Douglas R. Gipson
Senior Vice President, Nuclear Generation

Fermi 2
6400 North Dixie Hwy., Newport, Michigan 48166
Tel: 313.586.5201 Fax: 313.586.4172

Detroit Edison

September 28, 1998
NRC-98-0120

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington D C 20555-0001

References 1) Fermi 2
NRC Docket No. 50-341
NRC License No. NPF-43

2) Detroit Edison Letter to the NRC, NRC-98-0114, "Relief Requests PR-8 and PR-12," dated August 4, 1998

3) NRC Letter to Detroit Edison, "Telephone Conference Concerning Residual Heat Removal Pump Request for Relief PR-12," dated September 3, 1998

4) NUREG/CP-0152, "Proceedings of the Fourth NRC/ASME Symposium on Valve and Pump Testing," dated July 1996

Subject: Updated Relief Request PR 8 R2 and 12

Detroit Edison is submitting an updated Relief Request PR-12 for approval per the discussion with the NRC staff on August 19, 1998 (Reference 3). This Relief Request was originally submitted in Reference 2 and is being reformatted and updated to reflect the NRC/American Society of Mechanical Engineers (ASME) conference paper (Reference 4).

Detroit Edison believes that the proposed alternative would provide an acceptable level of quality and safety as described in the enclosed Relief Request.

Additionally, Relief Request PR-8-R2 is being resubmitted with the new revision and change number.

This relief request was originally submitted in Reference 2. Approval is requested by January 19, 1999 in order to minimize the potential for unnecessary testing. If you should have any questions concerning this request, please contact Mr. Norman K. Peterson, Director - Nuclear Licensing at (734) 586-4258

Sincerely,

Enclosures

cc: B. L. Burgess
G. A. Harris
A. J. Kugler
Regional Administrator, Region III
Supervisor, Electric Operators,
Michigan Public Service Commission

Enclosure to
NRC-98-0120

RELIEF REQUEST PR-8-R2
VIBRATION LIMITS RHR PUMPS A, B, AND D
2 PAGES

RELIEF REQUEST PR-8-R2

SYSTEM: Residual Heat Removal System

PUMPS:

Pump	Code Class	ISI Drawing
E1102C002A	2	6M721-5813-2
E1102C002B	2	6M721-5813-1
E1102C002D	2	6M721-5813-1

FUNCTION: The LPCI mode of operation of the RHR System pumps water into the RPV in time to cool the core, in case of low water level in the reactor or high pressure in the containment drywell.

SECTION XI CODE REQUIREMENTS FOR WHICH RELIEF IS REQUESTED: Vibration amplitude displacement shall be measured quarterly during inservice testing (Table IWP-3100-1 and IWP-3400(a)).

BASIS FOR RELIEF: During preoperational testing, the vibration velocity measurements for the RHR pumps were high (.19 to .27 ips) relative to the vibration velocity ranges given in Relief Request PR-1. Three of the four pumps fell into the alert range.

The preoperational vibration velocity measurements were part of a series of vibration tests which included vibration amplitude. The results of the tests are summarized in Detroit Edison Research Report 84D98-2 which concludes:

"The vibration measurements which were taken during the preoperational test indicate that the pumps are operating in a satisfactory condition."

Given that the pumps are operating acceptably at the higher vibration velocities, a new set of vibration velocity ranges were developed with the assistance of the vendor as described in Detroit Edison Engineering Research Report 85D15-5, Revision 1.

Report 85D15-5 recommends the measurement of overall velocity (filter out), overall amplitude (filter out) and running speed amplitude (filter in). All three quantities will be measured at the pump bearing and compared to the ranges given in alternate testing.

RELIEF REQUEST PR-8-R2 (Continued)

Testing data over 10 years (i.e., 1984 - 1994) using this criteria has revealed that the values for overall velocity have remained constant and that the action levels recommended in Report 85D15-5 are not conservative. Therefore, the vibration limits contained in ASM/ANSI OMa-1988, Part 6, Table 3 (ranges for test parameters) are being adopted as the vibration limits for overall velocity for the RHR pumps A, B, and D.

