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STN-50-529 Palo Verde Nuclear Station, Unit 2, Arizona Publi 05000529
STN-50-530 Palo Verde Nuclear Station, Unit 3, Arizona Publi 05000530
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SUBJECT: Forwards info re PVNGS charging pump data & recent initiatives to improve charging pump performance as requested at 970902 Region IV Mgt Meeting.

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102-04013- JML/SAB/RAS
September 16, 1997

U. S. Nuclear Regulatory Commission
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Reference: NRC Region IV Management Meeting, September 2, 1997

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Units 1, 2, and 3
Docket Nos. STN 50-528/529/530
PVNGS Charging Pump Performance

During the NRC Region IV Management Meeting, on September 2, 1997, Arizona Public Service Company (APS) was requested to supply information regarding PVNGS charging pump data and recent initiatives to improve charging pump performance. In response to that request, APS has attached the requested information.

Attachment 1 contains a description of PVNGS charging pump design, Maintenance Rule Performance, recent charging pump events and system enhancements and initiatives intended to improve system performance. Attachment 2 contains graphical data depicting charging pump performance for the last 12 months.

Should you have questions regarding this submittal, please contact Scott A. Bauer at (602) 393-5978.

Sincerely,

Gregg N. Overbeck
for JML

JML/SAB/RAS/mah

Attachment

cc: E. W. Merschoff
K. E. Perkins
K. M. Thomas
PVNGS Sr. Resident

A001

ATTACHMENT 1

"PVNGS Charging Pump Performance "

PVNGS CHARGING PUMP PERFORMANCE

CHARGING PUMP DESCRIPTION

Each PVNGS unit is supplied with three charging pumps which supply reactor coolant system (RCS) makeup, reactor coolant pump (RCP) seal injection and Pressurizer Auxiliary Spray flow. The charging pumps are three cylinder, positive displacement, reciprocating pumps. The design flowrate per pump is 44 gpm and design discharge head is 2735 psig. Typically, one charging pump is in continuous service, one is normally in service, and the third is in standby. The letdown and charging subsystem, which is part of the Chemical and Volume Control System (CVCS) is normally operated in automatic control by the pressurizer level controller to balance the letdown and charging rates and maintain pressurizer level within a programmed band. The positive displacement charging pumps are equipped with a leakage collection system and utilize suction stabilizers and pulsation dampers to minimize pressure fluctuations.

TECHNICAL SPECIFICATION REQUIREMENTS

PVNGS Technical Specification 3.1.2.4 requires two pumps to be operable when the unit is operating in Modes 1 through 4. Technical Specification 3.1.2.3 requires one pump to be operable when the unit is operating in modes 5 or 6. The safety related function of the charging pumps is to provide charging flow from the volume control tank, refueling water tank or spent fuel pool to the reactor coolant system.

CHARGING PUMP MAINTENANCE RULE PERFORMANCE

The PVNGS Maintenance Rule (MRule) Expert Panel currently classifies the CVCS as a High Risk system. PVNGS has established train level goals for each of the three charging pumps which provide a method to address degraded performance of a single train even though the system function is still available.

The charging pump reliability goal is to have no Repetitive MRule Functional Failures within a 36 month rolling window, which has been met. In the past 36 months there have not been any repetitive MRule functional failures. The goal for charging pump unavailability is < 15% per pump, which has also been met. Since the implementation of the MRule in June 1996, PVNGS has never exceeded its unavailability goal of less than 15%. The current unavailability values (based on a rolling 12 month window) considering both planned and unplanned unavailability are:

Pump No	Unit 1	Unit 2	Unit 3
CHA-P01	6.90%	5.20%	1.87%
CHB-P02	4.55%	2.30%	3.31%
CHE-P03	4.43%	4.48%	0.92%

A comparison of MRule unavailability data between PVNGS and other nuclear plants could be interpreted to indicate that PVNGS has a greater amount of unavailability hours per pump. However, PVNGS operates two charging pumps during normal operations due to the high demand of RCP seal injection, whereas other plants typically would operate a single charging pump. Since required pump maintenance can be directly correlated with pump run time, PVNGS expects to have a greater amount of unavailability hours.

