April 23, 2008

Vice President, Operations
Entergy Operations, Inc.
Grand Gulf Nuclear Station
P.O. Box 756
Port Gibson, MS 39150

SUBJECT: GRAND GULF NUCLEAR STATION, UNIT 1 – THREE RELIEF REQUESTS FOR JOCKEY PUMPS FOR THE THIRD 10-YEAR INSERVICE TESTING INTERVAL (TAC NOS. MD7518, MD7519, AND MD7520)

Dear Sir or Madam:

By letter dated November 29, 2007 (CNRO-2007-00042), Entergy Operations, Inc. (Entergy), submitted the following relief requests (RRs) for the Grand Gulf Nuclear Station (GGNS): PRR-GGNS-2007-1, PRR-GGNS-2007-2, and PRR-GGNS-2007-3. These three RRs are for the third 10-year inservice testing (IST) interval at GGNS. In these RRs, Entergy requested relief from certain IST requirements in the American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants (OM Code) of record for GGNS for this interval.

The Nuclear Regulatory Commission (NRC) staff has completed its review of the above RRs and enclosed is the NRC staff's safety evaluation (SE) for the RRs. Based on the enclosed SE and pursuant to paragraph 50.55a(a)(3)(ii) of Title 10 of the *Code of Federal Regulations*, the Commission authorizes PRR-GGNS-2007-1, PRR-GGNS-2007-2, and PRR-GGNS-2007-3 on the basis that complying with the specified requirements in the ASME OM Code would result in hardship to the licensee without a compensating increase in the level of quality and safety. Therefore, the RRs are authorized for the third 10-year IST interval, which commenced on December 1, 2007.

If you have any questions, please contact me at 301-415-1307 or via e-mail at jnd@nrc.gov.

Sincerely,

/RA/

Thomas G. Hiltz, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-416

Enclosure: Safety Evaluation

cc w/encl: See next page

April 23, 2008

Vice President, Operations
Entergy Operations, Inc.
Grand Gulf Nuclear Station
P.O. Box 756
Port Gibson, MS 39150

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ADAMS Accession No. ML081010019 (*) staff-provided SE

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE INSERVICE TESTING PROGRAM, THIRD 10-YEAR INTERVAL

RELIEF REQUESTS PRR-GGNS-2007-1, PRR-GGNS-2007-2, AND PRR-GGNS-2007-3

ENTERGY OPERATIONS, INC.

GRAND GULF NUCLEAR STATION, UNIT 1

DOCKET NO. 50-416

1.0 INTRODUCTION

By application dated November 29, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML073511442), Entergy Operations, Inc. (the licensee), submitted three relief requests (RRs) for the third 10-year inservice testing (IST) interval at the Grand Gulf Nuclear Station (GGNS). In these RRs, the licensee requested relief from certain IST requirements of the 2001 Edition through 2003 Addenda of the American Society of Mechanical Engineers (ASME) Code for Operation and Maintenance of Nuclear Power Plants (OM Code). In its application, the licensee stated that the GGNS third 10-year IST interval commenced on December 1, 2007.

In the attachment to its application, the licensee submitted three separate, but similar, RRs that address IST of the jockey pumps for three different emergency core cooling systems. The three RRs are the following: (1) PRR-GGNS-2007-1 for the residual heat removal (RHR) system jockey pumps A, B, and C; (2) PRR-GGNS-2007-2 for the low pressure core spray (LPCS) system jockey pump; and (3) PRR-GGNS-2007-3 for the high pressure core spray (HPCS) system jockey pump. The three RRs address the difficulty in the licensee accurately measuring the flow of the jockey pumps, which is required by the applicable ASME OM Code given in the previous paragraph. The licensee requested relief from certain requirements in ISTB-3300, "Reference Values," ISTB-3510, "Data Collection General," ISTB-5121, "Group A Test Procedure," and Table ISTB-3000-1, "Inservice Test Parameters," in the applicable ASME OM Code.

In the attachment, the licensee also provided RRs for Arkansas Nuclear One, River Bend Station, and Waterford Steam Electric Station. These RRs will be addressed in separate letters to the licensee.

These three RRs are a re-issuance by the licensee of RRs that were approved by the Nuclear Regulatory Commission (NRC) for GGNS in the previous interval, the GGNS second 10-year IST interval. The licensee stated that the proposed alternatives and the basis for the proposed alternatives for the current RRs for the third 10-year IST interval are not substantially different from the alternatives that were approved by NRC for the second 10-year IST interval.

2.0 REGULATORY EVALUATION

In Part 50, Section 50.55a, in Title 10 of the *Code of Federal Regulations* (i.e., 10 CFR 50.55a), the regulations require that IST of certain ASME Code Class 1, 2, and 3 pumps and valves be performed at 120-month (10-year) IST program intervals in accordance with the specified ASME Code and applicable addenda incorporated by reference in the regulations, except where alternatives have been authorized or relief has been requested by the licensee and granted by the NRC pursuant to paragraphs (a)(3)(i), (a)(3)(ii), or (f)(6)(i) of 10 CFR 50.55a.

