MISSISSIPPI POWER & LIGHT COMPANY
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P. O. BOX 1640, JACKSON, MISSISSIPPI 39205

July 20, 1984

NUCLEAR LICENSING & SAFETY DEPARTMENT

U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D. C. 20555

Attention: Mr. Harold R. Denton, Director

Dear Mr. Denton:

SUBJECT: Grand Gulf Nuclear Station
Units 1 and 2
Docket Nos. 50-416 and 50-417
License No. NPF-13
File: 0260/L-860.0
Additional Information - TDI Engine Inspection
AECM-84/0373

Following the NRC review of the Mississippi Power & Light TDI engine inspection results, the need for additional information and actions was identified. A request for additional information was transmitted July 17, 1984, in the NRC letter from E. G. Adensam to L. F. Dale. Enclosed are descriptions of MP&L actions and documentation of additional information in response to this request.

Responses to items A, B and C are attached in accordance with your requested schedule. A response to item D, except D.9, is also attached. This additional information will be completed by July 27, 1984.

It is the MP&L position that the Augmented Maintenance/Surveillance Program attached as Table A-1, which incorporates the current NRC positions, supercedes all previous commitments for the augmented program requirements.

Yours truly,

L. F. Dale
Director

FGB/SHH:rg
Attachment

cc: See next page

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cc: Mr. J. B. Richard (w/a)
Mr. R. B. McGehee (w/o)
Mr. N. S. Reynolds (w/o)
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Mr. Richard C. DeYoung, Director (w/a)
Office of Inspection & Enforcement
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Mr. J. P. O'Reilly, Regional Administrator (w/a)
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Region II
101 Marietta St., N.W., Suite 2900
Atlanta, Georgia 30323

NRC Request

A. MP&L should commit to the following Augmented Maintenance/Surveillance Program. This program should incorporate the MP&L proposals as provided in the July 5, 1984 submittal subject to the following revisions.

1. (Reference: MP&L report, Section 6.1)

Air roll tests should be performed four hours and 24 hours after each engine shutdown and prior to planned engine starts.

MP&L Response (See attached Table)

The engines will be air rolled four hours and 24 hours after each engine shutdown and prior to a planned start.

NRC Request

2. (Reference: MP&L report, Section 6.3)

Frequency of visual inspections of con rods and preload check of con rod bolts should be every 200 hours of engine operation or nine calendar months, whichever occurs first. These inspections should be performed on the Division II engine prior to plant operation above 5% power.

MP&L Response

Connecting rods will be visually inspected and the preload of the connecting rod bolts will be checked. These actions will be performed after every 200 hours of engine operation or nine calendar months, whichever comes first. These inspections will be performed on the Division II diesel engine prior to plant operation above 5% power.

rgl

NRC Request

3. (Reference: MP&L report, Section 6.4)

An additional requirement should be added to take a lube oil sample once per month while the engine is running.

MP&L Response

MP&L will sample the lube oil at the inlet of the lube oil filter on a monthly basis while the engine is running.

NRC Request

4. (Reference: MP&L report, Section 6.5)

Revise to assure that 100% of the air start capscrews will be inspected for torque per the schedule proposed by MP&L.

MP&L Response

Twenty five (25) percent of the head studs and rocker arm capscrews and 100% of the air start valve capscrews will be checked for preload relaxation after 270 hours of engine operation or the first refueling outage, whichever occurs first.

NRC Request

5. (Reference: MP&L report, Section 6.7)

Some clarification in the terms used in the MP&L July 5, 1984 submittal is requested. Also one item of surveillance, engine load, was not addressed. The following changes in Section 6.7 of the MP&L submittal are therefore recommended:

p. 57 Discussion, add the word "hourly" after "recorded" in line 2.

MP&L Response

During surveillance engine parameters will be monitored and recorded hourly after the engine has stabilized at operating temperatures and pressures.