RECENT CHARGING PUMP EVENTS

During the week of May 26, 1997, Unit 1 charging pumps CHA-P01 and CHB-P01 each experienced a failure that rendered the pumps inoperable. Neither failure challenged plant safety systems and subsequent investigations revealed that the failures were not related. Charging Pump CHA-P01 failed during post-maintenance functional testing due to being operated with low lube oil pressure. The root cause evaluation revealed that a damaged pressure gage gave an erroneous reading that led maintenance and operations personnel to run the pump with low oil pressure. Charging Pump CHB-P01 failed due to a loose connecting rod cap that led to a fatigue failure of the connecting rod/crosshead connection. The root cause evaluation revealed the vendor specified torque value for the connecting rod fasteners was too low. Corrective actions have been initiated to address the root cause of each failure and recurring failures are not expected.

During the week of July 21, 1997, the suction stabilizer of Unit 3 charging pump CHE-P01 failed and was declared inoperable. Inspection of the bladder revealed wear marks indicative of high bladder pressure. However, this was not a maintenance rule functional failure since a failed suction stabilizer does not prevent the charging pump from performing its safety functions. Operations procedures have been clarified to allow a charging pump with a failed suction stabilizer to remain operable. In this case, the pump was declared inoperable as a conservative measure by the shift operations crew.

During the week of September 1, 1997, prior to the start of the seventh refueling outage, Unit 2 charging pump CHB-P01 was reworked to replace the suction stabilizer bladder. Also during this period, Unit 2 charging pump CHE-P01 was repacked. Neither condition prevented the charging pumps from performing their intended safety function.

Over the past 7 months, two failures have occurred in Unit 1 on the same weld at the inlet of 1" drain valve CHB-V943. The failures were not declared maintenance rule functional failures due to redundancy in charging system design. Actions have been taken to determine the root cause of the failure. So far, vibration readings have been inconclusive and the latest failed weld is under investigation. Additional vibration readings have been scheduled and will be taken during various system line-ups.

CHARGING PUMP IMPROVEMENTS

Over the past several years, many modifications and enhancements have been made to improve the performance of the charging pumps. These modifications and enhancements in the predictive and preventive maintenance programs led to significant performance improvements in reliability and availability. The modifications and enhancements include:

- Through several design improvements (increased radius between the plunger and discharge check valve bores, shot peening stress concentration areas, change of material from 304 SS to 174-PH, removal of the land from the base of the discharge check valves, reduced size and relocation of the strongback bolt holes and lower torque on the strongback bolts) the approximate service life of a charging pump block has increased from 8,000 hours initially to 40,000 hours today (or about 4.5 years of continuous running).

- A plant modification has been completed on all nine pumps to divide the charging pump drain well into two halves. Secondary packing (seal-lube water) leakage is now routed directly to the auxiliary building sumps via the pump room floor drain. Oil leakage continues to drain to the charging pump oil drain tank (CPODT). By eliminating the need for operators to frequently drain the CPODT, far fewer repacks are required. Pumps continue to be repacked upon identification of primary packing (RCS make-up water) leakage.

- Water contamination of the crankcase oil during pump operation has been eliminated by installing a stainless steel "flinger" ring on the plungers of all nine charging pumps to prevent water from migrating from the process end to the power end of the pump plunger during operation. Since the modification was installed in 1996, the problem has not recurred.

- Improved oil seals on the bearings of the charging pump gear reducers and an oil fill cap extension pipe have reduced oil leakage, leading to improved safety and material condition of the charging pump skid.

