

2009 MOV USERS' GROUP MEETING

## **REDUCING OIL SEEPAGE IN SMB ACTUATORS**

Ken Brown, Eco Fluid Center

Pierre LeBel, AECL

Wayne Mackwood, Chemtura Co.

Troy Olmsted, Forsythe Lubrication Associates

## **OIL SEEPAGE**

- A FEW STATIONS HAD REPORTED OIL SEEPAGE (LEAKS) ISSUES. THIS WAS WITH A NUMBER OF GREASES.
- THEY DID NOT AFFECT FUNCTIONALITY.
- THE KNOWN ONES HAD CONTRIBUTING FACTORS WHICH WERE CORRECTED.

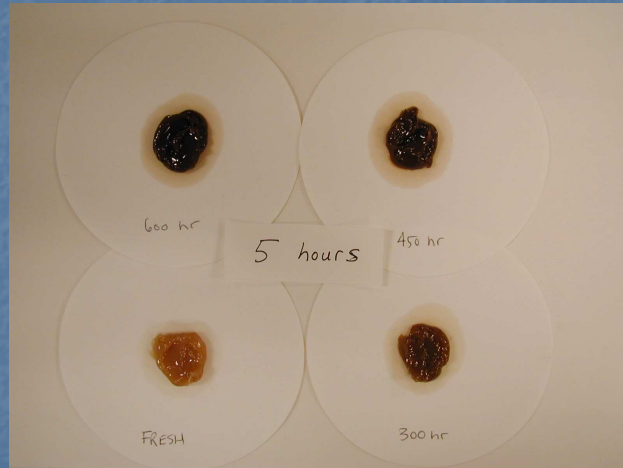
- BLEEDING IS THE SEPARATION OF A SMALL QUANTITY OF BASE OIL FROM THE THICKENING AGENT.
- SOME OIL SEPARATION CAN BE HELPFUL FOR EFFECTIVE LUBRICATION.

**177°C (350°F) FOR 66 HOURS**



**THE PREVIOUS CALCIUM COMPLEX GREASE QUICKLY AGE HARDENED**

## MOV LONG LIFE STAYS GREASELIKE LONGER



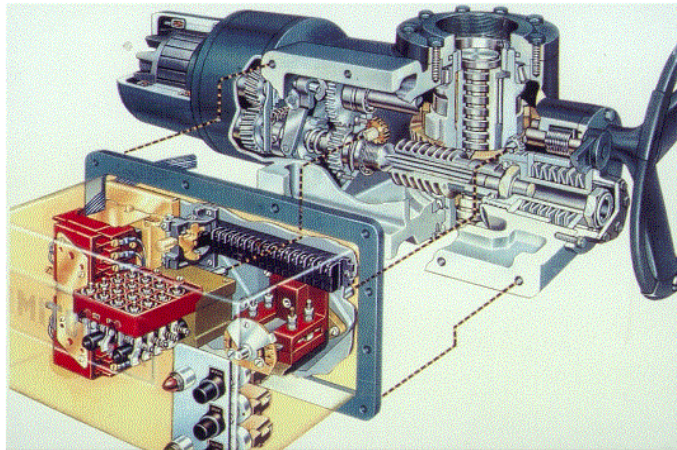
UP TO 600 HOURS AT 150°C (302°F)

