was performed on D/G B, there was some confusion as to the interpretation of the strip chart recording of the D/Gs voltage, speed and frequency. The zero values were not on the chart paper zero. I expressed my concern to the STAs and to a QA representative. All subsequent similar tests did not have this problem.

3. At one time a CPC sensor alarm was received and a computer technician was called to the control room. The shift tech was very unsure of himself and placed a call for guidance.

4. The potential problem that occurred during the ascent to 3% power with the log power reading 1% has been thoroughly discussed. I reviewed the T-power calculations that were made with the PMS data and was able to document in the NRC log that the maximum power that had been reached was 4.87%.

5. Chemistry had difficulty in determining the amount of dissolved H2 in the primary coolant.

6. OPS executed very well. The integration of the STAs, Reactor Engineering, Chemistry, etc., with the operations in the control room needs improvement.

ATTACHMENT 2

Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington U.S.A. 99352
Telephone (509)
Telex 15-2874

June 6, 1985

Mr. Jess Crews
NRC Region V
1450 Maria Lane, Suite 210
Walnut Creek, California 94596

Dear Jess:

SUBJECT: PALO VERDE STARTUP SPECIAL INSPECTION

As a member of the on-shift special inspection team at Palo Verde Power Plant, May 22-28, 1985, I observed the day shift including pre-shift-turnover briefings. I also observed achievement of initial criticality at 1:45 AM, May 25, 1985 and the first return to criticality at 10:56 AM May 27. In addition to control room oberservations I made two plant tours with NRC and plant personnel to verify equipment performance.

The operating crews which I observed carried out their duties responsibly and professionally. They worked as a team and exchanged observations, questions and cautions. They were knowledgeable about their plant and procedures.

In response to your request, my effort for this project was as follows. I reported 56 professional staff hours for billing purposes. In addition, I spent about 12 hours of casual overtime on project activities, exclusive of travel between Phoenix and the site.

Sincerely,

for Bryan F. Gore
Senior Research Scientist

BFG:drp

Specific Items Noted During Palo Verde
Startup and Low Power Physics Tests

5/22 - 5/28/85

1. The Low Power Physics Test Procedure, 72PY-1RX30, is vastly improved over the Low Power Physics Test Controlling Document, 72PY-1RX03, which it replaced prior to test initiation. Concerns which I expressed in my letter dated May 15, 1985 were remedied by this new procedure.

2. Noted a minor discrepancy between the Test Log and the Control Room Log when reviewing the sequence of actions leading to boration to subcriticality which had occurred when I was off shift. The CR log noted a second boron injection between 05:23 and 05:28 on May 27, 1985 which was not recorded in the test log. Notations in the test log satisfactorily identified the overboration incident and reported final boron concentration however.

3. Observed some minor confusion concerning the use of "NA" and logging of comments during an operator's first performance of RPS and ESF Channel Surveillances after entry into Mode 2 at 320 F for low power testing. He consulted with supervision, asked appropriate questions and made reasonable interpretations.

4. Reviewed temporary modifications to nuclear instrumentations Control Channel connections, for hookup of the reactivity computer, during a modification made during testing. Appropriate documentation, tagging and verification procedures were followed.

5. Suggested rewording a step in the recently modified Plant Protective System Functional Testing Procedure. Observed a technician incorrectly interpret an instruction to adjust a negative setpoint value to "20 mV greater than" the value. (He was corrected by the engineer who had modified the procedure and was overseeing its initial application). Suggested rewording step to "20 mV more positive than."

6. Shift briefing by operations personnel were clear and concise.

7. APS Monitoring and Audit personnel actively reviewed procedures for adequacy, change control and documentation of performance and surveillance data. They provided clarification of administrative details to operators and test personnel. Interactions which I observed were cordial and professional.

ATTACHMENT 3

Battelle
Pacific Northwest Laboratories
P.O. Box 999
Richland, Washington U.S.A. 99352
Telephone (509)
Telex 15-2874

June 18, 1985

Mr. Jess Crews
NRC Region V
1450 Maria Lane, Suite 210
Walnut Creek, CA 94596

Dear Jess:

SUBJECT: Palo Verde Startup Special Inspection

As a member of the on-shift special inspection team at Palo Verde Nuclear Generating Station (PVNGS), May 26-31, 1985, I observed the day shift operations including pre-shift turnover briefings between on-going and off-going operating crews as well as briefings between Engineering and Operations. In addition to the control room observations, I also made three plant tours to observe operations outside of the control room.