In accordance with 10 CFR 50.55a(f)(4)(ii), licensees are required to comply with the requirements of the latest edition and addenda of the ASME Code incorporated by reference in the regulations 12 months prior to the start of each 120-month IST program interval.

In accordance with 10 CFR 50.55a(f)(4)(iv), IST of pumps and valves may meet the requirements set forth in subsequent editions and addenda that are incorporated by reference in 10 CFR 50.55a(b), subject to NRC approval.

Portions of editions or addenda of the ASME Code may be used provided that all related requirements of the respective editions and addenda are met. In proposing alternatives or requesting relief, the licensee must demonstrate that: (1) the proposed alternatives would provide an acceptable level of quality and safety; (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) conformance is impractical for the facility. Section 50.55a of 10 CFR 50 authorizes the NRC to approve alternatives and to grant relief from ASME OM Code requirements upon making necessary findings.

NRC guidance contained in Generic Letter (GL) 89-04, “Guidance on Developing Acceptable Inservice Testing Programs,” and in GL 89-04, Supplement 1, provides alternatives to ASME Code requirements that are acceptable to the NRC staff. Further NRC guidance is given in NUREG-1482, Revision 1, “Guidelines for Inservice Testing at Nuclear Power Plants.”

3.0 TECHNICAL EVALUATION

3.1 Code Requirements

In the attachment to its application, in RRs PRR-GGNS-2007-1, PRR-GGNS-2007-2, and PRR-GGNS-2007-3, the licensee requested relief, for certain jockey pumps, from the following IST requirements of the 2001 Edition through 2003 Addenda of the ASME OM Code:

1. ISTB-3300 requires that reference values shall be established within ±20 percent of pump design flow for the Group A tests, if practicable. If not practicable, the reference point flow rate shall be established at the highest practical flow rate.

2. ISTB-3510 states that the full-scale range of each analog instrument shall be not greater than three times the reference value. It is also stated that the sensor location shall be established by the Owner, documented in the plant records, and shall be appropriate for the parameter being measured. The same location shall

be used for subsequent tests. Instruments that are position-sensitive shall be either permanently mounted, or provision shall be made to duplicate their position during each test.

3. ISTB-5121 states that Group A tests shall be conducted with the pump operating at a specified reference point. The test parameters shown in Table ISTB-3000-1 shall be determined and recorded as required by this paragraph. The resistance of the system shall be varied until the flow rate equals the reference point. The differential pressure shall then be determined and compared to its reference value. Alternatively, the flow rate shall be varied until the differential pressure equals the reference point and the flow rate determined and compared to the reference flow rate value.

4. Table ISTB-3000-1 lists flow rate as a required parameter for the Group A and comprehensive pump tests.

3.2 Pump Relief Request PRR-GGNS-2007-1

In this RR, the licensee requested relief from the above requirements in ISTB-3300, ISTB-3510, ISTB-5121, and Table ISTB-3000-1 for the following RHR jockey pumps:

Pump	Description	Class	Category
E12C003A	RHR Jockey Pump A	2	Group A
E12C003B	RHR Jockey Pump B	2	Group A
E12C003C	RHR Jockey Pump C	2	Group A

The licensee stated that the above pumps are ASME Code Class 2, centrifugal, motor-driven, OM Code Category A pumps.

3.2.1 Licensee's Basis for Requesting Relief

For this RR, in the attachment to its application, the licensee stated the following as its basis for requesting relief:

> These [three RHR] jockey pumps are required to operate whenever their respective LPCI [low pressure core injection]/RHR trains are in the operable condition. As such, the pumps perform continuous duty on a recirculation line and provide makeup as needed.
>
> Pressure taps exist in the jockey pump suction and discharge piping where pump suction and discharge pressure can be measured for calculation of differential pressure, and throttle valves exist which can be used to set differential pressure equal to the pump's reference value. However, the pump differential pressure information provided is of little use for analyzing the hydraulic condition of the jockey pump without being able to measure flow rate or set flow rate at a known reference value, as required by ASME OM Code-2001 Edition with addenda through OMb Code-2003 Addenda ISTB-5121(b).

