UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION OF THE OFFICE OF NUCLEAR REACTOR REGULATION FOR THE THIRD TEN-YEAR INTERVAL FOR THE PUMP AND VALVE INSERVICE TESTING PROGRAM SOUTHERN NUCLEAR OPERATING COMPANY, INC. HATCH UNITS 1 AND 2 DOCKET NOS. 50-321 AND 50-366

1.0 INTRODUCTION

Title 10 of the Code of Federal Regulations (10 CFR) Section 50.55a, requires that inservice testing (IST) of certain American Society of Mechanical Engineers (ASME) Code Class 1, 2, and 3 pumps and valves be performed in accordance with ASME OM Code 1990, except where relief has been requested and granted or proposed alternatives have been authorized by the Commission pursuant to 10 CFR 50.55a(f)(6)(i), (a)(3)(i), or (a)(3)(ii). In order to obtain authorization or relief, the licensee must demonstrate that: (1) conformance is impractical for its facility; (2) the proposed alternative provides an acceptable level of quality and safety; or (3) compliance would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Section 50.55a(f)(4)(iv) provides that inservice tests 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 the limitations and modifications listed, and subject to Commission approval. NRC guidance contained in Generic Letter (GL) 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," provided alternatives to the Code requirements determined to be acceptable to the staff and authorized the use of the alternatives in Positions 1, 2, 6, 7, 9, and 10 provided the licensee follows the guidance delineated in the applicable position. When an alternative is proposed, which is in accordance with GL 89-04 guidance and is documented in the IST program, no further evaluation is required; however, implementation of the alternative is subject to NRC inspection.

In a letter dated September 15, 1995, Georgia Power Company (GPC), licensee for the Edwin I. Hatch Nuclear Power Plant, Units 1 and 2, submitted its Third Ten-Year Interval IST Program for Pumps and Valves. The licensee's submittal included several proposed relief requests, deferred test justifications, and

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other sections of the licensee's IST program developed according to the requirements of the ASME OM Code 1990 Edition for pump and valve testing, with the exception of safety relief valves. Safety relief valve testing was written to the requirements of the ASME OM Code 1995 Edition.

By letter dated April 12, 1996, the NRC transmitted a Safety Evaluation (SE) that provided the staff's review of the licensee's IST relief requests. Two relief requests were denied and one relief request was granted on a provisional basis. In addition, four relief requests, which were granted on an interim or provisional basis during the second 10-year interval, did not address the concerns of the staff. Therefore, the licensee was requested to provide a response to the specific issues raised in the evaluation within 60 days of the date of the third 10-year interval SE.

In a letter dated June 4, 1996, the licensee addressed the items which were denied, required a response within 60 days, or were granted provisionally. Also, the licensee provided an additional response dated July 24, 1996, in which revisions to Relief Requests RR-V-4, RR-V-8, and RR-V-9 were submitted. On December 2, 1996, the licensee submitted a revised Relief Request RR-P-10, which included its evaluation of test parameters under current operating conditions, due to a recent power uprate. In addition, the licensee submitted new Relief Request RR-P-12 that addresses the use of control room instrumentation for high pressure coolant injection discharge pressure monitoring during performance of IST. The staff's review of the licensee's responses to the April 12 SE and the stated supplemental letters is discussed below.

2.0 IST PROGRAM ISSUES

Anomaly 7.1-Relief Request-P-9

By letter dated September 15, 1995, the licensee requested relief in RR-P-9 from the vibration value requirements specified in Table ISTB 5.2-2a, "Ranges for Test Parameters," of the ASME OM Code 1990. The licensee intended to use RR-P-9 as a general relief request applicable to all pumps in its IST program. The licensee had proposed to assign absolute alert and required action range limits for pumps that, according to the licensee's criteria, were classified as "smooth running pumps."

In its SE dated April 12, 1996, the NRC staff denied the general relief requested in RR-P-9 due to a recent plant event and a lack of consensus among industry representatives on this issue. However, the staff allowed the licensee to submit separate relief requests for each applicable pump, if specific pumps fell within the scope of the proposed relief request and the testing methodology allowed detection of pump degradation at the absolute vibration limits proposed in the relief request.