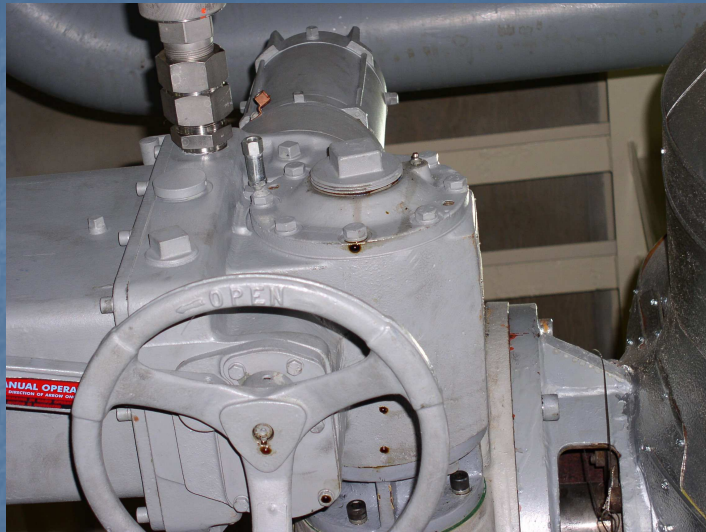
## ACTIONS

- RETESTED USING STANDARD ASTM OIL SEPARATION TEST. **OK**
- RAN OTHER ASTM OIL TESTS. **OK**
- RAN IP OIL SEPARATION. **OK**
- CONTACTED OTHER USERS, OVERHAUL SHOPS AND OEM. **OK**
- EXAMINED NONGREASE ISSUES. **YES**



- THE BASE OIL IS LESS DENSE THAN THE THICKENER SO IT WILL RISE TO THE SURFACE OF THE GREASE.
- FOR THE BASE OIL TO LEAK REQUIRES A PATH. THIS CAN BE A SEAL, GASKET OR PLUG.





## BASEOIL CONTENT

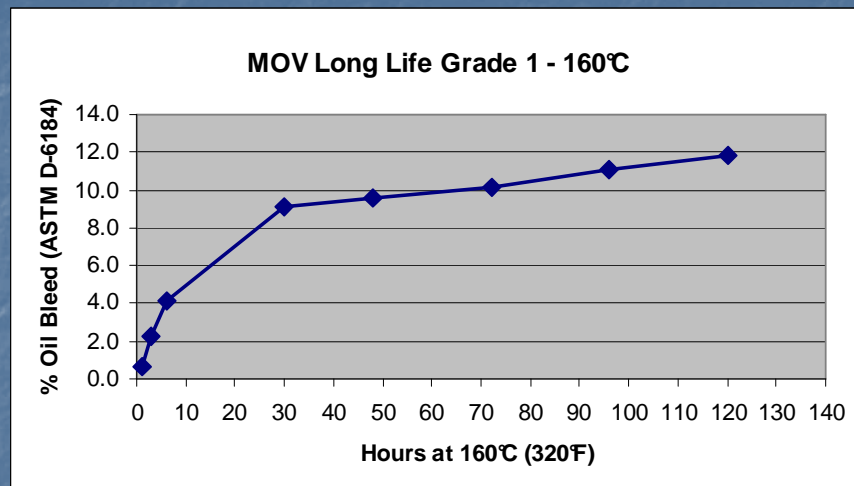
MOV LONG LIFE	
GRADE	% OIL
0	80
1	75
2	70