NRC Request

p. 58 Replace as noted:

- "lube oil pressure" to "engine inlet lube oil pressure"
- "combustion air L. P. pressure" and "combustion air R. B. pressure" to "air manifold pressure L. B. and R. B."
- "jacket water pressure" to "jacket water pressure in and out"
- "cylinder temperatures" to "all cylinder exhaust temperatures"
- add "engine load"
- add "Engine exhaust turbocharger turbine inlet temperatures"

MP&L Response

Engine inlet lube oil pressure (Lube oil pressure)*
Turbo L.O. R.F. pressure
Turbo L.O. L.F. pressure
Fuel oil pressure
Fuel oil filter D/P
Air manifold pressure L. B. (Combustion air L. B. Pressure)*
Air manifold pressure R. B. (Combustion air R. B. Pressure)*
Lube oil filter D/P
Jacket water pressure in and out
Crankcase vacuum
All cylinder exhaust temperatures
Stack temperatures (turbine inlet)

Lube oil inlet temperatures
Lube oil outlet temperatures
Jacket water inlet temperatures
Jacket water outlet temperatures
Tachometer
Hourmeter
Engine Load (kw) (Watts)*

* Log Sheet Titles for These Parameters

<u>NRC Request</u>

p. 59 <u>MP&L Proposed Action</u>, add "or each refueling cycle, whichever occurs first", after "operation" in line 3.

<u>MP&L Action</u>

Hot and cold crankshaft deflection checks will be performed after 270 hours of operation or each refueling cycle whichever occurs first.

<u>NRC Request</u>

p. 59 Add a new item of surveillance, namely "check the rotor float of at least one turbocharger and inspect stationary nozzle ring bolts, after 270 hours of operation or at the first refueling outage, whichever comes first".

<u>MP&L Action</u>

The rotor float of at least one turbocharger and the stationary nozzle ring bolts will be inspected after 270 hours of operation or at the first refueling outage whichever comes first.

NRC Request

p. 64 Table 6-2, add "clear water system (flush out)" with frequency of three to four years.

MP&L Action

A jacket water system flush every 3 to 4 years has been added to the attached table.

TABLE A-1

MP&L AUGMENTED MAINTENANCE/SURVEILLANCE PROGRAM

Maintenance Action	Frequency
Air Roll Engine	At 4 hours and at 24 hours after each shutdown and prior to planned 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 200 hours of engine operation, or 9 calendar months, whichever comes first.
Sample lubricating oil at inlet to lube oil filter while engine is running	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 pressures	Monthly
Check 25% of cylinder head studs and rock arm capscrews and 100% of the air start valve capscrews for preload relaxation.	After 270 hours of engine operation or refueling outage, whichever comes first.
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 each refueling outage, whichever comes first.
Record pertinent engine operating parameters	During surveillance testing.
Clean and inspect "Y" strainers in starting air system	Quarterly
Flush jacket water system	Three to four years.

NRC Request

B. MP&L should take appropriate steps to ensure that the TDI engines are not unnecessarily loaded above 185 psig BMEP during a loss of offsite power, and fully document how this has been accomplished.

MP&L Action

A precautionary note will be added to the GGNS Off-Normal Event Procedure for Loss of Offsite Power to provide the requested assurance. In addition, future training with respect to this procedure will explain both the basis for the note and the aspects to be taken into consideration in its application.

NRC Request

C. MP&L should propose changes to the plant Technical Specifications to specify that monthly and 18 month surveillance testing shall be conducted at an engine load corresponding to 185 psig BMEP (brake mean affective pressure).

MP&L Action

A Proposed Change to the Operating License is being processed to limit the loading during the surveillance testing per the NRC request.

NRC Request

D. MP&L should supplement its July 5, 1984 submittal with the following information:

1. The metallurgraphic analysis confirming that the turbocharger bolt failure was due to intergranular stress corrosion.

MP&L Response

Attachment II provides the results of an metallurgical evaluation of the failed turbocharger bolts. The results of the evaluation confirms that the failure was due to intergranular stress corrosion.

NRC Request

2. Results of the turbocharger inspection by Elliot.

MP&L Response

Turbocharger thrust bearing wear has been identified as one of 16 significant issues by the TDI Owner's Group. Inspection of the Division I turbocharger bearings was performed and additional conditions identified.