The methodology of ASME/ANSI Operations and Maintenance Code, Part 6 (OM-6), is to be utilized for RHR pump vibration monitoring. The provisions of ISTB 4.6.1, 4.6.4, 5.2, and 6.1 will be met. The RHR pumps are vertical centrifugal pumps. Since all provisions of OM-6 are being met, no additional approval from the NRC is required per NUREG-1482, paragraph 5.4.

ALTERNATE TESTING: Pump vibration over all velocity will be measured for each RHR pump accessible bearing in accordance with OM-6, paragraph 4.6.4(a). The acceptance criteria for RHR Pumps E1102C002A, E1102C002B, and E1102C002D will be that of OM-6, Table 3a:

	Overall Velocity
Acceptable Range:	≤ 0.325 in/sec
Alert Range:	0.326 in/sec to 0.700 in/sec
Required Action Range:	> 0.700 in/sec

Overall Amplitude and **Running Speed Amplitude** will continue to be measured with the ranges given in Table IWP-3100-2 applied as acceptance criteria.

Note: Pump Relief request PR-12 addresses RHR Pump E1102C002C vibration limits

Enclosure to
NRC-98-0120

RELIEF REQUEST PR-12
VIBRATION LIMIT RHR PUMP C
4 PAGES

RELIEF REQUEST PR-12

SYSTEM: Residual Heat Removal

PUMP: Residual Heat Removal Pump C

PUMP NO.: E1102C002C

CLASS: 2

ISI DRAWING: 6M721-5813-2

FUNCTIONS:
The LPCI mode of operation of the RHR System pumps water into the RPV in time to cool the core, in case of low water level in the reactor or high pressure in the containment drywell.

SECTION XI CODE REQUIREMENTS FOR WHICH RELIEF IS REQUESTED:
Vibration amplitude displacement shall be measured during inservice testing (Table IWP-3100-1 and IWP-3400 (a)). (Velocity readings are taken in lieu of mils displacement readings per Relief Request PR-8). IST evaluation 96-029 committed to taking the upper motor bearing vibration since it carries the pump thrust. This was in response to an NRC open item during NRC Inspection 95002. This IST evaluation used OM-6 absolute limits (0.325 In./sec/ - ALERT & 0.7 in./sec - REQUIRED ACTION) as the acceptance criteria.

BASIS FOR RELIEF: Fermi 2 Power Plant proposes an alternate program which is believed to be more comprehensive than that required by Section XI. The proposed program is based on vibration readings measured in velocity units rather than vibration amplitude in mils displacement. Previously approved Relief Request PR-8 requested this relief for all of the RHR pumps. Relief Request PR-8-R2 no longer will cover RHR Pump C; therefore, Relief Request PR-12 requests that (1) the RHR Pump C use readings measured in in/sec velocity units rather than vibration amplitude in mils displacement, as detailed in OMa-1988, Part 6, Paragraph 4.6.4 and (2) that further relief be granted in that for the upper thrust bearing of the RHR Pump C the Alert Range of Table 3A be increased from >0.325 in/sec to > 0.400 in/sec.

Pursuant to 10CRF50.55a(a)(3)(i) Detroit Edison is requesting relief from ASME Section XI requirements to run the pump on an increased periodicity due to vibration level exceeding the OM-6 Alert limit. This is based on analysis of the vibration data indicating that no pump degradation is taking place. Detroit Edison is proposing to use alternative vibration Alert Limits based on historical vibration data and analysis of that data. This provides an alternative method that still meets the intended function of monitoring the pump for degradation over time while keeping the Required Action level unchanged.

