MATERIAL CONCERNING GENERAL ELECTRIC WATER COOLED MOTOR
FOR REFERENCED (THREE MILE ISLAND, UNIT 1) NUCLEAR POWER PLANT

METROPOLITAN EDISON COMPANY

THREE MILE ISLAND NUCLEAR STATION

P.O. NO. 93342

AAF CONTROL NO. 477-577

GILBERT ASSOCIATES, INC.

READING, PENNSYLVANIA

SPECIFICATION R.O. 2637

MATERIAL CONCERNING

GENERAL ELECTRIC WATER COOLED MOTOR

FOR REFERENCED NUCLEAR POWER PLANT

AMERICAN AIR FILTER COMPANY, INC.

215 CENTRAL AVENUE

LOUISVILLE, KENTUCKY

MARCH 19, 1969

JOY MANUFACTURING CO.

BILL OF MATERIAL

DRAWING NO.

BILL OF MAT. NO. 500812-327

SHEET NO. 1 OF 7

NAME ELECTRIC MOTOR, WATER COOLED FOR NUCLEAR ENVIRONMENTS (GENERAL ELECTRIC COMPANY)

ORDER NO.

ISSUED DECEMBER 17, 1968 NBH957

NBJ21

NBJ97

NBJ283

QUANTITY PER ORDER	QUANTITY PER UNIT	PART NUMBER	NAME OF PART	COST PER PIECE	TOTAL AMOUNT
H.P.:			150/75		
VOLTS, PHASE, CYCLES:			460/3/60		
NAME PLATE AMPS:			181/120		
SPEED:			1200/600 RPM		
WINDING:			TWO SPEED-ONE WINDING-CONSTANT TORQUE		
FRAME:			S100		
BEARINGS:			ANTI-FRICTION RADIATION RESISTANT GREASE		
ENCLOSURE:			TOTALLY ENCLOSED WATER COOLED		
MOUNTING:			FOOTLESS C-FACE		
CONDUIT LOCATION:			SEALED TERMINAL STUDS ON BARREL-SEE NOTES		
RISE/AMBIENT:					
DUTY:			AXIAL FLOW FAN		
NEMA DESIGN:			B		
INSULATION:			CLASS H, FOR NUCLEAR APPLICATIONS		
CLAW LENGTH:			SEE NOTES		
TYPE:			SQUIRREL CAGE INDUCTION MULTI-SPEED		
SHAFT EXTENSION:			TAPERED, PER DRAWING 34C104212 (G.E.)		
SHAFT SEAL:			JOHN CRANE, OBL TYPE-8-V		
MANUFACTURER:			GENERAL ELECTRIC COMPANY		
DRAWING NUMBER:			34C104212 (G.E.)		
APPLICATION:			AXIVANE FAN, SERIES 2000, FOR NUCLEAR CONTAINMENT		
DATE:			12/17/68		
REMARKS:			SEE NOTES ON FOLLOWING PAGES		
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JOY MANUFACTURING CO.

BILL OF MATERIAL

BILL OF MAT. NO. 500812-327

SHEET NO. 2 OF 7

ORDER NO.

