

ENGINEERING WORK REQUEST  
EWR 99-031

STATUS: CLOSED UNIT: 0 SYSTEM: AF INITIATED: 12/08/98 CLOSED: 11/16/00 MSS #:   
INITIATOR: JOHN\_P SCHROEDER ADMINISTRATOR: CATHY SOUKUP ISSUE MANAGER: CATHY SOUKUP   
NUMBER OF OPEN ACTIONS : 0 NUMBER OF CLOSED ACTIONS : 1 TOTAL NUMBER OF ACTIONS : 1

AF Pump Recirculation Noise in Control Room

DESCRIPTION:

Operation of the AF pumps in the recirculation mode results in Control Room noise (CR 97-0720). Determine if the restriction orifices in the recirculation lines should be replaced with multiple stage restriction orifices. A boroscope inspection of one of these orifices (RO-4008) indicated damage to the orifice due to cavitation. (See J. P. Schroeder to review this video). If the noise is determined not to be a result of cavitation (for example: simply "flow" noise), then provide structural insulation to reduce noise transmission to the Control Room. Also, Operations has stated that Control Room noise was reduced when operating with the B CST at a level of 20 feet and a temp of approximately 100 degrees F. These CST conditions were present during U2R23 to fill the SG with heated water benefit:

BENEFIT:

Reduce Control Room distractions and cavitation damage to AF piping.

Significance Level = 4

STATUS UPDATE:

(09/02/99 JRM) CR 97-0720 action #1 has been closed to EWR 99-031

(20001116 WE8258 TCK) MR 99-029 \*A and \*D have/will install replacement orifices to resolve (among other things) the noise issue. No further action required under this EWR.

SCREENED BY :

REGULATORY REPORTABLE.....(Y/N):  
TS LCO ENTRY .....(Y/N):  
MSS REVIEW REQUIRED .....(Y/N):

DATE:

TS VIOLATION.....(Y/N):  
OPERABILITY IMPACT PER TS.(Y/N):  
SIGNIFICANCE ..... (A B C D):

COMMITMENT.....(Y/N):

N  
10 CFR 21.....(Y/N):  
ACTION .....(A N P R W):  
OPERABILITY DETERMINATION.(Y/N):

SUPPORTING DETERMINATIONS:

REFERENCES: CR 97-0720

IT-305A/B

CR 96-0574

MR 99-029\*A THRU 99-029\*D

ACTION NUMBER 1  
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DONE DUE DATE: 08/01/99 PRIORITY: 4 EXTENSIONS MADE: 1  
CREATED : 04/15/99 SEN CATHY SOUKUP RECEIVED: 04/19/99 SDM DICK HORNAK  
WORK DONE: 07/16/99 ALEX FOLTYNOWICZ APPROVED: 07/21/99 DICK HORNAK  
VERIFIED : 07/29/99 CATHY SOUKUP CLOSED : 07/29/99 CATHY SOUKUP

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BENEFIT:

Reduce Control Room distractions and cavitation damage to AF piping.

SUGGESTED SOLUTION:

Analyze flow characteristics of AF recirculation piping to determine if a multi-stage orifice will reduce operation noise. Install orifices as required. Flowserve Inc. has stated that they can provide the engineering and replacement orifices. They will need the Code that the orifice is required to be designed to before they can provide a cost estimate. Provide sound insulation design if needed.

EXPECTED ACTION BY ENGINEERING:

Implementation of design change (WO or Modification)

SUPERVISOR COMMENTS (SJY):

This is an operator distraction of low safety significance, but does present the potential to affect operator response due to increased noise level..

Significance Level = 4

(04/15/99 CAS2) Set Work Priority to 4.

(04/19/99 LJA1) Received Action into Group: SDC  
Responsible Person: RFH:DICK HORNAK

No Priority Assigned  
No Due Date Assigned

A/100

(04/23/99 RFH) Changed Responsible Person: From (RFH) to (AF)  
Changed Responsible Group: From (SDC) To (SDM).. Consolidate this with other open items tracking this issue. Close redundant items.

(04/23/99 RFH) Changed the Due Date from: << BLANK >> to 06/15/99

(06/04/99 AF) CR 96-0574, CR 97-0720, and EWR 99-031 had been written to report that operation of the AF pumps in the recirculation mode results in high level of noise in Control Room and Operation offices. The entire subject of noise in recirculating lines can be traced to two separate areas: 1. The piping itself. 2. The pressure-reducing orifice installed in the line to establish a specific flow under the prevailing pressure differentials.