Since the initial IST data was taken at the upper motor bearing on the RHR C pump, the overall vibration limits have periodically exceeded the 0.325 in./sec. ALERT limit. Vibration spectral

analysis has shown that the RHR C pump has the highest running speed peak (.2 - .2 in./sec.) of the 4 RHR pumps but this is well below any alert limit. The vibration spectral data also indicates a resonant frequency between 9 - 14 Hz. Both these items were identified in the initial vibration Engineering Research Report 85D15-5, Rev 1 dated 1984. What was not identified when IST Evaluation 96-029 and the Engineering Research Report were written, was the fact that the resonance frequency is cyclic, and/or changes from run to run, and is associated with small changes in flow. The combination of the running speed peak and the resonance frequency occasionally result in the overall vibration velocity exceeding the ALERT limit of 0.325 in./sec. The running speed peak is the best vibration indicator for actual pump condition and this peak has remained unchanged. No bearing peaks have been identified in the vibration spectrum and all other indicators: flow, oil analysis, and pressures indicate that the RHR C pump is operating in a satisfactory condition.

ASME/ANSI Operation and Maintenance Code, OMa-1988, Part 6 footnote to Section 4.3, states "Vibration measurements of pumps may be foundation, driver, and piping dependent. Therefore, if initial readings are high and have no obvious relationship to the pump, then vibration measurements should be taken at the driver, at the foundation, and on the piping and analyzed to ensure that the reference vibration measurements are representative of the pump and that the measured vibration levels will not prevent the pump from fulfilling its function." This is exactly the case on the RHR C pump. The data has been analyzed in IST Evaluation 97-042 by our on-site level 3 vibration expert and was found to be a resonant frequency between 9 - 14 HZ. This resonance frequency, either alone or in combination with the running speed peak, occasionally result in the overall vibration amplitude exceeding the 0.325 in./sec. ALERT LIMIT. The running speed peak has remained very steady (see trend 1) while the resonant peak varies greatly from run to run (see trend 2). Each structure has it's own resonance frequency based on the mass and stiffness of the system. Minor changes in either of these two components will change the resonance frequency. Differences in piping and hanger design between the four RHR pumps is the cause for the difference in the resonance frequency and therefore the vibration levels. The reason that the vibration levels change from run to run is that for a resonance frequency to "ring" it must be excited by some forcing function. In RHR C this forcing function is flow noise, which causes a broad band forcing frequency that varies slightly during each run.

As stated earlier Engineering Research Report 85D15-5, Rev 1 dated 1984 had identified these frequencies. At that time several attempts were made to stiffen the pump structure. These attempts only succeeded in transferring the energy to the piping. These supports were removed and the system returned to the previous configuration. When the upper motor bearing vibration data was added to the IST program and the data was found to be high, the shaft locking nut (which had been found to be a problem on a Core Spray pump) was checked along with the mounting bolts and hangers. No problems were identified. Additional vibration data was alsocollected and entered into a three dimensional model (FIGURE 1) program. This program

did not indicate any problems in either the pump or motor. FIGURE 2 is a high resolution vibration spectrum which shows the structural resonance and running speed peaks. TRENDS 1 and 2 indicate that the running speed spectral peaks have remained unchanged while the resonant peak can change with each run. With the resonant frequency being the cause for exceeding the alert vibration range there is little that can be done to the pump or rotating assembly (such as balancing or alignment) that will reduce this resonant vibration peak.

The required monitoring range is from ½ running speed to 1000 Hz. A filter was used to filter out the resonance below 14 Hz (<1/2 Running Speed). This helped, but occasionally the filtered overall vibration still exceeds 0.325 ips. The IST data taken 2/21/98 was .3587 in./sec. even with the filter. Vibration analysis of all the vibration points did not show any signs of a pump or motor problem. The only change noted was an increase in the resonance peak.

Given that the RHR C Pump is operating acceptably at vibration velocities at or slightly above the IST Program Alert Level with no change in running speed peak from the initial data taken in 1984, a new Alert vibration velocity level has been developed. This new velocity vibration alert level will allow for early detection of pump degradation prior to component failure while the Required Action level (0.7 in./sec.) will remain unchanged.