## ASTM D-6184 OIL SEPARATION

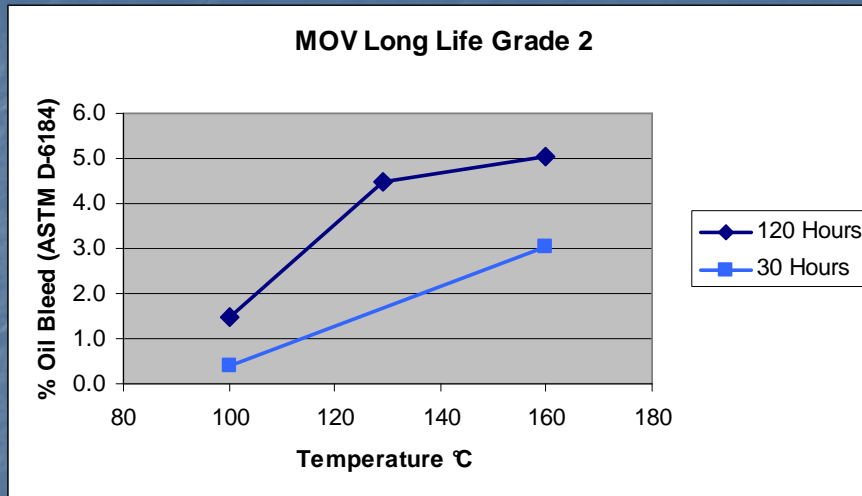


## BLEED AND EVAPORATION @ 150°C (EPRI)

	<i>Bleed 6 Hours</i>	<i>Bleed 25 Hours</i>	<i>Evap 6 Hours</i>	<i>Evap 24 Hours</i>
<b>MOV LL1</b>	4.69	7.44	0.41	1.54
<b>MOV LL2</b>	1.41	3.27	0.51	1.05







## THREADED PLUGS

- "AS OF TODAY WE DON'T HAVE ANY SEALANT RECOMMENDED FOR THE ACTUATOR GREASE PORTS."

**SOLUTION: USE A SEALANT**



## **GASKETS**

- **THE GASKETS TYPICALLY BEING USED ARE KLINGER C-4401 AND GARLOCK 2900.**
- **EXPANDED PTFE HAS ALSO BEEN USED AND AT ONE STATION THIS ELIMINATED THE OIL SEEPAGE WITH NEBULA EP.**
- **"ALL SMB ACTUATOR GASKETS AND SEALS ARE CONSIDERED NON-CRITICAL", UPDATE 92-1 ITEM 1.**

## **THE PROBLEM**

**THESE GASKETS CAN REPORTEDLY SEAL 100% OIL UP TO 1000 PSI SO WHAT CAUSES SEEPAGE?**

- **INSTALLATION PRACTICES**
- **INADEQUATE COMPRESSION**

## **GASKETS**

- **GASKETS ARE TESTED FOR SEALABILITY (ASTM F-37B) AND THEY ARE NOT 100% - AT 10 PSI THERE IS 0.25 ML/HR LEAKAGE.**
- **PLUS, THEY RELAX (ASTM F38B) 7-25% AFTER 22 HOURS AT 100°C.**

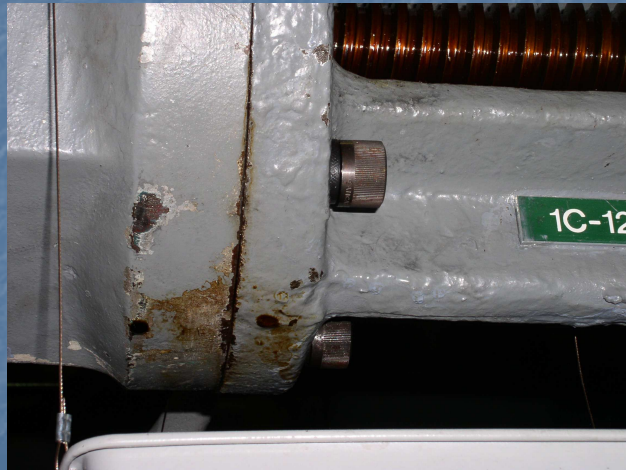
**SOLUTION: USE BETTER GASKETS**

## **GASKET INSTALLATION**

- **"THIS IS VERY BAD FOR THE GASKET. THE GASKET WILL SWELL." "I REPEAT IT IS OF UTMOST IMPORTANCE TO NOT USE ANY GREASE IN THE APPLICATION."**

**SOLUTION: DO NOT USE GREASE ON THE GASKETS**

## GASKET PINCHING

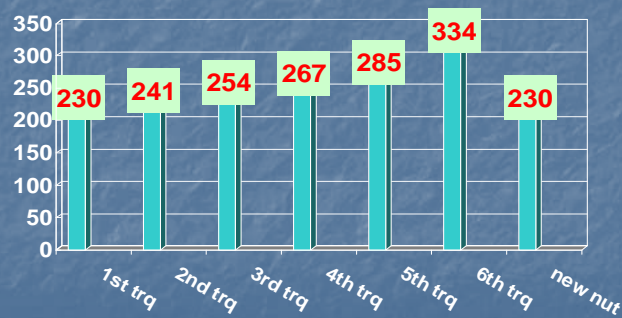


## FASTENER TORQUE

- "THERE ARE NO PROCEDURAL TORQUE REQUIREMENTS FOR ACTUATOR BOLTING OTHER THAN THE ACTUATOR TO YOKE."
- "TORQUING IS PERFORMED BY GOOD MAINTENANCE PRACTICE."