QUANTITY PER ORDER	QUANTITY PER UNIT	PART NUMBER	NAME OF PART	COST PER PIECE	TOTAL AMOUNT
			GENERAL DESIGN COMMENTS		
			THE FURNISHED UNIT WILL BE A SQUIRREL CAGE INDUCTION MOTOR, TOTALLY-ENCLOSED, WATER-COOLED, WITH TORQUE AND CURRENT CHARACTERISTICS TYPICAL OF NEMA DESIGN B, SUITABLE FOR FAN DRIVE APPLICATIONS. THE SPECIFIC HORSEPOWER, SPEED, VOLTAGE, AND OTHER CHARACTERISTICS FOR THE PARITUCLAR APPLICATION ARE AS PREVIOUSLY LISTED IN THIS DESCRIPTION.		
			THE CONSTRUCTION IS TO KEEP THE EXPECTED CONTAINMENT ATMOSPHERE FROM CONTACTING THE BEARINGS, WINDINGS, ROTOR AND OTHER INTERNAL PARTS OF THE MOTOR DURING NORMAL CONDITIONS, AND DURING THE ACCIDENT CONDITIONS DESCRIBED WITH THE SPECIFIC MOTOR RATING.		
			EXCLUSION OF THE AMBIENT ATMOSPHERE WILL BE ACCOMPLISHED BY A POSITIVE, PRESSURIZED, RUBBING SEAL BETWEEN THE BEARING HOUSING AND DRIVE SHAFT.		
			THE CONTAINMENT ACCIDENT CONDITIONS ARE DEFINED AS FOLLOWS:		
	1		RADIATION. 1.7 x 10^8 RADS OF GAMMA RADIATION DURING THE DESIGN LIFE OF THE MOTOR.		
	2		TEMPERATURE. EXPOSURE DURING THE ACCIDENT CONDITION TO 280°F. FOR A PERIOD OF 3-4 HOURS.		
	3		HUMIDITY. EXPOSURE DURING THE ACCIDENT CONDITION TO 100% RELATIVE HUMIDITY WITH WATER DROPLETS PLUS A SLIGHTLY CAUSTIC ATMOSPHERE.	1415	181

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QUANTITY PER ORDER	QUANTITY PER UNIT	PART NUMBER	NAME OF PART	COST PER PIECE	TOTAL AMOUNT

4. PRESSURE, VAPOR PRESSURES OF 70 PSIA DURING THE ACCIDENT CONDITION.

NORMAL OPERATING CONDITIONS ARE DEFINED AS:

1. OPERATING TEMPERATURE OF 125°F. TO 150°F.
2. AIR PRESSURES OF 18.3 PSIA
3. DESIGN LIFE OF 40 YEARS.

ENCLOSURE:

A. STATOR: DOUBLE SHELL, ROUND FRAME CONSTRUCTION, OF HEAVY FABRICATED STEEL, DESIGNED FOR COOLING WATER TO BE CIRCULATED BETWEEN INNER AND OUTER SHELL, IN A HELICAL PATTERN AROUND THE DIAMETER.

B. END SHIELDS: DRIVE END SHIELD WILL BE FABRICATED OF HEAVY STEEL. OPPOSITE DRIVE END SHIELD WILL BE CAST OF NODULAR IRON. SHIELDS WILL BE BOLTED TO THE STATOR FRAME AND A SEAL BETWEEN THE SHIELDS AND STATOR WILL BE MADE BY MEANS OF "O" RINGS AT THE RABBET FITS.

STATOR CORE AND WINDINGS:

PUNCHINGS ARE STACKED AND CLAMPED TOGETHER SECURELY, BY A WELDED CAGE, PRIOR TO BEING INSERTED IN THE STATOR FRAME IN THE SAME MANNER AS THE TYPICAL CUSTOM 8000 CONSTRUCTION. (DESCRIBED IN MORE DETAIL IN STANDARD PUBLICATIONS).

WINDINGS ARE INSERTED IN THE STATOR CORE, CONNECTED, BRACED AND FULLY IMPREGNATED BEFORE THE CORE IS INSTALLED IN THE STATOR FRAME.

JOY MANUFACTURING CO.

BILL OF MATERIAL

BILL OF MAT. NO. 500812-327

SHEET NO. 4 OF 7

ORDER NO.

QUANTITY PER ORDER	QUANTITY PER UNIT	PART NUMBER	NAME OF PART	COST PER PIECE	TOTAL AMOUNT

THE INSIDE DIAMETER OF THE STATOR FRAME HAS MACHINED SLOTS RUNNING THE LENGTH OF THE FRAME. THE RIBS OF THE CAGE USED TO CLAMP THE PUNCHINGS TOGETHER EXTEND OUTSIDE THE DIAMETER OF THE PUNCHINGS, AND THESE RIBS FIT IN THE SLOTS CUT IN THE STATOR FRAME. A POSITIVE INTERFERENCE FIT BETWEEN THE STATOR FRAME AND CORE IS OBTAINED BY HEATING THE FRAME BEFORE THE CORE IS INSERTED.