> There are no practical means of measuring the flow rate of these jockey pumps. No flow rate meters, orifices or other measurement devices are installed in the system for measurement of jockey pump flow rate. The installed main LPCI/RHR process flow measurement instrumentation loops, which are discussed below, cannot be used for jockey pump flow measurement. Attempts have been made to use portable ultrasonic flow instruments to measure jockey pump flow rate, but the results have been too variable to be repeatable.
>
> Flow orifices 1E12-FE-N014A, B, and C, which are installed in the system to measure flow rate of the main LPCI/RHR pumps 1E12C002A, B, and C, each have a rated maximum flow rate of 10,000 gpm [(gallons per minute)]. Each flow instrument loop, which consists of the flow orifice, flow transmitter, flow indicator and signal processing electronics, has an overall loop accuracy of between one and two percent of the maximum measurable flow rate. Even at the lower, more accurate, point, one percent accuracy is equivalent to 100 gpm, which is over 2-1/2 times the jockey pumps' rated flow rate of 40 gpm at 50 psid [(pounds per square inch differential)] (…).
>
> The flow orifices are installed in 18-inch NPS [(Nominal Pipe Size)] piping. Even if the typical operational jockey pump flow rate of 30 to 50 gpm registered on this flow instrumentation, it would not meet the requirements of ASME OM Code-2001 Edition through addenda OMb-2003 ISTB-3510(b)(1) and … ISTB-3510(c), since the full-scale ranges of these analog instruments are more than 200 times the probable reference values for these jockey pumps. Under ideal conditions, the jockey pump flows would be just barely detectable at the lower end of the instrument scales, and accurate measurement would be masked by instrument noise and other conditions.
>
> Additionally, the flow path for each of the jockey pumps in standby operation is through a minimum-flow return line with a flow-limiting orifice plate (1E12-RO-D002A, B, and C) which is sized to hold [the] flow rate reasonably constant at about 40 gpm (…), while providing adequate margin in jockey pump capacity to make up for any leakage from the main LPCI/RHR pump discharge header. Flow rate through this orifice plate cannot be measured, as discussed above, since there are no installed measurement points and portable flow rate instrumentation has not proven adequate. This flow rate also cannot be considered constant and repeatable enough to meet the requirements of ASME OM Code-2001 Edition through addenda OMb-2003 ISTB-3300(d), due to the potential for changes in the main LPCI/RHR discharge header leakage from test to test.

3.2.2 Licensee's Proposed Alternative Testing

In the attachment to its application, the licensee stated the following as its proposed alternative testing of the three RHR jockey pumps:

> Jockey pump discharge header pressure is continuously monitored, and an annunciator alarms in the Control Room if the discharge header pressure drops

below a preset value. This pressure alarm is currently adjusted to 40 psig [(pounds per square inch gauge)] for the Loop A and B jockey pumps, and 28 psig for the Loop C jockey pump. Based on the pumps' rated capacities (40 gpm at 50 psid, …) and the required suppression pool level during power operation (greater than, or equal to, 18 feet 4-1/12 inches and less than, or equal to, 18 feet 9-3/4 inches per Tech Spec LCO [(Technical Specification Limiting Condition for Operation)] 3.6.2.2), these low header pressure annunciators will alarm at approximately 70 percent of the Loop A and B jockey pumps' operating differential pressure, and at approximately 50 percent of the Loop C jockey pump's operating differential pressure.

Also, GGNS Technical Specification SR [(Surveillance Requirement)] 3.5.1.1 requires verification every 31 days that the respective LPCI/RHR headers are filled with water by venting the piping at the high point vents. Such continuous monitoring and monthly venting will provide timely warning if a jockey pump has failed, or that system leakage has exceeded the capacity of the jockey pump. In addition, these pumps are currently being monitored at least once a quarter under the GGNS Vibration Monitoring Program, which is currently not required by any Federal, state or industry requirements. Because rotating equipment faults that can be detected by vibration monitoring will show up any time the equipment is operating, returning these pumps to a fixed set of operating conditions is not necessary to detect such faults. The faults themselves, however, are affected by the equipment operating parameters. For example, if the equipment is heavily loaded, fault growth will typically be escalated.

These jockey pumps may be categorized as "smooth running," that is, they are typically running with very low vibration velocities. Each pump's flow rate is normally at or only slightly higher than the flow through the pump's minimum flow return piping. Any additional flow is typically only to make up for leakage from the main LPCI/RHR pump's discharge piping. Under these conditions, these pumps' reference values of vibration velocity are normally less than 0.05 inches per second (IPS).

Limits established in the GGNS Vibration Monitoring Program are not only based on vendor and industry data, but also on changes in vibration levels and in the spectral content of the vibration signals. Unlike ASME OM Code-2001 Edition through addenda OMb Code-2003 Addenda ISTB Table-ISTB-5100-1, "Acceptance Criteria," which has fixed Alert and Required Action limits at 2.5 times and 6 times respectively, of the reference values for vibration, the GGNS Vibration Monitoring Program analyzes changes in vibration spectrum or spectral content over time, looks for trends in the changes, and attempts to determine the reasons for the changes. If changes are determined to be from an equipment problem, rather than changes in operating parameters, increased monitoring is established to determine the rate of the trend, and equipment maintenance is scheduled to correct the problem before any vendor or industry recommendations or limits of the ASME OM Code-2001 Edition through addenda OMb Code-2003 Addenda ISTB are expected to be exceeded.