The operating crews that I observed performed their duties in a professional manner. They were alert, and had a very positive attitude toward their job. The personnel that I observed outside the control room on my plant tours were knowledgeable about their plant and procedures and were professional in the performance of their duties.

During the period of observation mentioned above, 40 professional staff hours were charged to the inspection as well as 10 hours of casual overtime that will not be billed to the inspection.

Sincerely,

John Boegel
Senior Research Engineer

AJB:hk

SPECIFIC ITEMS NOTED DURING PALO VERDE
STARTUP AND LOW POWER PHYSICS TESTS

MAY 27-31

1. Low Power Physics Tests were performed proficiently with good communication observed between operations and engineering personnel. A ground problem was observed by shift personnel on CEA subgroup 64. Two rods lagged the other rods causing a deviation alarm. I&C was notified and began to take voltage vs time measurements for each control rod maneuver to determine the nature of the problem. I observed these measurements, and found them to be performed professionally.

2. Observed Auxiliary Feed Pump A excess flow check valve test. Check valve did not perform satisfactorily. Engineering prepared a report documenting the problem and suggesting either repair or replacement of the valve. Procedures were followed correctly during the test and adequate safety precautions were taken during pump run-up. Debris (gum wrappers, etc.) was observed in the 'A' pump sump and once noted, was subsequently cleaned.

3. SIT B had a nitrogen overpressure leak throughout the entire period of my observation. The frequency of operator action to pressurize the tank progressed to once per shift. While this was an annoyance and distraction, the operating crews performed this exercise by procedure in a professional manner.

4. D/G A was inoperable due to an excessive amount of microbes found in the fuel tank. Because of this, D/G B had to be started once per shift. After about 11 minutes had elapsed following D/G B start and loading, D/G B tripped due to excessive vibration. This placed Unit 1 into a two hour action statement as per technical specifications. During this period I observed the trouble shooting efforts of plant engineering on D/G B. These personnel carried out their diagnostics professionally and exercised the proper personnel safety precautions. The vibration analysis team was very responsive to the problem and the awareness that the plant was in a two hour action statement or shutdown was foremost on the minds of each team member. Nothing was found to be faulty with D/G B and it was declared operable with three minutes to spare following a startup test run at full load. During the startup for the full load test, the procedure calls for local start. This procedure step was deviated and the D/G B was started remotely. Operations explained that this was due to the new diagnostic equipment that had been installed (voltage, frequency, etc.) and that the procedure was in the process of being changed. I did not see the PCN for this change, however.

5. As per technical specifications, the temperature in containment was being recorded hourly due to malfunctioning fire protection equipment. During one shift I observed that a temperature reading was not recorded on the shift log. This was noted by the shift crew one hour later. The incident was properly filed and will go the PRB for review.

6. The ongoing surveillance being performed on the RPS was a continuous annoyance and distraction. The operations crews handled this professionally.

7. In the control room, electronic equipment is available to the operations crew to give an audible alarm as a reminder to make hourly log entries, keep track of elapsed time when in action statements etc. This equipment is not being used to its fullest potential and very few of the operations crews know how to use it. The STA's seem to be the only ones trained on it.

Lawrence Livermore National Laboratory

ATTACHMENT 4

NUCLEAR SYSTEMS SAFETY
85-06-50 REGION V

June 28, 1985

Jesse Crews, Senior Reactor Engineer
U.S. Nuclear Regulatory Commission, Region V
1450 Maria Lane
Suite 202,
Walnut Creek, California 94596

Dear Mr. Crews:

Enclosed is a statement of my observations, findings, and comments as a member of the NRC Region V Enhanced Inspection Team during the initial reactor startup and low power physics tests at the Palo Verde Nuclear Generating Station, Unit 1.

Please contact me at (415) 423-0952 or FTS 8-543-0952 if further information is needed.

Sincerely,

L. Rolf Peterson
Nuclear Systems Safety Program

Observations and Comments
Initial Reactor Startup and Low Power Reactor Physics Tests
Palo Verde Nuclear Generating Station, Unit 1
NRC Region V Enhanced Inspection

by
L. Rolf Peterson, P.E.
Lawrence Livermore National Laboratory

June 21, 1985

Background

I participated as a consultant member of the NRC Region V Enhanced Inspection Team at Palo Verde Nuclear Generating Station, Unit 1 (Palo Verde 1), from May 22 through May 31, 1985. During this inspection I reviewed the procedures for initial criticality and low power physics tests, observed the performance of reactor test and reactor operations personnel during reactor startup and low power operation, and evaluated the preliminary results of the low power reactor physics tests.