In its letter dated June 4, 1996, the licensee withdrew RR-P-9. Because the testing is consistent with ASME Code requirements, relief is not required. Therefore, no further NRC evaluation is necessary for RR-P-9.

Anomaly 7.2-Relief Request-V-2

By letter dated September 15, 1995, the licensee requested relief in RR-V-2 from the stroke time acceptance criteria requirements of ASME OM Code 1990, Section ISTC 4.2.8(d), for main steam isolation valves 1(2)B21-F022A to D and 1(2)B21-F028A to D. The licensee had proposed to use upper and lower limiting stroke times contained in the Technical Specifications (TS) to determine the stroke-time acceptance criteria instead of the 50 percent increase in the stroke-time reference value required by the Code.

In its SE dated April 12, 1996, the staff denied RR-V-2 because updated Code corrective action requirements would not be implemented with the licensee's proposed relief request. Therefore, the proposed testing was not equivalent to the Code. The licensee did not demonstrate hardship or impracticality in performing the required testing in accordance with the Code. In addition, the testing was not impractical because the subject valves were equipped with remote position indication which would allow stroke-time testing to be performed in accordance with the Code requirements.

Subsequently, the licensee responded by submitting a letter dated June 4, 1996, in which it withdrew RR-V-2. The licensee indicated that it would establish reference values according to ISTC 3.3. Because the testing is consistent with ASME Code requirements, relief is not required. Therefore, no further NRC evaluation is necessary for RR-V-2.

Anomaly 7.3-Relief Requests-V-4 and V-9

By letter dated September 15, 1995, the licensee requested relief in RR-V-4 and RR-V-9 from the exercise test frequency, power-operated valve stroke testing, and stroke-time acceptance criteria requirements of the ASME OM Code 1990, Paragraphs ISTC 4.2.1, ISTC 4.2.4(a), and ISTC 4.2.8, for the Units 1 and 2 transverse incore probe (TIP) purge containment isolation valves 1(2)C51-F3012. The licensee had proposed to exercise these valves quarterly without measuring stroke time, verifying that the nitrogen flow in the associated tubing had stopped when the valve was stroked, and performing a local leak rate test in accordance with 10 CFR Part 50, Appendix J, each refueling outage.

In its SE dated April 12, 1996, the staff determined that the licensee satisfied the applicable Code requirements under ISTC 4.2.1 and 4.2.8 for the Units 1 and 2 TIP purge containment isolation valves 1(2)C51-F3012, and granted interim relief for RR-V-4 and RR-V-9 from the Code power-operated valve stroke test requirements under ISTC 4.2.4(a) for these valves for the second 10-year interval. This interim relief was based on the impracticality of performing testing in accordance with the Code requirements, and in consideration of the burden on the licensee if the Code requirements were imposed on the facility.

In its letter dated June 4, 1996, the licensee responded to the staff's concerns stated in the SE dated April 12, 1996, by indicating that RR-V-4 and RR-V-9 would be revised to require periodic replacement of Valves 1(2)C51-F3012 under an enhanced maintenance program and would be implemented during the next refueling outage for each unit. By letter dated July 24, 1996, the licensee submitted the revisions to RR-V-4 and RR-V-9 requiring periodic replacement of Valves 1(2)C51-F3012 under an enhanced maintenance program. RR-V-4 and RR-V-9 stated that Valves 1(2) C51-F3012 would be replaced during the 1997 refueling outage and every 5 years thereafter. The licensee has satisfied the conditions placed on interim relief for RR-V-4 and RR-V-9. Further, revised Relief Requests RR-V-4 and RR-V-9 are granted as impractical for the third 10-year interval pursuant to 10 CFR 50.55a(f)(6)(i).

Anomaly 7.5-Relief Request-V-8

By letter dated September 15, 1995, the licensee requested relief in RR-V-8 from the valve obturator movement observation requirements of ASME OM Code 1990, Paragraph ISTC 4.2.3, for the following air-operated equipment cooling water supply valves: 1(2)P41-F035A and B, 1(2)P41-F036A and B, 1(2)P41-F037A to D, 1(2)P41-F039A and B, 2P41-F340, and 2P41-F339A and B. The licensee had proposed to stroke time these valves by observing actual valve stem movement.