## Nut Re-use Example

230 Ft-lb. Required to Achieve A Bolt Load 18,440 lb.  
 $k = 0.2$       3/4"-10 Grade 5 Hex Head Bolt



## GASKET COMPRESSION FACTORS

1. THREADS (DAMAGE, NICKS, WORN)
2. FASTENER GRADE AND QUALITY
3. CONDITION OF HOUSING THREAD
4. CONDITION OF FASTENER HEAD
5. CONDITION OF SEAT
6. PRESENCE AND CONDITION OF WASHER
7. PAST HISTORY OF FASTENER (YIELDED PREVIOUSLY?)



8. PAINT/CORROSION PRODUCTS
9. LUBRICANT/ANTI SEIZE
10. GASKET CREEP
11. TOOL SIZE
12. FITTER PHYSIQUE
13. FITTER TRAINING
14. TORQUE MEASURING AIDS
15. OTHER?

**SOLUTION: ENSURE THAT GASKET COMPRESSION IS ADEQUATE**

## EPRI GOOD BOLTING PRACTICES

**TABLE 20**  
**Nut Rotation\***

Effective Bolt Length (Distance from Inside Face of Bolt Head to Outside Face of Nut Plus One Thread)	Disposition of Outer Faces of Bolted Parts		
	Both Faces Normal to Bolt Axis	One Face Normal to Bolt Axis & Other Face Sloped Not More Than 1:20 (Bevel Washers Not Used)	Both Faces Sloped Not More Than 1:20 From Normal to Bolt Axis (Bevel Washers Not Used)
Up to and including 4 diameters	1/3 turn	1/2 turn	2/3 turn
Over 4 diameters but not exceeding 8 diameters	1/2 turn	2/3 turn	5/6 turn
Over 8 diameters but not exceeding 12 diameters	2/3 turn	5/6 turn	1 turn

\*For bolting  $\geq$  1/2 in. A325 or A490

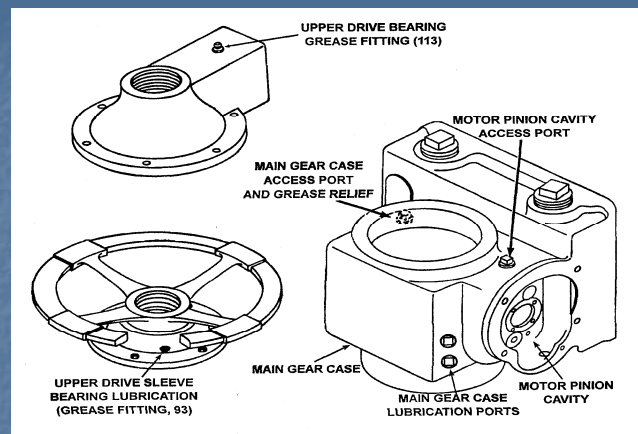
Small Bolts and Threaded Fasteners

125

## GREASE RELIEF VALVES

ENVIRONMENTALLY QUALIFIED (EQ) ACTUATORS INSTALLED IN HARSH ENVIRONMENTS (INSIDE PRIMARY CONTAINMENT OR HIGH ENERGY LINE BREAK (HELB) AREAS) SHOULD BE EQUIPPED WITH GREASE RELIEF VALVES.