The initial startup of Palo Verde 1 was conducted using Arizona Public Service Co. (APS), Palo Verde Nuclear Generating Station Manual, Procedure 72IC-1RX02, Initial Criticality, Revision 1, dated May 20, 1985. Startup and initial criticality was performed with the primary reactor coolant system (RCS) at 320 degrees F temperature and 600 psia pressure. Initial criticality was achieved at 0145 on May 25, 1985.

Low power reactor physics tests were conducted using APS Procedure 72PY-1RX30, Low Power Physics Test, Revision 0, dated May 22, 1985. Initial low power physics tests were conducted at RCS temperature / pressure = 320 degrees F / 600 psia. Final low power physics tests were conducted at RCS temperature / pressure = 565 degrees F / 2250 psia. The low power physics tests commenced on May 25, 1985, and were concluded on June 1, 1985.

On May 22, 1985, I attended a briefing by David Hoppes, the supervising APS reactor test engineer, and Frank Philpott, the lead Combustion Engineering (CE) reactor engineer on site for the Palo Verde 1 startup. The briefing summarized the plans for initial criticality and low power physics tests and reviewed the major evolutions included in the procedures cited above.

Initial Criticality

I reviewed in detail Procedure 72IC-1RX02, Initial Criticality. Seven properly approved Procedure Change Notices (PCNs) corrected minor discrepancies in the original Initial Criticality Procedure. I found that the procedure, including the PCNs, was complete and incorporated good operating practices for a safe approach to initial reactor criticality.

The procedure included adequate precautions to prevent an unanticipated criticality and to ensure proper detection of the neutron multiplication during startup. The procedure established safe initial conditions for reactor startup with a high boron concentration and all control element assembly (CEA) groups fully withdrawn except for CEA Group 5, which was withdrawn to half insertion.

The procedure for boron dilution to approach criticality was cautious and orderly. It provided for periodic sampling and laboratory analysis of the RCS and pressurizer boron concentrations and for monitoring RCS boronometer readings during boron dilution and mixing. The procedure called for Inverse Count Rate Ratio (ICRR or 1/M) plots versus boron concentration and versus time during boron dilution and mixing to assist in the prediction of conditions for initial criticality. The procedure also required verification of at least one decade of nuclear instrumentation response overlap between the startup channels and the log safety channels during the final portions of the approach to critical.

I observed operations in the control room during early stages of boron dilution on May 24, 1986, and I observed the final two hours of the approach to initial criticality. Initial criticality was declared at [illegible] p.m., May 25, 1986. All operations were safely and competently performed in accordance with the Initial Criticality Procedure.

The predicted RCS boron concentration for initial criticality with CEA Group 5 halfway withdrawn and all other CEAs fully withdrawn was 1063 ppm (± 100 ppm). The actual measured boron concentration at initial criticality in this configuration was 1054 ppm. This value was well within the acceptable uncertainty of the predicted critical boron concentration.

Low Power Physics Tests

After Palo Verde 1 initial criticality was established, APS entered Procedure 72PV-1RX30, Low Power Physics Test, Revision 0. Tests included in this procedure were:

Critical boron concentration measurements with different control rod configurations;

Isothermal temperature measurements with different control rod configurations;

Reactivity worth measurements of regulating CEA Groups 5, 4, 3, 2, and 1 insertions with no overlap at RCS 320 degrees F / 600 psia and withdrawals with no overlap at RCS 565 degrees F / 2250 psia;

Reactivity worth measurement of shutdown CEA Group B insertion at RCS 320 degrees F / 600 psia;

Reactivity worth measurement of insertion of Shutdown CEA Group A minus one CEA (Group A-1) at RCS 320 degrees F / 600 psia, simulating highest reactivity worth element CEA 77 stuck in the fully withdrawn position;

Pseudo-ejected CEA reactivity worth measurement at RCS 565 degrees F / 2250 psia;

Reactivity worth measurements of pseudo-dropped CEA, Part Length CEA (PLCEA), and PLCEA Subgroup at RCS 565 degrees F / 2250 psia;

CEA reactivity worth symmetry checks at RCS 565 degrees F / 2250 psia;

Reactivity worth measurement of PLCEA Group P (an optional measurement for information only);

CEA reactivity worth measurements by exchange of reactivity between CEA groups (optional measurements).