INSULATION: CLASS H MATERIALS WHICH HAVE DEMONSTRATED, BY PRIOR, DOCUMENTED TESTING, AN ABILITY TO RETAIN SATISFACTORY INSULATING PROPERTIES AFTER RADIATION DOSAGES OF 10^10 RADS ARE USED THROUGHOUT THE STATOR WINDINGS.

1. TURN INSULATION: QUADRUPLE COATED AROMATIC POLYMIDE (QML).
2. GROUND INSULATION: WRAPPED OR TAPED WITH A COMBINATION OF MICA AND GLASS. COILS ARE DIPPED AND BAKED WITH A SILICON RESIN VARNISH.
3. CONNECTIONS: WRAPPED OR TAPED WITH A COMBINATION OF MICA AND GLASS.
4. WEDGE & FILLER MATERIAL: SHEET SILICON GLASS CLOTH, STAPLE FIBERGLAS BASE.
5. COIL BRACING RING: (WHEN REQUIRED) STEEL WRAPPED WITH A GLASS AND MICA SILICON TREATED TAPE.
6. COIL TIE MATERIAL: CONTINUOUS FILAMENT GLASS CORD TREATED WITH SILICON RESIN VARNISH.
7. FINISH: THE FINISHED STATOR IS GIVEN MULTIPLE DIPS IN SILICON RESIN VARNISH AND BAKED AFTER EACH DIP.

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JOY MANUFACTURING CO.

BILL OF MATERIAL

BILL OF MAT. NO. 500812-327

SHEET NO. 5 OF 7

ORDER NO.

QUANTITY PER ORDER	QUANTITY PER UNIT	PART NUMBER	NAME OF PART	COST PER PIECE	TOTAL AMOUNT

BEARINGS: GREASE LUBRICATED, ANTIFRICTION BEARINGS ARE USED. THE DRIVE END HAS A ROLLER BEARING. THE OPPOSITE DRIVE END HAS A BALL BEARING. THE BALL BEARING IS DESIGNED TO TAKE THRUST LOADING. BOTH BEARINGS HAVE CALCULATED LIVES IN EXCESS OF 100,000 HOURS. A SPECIAL GREASE SUITABLE FOR THE RADIATION AND TEMPERATURE REQUIREMENTS WILL BE USED.

ROTOR: ROTOR PUNCHINGS ARE STACKED AND CLAMPED TOGETHER. ROTOR BARS AND END RINGS ARE MADE OF ALUMINUM WHICH IS CAST IN THE ROTOR PUNCHINGS. THIS IS DESCRIBED IN MORE DETAIL IN STANDARD PUBLICATIONS.

SHAFT SEAL: THE DRIVE END SHAFT SEAL IS A RUBBING DOUBLE SEAL UNIT USING WATER UNDER A PRESSURE GREATER THAN THE EXPECTED AMBIENT PRESSURE TO MAINTAIN THE SEAL. THE ONLY PARTS OF THE SEAL IN CONTACT WITH THE SHAFT ARE TWO O-RINGS.

THE SEAL IS DESIGNED TO ALLOW ENOUGH AXIAL MOVEMENT OF THE SHAFT TO ACCOMMODATE SHAFT EXPANSION.

THE SEAL WILL BE A "JOHN CRANE" DBL TYPE 8-1 AS MANUFACTURED BY CRANE PACKING COMPANY, OR EQUAL. [redacted].

TERMINAL CONNECTORS: TERMINAL CONNECTORS WILL BE CERAMIC INSULATED BUSHINGS, SIMILAR TO SPARK PLUGS. THREADED STUDS WILL BE PROVIDED FOR CONNECTION OF USERS MAIN POWER CABLE AND ACCESSORY WIRING. CONNECTIONS FOR ACCESSORIES WILL BE BROUGHT OUT AT A DIFFERENT

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JOY MANUFACTURING CO.

BILL OF MATERIAL

BILL OF MAT. NO. 50D812-327

SHEET NO. 6 OF 7

ORDER NO.