Each of the above areas have been reviewed for the possible contribution to the high level of noise in the AF recirculating piping system. Field walkdown of the affected piping confirmed existence of high level noise in the area. In addition, high frequency-low amplitude vibration was also observed. Inspection of piping supports performed by J. McNamara-Civil indicated that some of the U-bolts could be tightened which would possibly alleviate some of the vibration. However, this will not help in elimination or significant reduction of noise caused by cavitation erosion of recirculating line pressure reducing orifice. The pressure-reducing orifice in AF recirculating line controls the amount of water that is recirculated for the AF pump and provide initial pressure reduction of this high pressure fluid (1190 psig to 14.7 psig). The orifice is typically a stainless steel pipe with a multiple pressure reducing orifice plates inside. High pressure drops require multiple orifices in series to prevent cavitation and the associated noise. The solution to cavitation is to reduce the pressure from the inlet to the outlet gradually - without allowing the liquid pressure to drop below its vapor pressure. By always keeping the pressure through the component above the vapor pressure, cavitation can be successfully avoided. In this case, orifice with six (6) to nine (9) stages is required to eliminate cavitation and to have predicted noise level of less than 70 decibels. Although, drawing of the installed pressure-reducing orifice was not located therefore, making verification of the number of stages not possible. Based on the length of the orifice - 7 5/8", it was concluded that the installed orifices do not have required number of stages (6 to 9) to preclude cavitation. Furthermore, the type of noise, which sounds like gravel flowing through the piping is typical to the noise associated with cavitation. Therefore, it is concluded that the noise problem in AF pumps recirculating piping is caused by cavitation erosion in the pressure-reducing orifice. This conclusion is also supported by the results of the past visual inspection of pressure-reducing orifice RO-4008 (Pump P-35A), where deterioration was found to have resulted from cavitation erosion. NRC Information Notice 98-45 has been issued to address similar problem caused by cavitation erosion in orifices. Review of this notice reveals that orifice damaged by cavitation can cause flow-induced vibration. The vibration, in turn may cause socket welds to fail and also caused some damage to pipe supports and increased component failures. Based on the above it is recommended that an EAC evaluation be performed to look at three options to resolve this issue. A. Installation of a multi-stage pressure-reducing orifice. B. Replace existing pressure-reducing orifice with a pressure-reducing flow element in valve body. C. Retrofit Copos Vulcan control valve with multi-stage pressure-reducing trim.

(06/08/99 AF) Requested Due Date: 08/01/1999

(06/08/99 RFH) Changed the Due Date from: 06/15/1999 to 08/01/1999  
Evaluation is completed. Refer to above update. As discussed with R. Hornak this EWR should be submitted for evaluation to EAC. EAC meeting to discuss this EWR is scheduled for 6/15/99. This extension is requested to give enough time to initiate any action item requested by EAC.

(06/11/99 RFH) CR 96-574, Item 5 is being closed to this EWR.

(07/15/99 RFH) CR 96-0720, Item 1 is being closed to this item.

(07/16/99 AF) The EAC evaluation of this EWR is summarized in Meeting Minutes NPM 99-0749. EAC recommended to work on the two electric motor driven AF pumps in the year 2000. Evaluate performance of the new installation, then if necessary replace the orifices on turbine driven AF pumps in the year 2001. Based on the EAC recommendation, modification request for each AF pump was initiated. The following are the MR numbers associated with each pump: P-38A MR 99-029\*A Electric motor driven P-38B MR 99-029\*B Electric motor driven 1P-29 MR 99-029\*C Turbine driven 2P-29 MR 99-029\*D Turbine driven

(07/16/99 AF) Passed to DICK HORNAK for acceptance of work.

(07/21/99 RFH) Passed to CATHY SOUKUP for Verification.  
Based on the latest update, it is recommended that EWR 99-031 may be closed to the action being taken under the MRs 99-029\*A thru 99-029\*D.

(07/29/99 CMW) PLA Closure of Item.

(09/02/99 JRM) CR 97-0720 action #1 has been closed to EWR 99-031.

REFERENCES: CR 97-0720

IT-305A/B

CR 96-0574

MR 99-029\*A THRU 99-029\*D