

OCT 19 1984

Docket No. 50-416

LICENSEE: Mississippi Power & Light Company

FACILITY: Grand Gulf Nuclear Station, Unit 1

SUBJECT: SUMMARY OF JULY 13, 1984 MEETING WITH MP&L TO DISCUSS THE
INSPECTION OF A TDI DIESEL ENGINE AT GRAND GULF, UNIT 1

On July 13, 1984, a meeting was held in Bethesda, Maryland to discuss the inspection results obtained on one TDI diesel engine at Grand Gulf, Unit 1. The teardown inspection of the Division 1 diesel engine had been ordered by the NRC on May 22, 1984. The meeting was attended by representatives of NRC, NRC consultants, MP&L, MP&L consultants, DOE and IEAL. An attendance list is enclosed (Enclosure 1). A copy of the vugraphs used by MP&L for their presentation is also enclosed (Enclosure 2).

J. Richard (Sr. VP) briefly summarized the inspection results obtained to date and concluded that the TDI diesels (Division I and II) were acceptable for full power operation. T. Cloninger (MP&L) and B. Angle (MP&L) continued the presentation covering the material in the handout and the specific details of individual component inspection. The main topics covered were operational history for both diesels, turbocharger bolt failure, crankshaft deflection tests, differences in fabrication of the crankshafts for Division I and II, and the augmented inspection program. T. Cloninger summarized the presentation and indicated that the DR/QR-Phase II Report from MP&L would be submitted in September, 1984.

The staff and their consultants then proceeded to discuss the MP&L submittal of July 5, 1984 which presented the teardown inspection results for the Division I engine, a comparison of Division I and II components and the augmented maintenance/surveillance program. The failure to start events were also discussed and their relationship to engine reliability.

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Enclosures:
As stated

DESIGNATED ORIGINAL

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MEETING ATTENDEES
July 13, 1984

NRC

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C. Berlinger
C. Julian
E. Murphy
D. Persinko
T. Michaels
D. Houston

MP&L

J. Richard (Sr. VP)
L. Dale
T. Cloninger
B. Angle
D. Hardesty
S. Lewis
R. Courtney

NRC Consultants

W. Laity (PNL)
D. Dingee (PNL)
F. Zaloudec (PNL)
A. Henriksen
J. Horner
P. Louzecky
B. Kirkwood

MP&L Consultants

R. Gustafson
T. Iannuzzi
D. Davis
J. Guibert
W. Knight
J. Whitcomb
D. Vincent
E. Duda
J. Brihadesam
R. McGehee

DOE

K. Trickett

IEAL

G. Toth

MP&L D/G PRESENTATION OUTLINE

JULY 13, 1984

DIV. I INSPECTION RESULTS & DIVISION II SIMILARITY COMPARISON

- 1.0 HISTORY -- MILESTONES
- 2.0 OPERATIONS PRIOR TO JUNE 1984 INSPECTIONS
 - 2.1 OPERATING DATA, ACCUMULATED TO JUNE 1984
 - ° RUN TIMES, STARTS
 - ° RELIABILITY
 - ° RUN TIMES BY COMPONENT
 - 2.2 SUMMARY
- 3.0 DIVISION I INSPECTION PLAN
 - 3.1 SCOPE
 - 3.2 INSPECTION RESULTS
 - 3.3 PARTS REPLACEMENTS
 - 3.4 SUMMARY
- 4.0 POST INSPECTION TESTING
 - 4.1 VENDOR RECOMMENDED TESTING
 - 4.2 NRC REQUESTED TESTING
 - 4.3 TESTING INCIDENTS
 - 4.4 SUMMARY
- 5.0 DIVISION I/DIVISION II D/G SIMILARITY VERIFICATION
 - 5.1 PURPOSE
 - 5.2 SCOPE
 - 5.3 KEY COMPONENTS
 - 5.4 REVIEWS
 - 5.5 SUMMARY
- 6.0 AUGMENTED INSPECTION PLAN
- 7.0 CONCLUSIONS