In its SE dated April 12, 1996, the staff discussed that RR-V-8 applied to the same valves as RR-V-20, which was submitted in the second 10-year interval, to request relief from the ASME Section XI Code exercise procedure requirements for these valves. The request for RR-V-20 was granted with the provision that the licensee develop some means to verify full-stroke travel or repeatability of stroke-timing these valves. The staff granted interim relief for RR-V-8 for a period of 60 days from the date of the SE to allow the licensee time to revise its relief request to include the methods used in implementing the provisions imposed in the evaluation of RR-V-20 contained in the SE for the Hatch second 10-year program dated June 13, 1994.

In its letter dated June 4, 1996, the licensee indicated its intentions to revise RR-V-8 to demonstrate that local mechanical indication was used to verify full-stroke travel. Local mechanical indication had been available since the end of the second 10-year interval to verify full-stroke travel. By letter dated July 24, 1996, the licensee submitted the revision to RR-V-8 indicating that local mechanical indication is used to verify full-stroke travel. RR-V-8 stated that each valve is equipped with either a stem-mounted pointer and a yoke-mounted position indicating scale, or a percent open/closed indicator. The licensee has satisfied the conditions placed on interim relief for RR-V-8. Further, revised Relief Request RR-V-8 is granted as impractical for the third 10-year interval pursuant to 10 CFR 50.55a(f)(6)(i).

Anomaly 7.6-Refueling Outage Justification-V-2

By letter dated September 15, 1995, the licensee deferred testing of the power-operated valve stroke testing requirements of Paragraph ISTC 4.2.4 for the automatic depressurization relief valves for nuclear boiler system main steam overpressure protection to refueling outage frequency, because the test methods employed by the licensee differed from the Code requirements. This licensee action was evaluated as a relief request.

In its SE dated April 12, 1996, the staff granted relief for ROJ-V-2, with the provision that exercising of the valves be conducted during initial startup after the refueling outage to ensure that the valves had been properly reassembled as required by Appendix I of the OM Code. By letter dated June 4, 1996, the licensee indicated that site procedures were revised to reflect the provisional relief to require exercising the relief valves during initial startup after a refueling outage. No further NRC evaluation is required for ROJ-V-2; however, the licensee should redesignate ROJ-V-2 as a relief request (i.e., RR-V-XX) for completeness.

Anomaly 7.8-Pump Note 3

By letter dated June 4, 1996, the licensee indicated that Pump Note 6 did not apply to the reactor core isolation cooling (RCIC) system; however, Pump Note 3 was applicable to RCIC. The staff acknowledges that the pump note was misreferenced in the SE dated April 12, 1996, where the staff inadvertently referred to Pump Note 6 for the RCIC system, instead of Pump Note 3.

Evaluation of the licensee's request to exclude the RCIC system (other than the containment isolation function) from its IST Program will require further staff review. A response to Pump Note 3 will be provided upon completion of the staff's review.

Anomaly 7.9-Pump Note 7

In the licensee's letter dated September 15, 1995, Pump Note 7 stated that inlet and discharge pressure would not be recorded for the six diesel fuel oil transfer pumps and that the flow rate would be measured using an ultrasonic flow meter. The line would be considered a fixed resistance system.

In its SE dated April 12, 1996, the staff stated that failing to measure both inlet and discharge pressure is not in accordance with the Code test procedure requirements of Paragraph ISTB 5.2(d). Therefore, the staff requested the licensee to submit a relief request to use the proposed alternate testing.

By letter dated June 4, 1996, the licensee indicated that relief was not required because the diesel generator fuel oil transfer pumps were only included in an augmented testing program within the IST program. Because these pumps are non-Code class, they are outside the scope of the IST program and no further NRC evaluation is necessary.

Anomaly 7.12-Valve Note 13

In the licensee's letter dated September 15, 1995, Valve Note 13 stated, in part, that residual heat removal (RHR) minimum flow line valves 1E11-F046A and B were not provided with test connections to enable any measurements during pump testing and that partial flow would be confirmed by indirect means after reassembly.

