Q. Re page B-7: provide a maintenance history for the system in question identifying the numerous incidents of fouling and leaking piping and copies of the reports on the three most recent preventive maintenance inspections.

A. Maintenance history on generator cooling water system for surface air coolers:

Unit #1
1992 – Installation of one surface air cooler.
94/01/11 – Surface air cooler discharge valve (south) leaking around stem.
1995 – Replaced section of cooling water piping.
1996 – Cleaned all four surface air coolers and associated piping.
96/06/12 – Repaired leak in cooling water discharge line.
96/12/30 – Surface air cooler discharge valve #12 leaking around stem.
97/11/26 – Cooling water isolating valve #20 will not close fully.
1999 – Retubed one surface air cooler.

Unit #2
1987 – Replaced section of cooling water piping.
1992 – Retubed one surface air cooler.
94/02/09 – Conduct inspection of cooling water piping.
1996 – Cleaned supply and discharge surface air cooler piping.
96/02/13 – Check cooling water flows across orifice.

Attached are copies of the two most recent preventive maintenance inspections for each unit. The surface air cooler leak inspections are visual

and reporting is done in a non-formal way by means of verbal communication.

The preventive maintenance inspection reports show that the surface air cooler flow rates for both the North and South headers are below the normal required flow rate, 1100 lpm.

Corrosion of the surface air cooler piping is the major concern on these systems. The surface air cooler piping system is designed to use a Victaulic coupling system for ease of removal, installation, and inspection of the piping. The condition of the pipe ends and fittings is critical when using a Victaulic coupling system to ensure a good seal.

The corrosion within the 4-inch schedule 40 surface air cooler piping is approximately 0.080 – 0.110 inches deep. The 4-inch schedule 40 pipe has a wall thickness of 0.237-inch with Victaulic end cut grooves that are between 0.080 – 0.100 inches deep. The minimum pipe wall thickness in these Victaulic end cut grooves is 0.137-inch when the pipe was new. Given a maximum corrosion depth of 0.110-inch inside the pipe leaves only 0.027-inch pipe wall at the Victaulic end cut groove. In addition there is extensive pipe end corrosion that makes it difficult to ensure a leak free seal. Each unit has approximately 120 cut groove Victaulic end connections on the surface air cooling water system.

The average fouling thickness is measured to be around 1/4-inch, this can be seen in picture 4 on a section of 2-inch schedule 40 pipe. This amount of fouling reduces the flow rate through this pipe by approximately 45%.

Below are pictures of the pipe that show the typical state of corrosion that can be found throughout this 40 year old cooling water system.

Picture 1

A fouled 4-inch section of surface air cooler piping, removed from service this year due to severe corrosion. Picture taken August 2006.

Picture 2

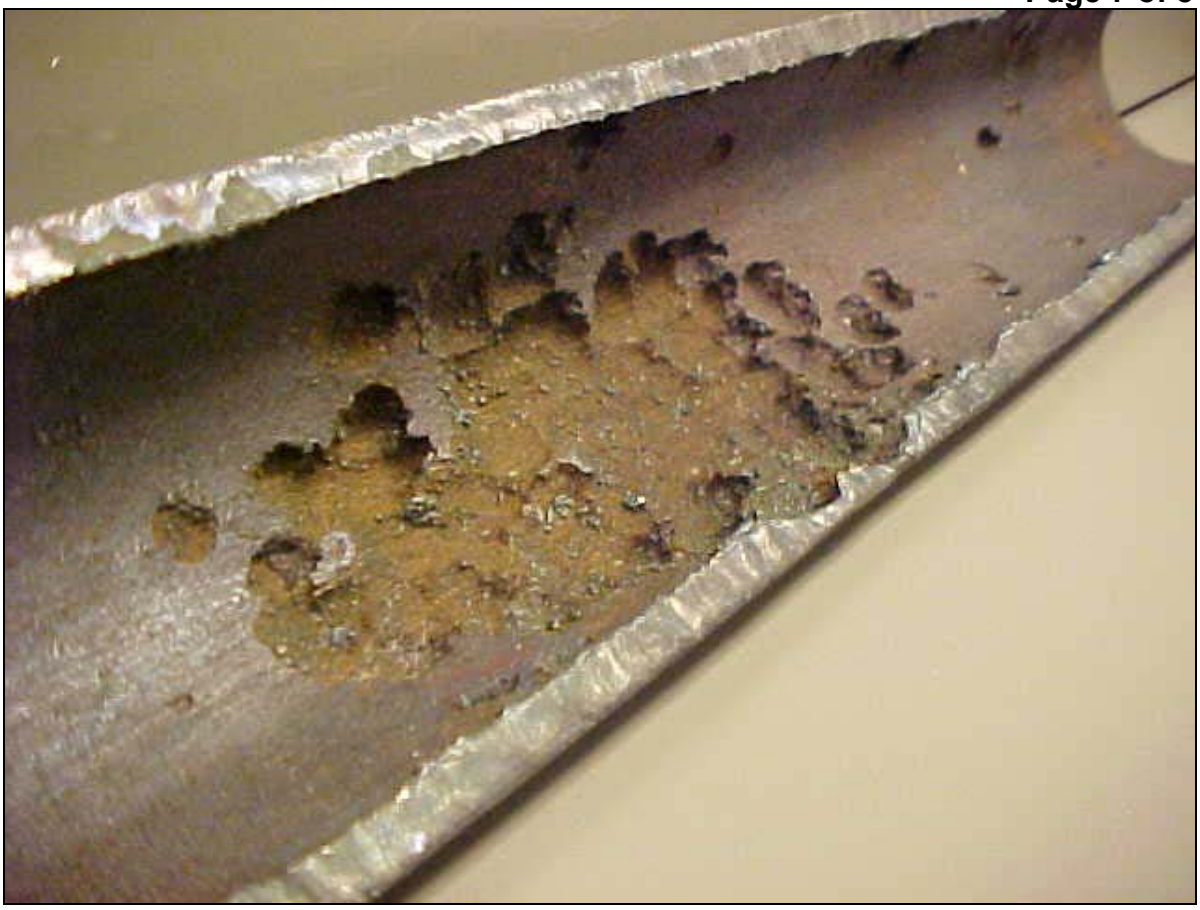
This is the same 4-inch section of pipe as in picture #1 after it has been cleaned. The corrosion pitting is on the order of 0.080-0.110 inch deep. Picture taken August 2006.