1.0 HISTORY -- MILESTONES
(APPROXIMATE DATES)

1975, 1976

D/Gs MANUFACTURED AND TESTED AT TDI

1977 - 1980

° D/Gs INSTALLED AT GGNS

NOV 1981

° REPLACED AF PISTONS

° INCORPORATED SIMS

JUN 1982

° BEGAN LOW POWER TESTING

AUG 1983

° SHOREHAM CRANKSHAFT FAILED

SEP 1983

° DIVISION I FIRE

DEC 1983

° TDI D/G OWNER'S GROUP FORMED

DEC 1983-

JAN 1984

° REPLACED AF MODIFIED PISTONS WITH AE

MAR 1984

° INSTALLED TEMPORARY GAS TURBINES

MAY 1984

° NRC ORDERED DIVISION I DISASSEMBLY AND INSPECTION

JUN 30, 1984

° DIVISION I ENGINE REASSEMBLED AND TESTING BEGAN

JUL 5, 1984

° DIVISION I PM AND NRC TESTING COMPLETED

JUL 5-8

° DIVISION II TURBOCHARGER INSPECTED, REFURBISHED AND TESTED

JUL 13

° FINAL PRESENTATION MADE TO NRC

2.0 OPERATIONS PRIOR TO JUNE 1984 INSPECTIONS

2.1 OPERATING DATA

- ° TOTAL RUN TIMES
- ° TOTAL STARTS
- ° DIESEL RELIABILITY (VALID TESTS)

2.2 SUMMARY

2.1 OPERATING DATA AT TIME OF JUNE 1984 INSPECTION

<u>TOTAL RUN HOURS</u>	<u>DIVISION I</u>	<u>DIVISION II</u>
SHOP AND PRE-OP RUN TIME (HRS)	535	252
SINCE DATE OF OL RUN TIME (HRS)	<u>862</u>	<u>641</u>
TOTAL RUN TIME (HRS) ⁽³⁾	1397	893
<u>TOTAL NO. OF STARTS</u> ⁽³⁾		
DELAVAL SHOP RUNS ⁽¹⁾	310 ⁽²⁾	5
PRE-OPERATIONAL RUNS	60	60
SINCE DATE OF OL RUNS	<u>192</u>	<u>125</u>
TOTAL STARTS	552	190

- NOTES:
1. SOURCE OF INFORMATION - DELAVAL TECHNICAL MANUALS.
 2. DIVISION I ENGINE HAD 300 PROTOTYPE RUNS FOR RELIABILITY TESTING.
 3. DATA AS OF JUNE 11, 1984.

2.1 (CONTINUED)

DIESEL RELIABILITY

VALID TESTS: DIVISION I -- 105

 DIVISION II -- 61

 166

VALID FAILURES: 3 (1 DIV I - CONTROL SYSTEM ELECTRICAL
 COMPONENT, 2-DIV I - UNKNOWN)

START RELIABILITY: 98.2%

DATA ESTIMATED AS OF JULY 9, 1984.

2.1 (CONTINUED)

COMPONENT IN-SERVICE HOURS, APPROXIMATE

	<u>DIVISION I*</u>	<u>DIVISION II**</u>
AE PISTON SKIRTS	270	200
CONNECTING ROD BEARINGS	270	200
MAIN BEARINGS	1400	900
CRANKSHAFTS	1400	900
BLOCKS	1400	900
BASE	1400	900
CAMSHAFTS	1400	900
PUSH RODS	270	150
MAIN CONNECTING RODS	1400	900
LINK RODS	1 @ 800	900
	7 @ 1400	
PISTON PIN BUSHINGS	1 @ 800	900
	15 @ 1400	
LINERS	3 @ 800	1 @ 200
	13 @ 1400	15 @ 900
CYLINDER HEADS	6 @ 270	2 @ 200
	10 @ 1400	14 @ 900
PISTON CROWNS	1400	900
TURBOCHARGERS	560	900

NOTE: * DATA AS OF DISASSEMBLY, MAY 25, 1984.