QUANTITY PER ORDER	QUANTITY PER UNIT	PART NUMBER	NAME OF PART	COST PER PIECE	TOTAL AMOUNT
			LOCATION FROM MAIN POWER CONNECTIONS. NO CONDUIT BOXES ARE FURNISHED.		
			ACCESSORIES:		
	1.		TEMPERATURE DETECTORS: THERMOCOUPLES WILL BE MOUNTED ON THE INSIDE OF THE FRAME TO MEASURE TEMPERATURE.		
	2.		MOISTURE DETECTORS: A MOISTURE DETECTOR WILL BE MOUNTED ON THE BOTTOM OF THE FRAME TO DETECT CONDENSATION BUILD-UP OR SEAL LEAKAGE.		
	3.		SPACE HEATERS: LOW VOLTAGE SINGLE PHASE SPACE HEATERS WILL BE SUPPLIED TO MAINTAIN INTERNAL TEMPERATURE SLIGHTLY ABOVE AMBIENT TEMPERATURE DURING MOTOR SHUTDOWN PERIODS TO BE FOR 115 VOLT/1/60.		
	4.		VIBRATION DETECTOR: A VIBRATION SWITCH WILL BE MOUNTED ON THE MOTOR TO DETECT EXCESSIVE VIBRATION. SEPARATE ELECTRICAL CONNECTIONS TO THIS SWITCH MUST BE MADE AT INSTALLATION SINCE IT IS EXTERNALLY MOUNTED ON THE MOTOR FRAME. TYPICAL SWITCH IS ROBERTSHAW VIBRASWITCH OR EQUAL.		
			TESTS: STANDARD FACTORY MOTOR TESTS TO CONSIST OF:		
	1.		RUNNING LIGHT CURRENT		
	2.		RESISTANCE (STATOR)		
	3.		1 PHASE IMPEDANCE AT 1/4 VOLTAGE		
	4.		RUNNING LIGHT WATTS		
	5.		HIPOT TEST		
	6.		COLD INSULATION MEGGAR		
	7.		OBSERVE UNDUE NOISE		
	8.		AIR GAP MEASUREMENT.		

JOY MANUFACTURING CO.

BILL OF MATERIAL

BILL OF MAT. NO. 500812-327

SHEET NO. 7 OF 7 ORDER NO.

QUANTITY PER ORDER	QUANTITY PER UNIT	PART NUMBER	NAME OF PART	COST PER PIECE	TOTAL AMOUNT
			QUALITY CONTROL: A COMPLETE QUALITY CONTROL PROCEDURE IN ACCORDANCE WITH MIL-Q-9858a AND DECAS REQUIREMENTS IS IN EFFECT IN OUR FACTORY. ADDITIONAL PROCEDURES WILL BE SET UP AS REQUIRED FOR SPECIAL FEATURES OF THESE SPECIFIC MOTORS.		

ADDITIONAL NOTES

(1) MOTOR LEADS TO EXTEND OUT OF MOTOR BARREL THRU A SEALED TERMINAL STUD ARRANGEMENT LOCATED AS FOLLOWS: MAINS-120° LOOKING IN AT FRONT END. ACCESSORIES-240° LOOKING IN AT FRONT END.

(2) SHAFT TAPER TO BE 1.250" PER FOOT, WITH 4" DIA. ON SHANK WITH OVERALL OF 9.5" LONG.

(3) INLET & OUTLET COOLING WATER FITTINGS FOR MOTOR ENCLOSURE AND SEAL ARE TO BE FURNISHED.

FORM 9018A-1

GENERAL ELECTRIC COMPANY

POST OFFICE BOX 5278, AKRON, OHIO 44313 . . . . . TELEPHONE 836-0466

INDUSTRIAL SALES DIVISION

March 7, 1969

REFERENCE: JOY'S PO # 7681 FOR CRANE SEAL TEST
G.E. REQUISITION # 379-09026

Joy Manufacturing Company
338 South Broadway
New Philadelphia, Ohio 44663

Attention: Mr. W. Bienko

Gentlemen:

Attached is the Crane Sealed Data on a 2¼ inch diameter Type 1 seal with cranelast bellows. However, this test was at 3600 RPM, giving a DN= 8100 RPM - in. The Joy Manufacturing Company application is a 4.0 diameter, 1200 RPM seal, giving a DN=4800. This value is 59.3% of the test DN value, meaning that the wear rates should be lower for application that the tested wear rates.

