

**ENGINE SYSTEMS, INC.**

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P21 97-52-1

TELEFAX

Date: September 23, 1997
Company: Office of Nuclear Reactor Regulation
Fax Number: 301-415-1887
Attention: Vern Hodge
Reference: Report #10CFR21-0073
From: Michael Nuding
Page: 1 of 9

Dear Sir:

Following this cover is a copy of our report 10CFR21-0076 for a 10CFR21 reportable defect with EMD air start motors. This report supercedes our interim report 10CFR21-0076-IR dated July 14, 1997.

A copy of this report is also being mailed to you. We will begin our notification to affected users tomorrow.

Should you have questions, please let us know.

Sincerely,

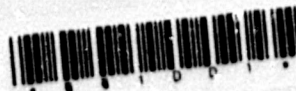
ENGINE SYSTEMS, INC.

Michael Nuding

Michael Nuding,
Quality Manager

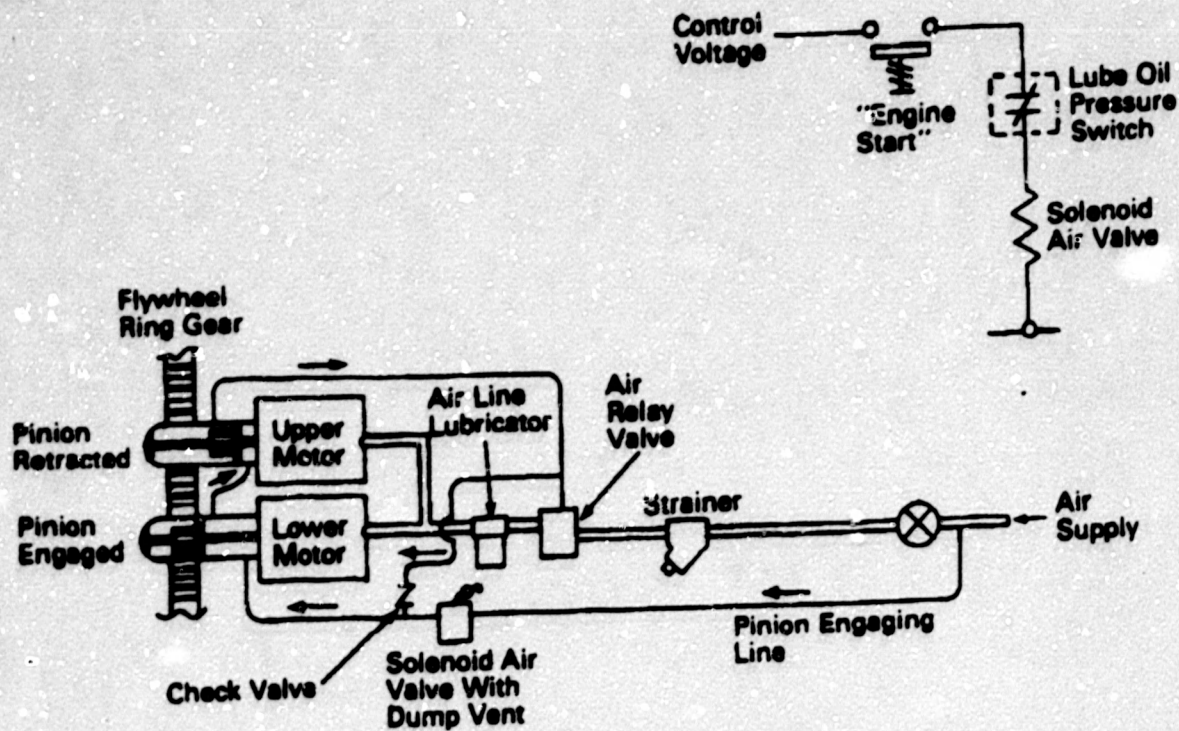
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Section 4



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Fig.4-3 - Typical Air Starting System Diagram

MAINTENANCE

The air starting system requires very little maintenance other than cleaning and lubrication.

The air line lubricator is the only component of the system which requires maintenance at intervals specified in the Scheduled Maintenance Program. Oil level in the bowl should be checked and the needle valves should be adjusted for an oil flow rate of three drops per minute. This can be checked visually through the sight glass in the front of the lubricator.

If oil does not flow, remove top plug and drip gland. Clean parts and passages, using kerosene, and blow out with compressed air.

Replace any defective gaskets or packing. Reassemble, tightening drip gland firmly, but carefully.

Compounded oils containing graphites, soap, or fillers should not be used in the lubricator.

Refer to applicable Engine Maintenance Manual for maintenance data on starting motors and unattached accessories.