During the disassembly of both Division I turbochargers, damage to the turbine blades and stationary nozzle rings was identified. In addition, two (2) stationary nozzle ring bolts on the right bank turbocharger and one (1) on the left bank turbocharger were found broken. Both turbochargers were sent to the manufacturer's service shop (Elliot Company) for a complete inspection and rebuild as required. Representatives of Failure Analysis Associates (FaAA) and Mississippi Power and Light Company (MP&L) were present at the service shop for disassembly and inspection.

The turbine discs for both turbochargers were completely re-bucketed (all blades replaced) due to foreign object damage to the blades. Both nozzle rings (stationary blades) were replaced due to foreign object damage. In the Division I RB turbocharger the foreign object was suspected to be one of the nozzle ring bolts, which was completely missing when the turbocharger was disassembled, and/or the blade from the nozzle ring which was broken and also missing. The foreign object in the Division I LB turbocharger which caused the turbine blade and nozzle ring damage is unknown.

The bearing clearances/float on both turbochargers were acceptable and very near the minimum assembly clearance/float limits. Rotor float for the right bank turbocharger was .0085 inches, and left bank .0075 inches. There was no evidence of turbocharger damage detected during the 500 hours of engine operation. The engines operated satisfactorily. The representative of FaAA inspected the bearings upon disassembly and noted that the conditions exhibited on the bearings (thrust bearing face wear and journal face wear) was the best that he had observed, especially in comparison to the bearings removed from the turbochargers of other nuclear facilities. FaAA estimated the thrust bearing face to be approximately 0.0005" to 0.0015" (essentially no wear) as compared to the 0.020" to 0.050" (approximate) wear shown at the other plants.

The Division II turbocharger stationary nozzle ring, vanes, bolts, and rotating turbine blades were also inspected. This additional inspection was prompted by observations made during the inspection of the Division I engine. The Division II turbochargers, conversely, showed no signs of rotating disc damage, though one vane was also found to be missing from each stationary nozzle ring. All bolts were intact and all moving elements were in excellent condition even though the Division II turbochargers had approximately 80% more operating hours than the Division I turbochargers. There was no indication of intergranular stress corrosion cracking in the Division II bolts. Turbine rotor float of Division II was measured and was well within acceptable tolerances (left bank .008" and right bank .009"), indicating insignificant thrust bearing wear. The old nozzle rings and blades were also carefully examined with liquid fluorescent dye. The blades and rings were found to be free of rejectable indications and were judged to be acceptable for further use; however, the nozzle ring assembly and bolts were replaced with new parts as normal maintenance practice. The Division II engine and turbochargers were then operationally tested at 70 - 100% load for 4 hours and returned to service. The turbochargers operated satisfactorily.

NRC Request

3. A detailed description of the method used and the results to confirm the surface area contact of the connecting rod serrated surface is at least 75% for all rods.

MP&L Response

Concerns had been expressed that with an insufficient amount of contact between the connecting rod box and master rod rack teeth, a potential could exist for preload relaxation of the connecting rod bolts, thus creating the potential for crack initiation in the connecting rod boxes.

As requested by the NRC, bluing of the rack teeth mating surfaces to the satisfaction of the TDI representative was performed. The TDI method of bluing was developed for new rod assemblies prior to final machining and had never been performed on rods that had experienced service. The TDI specified criteria for bluing acceptance of new connecting rod assemblies was evidence of approximately 75% contact between the serrated surfaces. The area of contact by TDI Design is 0.226 inches of the height of each tootn face.

Bluing was applied to the rack teeth on the master rod to obtain a semi-transparent film. The connecting rod box was mated to the master rod and stroked in a lapping motion. This process was performed on all eight (8) assemblies and revealed approximately 50% contact between the two (2) parts. There was also a definite pattern noted on all assemblies; the teeth adjacent to the crankpin bore showed little evidence of contact while those away from the bore showed increased contact. TDI indicated that this would be normal for a rod assembly that had experienced service. This would be due to minor distortion expected to occur from engine operation and service in the associated environment.

The representative of TDI indicated his acceptance of the rods. To provide an accurate representation of the mechnical fit achieved when assembled in the engine, the rod which had the least contact was re-examined. Again bluing was applied to the master rod then assembled with the connecting rod bolting approximately 1000 ft-lbs of torque. This resulted in a contact area of 80-90%. By using less than 50% of the assembly torque value of 2600 ft-lbs a mechanical connection was obtained that was acceptable to the TDI representative.