** DATA AS OF JULY 1, 1984.

2.2 SUMMARY

- ° 2 MAJOR DISASSEMBLIES AND INSPECTIONS HAVE BEEN PERFORMED PRIOR TO JUNE 1984 -- SOME PRODUCT IMPROVEMENTS WERE IMPLEMENTED

- ° GGNS TDI D/G START RELIABILITY IS 98.2%

- ° MAJOR ORIGINAL ENGINE KEY COMPONENTS HAD UP TO 1100 HOURS OPERATION. IMPROVED PARTS SUCH AS AE PISTONS PUSH RODS WERE INSTALLED. SOME PARTS WERE REPLACED AS STANDAPD MAINTENANCE PRACTICE

3.0 DIVISION I INSPECTION PLAN

3.1 SCOPE

3.2 INSPECTION RESULTS

3.3 PARTS REPLACEMENTS

3.4 SUMMARY

3.1 SCOPE OF INSPECTIONS, DIVISION I

- ° MET OR EXCEEDED REQUIREMENTS OF MAY 22, 1984 NRC ORDER
- ° CONSIDERED TDI D/G OWNER'S GROUP RECOMMENDATIONS
- ° REVIEWED BY INDEPENDENT CONSULTANTS
- ° TYPES OF NDE PERFORMED INCLUDED:
 - ° LIQUID PENETRANT
 - ° MAGNETIC PARTICLE
 - ° UNTRASOUND
 - ° RADIOGRAPH

3.2 INSPECTION RESULTS

<u>COMPONENT</u>	<u>INSPECTION TYPE</u>	<u>RESULTS</u>	<u>DISPOSITION</u>
CYLINDER HEADS	VIS, UT, LP, MT	ACC	
ENGINE BASE ASSEMBLY	VIS, LP, TORQUE	ACC	
ROCKER ARM CAPSCREWS	VIS, MT, HDNS, TORQUE, COMP	ACC	
CYLINDER BLOCK	VIS, DMSN, LP	ACC	
CYLINDER HEAD STUDS	VIS, HDNS, TORQUE, COMP	ACC	*
CYLINDER LINERS	VIS, DMSN, HDNS, COMP	ACC	*
LANDING AREA	VIS, DMSN, LP	ACC	*
TURBOCHARGER WELDS	VIS	ACC	
BRACKET-BOLTING	VIS, TORQUE, COMP	ACC	

* SEE SECTION 3.3, "PARTS REPLACEMENT"

3.2 INSPECTION RESULTS (CONTINUED)

<u>COMPONENT</u>	<u>INSPECTION TYPE</u>	<u>RESULTS</u>	<u>DISPOSITION</u>
TURBOCHARGER THRUST BEARINGS	VIS, DMSN	ACC	
CONNECTING ROD BOXES	VIS, DMSN, LP, MT, HDNS, TORQUE, COMP.	ACC	*
CONNECTING ROD BUSHINGS (WRIST PIN)	DMSN, LP, COMP.	ACC	
CONNECTING ROD BEARING SHELLS	VIS, DMSN, RT, LP	ACC	*
PISTON SKIRTS CROWNS STUDS	VIS, DMSN, MT, HDNS, TORQUE, COMP.	ACC	
CRANKSHAFT OIL HOLES	DMSN, LP	ACC	
CRANKCASE COVERS: GASKETS AND BOLTING	VIS, TORQUE	ACC	

* SEE SECTION 3.3, "PARTS REPLACEMENT"

3.2 INSPECTION RESULTS (CONTINUED)

<u>COMPONENT</u>	<u>INSPECTION TYPE</u>	<u>RESULTS</u>	<u>DISPOSITION</u>
FUEL OIL INJECTION TUBE	VIS	ACC	
INTAKE/EXHAUST PUSH RODS	VIS,LP	ACC	
CONNECTOR PUSH RODS	VIS,LP	ACC	
AIR START VALVE CAPSCREWS	VIS,DMSN,TORQUE	ACC	*
SUBCOVERS	VIS	ACC	**
IDLER GEAR	VIS	ACC	

* SEE SECTION 3.3, "PARTS REPLACEMENT"

3.3 JUNE 1984 PARTS REPLACEMENTS, DIVISION I

<u>COMPONENT</u>	<u>DISPOSITION</u>	<u>ACTION</u>
INTAKE/EXHAUST VALVES (4)	USE-AS-IS	REPLACED
RINGS (ALL)	N/R	REPLACED
CONNECTING ROD BOX ASSY (1)	USE-AS-IS	REPLACED
CONNECTING ROD BOLTS (ALL)	USE-AS-IS	REPLACED
SUBCOVERS (5)	USE-AS-IS	REPLACED
CONNECTING ROD BEARINGS (2)	USE-AS-IS	REPLACED
INTAKE/EXHAUST VALVE		
SPRINGS (5)	USE-AS-IS	REPLACED
TURBOCHARGERS (2)	REBUILD	REBUILT
CYLINDER HEADS (5)	USE-AS-IS	REINSTALLED
CYLINDER HEAD STUDS (2)	USE-AS-IS	REPLACED