Report No. 10CFR21-0076
SEPTEMBER 22, 1997

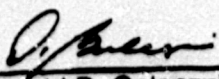
10CFR21 REPORTING OF DEFECTS
AND NON-COMPLIANCE

COMPONENT: EMD Air Start Motors #40047506 & #40047507

SYSTEM: Standby diesel generators with EMD diesel engines


CONCLUSION: Defect is reportable in accordance with 10CFR21.

PREPARED BY:


Donald D. Galeazzi
Engineering Manager

DATE: 9/28/97

REVIEWED BY:


Michael Nuding
Quality Assurance Manager

DATE: Sept 22 1997

SUMMARY:

This report supersedes our interim report 10CFR21-0076-IR dated July 14, 1997.

Engine Systems, Inc. (ESI) received notification on 5/14/97 from Commonwealth Edison, Quad Cities nuclear plant about an increase in starter pinion abutments after installing the "new" style air motors. ESI began an investigation of this issue through coordination with EMD and Ingersoll-Rand (I-R), the starter manufacturer.

I-R discontinued production of their model 89 air motor and recommended their model 88 as a replacement. The "new" style (#40047506 & #40047507) air motors (I-R model 88) were then issued by EMD as replacements for the "old" style (#8367694 & #8377435 respectively) air motors (I-R model 89). #40047506 & #8367694 are for use on left hand (standard) rotation engines (counter-clockwise while looking at engine flywheel) and are applicable for most EMD diesel generators. Right hand rotation engines use #40047507 & #8377435 and are only applicable for tandem diesel generator sets. Left hand rotation and right hand rotation air start motors are identical in design except some components are reversed or are manufactured as mirror images to enable opposite rotation.

The EMD design pipes the two air motor pinion lines in series before going to the main air valve "activate" input. The intent of this design is to pre-engage the pinion gear (achieve mesh between the pinion gear and the engine ring gear) before starting air is supplied to the motor to begin engine rotation (see Exhibit 1).

EMD has recently performed starting motor tests at their facility with I-R using both "old" and "new" style air motors. The results show that the "old" style air motor is not a pre-engagement type (although, I-R thought it was) and therefore it allows air motor rotation during pinion abutment. The testing also demonstrated that the "new" style starter is a positive engagement type and therefore it prevents motor rotation during pinion abutment. Under most starting scenarios, the pinion gear will properly mesh with the engine ring gear, the engine begins to crank and starts as normal. The pinion gear has chamfered teeth which allows the two gears to mesh easily; therefore, gear abutment is rare. If gear abutment does happen, the following will occur:

1. "Old" style starters:

This motor is not a pre-engagement type; therefore, the pinion gear and engine ring gear "roll into" mesh as the air motor begins to rotate. The engine cranks and starts normally.

Rolling into mesh is not a problem for most applications because of the main air valve design. From 1969 - present, EMD used a Graham-White (Salem) main air valve (EMD #8393335). This valve uses a 2 stage principle which allows a small amount of air to flow through the valve before the valve fully opens to deliver the main charge of air to the starting motors. This provides a smooth deliverance of air to the air motors and eliminates a "shock" of air. This also enables the air motors to rotate slowly for a very brief period of time before the main charge air is delivered to the air motors; thus, the pinion gear rotates slowly and meshes with the engine ring gear before full starting torque is applied by the motor. Prior to this 2 stage valve, a Grove Flexflo main air valve was used. This valve was not slow opening and gear damage could occur because full starting torque is applied during "roll in".

2. "New" style starters:

This motor is a pre-engagement type; therefore, engine rotation is prevented because the pinion has not traveled a sufficient distance to release an activate air signal to the main air valve. The engine fails to start.

EMD feels that the pre-engagement operation of the current design "new" style starter decreases engine starting reliability and therefore is not acceptable for use on the EMD engine. The "old" style starter has demonstrated many years of reliable engine starting on the EMD diesel engine and its continued use is recommended. I-R is investigating reinstatement of the "old" style starter for exclusive use by EMD. They are also looking at modifying the "new" style starter so that it performs identically to the "old" style.

COMPONENT:

EMD #40047508	I-R #150BMPD88R543335	For left hand (standard) rotation engine.
EMD #40047507	I-R #150BMPD88L543336	For right hand (reverse) rotation engine.