REF: EPRI NP6631, R1S JUNE 1995, 10.1.3.2



**SOLUTION: USE GREASE RELIEF VALVES WHEN REQUIRED**

## GREASING

- DO NOT OVERFILL THE GEARBOXES
- DO NOT LEAVE GREASE ON THE GREASE FITTINGS
- ONLY SMEAR A BIT ON SEALS
- DO NOT PUMP INTO FITTINGS UNTIL GREASE COMES OUT OR YOU FEEL RESISTANCE

**SOLUTION: USE THE RIGHT AMOUNT OF GREASE**

## NLGI GREASE GRADES

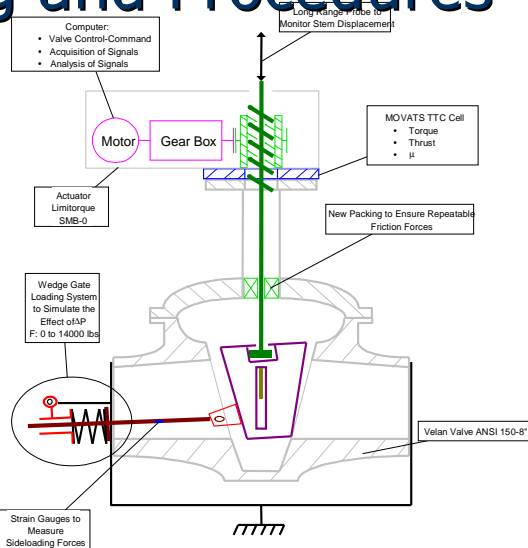
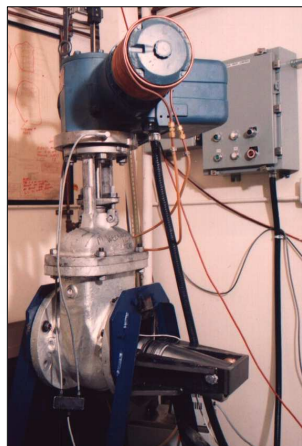
GRADE	PENETRATION
000	445-475
00	400-430
0	355-385
1	310-340
2	265-295
3	220-250
4	175-205
5	130-160
6	85-115

