UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

March 31, 1995

NRC INFORMATION NOTICE 95-18, SUPPLEMENT 1: POTENTIAL PRESSURE-LOCKING OF SAFETY-RELATED POWER-OPERATED GATE VALVES

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) supplement to alert addressees to additional analyses identifying the potential susceptibility of multiple safety injection flow paths to a common mode failure due to pressure-locking. It is expected that recipients will review this additional information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Background

The NRC staff issued IN 95-14, "Susceptibility of Containment Sump Recirculation Gate Valves to Pressure Locking," on February 28, 1995, in response to the determination by the licensee of the Millstone Nuclear Power Station that both of the Unit 2 containment sump recirculation motor-operated gate valves may experience pressure-locking during a design-basis loss-of-coolant accident (LOCA) and fail to open. The failure of both of these valves would make a water source for the emergency core cooling system and the containment spray unavailable during the recirculation phase of the LOCA.

The NRC staff issued IN 95-18, "Potential Pressure-Locking of Safety-Related Power-Operated Gate Valves," on March 15, 1995, in response to the determination by the licensee of the Haddam Neck Nuclear Power Plant that all of its high-pressure and low-pressure safety injection valves were susceptible to pressure-locking. The licensee subsequently concluded that both low-pressure safety injection valves and two of the four high-pressure safety injection valves were inoperable.

Description of Circumstances

On March 9, 1995, the Connecticut Yankee Atomic Power Company reported that seven motor-operated gate valves in the safety injection systems at the Haddam Neck Nuclear Power Plant were susceptible to pressure-locking to the extent

that the operability of valves may have been jeopardized. This report was made after factoring in more accurate friction coefficients and unseating forces that were determined from in-situ diagnostic testing during the current refueling outage. The circumstances surrounding this report were described in IN 95-18.

On March 15, 1995, and in later reviews the licensee identified more valves that were susceptible to pressure-locking. Their susceptibilities were described as follows:

1. Two charging system injection valves (CH-MOV-292B and 292C). These normally open valves may be required to close to prevent residual heat removal (RHR) pump runout. Once closed, the valves would be susceptible to pressure-locking due to heatup of the fluid in the bonnet caused by high containment temperature. This could prevent the valve from reopening for subsequent accident mitigation. (See Attachment 1)

2. Two cross connect valves from RHR to high-pressure safety injection (SI-MOV-901 and 902). These normally shut valves could become pressurized from the discharge of the low-pressure safety injection pumps and fail to open when required for high-pressure recirculation. (See Attachment 2)

3. The flex wedge shutdown cooling valves connected to the reactor coolant system could be overpressurized due to normal plant heat up. The plant heat up after shutdown cooling isolation could raise the pressure in the valve bonnet area to levels beyond code allowable limits. The licensee is currently inspecting the valves for damage.

The Haddam Neck plant has been shut down for refueling since January 28, 1995. The licensee plans to modify the susceptible valves before restarting the plant. Proposed modifications consist of drilling a hole in the valve disc or venting the bonnet area to relieve internal pressure.

Discussion

Pressure-locking could affect valves in a variety of safety related applications. IN 95-14 addressed how containment sump valves and steamline valves could be affected. IN 95-18 addressed the susceptibility of reactor coolant system boundary valves in the safety injection system to pressure-locking. This information notice addresses the pressure locking phenomenon for more valves that could become pressure-locked during accident mitigation and further clarifies the pressure-locking phenomenon for the valves identified in IN 95-14.

Pressure-locking occurs in flexible-wedge and double-disc gate valves when fluid becomes pressurized within the valve bonnet, creating a large internal

pressure, and the actuator is not capable of overcoming the additional thrust required while there is differential pressure across both valve discs. Susceptible valves are normally closed valves that need to open for accident mitigation, or valves that are closed during an accident and need to open for subsequent accident mitigation. Two primary mechanisms were identified which can cause the large differential pressures across the valve discs.

The first mechanism can occur when the valve is being exposed to high pressure fluid, usually from the reactor coolant system (RCS), and the bonnet is pressurized by leakage past the valve seat. If the high pressure side of the valve is subsequently depressurized, as during a LOCA, the high pressure fluid remains trapped in the valve bonnet and retains a high pressure in the bonnet and produces additional resistance for valve opening.

The second mechanism is thermally induced pressure-locking; fluid is trapped in the valve bonnet and subsequently experiences a thermal heatup that causes a large increase in bonnet pressure and creates a significantly higher resistance to valve opening along with differential pressure across the valve discs. For example, this could occur if these valves were exercised at lower temperature and the cooler water in the bonnet later expanded as a result of an RCS heatup or in a post-accident containment environment. The Haddam Neck licensee estimates that the pressure increase could exceed code allowable for shutdown cooling isolation valves. This problem could apply to any valves independent of its operator type. This failure mechanism would not be revealed in dynamic testing since the valves are not subjected to significant temperature transients during this testing.