In its SE dated April 12, 1996, the staff stated that this note was consistent with NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants." However, this note may also have been applicable to RHR minimum flow line valves 1E11-F046C and D, and 2E11-F046A to D as the configuration for these valves appeared identical to the 1E11-F046A and B valves. Therefore, the licensee was asked to review the scope of this note to determine if it also applied to RHR minimum flow line valves 1E11-F046C and D, and 2E11-F046A to D, and to revise its IST program accordingly.

In its letter dated June 4, 1996, the licensee indicated that Valve Note 13 also applied to RHR minimum flow line valves 1E11-F046C and D, and 2E11-F046A and D. The licensee revised the IST program to incorporate the appropriate information. No further NRC evaluation is necessary.

Anomaly 7.14-Valve Notes 16, 17, 19, and 20

These notes are related to valves in the RCIC system. As stated for Pump Note 3, a response to Valve Notes 16, 17, 19, and 20 will be provided upon completion of the staff's review of the inclusion of the RCIC system in the IST program.

Anomaly 7.15-Relief Request-P-10

In its letter dated September 15, 1995, the licensee requested relief in RR-P-10 from the vibration value requirements specified in Table ISTB 5.2-2a, "Ranges for Test Parameters," of the ASME OM Code 1990 for the high pressure coolant injection (HPCI) pumps 1(2)E41-C001. The licensee proposed to raise the Code vibration alert range limit from 2.5Vr to 6Vr or 0.4 inch/second (in/sec) to 0.7 in/sec.

In its SE dated April 12, 1996, the staff authorized the licensee's proposed alternative to the Code vibration alert range limits of Table ISTB 5.2-2b for the HPCI pump, with the provision that the alternative only apply to the vertical direction of the inner main pump bearing which had experienced vibration levels above the absolute alert limit. The staff also indicated that all other directions would continue to be subject to the vibration limits specified in Table ISTB 5.2-2b. In addition, the staff requested that the licensee revise its IST program and test procedures to reflect the elements of the provisional relief.

By letter dated June 4, 1996, the licensee indicated that the HPCI reference values had been changed due to the power uprate. Therefore, the licensee placed implementation of this relief request on hold, pending its evaluation of test parameters under current operating conditions. By letter dated December 2, 1996, the licensee submitted revised Relief Request RR-P-10.

Relief Request RR-P-10:

Relief was requested from the vibration acceptance criteria of ASME OM Code 1990, Table ISTB 5.2-2, for the HPCI pumps 1E41-C001 and 2E41-C001. The licensee proposed to perform vibration spectrum monitoring routinely and to extend the Alert Range absolute limit from 0.4 in/sec to 0.7 in/sec.

Licensee's Basis for Requesting Relief:

The HPCI main pump design resulted in a structural casing resonance at very near the reference speed established for IST (i.e., Nr = 3900 rpm vs. resonant speed = 3950 rpm). This results in a peak radial vibration value on the main pump inboard and outboard bearing housings that routinely, but not always, exceeds the 0.325 in/sec OM Code fixed vibration value for the Alert Range and, thus, places the HPCI pump on an increased frequency testing.

The Maintenance Engineering Department personnel along with Architect Engineer vibration specialists have reviewed the spectral data for the main pump and their evaluation indicates the largest peak vibration values at 1X running speed (usually unbalance), 2X running speed (usually misalignment), 5X running speed (booster pump vane pass frequency), and 7X running speed (main pump vane pass frequency). Of these peaks, the highest occurs at 1X running speed. Tests were conducted with the HPCI pump operating at different speeds and the results indicated that the 1X vibration peak fluctuated significantly with only nominal changes in the speed of the HPCI pump.

The HPCI pump IST is performed by setting the flow rate and the turbine speed at the reference values and then monitoring the differential pressure. The turbine speed and flow rate are set as close as can be read on the instrumentation; however, the HPCI flow controller will vary the turbine and pump speed as it searches to maintain the selected flow rate. This speed variance is within the Code allowable $\pm$ 1% of the reference value.