Since the torqued rod assembly was the one which had the least contact area of the eight rods and it was satisfactorily checked to greater than 75% contact area, it was concluded that the process adequately demonstrated acceptability of the connecting rod seating surfaces.

NRC Request

4. Documented results of measurements of the cylinder head fire deck surface flatness.

MP&L Response

A straight edge and micrometer were utilized to obtain baseline information for the cylinder head fire deck profiles. Measurements were taken at six different locations on the fire deck. Readings varied from head to head as to the depth of the fire deck depression. Results of the measurements are shown in TABLE 1.

Changes in readings taken across the fire deck were due to the curvature of the fire deck and were consistent for all heads and did not indicate a problem with head warpage. These readings were taken for baseline data to be used in the future to determine if warpage of the heads may have occurred.

NRC Request

5. The inspection, engineering and metallurgical evaluation reports confirming the acceptability of the two cylinder heads containing cracks in the stellite seats.

MP&L Response

Attachment III provides the results of a metallurgical evaluation performed on the Division II D/G number 5 right bank cylinder head.

All Division I D/G heads were inspected and met the recommended acceptance criteria specified in the report.

NRC Request

6. Information regarding whether cylinder heads studs were replaced by stud of the same or different designs.

MP&L Response

As noted in the inspection report (AECM-84/0345), cylinder head studs numbers 4 and 5 on the left bank number 3 cylinder were replaced with new studs as a maintenance item. The old studs were of the straight shank design and were replaced with studs of the necked down shank design. During the visual inspection of the head studs, it was noted that the #2 stud for the #1 RB cylinder was also of the necked shank design. The remaining 125 head studs on the Division I diesel engine are of the straight shank design. The cylinder head stud stress analysis report prepared for the TDI D/G Owners Group in March, 1984 concluded that both stud designs are adequate for the applicable engines and service conditions.

NRC Request

7. A description of the indications noted and the engineering disposition concerning the relative motion between the piston crown and skirt.

MP&L Response

Inspection of the Division I diesel engine type "AE" piston skirts by an independent consultant revealed very minor fretting on an area adjacent to the stud holes on two piston skirts. The two patches of fretting were approximately 1 1/2 inches long by 1/4 to 5/16 inches in width and were located outboard of the stud hole. Consultation with a TDI engineering representative was initiated. It was concluded by both consultants that the fretting observed was not considered unusual. In addition, a review of the torque check records indicated that the preload applied to the crown studs following the January disassembly had showed no significant signs of relaxation. Both the independent consultant and TDI engineering concluded that the service life of the pistons would not be affected.

NRC Request

8. Documented crankshaft deflections relative to TDI specifications.

MP&L Response

The results of the hot crankshaft deflection checks performed after the breakin run on the Division I D/G are shown in TABLE 1. The results are within the standards specified by the vendor indicating that main bearings, foundation bolt torquing and alignment of the engine with the generator are acceptable.

NRC Request

9. Crankshaft torsiographs and preturbine exhaust temperature data at 0%, 25%, 50%, 75%, and 100% of engine nameplate loading. (these data should be taken prior to plant operation above 5% power). Regarding the torsiographs, the staff is specifically interested in the vibratory amplitudes of the criticals at 450 RPM.

MP&L Response

To be provided when complete.

NRC Request

10. Status of MP&L investigation of recent failures to start of the Division I engine (LERs 84-016, 84-023).

MP&L Response

On 3/24/84 the Division I diesel generator failed to start upon receipt of an inadvertant LOCA signal generated during response time testing of ECCS valves.

Extensive evaluation and testing was performed to determine the cause of the diesel generator failure to start. Investigation of the diesel generator emergency start circuitry revealed no component failures or inadequacies. When given another start signal, the diesel generator started and ran with no problems. The conditions of the failure to start were repeated, a total of eleven actual diesel generator starts were performed, and individual components of the start logic and mechanism were repeatedly tested, however, the failure to start could not be repeated and nothing could be found which could have caused the failure. After all troubleshooting and functional testing, which revealed no problems, the functional surveillance test was performed on the diesel generator and it was declared operational. The failure to start was considered a valid failure.