CUSTOMERS AFFECTED:

Commonwealth Edison, Quad Cities is the only ESI customer to report this type of problem. According to Quad Cities, Savannah River also experienced increased pinion abutment after installing the "new" style air motor (motors not supplied by ESI). These two installations are somewhat unique because they do not have redundant banks of air start motors and they do not have pinion recycle circuitry. Most EMD nuclear safety related diesel generators have both of these features. Units with redundant banks of starting motors and recycle circuitry are less likely to notice a change in starting reliability after installing the "new" style air motors. Redundant banks (if activated simultaneously) increase the probability of engine rotation during a pinion abutment condition because it is unlikely that abutment will occur simultaneously on both banks. Tandem diesel generators have an even smaller chance of start failure from pinion abutment because the quantity of air starting banks is doubled by having the second engine. Recycle circuitry will retract the pinions and activate another start attempt if abutment occurs. This virtually eliminates a start failure due to pinion abutment; although starting time will obviously increase. New York Power and TVA have reported that they have not experienced any change in starting reliability since installing the "new" style air start motors. Note that the EDG's at both of these sites have redundant banks of air start motors with pinion recycle circuitry.

"NEW" STYLE AIR START MOTOR SALES

<u>Customer</u>	<u>Part Number</u>	<u>Cust. P.O.</u>	<u>Qty</u>	<u>Ship date</u>
Commonwealth Ed.	40047506	47C520	2	2/27/97
	40047506	40D446	2	3/31/97
	40047506	43D261	2	6/02/97
	40047506	RS 358781GS2	2	7/25/94
E G & G Rocky Flats	40047506	95-4-80628	8	12/05/95
Entergy-River Bend	40047506	PK0004104 KQ	1	10/24/94
Knolls Atomic	40047506	OH952K204300	1	4/03/96
Korea Electric Power	40047506	S 94 66292	2	2/28/95
NYPA-Fitzpatrick	40047506	P92NJB45165B001/1052012	4	3/01/95
TVA-Watts Bar	40047506	P92NJB45165B001/1142601	1	3/10/97
	40047507			

DEFECT:

A replacement air start motor was recommended which did not function the same as the original part. Differences between the "old" and "new" motors were not completely defined by the manufacturer and therefore were not passed along to the user. Some of these differences affect the operation of the engine starting system such that a start motor pinion gear to engine ring gear abutment results in a start failure. The differences are:

<u>Component</u>	<u>"Old" style</u>	<u>"New" style</u>	<u>Reason</u>
pinion piston seal	metal ring.	o-ring.	improved sealing.
pinion piston	a. seal @ 0.380" from press face.	a. seal @ 0.125" from press face.	a. unknown.
	b. 0.1" groove.	b. 0.242" groove.	b. piston seal change.
drive housing	a. 4.4375" long.	a. 4.00" long.	a. standardize parts.
	b. 1/4" npt ports thru to piston.	b. 1/4" npt ports neck to 1/8" dia.	b. to accommodate o-ring seal on piston.

CORRECTIVE ACTION:

Replace the "new" style air start motors with the "old" style motors. At this time, the "old" style starter is only available through a rebuild program offered by ESI. Eventually, I-R may be able to reinstate the "old" style starter and make it available as a new part and/or modify the current "new" style starter to make it perform identically to the "old" style.

1. Users without redundant starter banks and/or pinion recycle circuitry

Replace the "new" style air start motors with the "old" style motors as soon as possible. It is our understanding that Commonwealth Edison has already completed this.

2. Users with redundant starter banks and/or pinion recycle circuitry

Replace the "new" style air start motors with the "old" style motors at earliest convenience. Starting reliability may still be impacted by the "new" style motor, particularly if both starting banks are not simultaneously activated during starting. Pinion recycle circuitry will most likely prevent a start failure caused by abutment, but starting time will be increased.

3. Users with Grove Flexflo main air valves

Wisconsin Electric, Point Beach has advised that they have had at least two occurrences of pinion shaft shearing on their G01 and G02 EDG's. They have also advised that their G01 and G02 EDG's have had a history of air start problems which have been attributed to pinion abutments. ESI believes the WE air motor problems have been caused by the "roll in" design in combination with the Grove Flexflo valve. As discussed previously, this is not a 2-stage valve and therefore full starting torque is applied immediately upon activation of the valve. During abutment, the pinion gear and shaft are exposed to addition stresses as this torque is applied during the "roll in" process. ESI has not received reports about these types of events occurring at other installations; therefore, we are not considering this a generic issue. Our recommendation to users with Flexflo valves is to review past history. If problems similar to those experienced at Point Beach have occurred, replacement of the Flexflo valve with the Graham-White (Salem) valve is advised.

Contact Engine System's Parts department for replacement "old" style starters.

EXHIBIT 1

**EMD AIR START SYSTEM DESCRIPTION
(2 PAGES)**