The nominal turbine speed for the HPCI pump IST is 3900 rpm (65 Hz). A dead blow hammer test of the HPCI pump casing resulted in a natural frequency of 65.9 Hz. During a trial test, the vibration magnitude of the inboard bearing doubled (0.11 in/sec to 0.22 in/sec) when the turbine speed increased from 62.9 Hz (3770 rpm) to 64.8 Hz (3890 rpm). While this amplitude is not sufficient to place the pump in the Alert Range, when it is added to that of some nominal unbalance (1X) or amplitudes occurring at frequencies from other sources, the vibration amplitude will sometimes exceed the 0.325 in/sec allowable by the OM Code which results in an increase in test frequency for the pump. This phenomenon occurs randomly which indicates that it is not indicative of mechanical degradation. Spectral vibration analysis indicated that there are no mechanical concerns with the HPCI main pump operation. Additionally, shaft vibration data obtained from proximity probes revealed very low amplitudes at the 1X operating speed with vibration amplitudes being

measured at approximately 0.4 mils. Analysis of this shaft vibration data did not detect any natural frequencies associated with the shaft which indicates that the natural frequencies identified for the bearing housing are structural related with no participation from the shaft.

Additionally, maintenance engineering personnel discussed this vibration issue with the pump vendor (Byron & Jackson) and the vendor agrees that the proposed alternative vibration limit (as described below) is not unreasonable and should not result in accelerated degradation of the HPCI main pump.

Based on current testing data and analysis by the maintenance engineering department, there is no apparent trend of mechanical degradation and no apparent justification for increasing the HPCI pump test frequency when the vibration level randomly exceeds the 0.325 in/sec Code allowable value during the testing.

Alternate Testing:

The Alert Range for the HPCI main pump outboard and inboard radial bearings will be set at 2.5Vr to 6Vr or 0.4 in/sec to 0.7 in/sec. In addition to the normal HPCI pump IST vibration monitoring, Plant Hatch maintenance engineering department personnel will routinely perform spectral analysis of the vibration data to ensure that no trends toward mechanical degradation go undetected. This nominal increase in the lower limit for the Alert Range will not affect the operational readiness of the HPCI main pump and the OM Code maximum allowable vibration limits for the Required Action Range are being maintained.

Evaluation:

The vibration acceptance criteria of ASME OM Code 1990, Table ISTB 5.2-2, are established so that appropriate corrective actions are taken on pumps with significant mechanical degradation. The absolute limits are set at levels that display significant degradation for most pump installations, regardless of the reference vibration value. The licensee proposed to routinely perform a spectral analysis of the vibration data to ensure that no trends toward mechanical degradation go undetected and to extend the Alert Range absolute limit from 0.4 in/sec to 0.7 in/sec.

This proposal was previously covered under ASME Section XI, Paragraph IWP-3210, which states in part: "If these ranges cannot be met, the Owner shall specify in the record of test (IWP-6000), the reduced range limits to allow the pump to fulfill its function, and those ranges shall be used in lieu of the ranges given in Table IWP-3100-02." However, the Owner cannot expand the Code allowable ranges for vibration without submitting and receiving approval in a relief request.

In its relief request, the licensee indicated that an extensive analysis had been performed to display that there are no mechanical concerns with the HPCI main pump operation. Additionally, shaft vibration data obtained from the proximity probes revealed very low amplitudes at their 1X operating speed with

vibration amplitudes being measured at approximately 0.4 mils. The licensee's analysis of this shaft vibration data did not detect any natural frequencies associated with the shaft, which indicated that the natural frequencies identified for the bearing housing are structural-related with no participation from the shaft. Therefore, the licensee determined that the high vibration levels did not indicate pump mechanical degradation and did not represent phenomena that could prevent the pumps from performing their intended functions. The licensee's proposed vibration acceptance criteria, together with its proposal to perform pump vibration spectrum analysis routinely, with the specified Alert and Required Action Ranges, should result in corrective action being taken on a pump prior to the occurrence of significant degradation.

A spectrum analysis measures a narrow vibration band width over a wide frequency range and indicates the frequency and magnitude of vibration peaks, which permits identification of problems with bearings and other pump mechanical components. The spectrum analysis allows a more comprehensive evaluation of pump condition than the Code-required wide range vibration measurements.

Conclusion:

The staff concludes that the alternative may be authorized pursuant to 10 CFR 50.55a(a)(3)(i) based on the determination that the licensee's proposal provides an acceptable level of quality and safety.