Hydraulic condition of the jockey pumps will be considered acceptable by continuous monitoring of pump discharge header pressures and verifying adequate header pressures as indicated by the absence of low pressure alarms. Corrective action will be taken if a header low pressure alarm sounds, indicating low header pressure.

Vibration will continue to be measured on these pumps as required by the ASME OM Code-2001 Edition through addenda OMb Code-2003 Addenda. Differential pressure will be set equal to [its] reference value prior to the measurements (Reference values of vibration were taken with the jockey pumps in normal operation with header pressure alarm cleared and flow rate through the jockey pump minimum flow return orifice plate). If a measured vibration velocity exceeds an Alert, or Required Action limit according to ASME OM Code-2001 Edition through addenda OMb Code-2003 Addenda ISTB-Table- ISTB-5100-1, "Acceptance Criteria," the required actions of ASME OM Code-2001 Edition through addenda OMb Code-2003 Addenda ISTB-6200, "Corrective Action," will be taken.

3.2.3 Evaluation

The applicable ISTB-5121 requires that a Group A test be conducted with the pump operating at a specified reference point. The resistance of the system shall be varied until the flow rate equals the reference point. The differential pressure shall then be determined and compared to its reference value. Alternatively, the flow rate shall be varied until the differential pressure equals the reference point, and the flow rate determined and compared to the reference flow rate value.

There are no current means of accurately measuring the flow rates of the applicable RHR jockey pumps, E12C003A, B, and C, because no flow rate meters, orifices or other measurement devices are installed in the RHR system for the measurement of flow rates. The installed main LPCI/RHR process flow measurement instrumentation loops cannot be used for jockey pump flow measurement because the full-scale ranges of these flow instruments are too large to accurately measure the small flow rates of the RHR jockey pumps. As shown by the licensee, the jockey pump flow rates would be just barely detectable at the lower end of the instrument scales, and accurate measurement would be masked by instrument noise and other conditions. The licensee stated that it has attempted to use ultrasonic flow instruments to measure the jockey pumps' flow rate, but the results have been too variable to be repeatable. Therefore, the NRC staff concludes that the jockey pump flow rates cannot be meaningfully measured due to the lack of on-line flow instrumentation in the jockey pump minimum flow return lines that can accurately measure the flow rates of these pumps. Therefore, imposing the ASME OM Code requirements would result in a hardship for the licensee because it would require system modification and installation of on-line flow devices.

The RHR jockey pumps are continuously operating pumps. Their safety function is to keep the RHR discharge header piping in a filled condition to prevent a water hammer upon the start of a main RHR pump. The actual output and hydraulic performance of the RHR jockey pumps are not critical to the safety function, as long as the pumps are capable of maintaining the piping full of water.

In lieu of a Code-required Group A test and flow measurement, the licensee has proposed to continuously monitor the pump discharge header pressures by means of a low pressure annunciator in the control room. The low pressure alarm will provide an early detection of a low header pressure and insufficient flow from the jockey pumps. Also, GGNS TS SR 3.5.1 1 requires verification every 31 days that the respective LPCI/RHR headers are filled with water by venting the piping at the high-point vents, which would be an indication of insufficient jockey pump flow. The continuous monitoring of discharge header pressure in the control room and monthly (more frequent than quarterly) venting surveillance at high points will provide reasonable assurance that the jockey pumps are operable and have sufficient flow, or that the system leakage has not exceeded the capacity of the jockey pumps. In addition, the proposed vibration measurement meets the ASME OM Code requirements and will provide the required test results reflecting the mechanical condition of the pumps.

Based on the above discussion, the NRC staff concludes that the proposed alternative would provide reasonable assurance of the operational readiness of the three RHR jockey pumps E12C003A, B, and C and their capability to perform their safety function of keeping the RHR header piping in a filled condition.

3.2.4 Conclusion

Based on the above evaluation, the NRC staff concludes that the licensee's proposed alternatives in RR PRR-GGNS-2007-1 to the ASME OM Code IST requirements for the RHR jockey pumps E12C003A, B, and C are acceptable on the basis that the licensee's proposed alternative provides reasonable assurance of the operational readiness of the jockey pumps and their capability to perform their safety function of keeping the RHR header piping in a filled condition. Based on this, the NRC staff further concludes that complying with the specified ASME OM Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The alternatives are for the third 10-year IST program interval.

3.3 Pump Relief Request PRR-GGNS-2007-2

In this RR, the licensee requested relief from requirements in ISTB-3300, ISTB-3510, ISTB-5121, and Table ISTB-3000-1, as discussed in Section 3.1 of this safety evaluation, for the Low Pressure Core Spray System (LPCS) jockey pump E21C002. The licensee stated that this is an ASME Code Class 2, centrifugal, motor-driven, OM Code Category A pump.