The licensee had evaluated these valves in 1990 for possible pressure-locking and thermal-binding on the basis of existing test data and industry information and had concluded that the valves were not susceptible to these problems. This evaluation had concluded that any temperature rise in the bonnet area would be dissipated to the pipe and environment. However, recent diagnostic testing has shown that the friction coefficients, the unseating forces, and the methodology previously used were nonconservative. The licensee performed a reanalysis to calculate thrust requirements using more conservative stem friction factors based on recent industry experience, and more accurate unseating forces using modern test equipment and concluded that these valves might not operate as a result of pressure-locking problems.

As noted in IN 95-14 and IN 95-18, the NRC staff and the nuclear industry have been aware of disc binding problems of gate valves for many years. The industry has issued several event reports describing the failure of safety-related gate valves to operate because of pressure-locking or thermal-binding of the valve discs. Several generic industry communications have given information on identifying susceptible valves and performing appropriate preventive and corrective measures. These mechanisms represent potential common cause failure modes that can render redundant trains of safety-related emergency core cooling systems incapable of performing their safety functions. The NRC staff published a draft generic letter for public comment on March 27, 1995 titled, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," which addresses this issue in greater detail.

Additional Related Generic Communications

On February 26, 1992, the NRC staff issued IN 92-17, "NRC Inspections of Programs Being Developed at Nuclear Power Plants in Response to Generic Letter 89-10."

On April 2, 1992, the NRC staff issued IN 92-26, "Pressure-Locking of Motor-Operated Flexible Wedge Gate Valves."

In Enclosure 1 to Supplement 6 of Generic Letter 89-10, "Information on Schedule and Grouping, and Responses to Additional Public Questions," dated March 8, 1994, the NRC staff discussed pressure-locking and thermal-binding of motor-operated gate valves. The staff also described an acceptable approach for licensees to address the potential for pressure-locking of motor-operated gate valves as part of their GL 89-10 programs.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

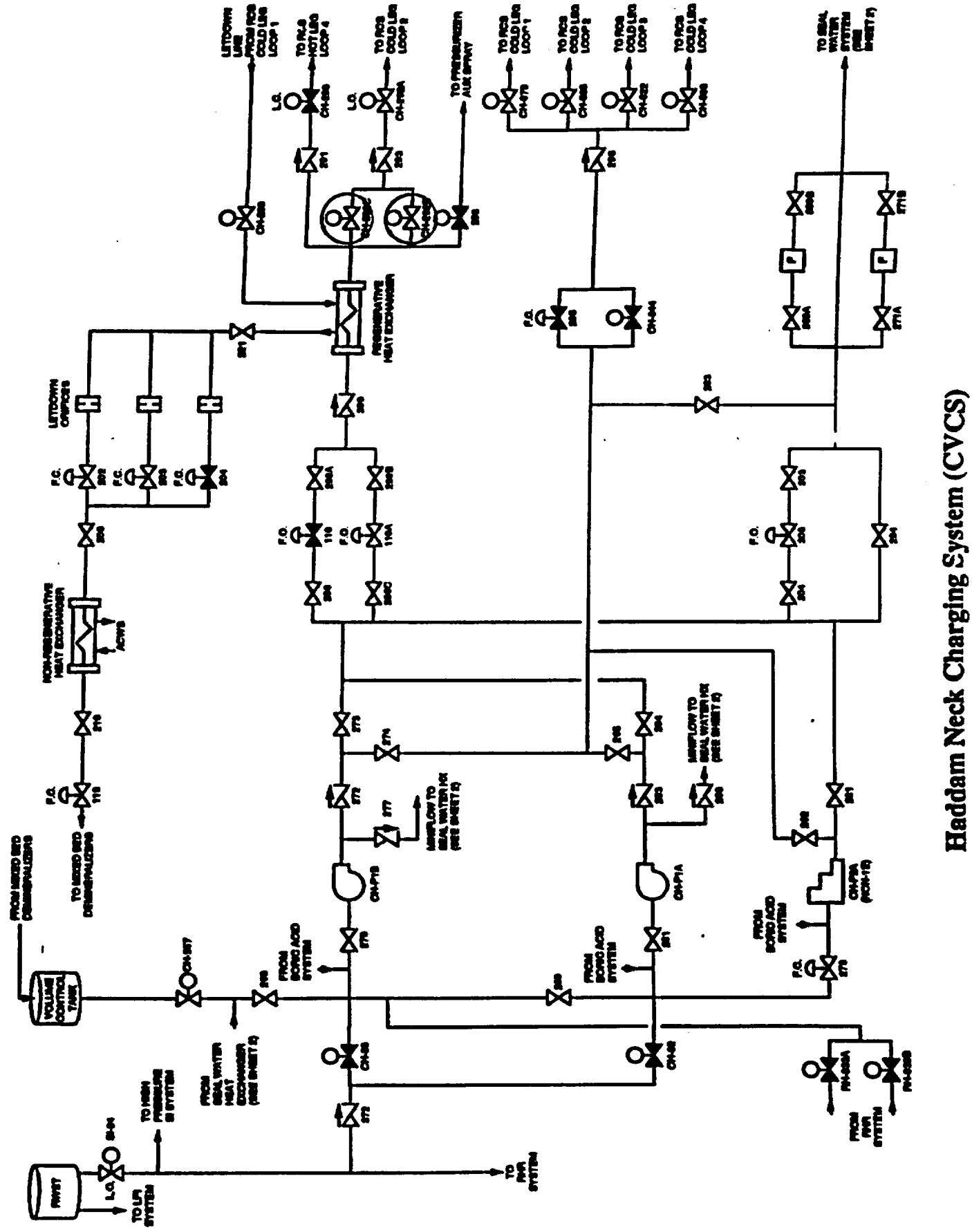
Brian K. Grimes, Director
Division of Project Support
Office of Nuclear Reactor Regulation