Per NUREG/CP-0152 four key components should be considered for relief. These four components are stated below with the corresponding basis:

- Spectral analysis - Spectral data indicates that the overall vibration levels are primarily made up of two basic frequencies, running speed and a 9-14 Hz resonance. Spectral data does not indicate any problem with bearings or the rotating elements such as imbalance or misalignment.
- Historical data - Vibration data from 1984 indicated that the frequencies described in the spectral analysis are not new and have been observed since this pump was first installed. The only spectral frequency that periodically changes in amplitude is the resonance frequency when it is excited by flow noise.
- Attempts to correct - When the equipment was first installed in 1984, stiffeners were installed to reduce the vibration. These attempts only increased the piping vibration levels and were subsequently removed. When the upper motor bearing vibration data was added to the IST program and the data was found to be high, the shaft locking nut (which had been found to be a problem on a Core Spray pump) was checked along with the mounting bolts and hangers. No problems were identified. Additional vibration data was also collected and entered into a three dimensional model (FIGURE 1) program. This program did not indicate any problems in either the pump or motor.
- Have data evaluated by manufacturer or vibration expert - All of the historical and recent vibration data has been reviewed by the Principle Reliability Engineer, a level 3 vibration analyst. The conclusion reached is that the primary cause of the periodically high overall vibration level is changes in the resonant frequency. No problems or degrading trends are observed in the vibration data, this included phase and modal analysis. Attempting to balance

or align this pump will have very little impact on changing the resonant vibration levels and therefore have little effect on overall vibration levels..

ALTERNATE TESTING: Pump vibration overall velocity will be measured for the RHR C pump accessible bearing in accordance with OM-6, paragraph 4.6.4(a). The acceptance criteria of OM-6, Table 3a will be used for the pump bearing:

Overall Velocity

Acceptable Range: ≤ 0.325 in/sec

Alert Range: 0.326 in/sec to 0.700 in/sec

Required Action Range: > 0.700 in/sec

For the RHR pump C upper motor bearing, pump thrust bearing, Table 3a will be modified to increase the Alert Range from > 0.325 in/sec to > 0.400 in/sec.

Vibration Acceptance Criteria

Vibration Parameter	Required Action Range	Alert Range	Acceptable Range
Overall Velocity (OVVEA1) Horizontal Inline	> 0.700 in./sec.	> 0.400 in./sec. to 0.700 in./sec.	≤ 0.400 in./sec.
Overall Velocity (OVVEA2) Horizontal 90°	> 0.700 in./sec.	> 0.400 in./sec. to 0.700 in./sec.	≤ 0.400 in./sec.
Overall Velocity (OVVEA3) Vertical	> 0.700 in./sec.	> 0.400 in./sec. to 0.700 in./sec.	≤ 0.400 in./sec.
Overall Velocity (OVVEC1) Horizontal Inline	> 0.700 in./sec.	> 0.325 in./sec. to 0.700 in./sec.	≤ 0.325 in./sec.
Overall Velocity (OVVEC2) Horizontal 90°	> 0.700 in./sec.	> 0.325 in./sec. to 0.700 in./sec.	≤ 0.325 in./sec.

Overall Amplitude and **Running Speed Amplitude** will continue to be measured with ranges given in Table IWP-3100-2 applied as acceptance criteria.