3.3.1 Licensee's Basis for Requesting Relief

In the attachment to its application, for the LPCS jockey pump, the licensee stated:

> This [LPCS] jockey pump is required to operate whenever the LPCS system is in the operable condition. As such, the pump performs continuous duty on a recirculation line and provides makeup as needed.
>
> Pressure taps exist in the jockey pump suction and discharge piping where pump suction and discharge pressure can be measured for calculation of differential pressure, and a throttle valve exists which can be used to set differential pressure

equal to the pump's reference value. However, the pump differential pressure information provided is of little use for analyzing the hydraulic condition of the jockey pump without being able to measure flow rate or set flow rate at a known reference value, as required by […] ISTB-5121(b).

There are no practical means of measuring the flow rate of this jockey pump. No flow rate meters, orifices or other measurement devices are installed in the system for measurement of jockey pump flow rate. The installed main process flow measurement instrumentation loop, which is discussed below, cannot be used for jockey pump flow measurement. Attempts have been made to use ultrasonic flow instruments to measure jockey pump flow rate, but the results have been too variable to be repeatable.

Flow orifice 1E21-FE-N002, which is installed in the system to measure flow rate of the main LPCS pump 1E12C001, has a rated maximum flow rate of 10,000 gpm. The flow instrument loop, which consists of the flow orifice, flow transmitter, flow indicator and signal processing electronics, has an overall loop accuracy of between one and two percent of the maximum measurable flow rate. Even at the lower, more accurate, point, one percent accuracy is equivalent to 100 gpm, which is over 2-1/2 times the jockey pump's rated flow rate of 40 gpm at 45 psid (…). The flow orifice is installed in 16-inch NPS piping. Even if the typical operational jockey pump flow rate of 30 to 50 gpm registered on this flow instrumentation, it would not meet the requirements of […] ISTB-3510(b) and ISTB-3510(c), since the full-scale range of this analog instrument is more than 200 times the probable reference values for this jockey pump. Under ideal conditions, the jockey pump flow would be just barely detectable at the lower end of the instrument scale, and accurate measurement would be masked by instrument noise and other conditions.

Additionally, the flow path for the jockey pump in standby operation is through a minimum-flow return line with a flow restricting orifice plate (1E21-RO-D003) which is sized to hold flow rate reasonably constant at about 40 gpm (SAR Figure 5.4-19), while providing adequate margin in jockey pump capacity to make up for any leakage from the main LPCS pump discharge header. Flow rate through this orifice plate cannot be measured, as discussed above, since there are no installed measurement points and portable flow rate instrumentation has not proven adequate. This flow rate also cannot be considered constant and repeatable enough to meet the requirements of […] ISTB-3300, due to the potential for changes in the main LPCS discharge header leakage from test to test.

3.3.2 Licensee's Proposed Alternative Testing

In the attachment to its application, the licensee stated the following for the LPCS jockey pump E21C002:

> Jockey pump discharge header pressure is continuously monitored, and an annunciator alarms in the Control Room if the main LPCS discharge header

pressure drops below a preset value (currently 32 psig). Based on the jockey pump's rated capacity (40 gpm at 45 psid …) and the required suppression pool level during power operation (greater than, or equal to, 18 feet 4-1/12 inches and less than, or equal to, 18 feet 9-3/4 inches per Tech[nical] Spec[ification] LCO 3.6.2.2), this low header pressure annunciator will alarm at approximately 60 percent of the jockey pump's operating differential pressure.

Also, GGNS Technical Specification SR 3.5.1.1 requires verification every 31 days that the main LPCS header is filled with water by venting the piping at the high point vent. Such continuous monitoring and monthly venting will provide timely warning if the jockey pump has failed, or that system leakage has exceeded the capacity of the jockey pump.

In addition, the pump is currently being monitored at least once a quarter under the GGNS Vibration Monitoring Program, which is currently not required by any Federal, state or industry requirements. Because rotating equipment faults that can be detected by vibration monitoring will show up any time the equipment is operating, returning the pump to a fixed set of operating conditions is not necessary to detect such faults. The faults themselves, however, are affected by the equipment operating parameters. For example, if the equipment is heavily loaded, fault growth will typically be escalated.

This jockey pump may be categorized as "smooth running," that is, they are typically running with very low vibration velocities. The pump's flow rate is normally at or only slightly higher than the flow through the pump's minimum flow return piping. Any additional flow is typically only to make up for leakage from the main LPCS pump's discharge piping. Under these conditions, the pump's reference values of vibration velocity are normally less than 0.05 inches per second (IPS).

Limits established in the GGNS Vibration Monitoring Program are not only based on vendor and industry data but also on changes in vibration levels and in the spectral content of the vibration signals. Unlike … Table-ISTB-5100-1, "Acceptance Criteria," which has fixed Alert and Required Action limits at 2.5 times and 6 times, respectively, of the reference values, the GGNS Vibration Monitoring Program analyzes changes in vibration spectrum or spectral content over time, looks for trends in the changes, and attempts to determine the reasons for the changes. If changes are determined to be from an equipment problem, rather than changes in operating parameters, increased monitoring is established to determine the rate of the trend and equipment maintenance is scheduled to correct the problem before any vendor or industry recommendations or limits of … ISTB are expected to be exceeded.