SR 84-023

On 5/5/84 the Division I diesel generator failed to start upon a manual start signal for a monthly surveillance test. The engine turned approximately one turn and stopped. The diesel generator was instrumented and extensive troubleshooting and testing performed, but no component problems were identified. Ten sucessful starts were accomplished during the troubleshooting efforts, however, the failure could not be repeated or any component malfunction identified. The functional surveillance test was performed on the diesel generator and the D/G declared operable. The monthly functional surveillance was revised to include additional instrumentation to monitor solenoid start signals on both diesel generators in a continuing effort to identify the cause of the failure of the Division I D/G to start. The failure to start was considered a valid failure.

NRC Request

11. In addition to leaks addressed in MP&L's February 20, 1984 report, MP&L has experienced several other instances of fuel-oil line leaks; 9/1/83, Division 1; 9/23/83, Division 1; 10/22/83, Division 2; 10/28/83, Division 1; 10/26/83, Division 2; and 11/5/83, Division 2. Provide a description of the root causes of these leaks and corrective actions taken by MP&L to prevent a reoccurence.

MP&L Response

MP&L has experienced several instances of fuel oil line leaks between September 1, 1983 and December 1, 1983. The incidents are as follows:

Division I D/G

- o 9/1/83 - Injector return line leak
- o 9/23/83 - Injector return line elbow leak

Division II D/G

- o 10/21/83 - Hole rubbed in fuel oil filter different'al pressure sensing line
- o 10/26/83 - Injector return line leak
- o 11/03/83 - Injector return line leak

The injector return line leaks on 9/1/83, 10/26/83 and 11/03/83 were due to physical damage (crimped or bent) that had been incurred during previous maintenance activities. On these three occasions, the lines were replaced with new lines.

On 9/23/83, an elbow on an injector return line on the Division I D/G was found leaking due to insufficient tightness. The elbow was removed, cleaned and reinstalled. A new injector line was also installed with the elbow and a 168 hour test run performed. No further leakage was observed.

On 10/21/83 a leak was discovered on a differential pressure sensing line on the Division II D/G. Investigation found that a hole in the line where the line had been rubbing against an adjacent component. The line was replaced and routed away from adjacent components.

NRC Request

12. Describe the circumstances and cause of the air start valve failure on the Division I engine on 9/17/83. Why didn't the preventive maintenance program described in LER 83-082 prevent this failure?

MP&L Response

On 9/17/83 during engine testing for the engine rework following the fire, temperature readings on the air start valves supply headers indicated that an air start valve had started to leak by. An elective shutdown of the diesel was performed and the air start valve replaced. Prior to this testing, while the engine was being reworked, the starting air system had been shutdown and depressurized for several weeks. The air start valve failure is attribuced to an accumulation of moisture and contaminants in the air start system while depressurized. On 11/5/83 an air start valve on the Division II D/G was found leaking and was replaced. The preventive maintenance on the air start system had not been performed on the Division II D/G prior to this failure. The PMs have been performed on both D/Gs with no subsequent failures of air start valves reported. Operator's rounds also include a blowdown of the starting air receiver to remove any accumulated moisture once every 24 hours.

NRC Request

13. Describe the circumstances of the stuck open air start solenoid valve failure on 1/8/84 (Division 2), and corrective actions taken to prevent recurrence.

MP&L Response

On 1/8/84 a starting air solenoid valve on the Division II diesel generator stuck open on a manual start attempt. Disassembly of the valve found moisture and contaminants in the valve that had caused it to stick in the open position. The valve was cleaned, reassembled and tested satisfactorily. A preventive maintenance program was established to periodically clean the air start solenoid valves. The incident occurred during testing following the December, 1983 disassembly and inspection of the Division II diesel engine. During this disassembly, the starting air system had been shutdown and depressurized for several weeks. The incident is attributed to accumulation of moisture and contaminants in the air start system while depressurized. The establishment of the PM program for periodical cleaning of the air start solenoid valves will minimize the probability of the recurrence of an incident of this type.