- A material change on the charging pump primary packing from a braided style to a chevron style has significantly reduced primary packing leakage. As a conservative measure, the charging pumps are repacked upon identification of the slightest amount of primary packing leakage, which occurs approximately twice per year.

- The low lube oil alarm setpoint was increased from 10 psig to 18 psig to protect the pump from operating with a lube oil pressure that was not sufficient to protect the pump from damage.

- Installation of pulsation dampers on the pumps has reduced stresses on the charging pump and system components. Precharge systems for the pulsation dampers and suction stabilizers, along with administrative controls have greatly reduced failures.

- Installation of "vampire" fittings on the oil drain ports of the crankcase and gearbox of each charging pump allows oil sampling without taking the pump out of service.

- A unique laser block alignment method developed by the mechanical maintenance technicians has reduced the chance that the crossheads will incur damage during operation. Alignments are performed each time a block is replaced.

- Synthetic oil is now used in the gearboxes which provides a better lubricating film and will be more resistant to break down during operation. Longer gearbox service life is expected.

- A baffle plate installed in the crosshead region of the crankcase of Unit 2 charging pump CHE-P01 eliminated a chronic oil baffle packing leak on that pump. A Plexiglas crankcase cover installed during retest allowed visual verification of the effectiveness of the baffle plate.

- Addition of a snubber in the oil line upstream of the low lube oil pressure switch has effectively eliminated switch, relay and gage damage. Pulsations in the lube oil system had previously caused excessive wear in the components.

- The original lube oil filters were replaced with filters equipped with a pop up flag that activates upon high pressure drop indicating when the filter needs to be changed. Filters that were once changed out prematurely as a conservative preventative measure are now changed less frequently without adverse impact to the lube oil system.

- PVNGS is now performing gear reducer rebuilds. Mechanics have attended training at the vendors facilities in Minnesota.

- Several changes have been made to facilitate removing charging pump blocks when required for maintenance activities. Hanger modifications, the addition of lifting pins on embed plates and erection of a temporary rigging scaffold have reduced the amount of time a pump is out of service when a block is removed.

- Primary packing improvements and RP decontamination efforts have significantly reduced the amount of contamination in the charging pump rooms. Work such as a pump repack that was once performed in PC's, plastics and respirators can now be performed in a lab coat and gloves which results in a significant time savings.

- The charging pump maintenance procedure has been enhanced to provide more of the information that the maintenance technicians need when inspecting and reworking the charging pumps. Consolidating the documentation required to perform pump work improves the efficiency and reduces the time that the pump is out of service.

- Improved scheduling of work has reduced the amount of time the pumps are down for maintenance. Tasks are grouped together in a scheduling "window" as opposed to taking the pump out for each individual task.

- Regular sampling of oil and vibration readings on the charging pump crankcase and gearboxes provide trend data that is used to determine the optimal time for removing the pumps from service to perform maintenance.