Hydraulic condition of the jockey pump will be considered acceptable by continuing to monitoring the pump discharge header pressure and verifying adequate header pressure as indicated by the absence of [the] low pressure alarm. Corrective action will be taken if the header low pressure alarm sounds, indicating low header pressure.

> Vibration will continue to be measured on this pump as required by ASME OM Code-2001 Edition through addenda OMb Code-2003 Addenda. Differential pressure will be set to equal [its] reference value prior to the measurements (Reference values of vibration were taken with the jockey pump in normal operation with header pressure alarm cleared and flow rate through the jockey pump minimum flow return orifice plate). If a measured vibration velocity exceeds an Alert, or Required Action limit according to … Table-ISTB-5100-1, "Acceptance Criteria," the required actions of … ISTB-6200, "Corrective Action," will be taken.

3.3.3 Evaluation

The applicable ISTB-5121 requires that a Group A test be conducted with the pump operating at a specified reference point. The resistance of the system shall be varied until the flow rate equals the reference point. The differential pressure shall then be determined and compared to its reference value. Alternatively, the flow rate shall be varied until the differential pressure equals the reference point, and the flow rate determined and compared to the reference flow rate value.

There are no current means of accurately measuring the flow of the LPCS jockey pump E21C002, because no flow rate meters, orifices or other measurement devices are installed in the LPCS system for the measurement of flow rate. The installed main LPCS process flow measurement instrumentation loops cannot be used for jockey pump flow measurement because the full-scale ranges of these flow instruments are too large to accurately measure the flow rates of the LPCS jockey pump. As shown by the licensee, the jockey pump flow rate would be just barely detectable at the lower end of the instrument scales, and accurate measurement would be masked by instrument noise and other conditions. The licensee stated that it has attempted to use ultrasonic flow instruments to measure the jockey pump's flow rate, but the results have been too variable to be repeatable. Therefore, the NRC staff concludes that the jockey pump flow rate cannot be meaningfully measured due to the lack of on-line flow instrumentation in the jockey pump minimum flow return line that can accurately measure the flow rate of the pump. Therefore, imposing the ASME OM Code requirements would result in a hardship for the licensee because it would require system modification and installation of on-line flow devices.

The LPCS jockey pump is a continuously operating pump. Its safety function is to keep the LPCS discharge header piping in a filled condition to prevent a water hammer upon the start of a main LPCS pump. The actual output and hydraulic performance of the LPCS jockey pump is not critical to the safety function, as long as the pump is capable of maintaining the piping full of water.

In lieu of a Code-required Group A test and flow measurement, the licensee proposed to continuously monitor the pump discharge header pressure by means of a low pressure annunciator in the control room. The low pressure alarm will provide an early detection of a low header pressure and insufficient flow from the jockey pump. Also, GGNS Technical Specification SR 3.5.1 1 requires verification every 31 days that the LPCS header is filled with water by venting the piping at the high-point vents. The continuous monitoring of discharge

header pressure in the control room and monthly (more frequent than quarterly) venting surveillance at high points will provide reasonable assurance that the LPCS jockey pump is operable, or that the system leakage has not exceeded the capacity of the jockey pump. In addition, the proposed vibration measurement meets the ASME OM Code requirements and will provide the required test results reflecting the mechanical condition of the pump.

Based on the above evaluation, the NRC staff concludes that the proposed alternative would provide reasonable assurance of the operational readiness of LPCS jockey pump E21C002 and its capability to perform its safety function of keeping the LPCS header piping in a filled condition.

3.3.4 Conclusion

Based on the above evaluation, the NRC staff concludes that the licensee's proposed alternatives in RR PRR-GGNS-2007-2 to the ASME Code IST requirements for LPCS jockey pump E21C002 are acceptable on the basis that the licensee's proposed alternative provides reasonable assurance of the operational readiness of the LPCS jockey pump and its capability to perform its safety function of keeping the LPCS header piping in a filled condition. Based on this, the NRC staff further concludes that complying with the specified ASME OM Code requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. The alternatives are for the third 10-year IST program interval.

3.4 Pump Relief Request PRR-GGNS-2007-3

In this RR, the licensee requested relief from the requirements in ISTB-3300, ISTB-3510, ISTB-5121, and Table ISTB-3000-1, as discussed in Section 3.1 of this safety evaluation, for the High Pressure Core Spray System (HPCS) jockey pump E22C003. The licensee stated that the pump is an ASME Code Class 2, centrifugal, motor-driven, OM Code Category A pump.