Picture 3

This is the same 4-inch section of pipe as in picture #2, showing the amount of corrosion on the end. Picture taken August 2006.

Picture 4

This is a typical section of 2 inch cooling water pipe that shows the amount of fouling present and the severity of localized corrosion after the pipe was cleaned. Picture taken August 2006.



Picture 5

This is the same section of 2-inch cooling water pipe shown in picture #4, showing how deep the localized corrosion has gone, resulting in over 90% wall loss. Picture taken August 2006.

Picture 6

This is the same section of 2-inch cooling water pipe as in picture #5, showing how deep the corrosion penetrates the wall. Picture taken August 2006.

NEWFOUNDLAND & LABRADOR HYDRO
HYDRO GENERATION
PREVENTIVE MAINTENANCE CHECKSHEETS

Sheet: 1 of 2
Rev. No.: 4
Rev. Date: 01-03-15
Index No. 849 Binder #5

PM Checksheet No. : PM6-58748-MBDE
Item No. & Description: 58748 - Generator - Unit No. 1 - BDE
Type of Inspection: PM6
Department: Mechanical
Asset Approval: Fred Burden
Inspection Start Date:
Insp. Comp. Date:
Supervisor's Review Signature & Date:
Planner's Review Signature & Date:
Reference Drawing and Manuals:

RKmg
apR-26/04.

B Judge 2004/04/26

ACTIVITIES (Initial Box Upon Completion)		REMARKS
CRITICAL PARTS INSPECTION		
1. Generator Brakes		
Responsibility - Mechanical Maintenance "A"		
a) Check brake pads thickness and record: _____ Minimum wear surface is ¼".	(EO)	½"
b) Check brake pads for cracks. Report to supervisor immediately if pads need replacement.	(EO)	
c) Check brake track for excessive scouring or warpage.	(EO)	
d) Check spring retaining nuts for looseness, missing set screws. Re-torque.	(EO)	
e) Grease brake cylinders. Check for excessive leakage.	(EO)	
f) Check air pipes for leaks.	(EO)	
g) If unit shut down in excess of 48 hours, jack unit.	(EO WG)	
2. Guide Bearing		
Responsibility - Mechanical Maintenance "A"		
a) Check calibration of oil level system with P&C.	(RW)	
b) Clean external bearing assembly. Check for leaks, loose bolts.	(EO)	
c) Check water inlet to bearing coolers for leaks.	(EO)	
d) Clean orifice on generator cooling water Rosemount Transducer.	(EO)	
e) Check Rosemount in Control Room or T/G panel. Record: Normal 454 LPM Actual 640 LPM	(EO)	