3.4 SUMMARY OF RESULTS OF JUNE 1984 DIVISION I INSPECTIONS

- ° OVER 2,000 NDE INSPECTIONS PERFORMED
- ° ALL NOTED INDICATIONS WERE IDENTIFIED AND DISPOSITIONED
- ° 3 TURBOCHARGER STATIONARY NOZZLE RING BOLTS WERE FOUND BROKEN - BOLTS AND NOZZLE RINGS WERE REPLACED
- ° ALL COMPONENTS CONTAINED IN NRC ORDER ACCEPTABLE FOR FURTHER SERVICE

4.0 POST INSPECTION TESTING, DIVISION I

4.1 VENDOR RECOMMENDED TESTING

4.2 NRC REQUESTED TESTING

4.3 SURVEILLANCE TESTING

4.4 TESTING INCIDENTS

4.5 SUMMARY

4.1 POST INSPECTION TESTING, DIVISION I

- ° BREAKIN RUNS

- ° NO LOAD FOR 15 MIN. FOR ENGINE CHECKS &
ADJUSTMENTS

- ° ENGINE INTERNALS INSPECTIONS

- ° 20% LOAD FOR 1 HOUR

- ° VARYING LOADS FROM 25 TO 100% FOR APPROXIMATELY 8
HOURS

- ° HOT CRANKSHAFT DEFLECTION CHECKS

- ° COLD COMPRESSION CHECKS

- ° ALL RUNS AND INSPECTIONS WERE SATISFACTORY AND
COMPLETED IN ACCORDANCE WITH TDI SIM-99

- ° TOTAL RUN TIME = 9 HOURS

4.2 NRC REQUIRED TESTING, DIVISION I

- ° 10 MODIFIED STARTS WITH 3-5 MIN. LOADING TO 50% AND RUN FOR MINIMUM OF 1 HOUR AT APPROXIMATELY 50%
- ° 2 FAST STARTS, MANUAL START FROM CONTROL ROOM, SEQUENCE 3 PUMPS ON IN 10 SECONDS, LOAD TO 70% AND MAINTAIN AT MINIMUM OF 70% FOR 4 HOURS
- ° 1 24 HOUR RUN AT A MINIMUM OF 70% LOAD
- ° ALL 13 STARTS PERFORMED SUCCESSFULLY WITHOUT FAILURE OR MALFUNCTION
- ° TOTAL RUN TIME = 42 HOURS

4.3 TESTING INCIDENTS

POST MAINTENANCE TESTING INCIDENTS

DIVISION I D/G TRIPPED ON CURRENT DIFFERENTIAL DURING BREAKIN RUN

- ° PHASE B REACTOR FAILED
- ° THERMAL AGING AND BREAKDOWN OF INSULATION
- ° ALL THREE DIVISION I REACTORS REPLACED
- ° DIVISION II REACTORS INSPECTED - NO SIGNS OF
DEGRADATION

4.4 SUMMARY

- ° VENDOR RECOMMENDED TESTING WAS PERFORMED SATISFACTORILY

- ° INRC REQUESTED TESTING WAS PERFORMED SATISFACTORILY

- ° INCIDENT OCCURRING DURING BREAKIN RUN WAS EVALUATED FOR
CAUSE AND GENERIC IMPACT. THE FINDINGS INDICATED THAT IT
WAS APPLICABLE TO DIVISION I