Technical contacts: Thomas Scarbrough, NRR
(301) 415-2794

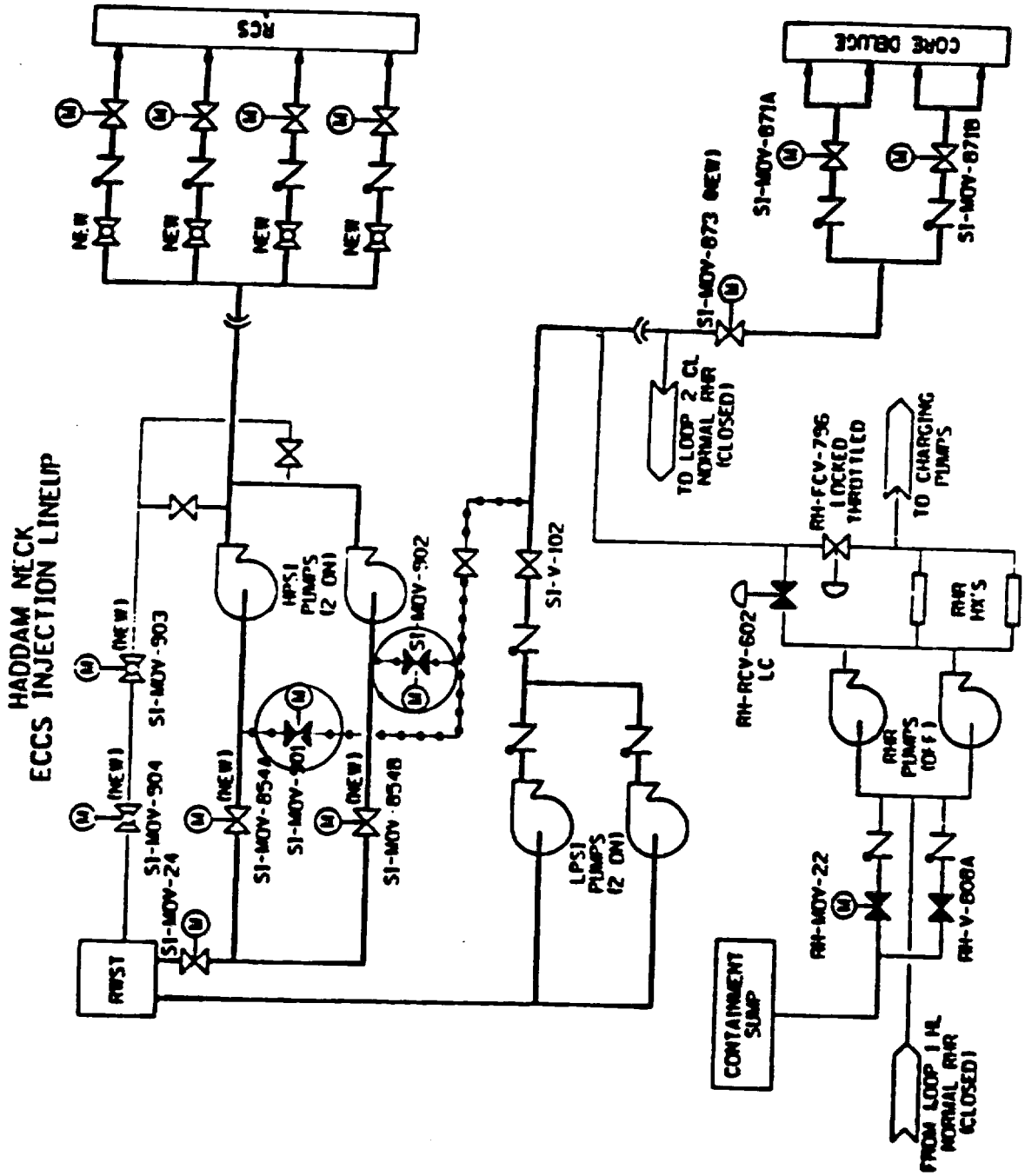
John Tappert, NRR
(301) 415-1167

Attachments:
1. Haddam Neck Charging System
2. Haddam Neck ECCS Injection Lineup
3. List of Recently Issued NRC Information Notices

Attachments Filed in Jacket



Haddam Neck Charging System (CVCS)


HADDAM NECK
ECCS INJECTION LINEUP
RCS
CORE DELUGE
SI-MOV-871A
SI-MOV-871B
SI-MOV-873 (NEW)
TO LOOP 2 CL
NORMAL RHR
(CLOSED)
RH-FCV-756
LOCKED
THROTTLED
TO CHARGING
PUMPS
SI-V-102
HPSI
PUMPS
(2 ON)
SI-MOV-902
SI-MOV-903
SI-MOV-904
SI-MOV-24
SI-MOV-854A
SI-MOV-854B
SI-MOV-851
LPSI
PUMPS
(2 ON)
RH-RCV-602
LC
RHR
HX'S
RHR
PUMPS
(OFF)
RH-MOV-22
RH-V-606A
RWST
CONTAINMENT
SUMP
FROM LOOP 1 HL
NORMAL RHR
(CLOSED)

LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
95-20	Failures in Rosemount Pressure Transmitters due to Hydrogen Permeation into the Sensor Cell	03/22/95	All holders of OLs or CPs for nuclear power reactors.
95-19	Failure of Reactor Trip Breaker to Open Because of Cutoff Switch Material Lodged in the Trip Latch Mechanism	03/22/95	All holders of OLs or CPs for nuclear power reactors.
95-18	Potential Pressure-Locking of Safety-Related Power-Operated Gate Valves	03/15/95	All holders of OLs or CPs for nuclear power reactors.
95-17	Reactor Vessel Top Guide and Core Plate Cracking	03/10/95	All holders of OLs or CPs for boiling water reactors.
95-16	Vibration Caused by Increased Recirculation Flow in a Boiling Water Reactor	03/09/95	All holders of OLs or CPs for boiling water reactors.