# Results from 2008-2009 Stem/Stem-Nut Lubrication Tests

Comparison of MOV-LL NLGI Grade 1 to NLGI  
Grade 2

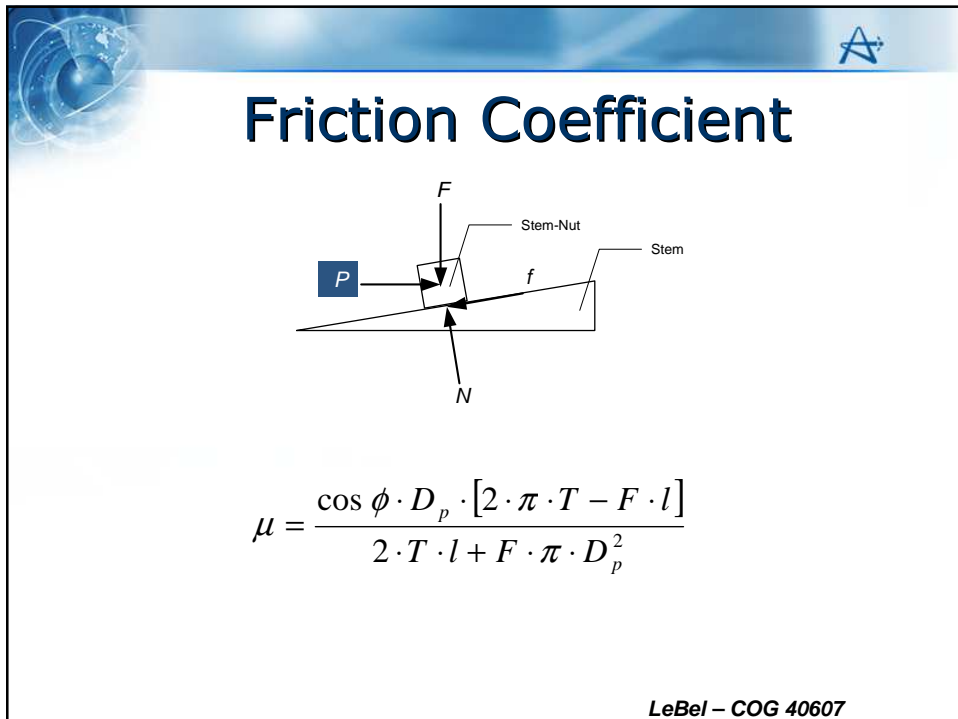
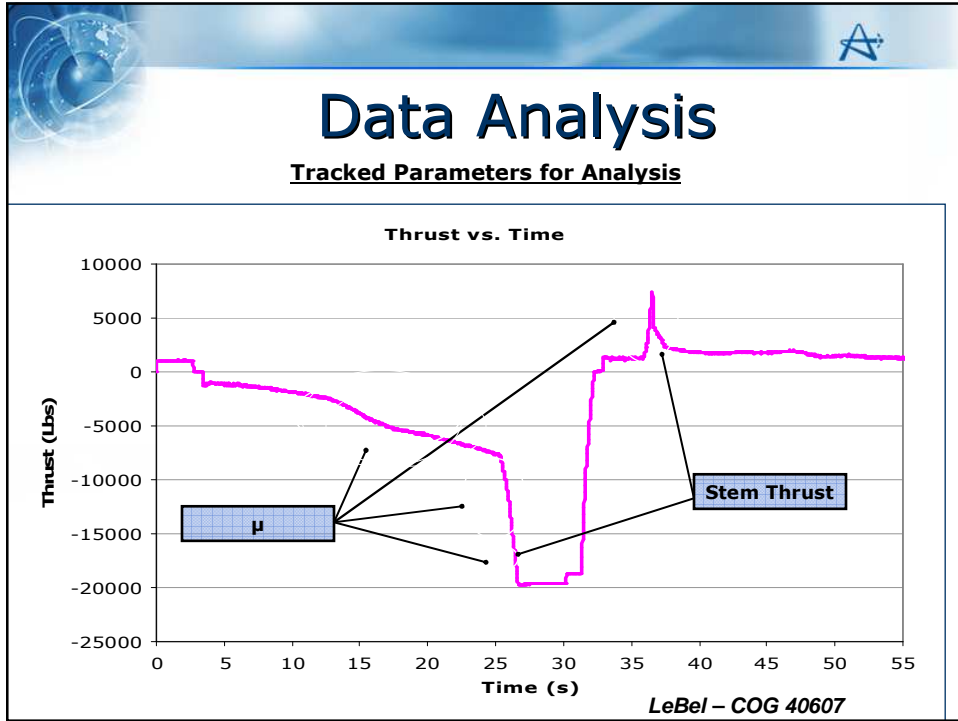
**Pierre LeBel**  
R&D Officer  
MOV Users Group Annual Meeting  
January 2009  
Chalk River  
Laboratories  
lebelp@aecl.ca

## Test Rig and Procedures



LeBel – COG 40607






MOV Long Life			
<u>Effect of Production Batch</u> Fresh Unaged Formulation, 250 Cycle Test			
	Batch #1	Batch #2	Batch #3
<b>μ at unseating peak Variation over 250 cycles</b>	0.098 0.020	0.1147 0.0050	0.1216 0.0085
<b>μ during seating Variation over 250 cycles</b>	0.113 0.005	0.111 0.0132	0.117 0.013
<b>μ during ΔP phase</b>	0.112	0.118	0.110
<b>Thrust near TST Variation over 250 cycles</b>	68 kN 3.5%	72kN 2.3%	71 kN 1.6%