5.0 DIVISION I AND DIVISION II SIMILARITY VERIFICATION

5.1 PURPOSE

5.2 SCOPE

5.3 KEY COMPONENTS

5.4 REVIEWS

5.5 SUMMARY

5.1 PURPOSE

- ° EXAMINE TDI RECORDS ON KEY COMPONENTS

- ° DETERMINE IF DIVISION I AND DIVISION II KEY COMPONENTS
ARE SIMILAR

- ° DIVISION I AND DIVISION II KEY COMPONENT SIMILARITY
WILL ELIMINATE NEED TO DISMANTLE DIVISION II

5.2 SCOPE OF SIMILARITY REVIEW

- ° ESTABLISH A TIME FRAME FOR MANUFACTURE OF COMPONENT

- ° REVIEW FOLLOWING THREE CATEGORIES FOR EACH COMPONENT
 - ° MATERIALS

 - ° DRAWINGS

 - ° PROCESSES

5.3 KEY COMPONENTS REVIEWD

CYLINDER HEADS
ENGINE BASE ASSEMBLY
ROCKER ARM CAPSCREWS
CYLINDER BLOCK AND LANDING AREA
CYLINDER HEAD STUDS
CYLINDER LINERS
TURBOCHARGER BRACKET BOLTING
CONNECTING ROD BOXES
CONNECTING ROD BOX BOLTS
CONNECTING ROD BUSHINGS (WRIST PINS)
CONNECTING ROD BEARING SHELLS (UPPER AND LOWER)
PISTON CROWNS
PISTON SKIRTS
PISTON STUDS
CRANKSHAFT
CRANKCASE COVERS: GASKETS & BOLTING
FUEL OIL INJECTION TUBES
PUSH ROD, INTAKE AND EXHAUST
PUSH ROD, CONNECTOR
AIR START VALVE CAPSCREWS
TURBOCHARGER

5.4 MATERIALS REVIEW

MATERIAL CAST AT TDI

HEAT NUMBERS

- CHEMICAL PROPERTIES
- PHYSICAL PROPERTIES

MATERIAL SPECIFICATIONS

- TDI MATERIAL SPECIFICATIONS
- INDUSTRY SPECIFICATIONS (ASTM)

MATERIAL PURCHASED BY TDI

- PURCHASE ORDER
- PURCHASE SPECIFICATION
- REVIEW RECEIPT INSPECTION RECORDS

5.4 (CONTINUED)

DRAWING REVIEW

- ° IDENTIFIED THE APPROPRIATE DRAWING
- ° COMPARED LATEST REVISION TO TIME FRAME
- ° REVIEWED ALL DRAWING REVISIONS THAT OCCURRED DURING TIME THE FRAME
- ° DETERMINED IF ANY REVISIONS AFFECT SIMILARITY

5.4 (CONTINUED)

PROCESSES REVIEW

- ° IDENTIFIED THE APPROPRIATE ROUTE SHEETS
(MANUFACTURING INSTRUCTIONS)
- ° COMPARED LATEST REVISION TO TIME FRAME
- ° REVIEWED ALL ROUTE SHEET REVISIONS THAT OCCURRED
DURING THE TIME FRAME
- ° DETERMINED IF ANY REVISIONS AFFECT SIMILARITY
- ° IF A PURCHASED PART REVIEWED RECEIPT INSPECTIONS
RECORDS

5.5 SUMMARY OF AS MANUFACTURED SIMILARITY

- ° SUMMARY: VERIFICATION REVIEWS INCLUDED
 - ESTABLISHED MANUFACTURING TIME FRAME OF CURRENTLY INSTALLED KEY COMPONENTS
 - ORIGINAL MATERIAL REQUIREMENTS & SUBSEQUENT REVISIONS
 - ORIGINAL DRAWING REQUIREMENTS & SUBSEQUENT REVISIONS
 - ORIGINAL COMPONENT PROCESS REQUIREMENTS & SUBSEQUENT REVISIONS

- ° CONCLUSION: VERIFICATION WITH SUPPORTING OBJECTIVE EVIDENCE HAS BEEN OBTAINED THAT THE DIVISION I & DIVISION II DIESEL ENGINES ARE OF SIMILAR AS-MANUFACTURED QUALITY

6.0 AUGMENTED INSPECTION PLAN

MAINTENANCE ACTION

FREQUENCY

AIR ROLL ENGINE

AT 4 HOURS AFTER SHUTDOWN AND WEEKLY THEREAFTER. ENGINE ALSO AIR ROLLED PRIOR TO MANUAL START.

VISUALLY INSPECT EXTERNALS OF ENGINE BLOCK AND BASE

MONTHLY OR AFTER EVERY 24 HOURS OF ENGINE OPERATION, WHICHEVER COMES FIRST.