Relief Request RR-P-12:

In its letter dated December 2, 1996, the licensee submitted Relief Request RR-P-12 that was developed to address the use of control room instrumentation for HPCI discharge pressure monitoring during performance of IST.

Licensee's Basis for Requesting Relief:

The installed instrumentation was not designed with the instrument range requirements of the OM Code paragraph ISTB 4.6.1(B)(2) taken into consideration. The installed instrument ranges are itemized below.

Instrument	Range	Reference Value	% Full Scale
1E41-PI-R601	0-1500 psig	= 1200 psig	80%
2E41-PI-R601	0-1500 psig	= 1200 psig	80%

Even though digital instruments 1(2)E41-PI-R601 do not satisfy the OM Code-required range limit, such that the reference value is $\leq$ 70% of the calibrated range, these existing digital indicators have sufficient range margin (i.e., approximately 300 psig) above the reference pressure value to ensure accurate and repeatable measurement during testing. The existing digital instruments are calibrated across the full scale range (0-1500 psig) to $\pm$ 1% and the total loop accuracy for pump discharge pressure instrumentation is calibrated to

± 1.12% full scale, which is more accurate than required by the OM Code (± 2%). Satisfying the OM Code range requirement would require installing digital indicators which have a full scale range of 0-2000 psig. This increase in range would also result in an increase in the allowable accuracy of the instrument loop (0.02 x 2000 = ± 40 psig), whereas the existing instrument loop has a calibration accuracy of ± 17 psig (0.0112 x 1500). Replacing the existing digital indicators with wider range indicators just to ensure that the reference value is ≤ 70% of the full scale range, as opposed to 80% full scale range, when considering an instrument with a range of 0-1500 psig, is not warranted, considering the expense and manpower required to implement the change. The existing digital indicators with 0-1500 psig range provide data that is sufficient to allow assessment of pump operational readiness and to monitor for degradation.

Alternate Testing:

The installed instrumentation will be used.

Evaluation:

Subsection ISTB 4.6 of ASME OM Code 1990 requires that digital instruments be accurate to ± 2% of the reading over the calibrated range and that reference values not exceed 70% of the calibrated range. The licensee's existing digital instruments are calibrated across the full scale range (0-1500 psig) to ± 1% and the total loop accuracy for pump discharge pressure instrumentation is calibrated to ± 1.12% full scale which is more accurate than required by the OM Code (± 2%). Satisfying the OM Code range requirement would require installing digital indicators which have a full scale range of 0-2000 psig.

The staff agrees that the replacement of the present equipment is not warranted in that the increased instrument range would allow a greater calibration inaccuracy than the present equipment. The staff believes that the existing digital indicators with 0-1500 psig range provide sufficient data to assess for operational readiness and to monitor for degradation with respect to the HPCI pump. The staff considers the present equipment to provide an acceptable level of quality and safety in meeting the IST program requirements.

Conclusion:

The staff concludes that the alternative may be authorized pursuant to 10 CFR 50.55a(a)(3)(i) based on the determination that the licensee's proposal provides an acceptable level of quality and safety.

3.0 CONCLUSION

Relief Requests RR-P-10 and RR-P-12 are authorized pursuant to 10 CFR 50.55a(a)(3)(i) based on the determination that the licensee's proposal provides an acceptable level of quality and safety. The licensee has withdrawn Relief Requests RR-P-9 and RR-V-2. The licensee has revised Relief Requests RR-V-4, RR-V-9, and RR-V-8 to satisfy the conditions placed on interim relief in the SE dated April 12, 1996, for the second 10-year interval. Further, revised Relief Requests RR-V-4, RR-V-8, and RR-V-9 are granted as impractical for the third 10-year interval pursuant to 10 CFR 50.55a(f)(6)(i). The licensee has satisfied the conditions placed on acceptance of ROJ-V-2, but the licensee should redesignate the ROJ as a relief request. The licensee clarified Pump Note 7 regarding the diesel fuel oil transfer pumps, and Valve Note 13 on the RHR minimum flow line valves. In a separate evaluation, the staff will address Pump Note 3 and Valve Notes 16, 17, 19, and 20, regarding whether the RCIC system (other than its containment isolation function) may be removed from the IST program.

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