3.4.1 Licensee's Basis for Requesting Relief

In the attachment to its application, for the HPCS jockey pump, the licensee stated:

> [The HPCS] jockey pump is required to operate whenever the HPCS system is in the operable condition. As such, the pump performs continuous duty on a recirculation line and provides makeup as needed.
>
> Pressure taps exist in the jockey pump suction and discharge piping where pump suction and discharge pressure can be measured for calculation of differential pressure, and a throttle valve exists which can be used to set differential pressure equal to the pump's reference value. However, the pump differential pressure information provided is of little use for analyzing the hydraulic condition of the jockey pump without being able to measure flow rate or set flow rate at a known reference value, as required by … ISTB-5121(b).
>
> There are no practical means of measuring the flow rate of this pump. No flow rate meters, orifices or other measurement devices are installed in the system for measurement of jockey pump flow rate. The installed main process flow

measurement instrumentation loop, which is discussed below, cannot be used for jockey pump flow measurement. Attempts have been made to use ultrasonic flow instruments to measure jockey pump flow rate, but the results have been inconsistent and unrepeatable.

Flow orifice 1E22-FE-N007, which is installed in the system to measure flow rate of the main HPCS pump 1E22C001, has a rated maximum flow rate of 10,000 gpm. The flow instrument loop, which consists of the flow orifice, flow transmitter, flow indicator and signal processing electronics, has an overall loop accuracy of between one and two percent of the maximum measurable flow rate. Even at the lower, more accurate, point, one percent accuracy is equivalent to 100 gpm, which is over 2-1/2 times the jockey pump's rated flow rate of 40 gpm at 45 psid (…). The flow orifice is installed in 16-inch NPS piping. Even if the typical operational jockey pump flow rate of 30 to 50 gpm registered on this flow instrumentation, it would not meet the requirements of … ISTB-3510(b)(1) and … ISTB-3510(c), since the full-scale range of this analog instrument is more than 200 times the probable reference value for this jockey pump. Under ideal conditions, the jockey pump flow would be just barely detectable at the lower end of the instrument scale, and accurate measurement would be masked by instrument noise and other variables.

Additionally, the flow path for the jockey pump in standby operation is through a minimum-flow return line with a flow-restricting orifice plate (1E22-RO-D003) which is sized to hold flow rate reasonably constant at about 40 gpm (…), while providing adequate margin in jockey pump capacity to make up for any leakage from the main HPCS pump discharge header. Flow rate through this orifice plate cannot be measured, as discussed above, since there are no installed measurement points and portable flow rate instrumentation has not proven adequate. This flow rate also cannot be considered constant and repeatable enough to meet the requirements of … ISTB-3300(d), due to the potential for changes in the main HPCS discharge header leakage from test to test.

3.4.2 Licensee's Proposed Alternative Testing

In the attachment to its application, the licensee stated the following for the HPCS jockey pump:

Jockey pump discharge header pressure is continuously monitored, and an annunciator alarms in the Control Room if the discharge header pressure drops below a preset value (currently 28 psig). Based on the pump's rated capacity (40 gpm at 45 psid, …) and the required suppression pool level during power operation (greater than, or equal to, 18 feet 4-1/12 inches and less than, or equal to, 18 feet 9-3/4 inches per Tech[nical] Spec[ification] LCO 3.6.2.2), this low header pressure annunciator will alarm at approximately 55 percent of the jockey pump's operating differential pressure.

Also, GGNS Technical Specification SR 3.5.1.1 requires verification every 31 days that the respective header is filled with water by venting the piping at the high point vents. Such continuous monitoring and monthly venting will provide

timely warning if the jockey pump has failed, or that system leakage has exceeded the capacity of the jockey pump.

In addition, the pump is currently being monitored at least once a quarter under the GGNS Vibration Monitoring Program, which is currently not required by any Federal, state or industry requirements. Because rotating equipment faults that can be detected by vibration monitoring will show up any time the equipment is operating, returning the pump to a fixed set of operating conditions is not necessary to detect such faults. The faults themselves, however, are affected by the equipment operating parameters. For example, if the equipment is heavily loaded, fault growth will typically be escalated.

This jockey pump may be categorized as "smooth running," that is, it is typically running with very low vibration velocities. The pump's flow rate is normally at or only slightly higher than the flow through the pump's minimum flow return piping. Any additional flow is typically only to make up for leakage from the main HPCS pump's discharge piping. Under these conditions, the pump's reference values of vibration velocity are normally less than 0.05 inches per second (IPS).

Limits established in the GGNS Vibration Monitoring Program are not only based on vendor and industry data, but also on changes in vibration levels and in the spectral content of the vibration signals. Unlike … Table-ISTB-5100-1, "Acceptance Criteria," which has fixed Alert and Required Action limits at 2.5 times and 6 times, respectively, of the reference values, the GGNS Vibration Monitoring Program analyzes changes in vibration spectrum or spectral content over time, looks for trends in the changes, and attempts to determine the reasons for the changes. If changes are determined to be from an equipment problem, rather than changes in operating parameters, increased monitoring is established to determine the rate of the trend and equipment maintenance is scheduled to correct the problem before any vendor or industry recommendations or limits of ASME OM Code-2001 Edition through addenda OMb Code-2003 Addenda ISTB are expected to be exceeded.