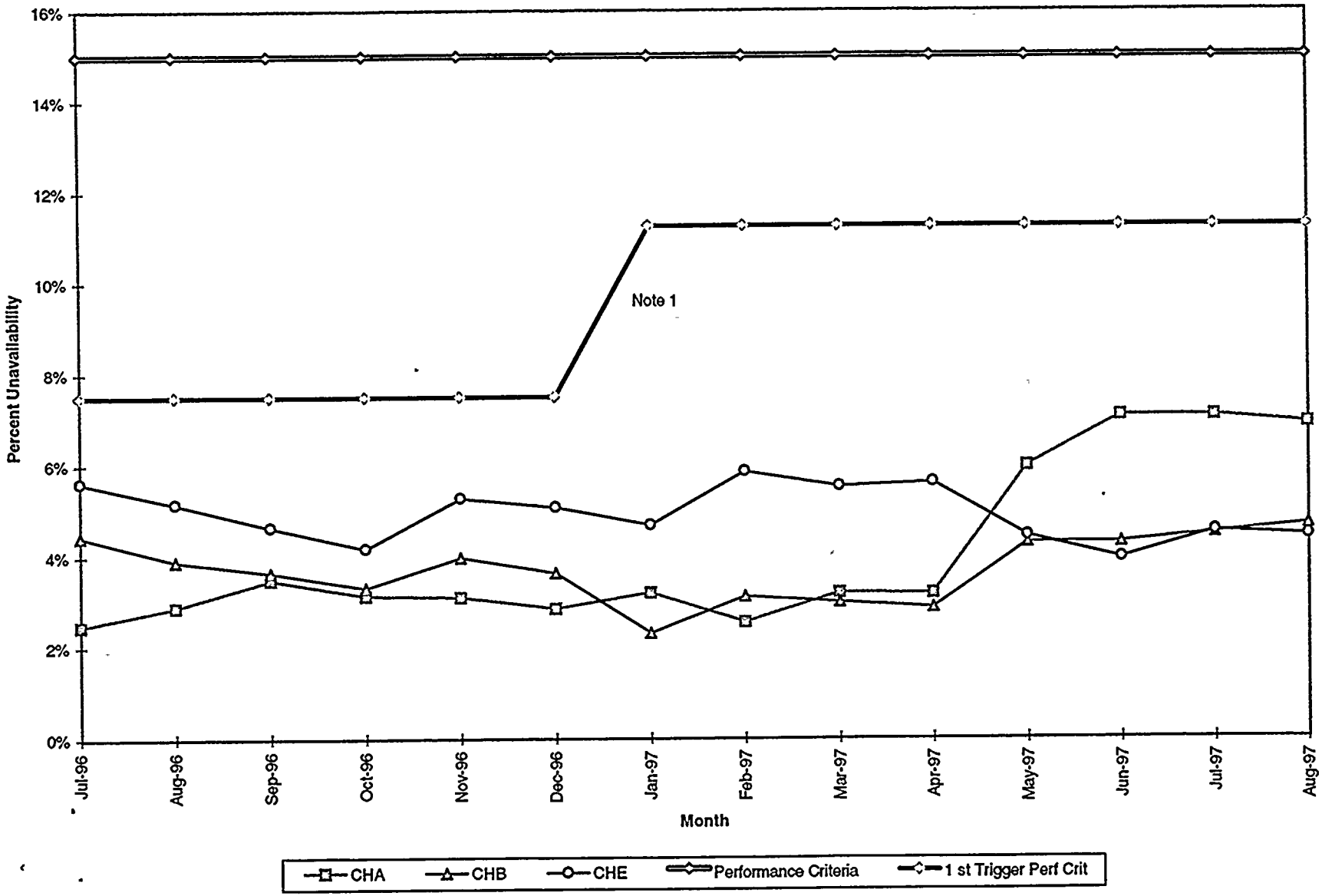
SUMMARY

Reliability and unavailability of the charging pumps is currently acceptable to MRule targets and comparable to others in the industry for this type of pump and service cycle. PVNGS charging pumps have experienced no repetitive MRule functional failures, and are well within established unavailability goals. In addition, PVNGS continues to work to improve charging pump reliability and availability.

ATTACHMENT 2

"Charging Pump Performance Graphs"

Unit 1 Charging Pump Unavailability
(12 month rolling window)



Note 1: The Maintenance Rule Expert Panel modified the 1st Trigger from 50% to 75% of the Performance Criteria