Please contact us for additional assistance and/or information. It is our business to make you happy.

Very truly yours,

Curtis L. Mack

Curtis L. Mack
Sales Assistant

CLM:mm
Attachment

cc: Mr. W. Olson
Mr. D. Coutts Joy Manufacturing Company
Mr. T. Adamich

CRANE PACKING COMPANY

PROJECT #1205
2-1/4" TYPE 1 SEAL WITH CRANELAST BELLOWS FOR NUCLEAR POWER PLANT PUMP APPLICATION
PROGRESS REPORT #1

PURPOSE

To determine if a 2-1/4" type 1 seal with Cranelast bellows can function satisfactorily under typical Nuclear power plant pump conditions after bellows has been exposed to 1.1×10^8 RADS gamma radiation from a Cobalt 60 source.

SUMMARY AND CONCLUSION

The seal operated satisfactorily throughout the 3 test phases totaling 500 hours. There was no visible leakage throughout the test. The total washer wear during the 500 hour test was .0024". The bellows hardness increased from 70.5 to 74.5 I.R.H. during the 500 hour test.

This test then indicates that a 2-1/4" type 1 seal with a Cranelast bellows can function satisfactorily after exposure to 1.1×10^8 RADS gamma radiation.

Further testing is in progress on the 2-1/4" and 3-1/4" seal sizes to obtain additional washer wear rate data.

TEST CONDITIONS AND PROCEDURE

The following conditions were the same in all three phases of this test:

TEST RIG:	#13 (See Figure B)
SEAL TYPE:	Std. T-1 Dwg. D-2250-622
SHAFT SIZE:	2.250
SHAFT SPEED:	3600 RPM
SEAL MAT'L.:	1881 Tungsten Carbide D-2125-603
WASHER MAT'L.:	P_{15} carbon
SEC. SEAL MAT'L.:	O-6001 EPR

CRANE PACKING COMPANY

PROJECT #1205

TEST CONDITIONS AND PROCEDURE - contd.

RET. & SPRING MAT'L.:	18-8 SS
FLUID:	2% Boric Acid in H_2O
PV:	471×10^6 @ 250 PSIG
% BAL.:	118

The test was broken down into three temperature pressure and duration phases with washer wear measurements taken after each phase. The seal was reinstalled in the test unit without re-lapping the faces.

PHASE BREAKDOWN

PHASE	TEMP.	PRESS.	DURATION
A	160°F	250 PSIG	200 HRS.
B	300°F	65 PSIG	100 HRS.
C	160°F	50 PSIG	200 HRS.

RESULTS: See Tables belows

DATA SUMMARY

PHASE	TEMP.	PRESS.	TEST HOURS	FACE WEAR WASHER	FACE WEAR SEAT	LEAKAGE
A	160°	250	200	.0010	N.A.	00
B	300°	65	100	.0010	N.A.	00
C	160°	50	200	.0004	110μ"*	00

*TOTAL WEAR FOR 500 HOURS

BELLOWS HARDNESS IN IRDH

UNEXPOSED 0 TEST HOURS	EXPOSURE I 0 TEST HOURS	EXPOSURE I AFTER 500 TEST HOURS
61 - 63	70 - 71	73 - 76
AVG. 62	AVG. 70.5	AVG. 74.5

I.R.D.H. = International Rubber Hardness Degrees
EXPOSURE I 1.1×10^8 RADS GAMMA Radiation from a CO-60 source performed by Westinghouse