LeBel – COG 40607

MOV Long Life		
<u>Effect of NLGI Grade</u> Fresh Unaged Formulation 250 Cycle Test		
	NLGI Grade 1	NLGI Grade 2
<b>μ at unseating peak Variation over 250 cycles</b>	0.1147 0.0050	0.1174 0.0076
<b>μ during seating Variation over 250 cycles</b>	0.1109 0.0132	0.1110 0.0046
<b>μ during ΔP phase</b>	0.1180	0.1104
<b>Thrust near TST Variation over 250 cycles</b>	72.0 kN 2.3%	71.6 kN 2.3%

LeBel – COG 40607




## Conclusion

- Very similar results were obtained when testing unaged MOV-LL grease samples from various production batches.
- The coefficients of friction obtained when testing unaged MOV-LL Grade 1 and unaged MOV-LL Grade 2 in the MOV test stand were similar.

## Recommendations

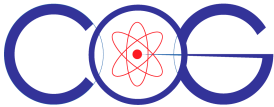
- Although the MOV-LL Grade 2 has a good rating for the 250 cycle unaged test, a standard test program that includes aged and accident condition grease should be conducted before considering interchanging MOV-LL Grade 1 and MOV-LL Grade 2 on site.

*LeBel – COG 40607*



## Funding for this R&D Project

CANDU Owners Group Inc.



*"Strength Through Co-operation"*

*LeBel – COG 40607*

## **SUMMARY**

- GREASES ARE MAINLY OIL AND SOME OIL SEPARATION OF THE GREASE IS NORMAL.
- IT IS NOT NORMAL FOR THE OIL TO BE ABLE TO LEAK EXCESSIVELY FROM THE MOV GEARBOX.
- IN MOST CASES THERE WERE EXTENUATING REASONS WHICH CAN BE EASILY CORRECTED.

## **CONCLUSIONS**

1. USE ONLY AS MUCH GREASE AS IS REQUIRED AND PROVIDE PRESSURE RELIEF WHEN GREASING.
2. FOR EQ MOV'S OR THOSE THAT MIGHT BE SUBJECTED TO RAPID TEMPERATURES INCREASES, CONSIDER GREASE PRESSURE RELIEF VALVES.



**3. DO NOT USE GREASE ON GASKETS TO HOLD THEM IN PLACE DURING INSTALLATION.**

**4. DO USE THE REQUIRED FASTENER TIGHTENING TO GET THE CORRECT GASKET COMPRESSION.**

**5. DO USE THREAD SEALANTS ON THE PLUGS.**

**6. FOR HIGH TEMPERATURE APPLICATIONS CONSIDER USING MOV LONG LIFE GRADE 2**

## HELPFUL DOCUMENTATION

'EPRI 'COMPARATIVE ANALYSIS OF NEBULA AND MOV LONG LIFE FOR LIMITORQUE MAIN GEARBOX APPLICATIONS', REPORT #1003483, DECEMBER 2002

MOV USERS' GROUP POSITION PAPER 'EQUIVALENT REPLACEMENT EVALUATION FOR MOV GEARBOX LUBRICANT', E. CAVEY, MUG FILE 02G-J01, MAY 2002

INEEL 'MOV STEM LUBRICANT AGING RESEARCH', K. DEWALL & J. WATKINS, INEEL/EXT – 02-00975, SEP 02. SEE ALSO MUG FILE 03J-P21, HANDOUTS JAN 2003

'RATE OF LOADING', F. BENSINGER (FLOWSERVE), MUG FILE 03J-P07, HANDOUTS JAN 2003

'ALL-IN-ONE, AN UPDATE ON MOV LONG LIFE', K. BROWN ET AL, MUG FILE 03J-P04, HANDOUTS JAN 2003

'MOV LONG LIFE LIMITSWITCH APPLICATIONS, K. BROWN ET AL, MUG FILE 04J-P07 & P11, JAN 2004

MOV LONG LIFE CONDITION MONIITORING, K, BROWN ET AL, JAN 2005

# THANK YOU