Hydraulic condition of the jockey pump will be considered acceptable by continuing to monitor the pump discharge header pressure and verifying adequate header pressure as indicated by the absence of [the] low pressure alarm. Corrective action will be taken if the header low pressure alarm sounds, indicating low header pressure.

Vibration will continue to be measured on this pump as required by ASME OM Code-2001 Edition through addenda OMb Code-2003 Addenda. Differential pressure will be set to equal to its reference value prior to the measurements. (Reference values of vibration were taken with the jockey pump in normal operation with header pressure alarm cleared and flow rate through the jockey pump minimum flow return orifice plate). If a measured vibration velocity exceeds an Alert or Required Action limit according to … Table-ISTB-5100-1, "Acceptance Criteria," the required actions of … ISTB-6200, "Corrective Action," will be taken.

3.4.3 Evaluation

The applicable ISTB-5121 requires that a Group A test be conducted with the pump operating at a specified reference point. The resistance of the system shall be varied until the flow rate equals the reference point. The differential pressure shall then be determined and compared to its reference value. Alternatively, the flow rate shall be varied until the differential pressure equals the reference point, and the flow rate determined and compared to the reference flow rate value.

There are no current means of accurately measuring the flow of the HPCS jockey pump E22C003, because no flow rate meters, orifices or other measurement devices are installed in the HPCS system for measurement of flow rate. The installed main HPCS process flow measurement instrumentation loops cannot be used for jockey pump flow measurement because the full-scale ranges of these flow instruments are too large to accurately measure the flow rates of the HPCS jockey pump. As shown by the licensee, the jockey pump flow rate would be just barely detectable at the lower end of the instrument scales, and accurate measurement would be masked by instrument noise and other conditions. The licensee stated that it has attempted to use ultrasonic flow instruments to measure the jockey pump's flow rate, but the results have been too variable to be repeatable. Therefore, the NRC staff concludes that the jockey pump flow rate cannot be meaningfully measured due to the lack of on-line flow instrumentation in the jockey pump minimum flow return line that can accurately measure the flow rate of the pump. Therefore, imposing the ASME OM Code requirements would result in a hardship for the licensee because it would require system modification and installation of on-line flow devices.

The HPCS jockey pump is a continuously operating pump. Its safety function is to keep the HPCS discharge header piping in a filled condition to prevent a water hammer upon the start of a main HPCS pump. The actual output and hydraulic performance of the HPCS jockey pump is not critical to the safety function, as long as the pump is capable of maintaining the piping full of water.

In lieu of a Code-required Group A test and flow measurement, the licensee proposed to continuously monitor the pump discharge header pressure by means of a low pressure annunciator in the control room. The low pressure alarm will provide an early detection of a low header pressure and insufficient flow from the jockey pump. Also, GGNS Technical Specification SR 3.5.1 1 requires verification every 31 days that the HPCS header is filled with water by venting the piping at the high-point vents. The continuous monitoring of discharge header pressure in the control room and monthly (more frequent than quarterly) venting surveillance at high points will provide reasonable assurance that the jockey pump is operable, or that the system leakage has not exceeded the capacity of the jockey pump. In addition, the proposed vibration measurement meets the ASME OM Code requirements and will provide the required test results reflecting the mechanical condition of the pump.

Based on the above evaluation, the NRC staff concludes that the proposed alternative would provide reasonable assurance of the operational readiness of HPCS jockey pump E22C003 and its capability to perform its safety function of keeping the HPCS header piping in a filled condition.

3.4.4 Conclusion

Based on the above evaluation, the NRC staff concludes that the licensee's proposed alternatives in RR PRR-GGNS-2007-3 to the ASME OM Code IST requirements for the HPCS jockey pump E22C003 are acceptable on the basis that the licensee's proposed alternative provides reasonable assurance of the operational readiness of the pump and its capability of performing its safety function of keeping the HPCS header piping in a filled condition. Based on this, the NRC staff further concludes that complying with the specified ASME OM Code requirements would result in hardship or unusual difficulty to the licensee without a compensating increase in the level of quality and safety. The alternatives are for the third 10-year IST program interval.

3.5 CONCLUSION

The NRC staff has reviewed and evaluated RRs PRR-GGNS-2007-1, PRR-GGNS-2007-2, and PRR-GGNS-2007-3 that were submitted by the licensee in its application dated November 29, 2007. Based on its above evaluation of the three RRs, the NRC staff concludes that the alternatives to the applicable ASME Code in these RRs provide reasonable assurance of the operational readiness of the pumps and are authorized pursuant to 10 CFR 50.55a(a)(3)(ii) on the basis that complying with the specified ASME OM Code requirements would result in hardship or unusual difficulty to the licensee without a compensating increase in the level of quality and safety. The alternatives are authorized for the third 10-year IST program interval.

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