JDE Item No & Descriptoin: 58748 - Generator - Unit No. 1 - BDE Type of Inspection: PM6 Department: Mechanical	Sheet 2 of 2 Rev. #: 4 Rev. Date: 01-03-15 Index No.: 849 Binder #5
ACTIVITIES (Initial Box Upon Completion)	**REMARKS**

ROUTINE PM INSPECTION

1. Check SAC for leaks. (EO)
2. Clean orifices on coolers - North & South. (EO)
3. Check Rosemount in Control Room. (EO)

   Record North SAC:

   Normal 1100 LPM Actual 970 LPM

   Record South SAC:

   Normal 1100 LPM Actual 996 LPM
4. Take oil sample and forward to Engineering for analysis. (EO)

NEWFOUNDLAND & LABRADOR HYDRO
HYDRO GENERATION
PREVENTIVE MAINTENANCE CHECKSHEETS

Sheet: 1 of 2
Rev. No.: 4
Rev. Date: 01-03-15
Index No. 849 Binder #5

PM Checksheet No. : PM6-58748-MBDE
Item No. & Description: 58748 - Generator - Unit No. 1 - BDE
Type of Inspection: PM6
Department: Mechanical Asset Approval: Fred Burden
Inspection Start Date: 2005/03/21 R EVANS S ORLAN Insp. Comp. Date: 2005/04/01
Supervisor's Review Signature & Date: Planner 05/04/05 Planner's Review Signature & Date: RKmq 05/04/11
Reference Drawing and Manuals:

ACTIVITIES (Initial Box Upon Completion)	REMARKS
CRITICAL PARTS INSPECTION	
1. Generator Brakes	
Responsibility - Mechanical Maintenance "A"	
a) Check brake pads thickness and record: _____ Minimum wear surface is ¼". R.E (B.L)	Good
b) Check brake pads for cracks. Report to supervisor immediately if pads need replacement. R.E (BO)	changed one set of pads on Axis 2. 2005-03-28
c) Check brake track for excessive scouring or warpage. R.E (B.L)	Good
d) Check spring retaining nuts for looseness, missing set screws. Re-torque. R.E (B.L)	Good
e) Grease brake cylinders. Check for excessive leakage. R.E (B.L)	Greased - 2005-03-24
f) Check air pipes for leaks. R.E (B.L)	Good
g) If unit shut down in excess of 48 hours, jack unit. (R.W BF)	
2. Guide Bearing	
Responsibility - Mechanical Maintenance "A"	
a) Check calibration of oil level system with P&C. (R.W BF)	
b) Clean external bearing assembly. Check for leaks, loose bolts. E.O (B.F)	2005-03-23
c) Check water inlet to bearing coolers for leaks. R.W E.O B.(F)	2005-03-23
d) Clean orifice on generator cooling water Rosemount Transducer. (K.M SO)	
e) Check Rosemount in Control Room or T/G panel. Record: Normal 454 LPM Actual 601 (K.M SO)	

JDE Item No & Descriptoin: 58748 - Generator - Unit No. 1 - BDE Type of Inspection: PM6 Department: Mechanical	Sheet 2 of 2 Rev. #: 4 Rev. Date: 01-03-15 Index No.: 849 Binder #5
ACTIVITIES (Initial Box Upon Completion)	**REMARKS**

ROUTINE PM INSPECTION

1. **Check SAC for leaks.** (KM 50)
2. **Clean orifices on coolers - North & South.** (KM 50)
3. **Check Rosemount in Control Room.** (KM 50)

Record North SAC:

Normal 1100 LPM **Actual** 903

Record South SAC:

Normal 1100 LPM **Actual** 620

4. **Take oil sample and forward to Engineering for analysis.** N.E (BL) — 2005-02-24

NEWFOUNDLAND & LABRADOR HYDRO
HYDRO GENERATION
PREVENTIVE MAINTENANCE CHECKSHEETS

Sheet: 1 of 2
Rev. No.: 4
Rev. Date: 01-03-15
Index No. 850 Binder #5

PM Checksheet No. : PM6-58613-MBDE
Item No. & Description: 58613 - Generator - Unit No. 2 - BDE
Type of Inspection: PM6
Department: Mechanical Asset Approval: Fred Burden
Inspection Start Date: Insp. Comp. Date:
Supervisor's Review Signature & Date: Planner's Review Signature & Date:
Reference Drawing and Manuals: 2004/05/04