I reviewed APS Procedure 72PY-1RX30, Rev 0, Low Power Physics Test, prior to and during the time that I observed the low power physics tests at Palo Verde 1. The procedure was modified by four PCNs to correct minor discrepancies and to change the frequency of boron sampling during long periods of boron stability. I found that the procedure was complete and explicit for all physics test activities. The procedure established prerequisites for low power physics testing that included comprehensive personnel indoctrination; pretest briefing of operations personnel; equipment availability, calibration, and configuration requirements; and special surveillance requirements. Initial conditions for entery into the procedure were clearly stated. Special precautions to be observed during the procedure were provided.

I observed in the control room representative portions of all activities and measurements during the low power physics tests. All tasks were performed in accordance with the test procedure and approved PCNs.

During the low power physics tests, the normal shift test crew was an APS Responsible Engineer, two assistants, and a Combustion Engineering representative. I observed that the reactor test and reactor operating crews properly followed test procedures throughout the tests. The APS and Combustion Engineering reactor test personnel had a good basic understaning of the measurements being made and used proper test techniques to ensure that valid data was obtained. I also observed close cooperation between the APS reactor test personnel and the Combustion Engineering representatives.

The APS reactor test personnel were noticeably dependent upon the advice of the more experienced Combustion Engineering representatives during the approach to initial criticality and during early portions of the low power physics tests. I noted a definite increase in confidence and

improvement in the APS reactor test personnel as they gained experience during the course of the low power physics tests.

During the low power physics tests I reviewed raw data and observed the APS data analysis process. All experiment data was analyzed by at least two people to detect errors and minimize interpretive variation. Good records were kept of all raw data for future reference. I found the data analysis effort was well planned and adequately staffed. I did not observe any discrepancies that went undetected or uncorrected. I believe that the data obtained was good and that the final results of data analyses were accurate.

In all cases except one, the measured parameters conformed to predicted design values that were provided by Combustion Engineering and incorporated into the APS procedure. The predicted worth for insertion of CEA Group A minus one CEA withdrawn to simulate a stuck rod assembly (CEA Group A-1) was -0.37 %Dk/k with an acceptance range between -0.47 and -1.27 %Dk/k. The measured reactivity worth of CEA Group A-1 was -0.55 %Dk/k. The larger than expected negative reactivity of CEA Group A-1 is not a safety problem since it indicates that more shutdown reactivity than was predicted is available from insertion of this CEA group when one of the highest worth CEAs in the group is stuck in the fully withdrawn position.

APS test personnel generated a Test Exception Report (TER) for the CEA Group A-1 measurement and initiated an Engineering Evaluation Request (EER). The APS Test Results Review Group (TRRG) reviewed the TER on May 30. The TRRG made an interim determination that the higher than expected negative reactivity worth of CEA Group A-1 did not impact safety in Mode 1 below 20% power. The TRRG referred the EER to Combustion Engineering for final evaluation of the impact of exceeding the expected negative reactivity worth. I agree with the TRRG evaluation and disposition of this deviation from predicted test results.

CONCLUSIONS

I found that Arizona Public Service had adequate and complete procedures in place to safely conduct the startup to initial criticality and the low power physics tests at Palo Verde Nuclear Generating Station, Unit 1.

The Palo Verde 1 operating crews and reactor test personnel that I observed on shift in the control room during initial startup and throughout the performance of low power physics tests followed established procedures.

I observed that the Palo Verde 1 reactor operating crews and reactor test personnel performed the approach to initial criticality and all low power physics tests competently. I also observed good cooperation and assistance from Combustion Engineering representatives on shift during the Palo Verde 1 startup and low power physics tests.

I observed representative portions of the data acquisition and analysis activities by the reactor test personnel during initial criticality startup and low power physics tests. Accurate data was obtained for all startup and test evolutions. I concur with the test data analyses and evaluations made by Arizona Public Service and Combustion Engineering personnel. No deviations from expected nuclear design characteristics that would adversely affect safety of operations of Palo Verde 1 were observed during the initial reactor startup and the low power physics test program.

L. Rolf Peterson, P.E.
Nuclear Systems Safety Program
Lawrence Livermore National Laboratory