FIGURE 1
3 Dimensional Model

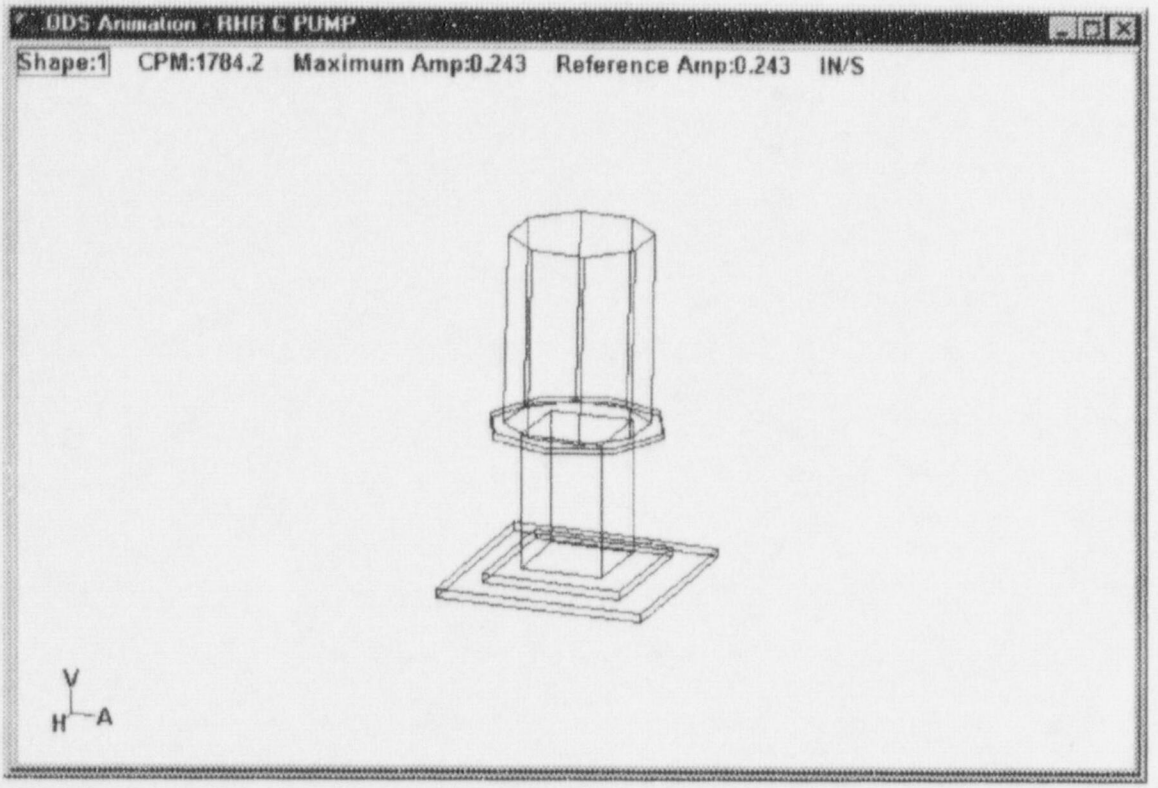
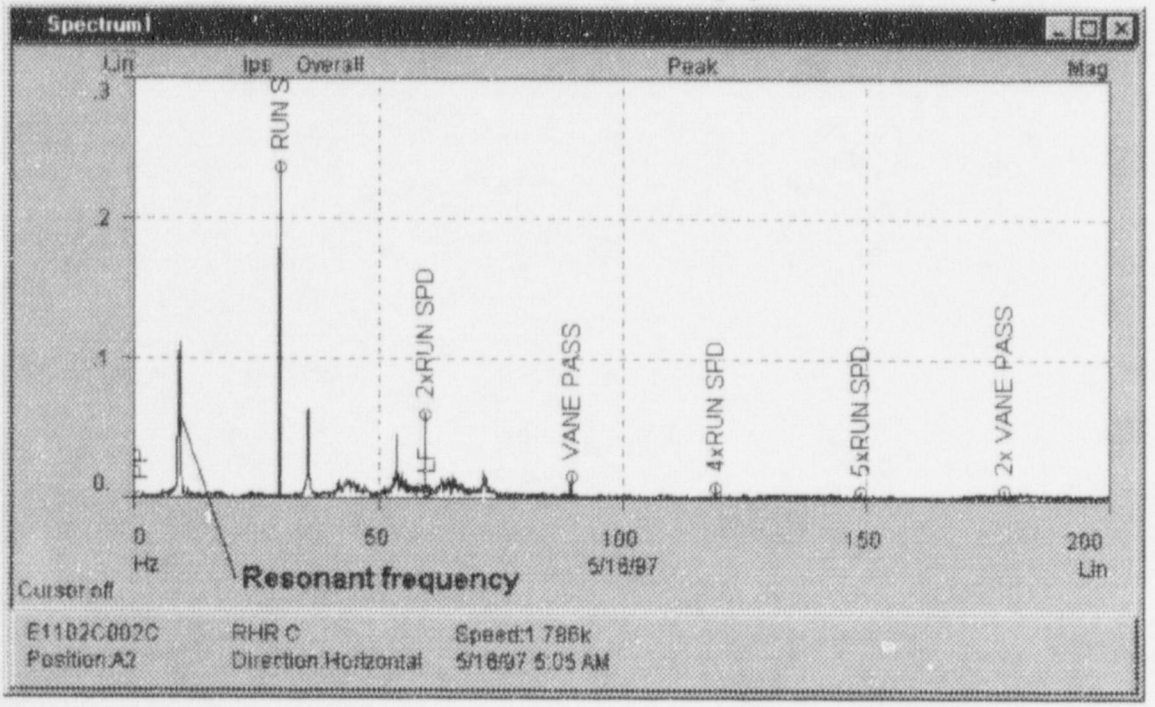
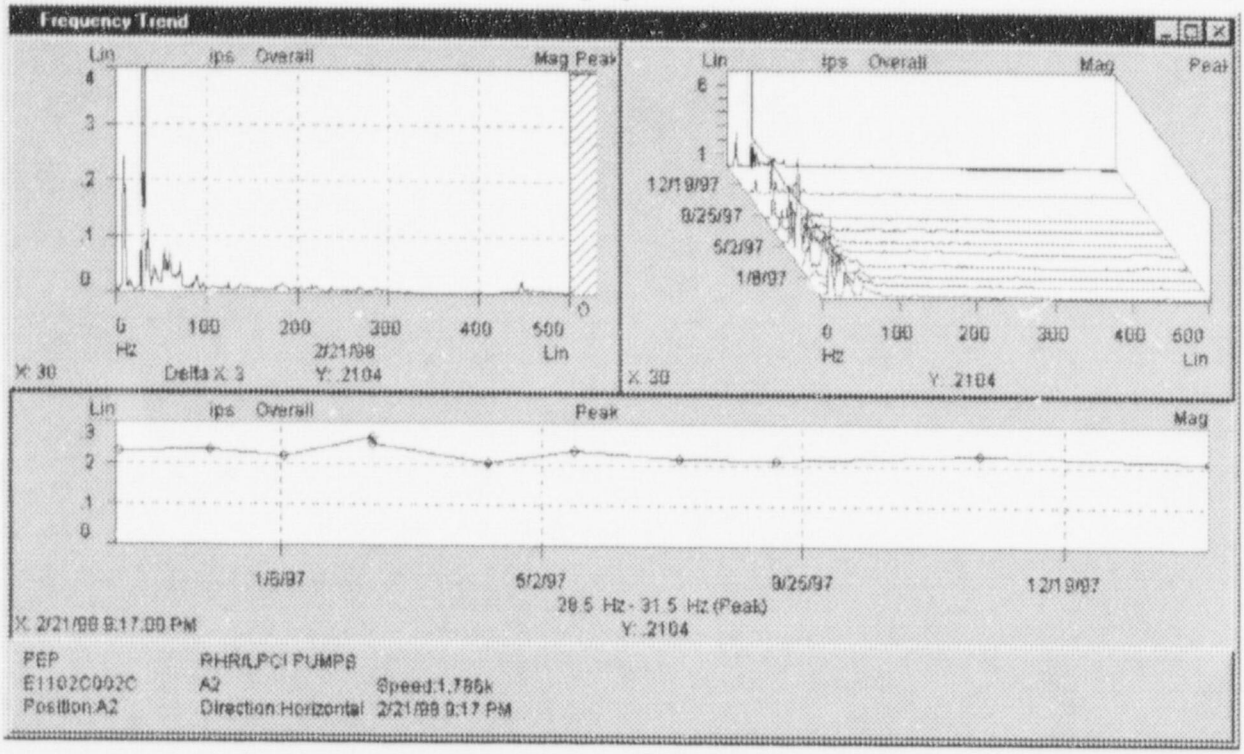


FIGURE 2
High resolution spectrum showing running speed and resonant peaks.



TREND 1
Running Speed Trend



TREND 2
5 -15 Hz Resonance Trend