95-15	Inadequate Logic Testing of Safety-Related Circuits	03/07/95	All holders of OLs or CPs for nuclear power reactors.
95-14	Susceptibility of Containment Sump Recirculation Gate Valves to Pressure Locking	02/28/95	All holders of OLs or CPs for nuclear power reactors.
95-13	Potential for Data Collection Equipment to Affect Protection System Performance	02/24/95	All holders of OLs or CPs for nuclear power reactors.
95-12	Potentially Nonconforming Fasteners Supplied by A&G Engineering II, Inc.	02/21/95	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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orig /s/'d by BKGrimes

Brian K. Grimes, Director
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Attachments:
1. Haddam Neck Charging System
2. Haddam Neck ECCS Injection Lineup
3. List of Recently Issued NRC Information Notices

DOCUMENT NAME: 9518SP1.IN
*See previous concurrence

OFFICE	OECB:DOPS	ADM:PUB	SC/OECB:DOPS	EMEB:DE	C:SRXB/DSSA
NAME	JTappert*	Tech Editor*	EGoodwin*	TScarbrough*	RCJones*
DATE	03/20/95	03/20/95	03/21/95	03/21/95	03/21/95

OFFICE	EMEB:DE	C/EMEB:DE	OECB:DOPS	C/OECB:DOPS	D/DOPS
NAME	PChen*	RWessman*	RKiessel*	AChaffee*	BGrimes
DATE	03/21/95	03/21/95	03/22/95	03/22/95	03/29/95

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DOCUMENT NAME: G:\JRT\IN95-18.S1

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NAME	JTappert*	Tech Editor*	EGoodwin*	TScarbrough*	RCJones*
DATE	03/20/95	3 / 20/95	3/ 21/95	3/ 21/95	3/21 /95

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