Attachment 2
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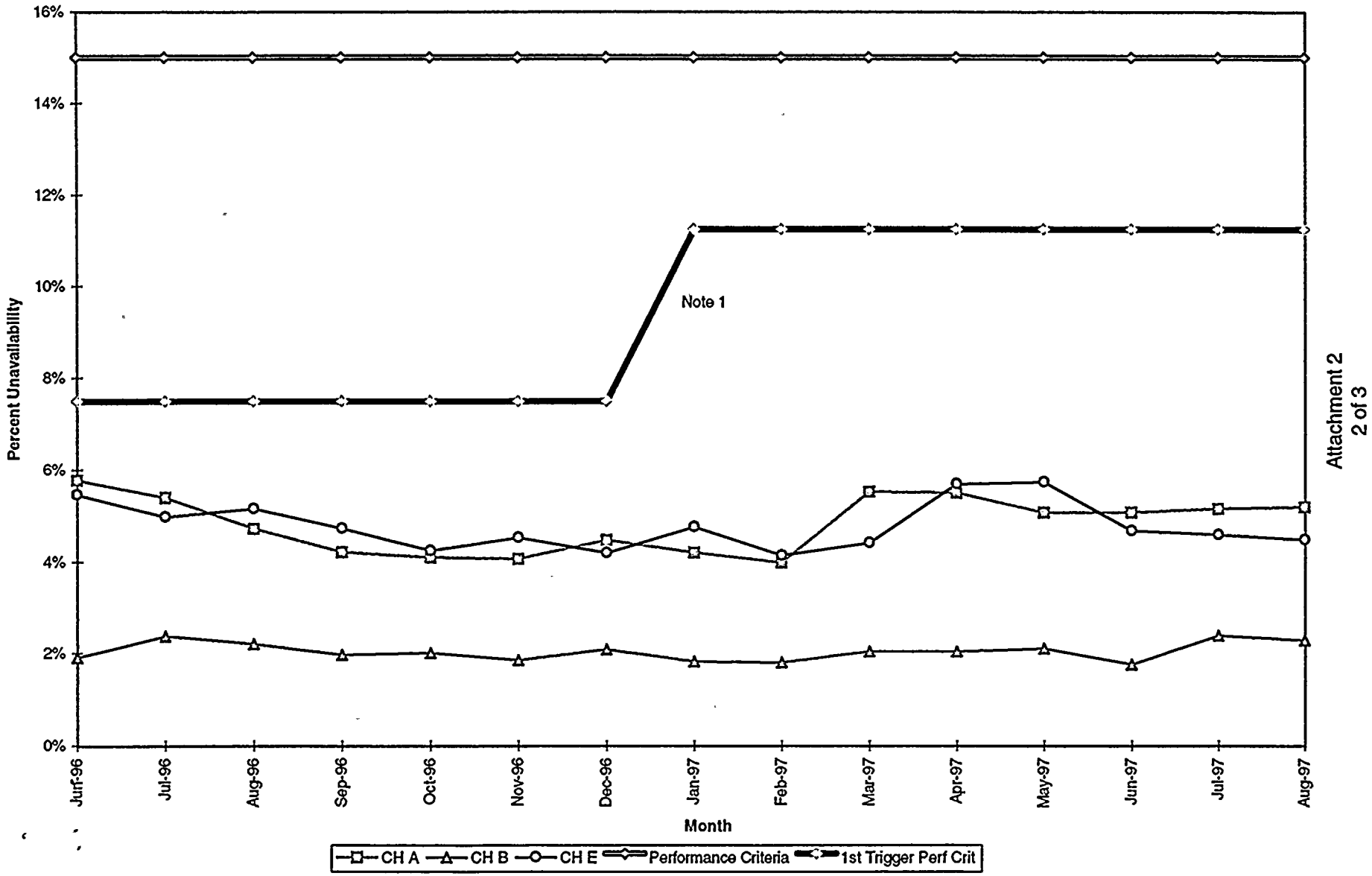
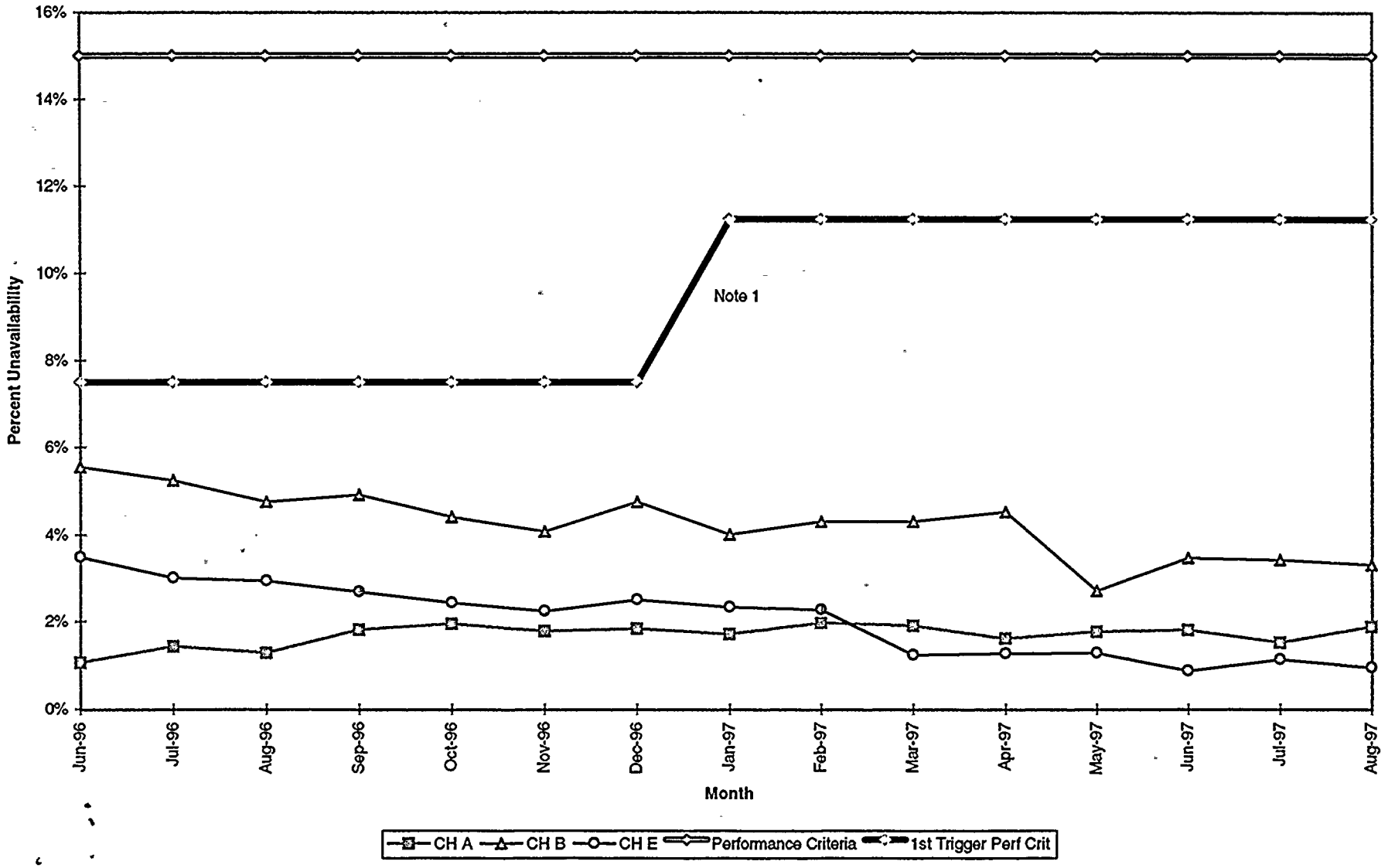
Unit 2 Charging Pump Unavailability
(12 month rolling window)



Note 1: The Maintenance Rule Expert Panel modified the 1st Trigger from 50% to 75% of the Performance Criteria

Attachment 2
2 of 3

Unit 3 Charging Pump Unavailability
(12 month rolling window)



Note 1: The Maintenance Rule Expert Panel modified the 1st Trigger from 50% to 75% of the Performance Criteria

Attachment 2
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