VISUALLY INSPECT ALL CONNECTING RODS AND CHECK FOR PRELOAD RELAXATION

AFTER 50 STARTS OR 270 HOURS OF ENGINE OPERATION, WHICHEVER COMES FIRST.

INSPECT LUBRICATING OIL FOR WATER

MONTHLY OR AFTER 24 HOURS OF ENGINE OPERATION, WHICHEVER COMES FIRST.

SEND LUBRICATING OIL SAMPLE TO LABORATORY FOR ANALYSIS

MONTHLY

INSPECT SAMPLE OF LUBRICATING OIL FROM BOTTOM OF SUMP FOR WATER

MONTHLY

RECORD FILTER DIFFERENTIAL

MONTHLY

CHECK 25% OF CYLINDER HEAD STUDS ROCKER ARM CAPSCREWS, AIR START VALVE CAPSCREWS FOR PRELOAD RELAXATION

AFTER 270 HOURS OF ENGINE OPERATION OR REFUELING UPTAKE WHICHEVER COMES FIRST.

6.0 (CONTINUED)

AUGUMENTED INSPECTION PLAN

MAINTENANCE ACTION

FREQUENCY

VISUALLY CHECK CAMS TAPPETS
AND PUSH RODS

AFTER 270 HOURS OF ENGINE
OPERATION OR REFUELING
OUTAGE, WHICHEVER COMES FIRST.

CHECK CRANKSHAFT DEFLECTION

AFTER 270 HOURS OF ENGINE
OPERATION OR REFUELING OUTAGE,
WHICHEVER COMES FIRST.

RECORD PERTINENT ENGINE
OPERATING PARAMETERS

DURING SURVEILLANCE TESTING.

CLEAN AND INSPECT "Y" STRAINERS
AIR SYSTEM

QUARTERLY

CHECK THE ROTOR FLOAT OF
AT LEAST ONE TURBOCHARGER AND
INSPECT STATIONARY NOZZLE RING
BOLTS

AFTER 270 HOURS OF ENGINE
OPERATION OR REFUELING OUTAGE,
WHICHEVER COMES FIRST.

7.0 CONCLUSIONS

- ° DIVISION I D/G ENGINE AND TURBOCHARGERS WERE DISASSEMBLED INSPECTED, PARTS DISPOSITIONED AND SATISFACTORILY TESTED IN ACCORDANCE WITH THE VENDOR'S RECOMMENDATIONS, REQUIREMENTS, TDI OWNER'S GROUP GUIDELINES, AND MP&L'S MAINTENANCE PRACTICES
- ° VERIFICATIONS OF THE SIMILARITY OF DIVISION I AND DIVISION II KEY COMPONENTS WERE MADE. THE ENGINES AND COMPONENTS WERE DETERMINED TO HAVE SIMILAR AS-MANUFACTURED QUALITY
- ° BASED ON THESE FAVORABLE COMPARISONS, DISASSEMBLY AND INSPECTION OF THE DIVISION II ENGINE IS NOT WARRANTED AT THIS TIME
- ° AS A RESULT OF THE FAVORABLE FINDINGS ABOVE, A REVISED AUGMENTED MP&L INSPECTION, MAINTENANCE, AND TESTING PROGRAM HAS BEEN PROPOSED. THE PROGRAM IS DESIGNED TO MAINTAIN HIGHEST POSSIBLE RELIABILITY AND AVAILABILITY OF THE TDI EMERGENCY DIESEL GENERATOR SYSTEM
- ° THE TDI OWNER'S GROUP DR/QR PROGRAM RECOMMENDATIONS AND GUIDELINES WILL CONTINUE TO BE IMPLEMENTED AS APPROPRIATE TO GGNS
- ° THE MP&L PROGRAM MEETS OR EXCEEDS THE INTENT OF THE NRC REQUIREMENTS, TDI OG GUIDELINES AND INDUSTRY PRACTICES
- ° THE ACCEPTABLE CONDITION OF THE DIVISION I AND DIVISION II ENGINES HAS BEEN ADEQUATELY DEMONSTRATED TO PERMIT FULL POWER OPERATION

MEETING SUMMARY DISTRIBUTION

Docket No(s): 50-416
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