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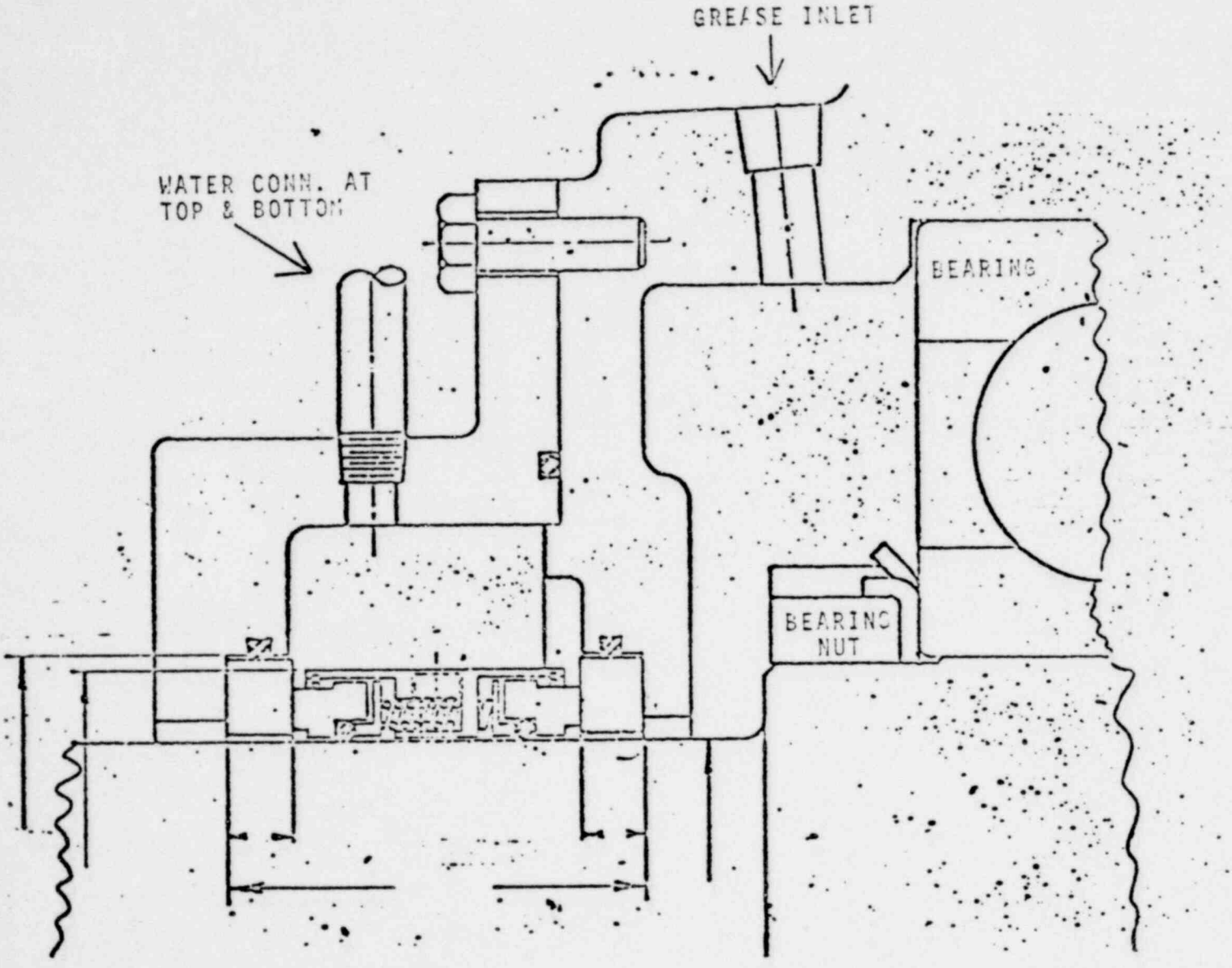
Please see Fig. A attached for results of tests run on tensile specimen taken from ASTM slabs of O-6001 EPR compound before and after exposure to 1.1×10^8 RADS CO-60 gamma radiation.

Roger H Andersen

ROGER ANDERSEN

RA/ml



TYPICAL CONSTRUCTION
BEARING SEAL
FOR
WATER COOLED FAN MOTOR

"JOHN CRANE" DBL TYPE-8-1
SHAFT SEAL

GENERAL ELECTRIC CO.
SCHENECTADY, N.Y.

REV. SKETCH 11/15/68 E.N.D.