NRC Request

14. Describe the circumstances of the stuck fuel pump event (Division I) on 8/19/83, and corrective actions taken.

MP&L Response

On 8/19/83 an inspection of the Division I diesel engine disclosed that the rack spring for the #7 left bank fuel pump was sticking and not functioning properly. Further inspection after engine shutdown revealed corrosion on the rack spring. The spring was cleaned, lubricated and returned to service. The fuel pump was not replaced as previously indicated. Periodic exercising and lubrication of the fuel racks has been established as a normal preventive maintenance item. No further problems have been identified to date.

NRC Request

15. Describe the circumstances of the cracks of the Division 2 airbox on 10/28/83, its potential impact upon engine operability, and corrective actions.

MP&L Response

On 10/28/83 an inspection of the Division II diesel engine during a maintenance retest identified a cracked weld on the aftercooler air box. The weld was ground out and replaced. The cracked weld on the air box had no effect on the operation of the Division II diesel engine.

TABLE 1

Cylinder Head Baseline
Data for Flatness

Cylinder Head	A	B	C	D	E	F
RB-1	<.002	.004	.004	.004	.002	<.002
RB-2	<.002	.005	.008	.008	.005	<.002
RB-3	.002	.003	.004	.004	.003	<.002
RB-4	<.002	.007	.008	.006	.007	<.002
RB-5	<.002	.004	.012	.007	.003	<.002
RB-6	<.002	.002	.002	.003	.002	<.002
RB-7	<.002	.003	.009	.007	.003	<.002
RB-8	.003	.016	.0[illegible]9	.014	.015	.004
LB-1	.002	.007	.007	.005	.006	<.002
LB-2	<.002	.005	.008	.006	.004	<.002
LB-3	<.002	.004	.006	.006	.004	<.002
LB-4	<.002	.004	.007	.007	.004	<.002
LB-5	<.002	.005	.009	.004	.004	<.002
LB-6	<.002	.005	.006	.007	.004	<.002
LB-7	<.002	.006	.003	.003	.006	<.002
LB-8	<.002	.004	.006	.004	.004	<.002

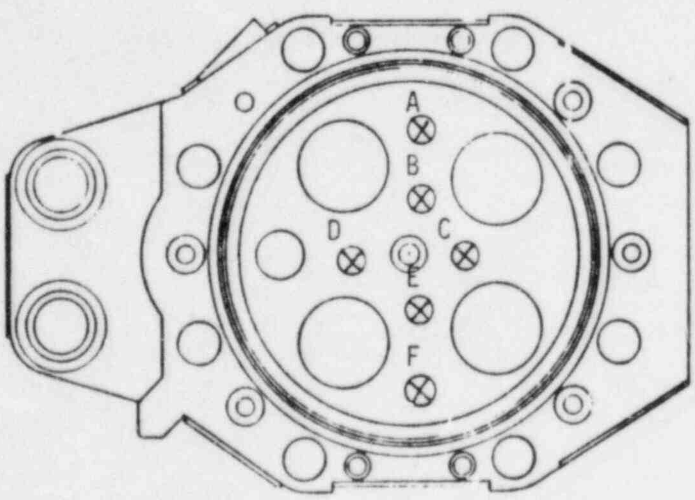

TABLE 2

Division I D/G Hot
Crankshaft Deflection Checks
Readings Recorded in MILs

Cyl. No. Starting At Gear Case ED	CRANKSHAFT POSITION 1	2	3	4	5
1	0	0	0	-1	-1
2	0	+1/4	0	-1/2	-3/4
3	0	0	-1/2	-1	-1
4	0	-1/4	-1	-1	-1/2
5	0	-1/4	-1	-1	-1/2
6	0	-3/4	-1	-1	-3/4
7	0	-1/4	-3/4	-3/4	-1/4
8	0	0	-1/2	-1/2	-1/4

DEFLECTION STANDARDS

If the deflection in any crank of an engine in service exceeds 3 mils (0.003 inch/0.0762 mm), corrective action is indicated. If the deflection in any web exceeds 6 mils (0.006 inch/0.1524 mm), the engine should be taken out of service until the fault is corrected. Corrective action is also necessary if the total deflection in any pair of adjacent cranks exceeds 3 mils. For example, if the deflection in one crank is plus two mils, and the deflection in an adjacent crank is minus two mils, the total deflection is four mils, and corrective action is indicated.