R King May 10/04.
Con Organ 04/05/04

ACTIVITIES (Initial Box Upon Completion)	REMARKS
CRITICAL PARTS INSPECTION	
1. Generator Brakes	
Responsibility - Mechanical Maintenance "A"	
a) Check brake pads thickness and record: _____ Minimum wear surface is ¼". (KM WC)	5/8" - 3/4"
b) Check brake pads for cracks. Report to supervisor immediately if pads need replacement. (KM WC)	
c) Check brake track for excessive scouring or warpage. (KM WC)	
d) Check spring retaining nuts for looseness, missing set screws. Re-torque. (KM WC)	
e) Grease brake cylinders. Check for excessive leakage. (KM WC)	
f) Check air pipes for leaks. (KM WC)	
g) If unit shut down in excess of 48 hours, jack unit. (RW BF)	
2. Guide Bearing	
Responsibility - Mechanical Maintenance "A"	
a) Check calibration of oil level system with P&C. (KM)	
b) Clean external bearing assembly. Check for leaks, loose bolts. (KM WC)	
c) Check water inlet to bearing coolers for leaks. (KM WC)	
d) Clean orifice on generator cooling water Rosemount Transducer. (KM WC)	
e) Check Rosemount in Control Room or T/G panel. Record: Normal 454 LPM Actual 709 (KM WC)	

JDE Item No. & Description: 58613 - Generator - Unit No. 2 - BDE Type of Inspection: PM6 Department: Mechanical	Sheet 2 of 2 Rev. #: 4 Rev. Date: 01-03-15 Index No.: 850 Binder #5
ACTIVITIES (Initial Box Upon Completion)	**REMARKS**

ROUTINE PM INSPECTION

1. Check SAC for leaks. (KM WC)
2. Clean orifices on coolers - North & South. (KM WC)
3. Check Rosemount in Control Room. (KM WC)

   Record North SAC:

   Normal 1100 LPM Actual — 1022 LPM

   Record South SAC:

   Normal 1100 LPM Actual — 1000 LPM
4. Take oil sample and forward to Engineering for analysis. (KM WC)

NEWFOUNDLAND & LABRADOR HYDRO
HYDRO GENERATION
PREVENTIVE MAINTENANCE CHECKSHEETS

Sheet: 1 of 2
Rev. No.: 4
Rev. Date: 01-03-15
Index No. 850 Binder #5

PM Checksheet No. : PM6-58613-MBDE
Item No. & Description: 58613 - Generator - Unit No. 2 - BDE
Type of Inspection: PM6
Department: Mechanical
Asset Approval: Fred Burden
Inspection Start Date:
Insp. Comp. Date:
Supervisor's Review Signature & Date: R King 05/05/13.
Planner's Review Signature & Date: R Skinner 05/05/03
2005/04/18

ACTIVITIES (Initial Box Upon Completion)	REMARKS
CRITICAL PARTS INSPECTION	
1. Generator Brakes	
Responsibility - Mechanical Maintenance "A"	
a) Check brake pads thickness and record: 5/16 Minimum wear surface is ¼". (BF AO EO BL)	
b) Check brake pads for cracks. Report to supervisor immediately if pads need replacement. (BF AO EO BL)	
c) Check brake track for excessive scouring or warpage. (BF AO EO BL)	
d) Check spring retaining nuts for looseness, missing set screws. Re-torque. (BF AO EO BL)	
e) Grease brake cylinders. Check for excessive leakage. (BF AO EO BL)	
f) Check air pipes for leaks. (BF AO EO BL)	
g) If unit shut down in excess of 48 hours, jack unit. (KM AL)	Unit Jacked
2. Guide Bearing	
Responsibility - Mechanical Maintenance "A"	
a) Check calibration of oil level system with P&C. (BF SO)	
b) Clean external bearing assembly. Check for leaks, loose bolts. (AO EO)	
c) Check water inlet to bearing coolers for leaks. (BF AO EO BL)	
d) Clean orifice on generator cooling water Rosemount Transducer. (AO EO)	
e) Check Rosemount in Control Room or T/G panel. Record: Normal 454 LPM Actual _____ (BF)	657 LPM

JDE Item No. & Description: 58613 - Generator - Unit No. 2 - BDE Type of Inspection: PM6 Department: Mechanical	Sheet 2 of 2 Rev. #: 4 Rev. Date: 01-03-15 Index No.: 850 Binder #5

ACTIVITIES (Initial Box Upon Completion)	REMARKS

ROUTINE PM INSPECTION

1. **Check SAC for leaks.** (50 B.L.)
2. **Clean orifices on coolers - North & South.** (S.O. B.L.)
3. **Check Rosemount in Control Room.** (S.O. B.L.)

   Record North SAC:

   Normal 1100 LPM Actual 997

   Record South SAC:

   Normal 1100 LPM Actual 855

4. **Take oil sample and forward to Engineering for analysis.** (EO AO)