BNGS B
VALVE PACKING PROGRAM

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ABSTRACT

The Bruce B Valve Packing Program began in 1987. The early history and development were presented at the 1992 International Candu Maintenance Conference.

This presentation covers the evolution of the Bruce B Valve Packing Program over the period 1992 to 1995.

HISTORY 1992-1995

By 1992 the program had started to change, with Bruce B doing about 70% preventative maintenance and 30% corrective maintenance.

During this time Bruce B changed to composite graphite sets. A 3 year project to repack all steam heating system valves with graphite/yarn rings was undertaken by the Central Maintenance Facility, (CMF). An exception to this was the reheat boundary isolation valves that were repacked with composite/graphite sets and live-loaded. The repacking of the building and heating steam systems continued between planned outages and by now the preventative to corrective maintenance percentage ratio had further improved to 80/20.

1993 saw a new valve data base developed by Ontario Hydro's Integrated Systems Department (ISD) that by now included a schematic of the packing arrangement. The Air Operated Valve (AOV) program was initiated to address the AOV packing problems directly influenced by AOV components, mainly actuator size. It was considered that the three equipment maintenance programs, specifically those for AOVs, Motor Operated Valves (MOV) and Valve Packing would interact to improve overall valve reliability in the station. This close working relationship would be coordinated by the Maintenance Support Department.

Throughout this period the Integrated Valve Actuator Program (IVAP) packing working group, has continued to work closely with Atomic Energy of Canada Limited, Chalk River Laboratories (AECL-CRL) and Ontario Hydro's Nuclear Systems Services (NSS)-Equipment and Systems Engineering Department in further development, testing and documentation of improvements in graphite packing configurations.

There has been continued development and improvement of the valve packing database. It forms a central part of the station valve packing program and is constantly undergoing development and improvement.

As previously found in 1991 a peer evaluation in October,1994 again found the valve packing program a significant strength in that it had become a mature program and has been effective in minimizing leaks throughout the station.

A Liberty Technologies Packing 'Nforcer was purchased early in 1995 to perform valve packing diagnostics. A strain gauge measurement is taken on the stem and then converted to give an indication of stem friction using a PC software program. This device has been used as a diagnostic tool on ECI MV's in Unit 6, and on ECI and Maintenance Cooling MV's in Unit 8. These MV's are presently packed with the original asbestos type packing. The Unit 6 results varied from 4000 lbF to 9000 lbF while Unit 8 was from 3900 lbF to 9500 lbF. The expected friction during initial installation for asbestos packing was calculated to be in the range of 9000 lbF to 11,000 lbF. The diagnostics are being performed on the ECI and Maintenance Cooling Valves to determine which MV's have the lowest packing load so that they can be targeted for replacement during future planned outages.

In 1991 Unit 7 Maintenance Cooling MV1 had a cracked leakoff line to collection. The resulting investigation determined that the root cause for the failure of the stainless steel leakoff line was stress corrosion cracking. This was directly related to the leachable chlorides present in the asbestos packing material. As a direct result of this event it was recommended that Bruce B develop a program to replace the asbestos packing in all valves containing John Crane 1871 to prevent a similar occurrence elsewhere.

During the period May to June 1995, Units 5, 6 and 7 feed bleed and relief system Control Valves (CV's) (Fisher Model 667 DBQ, 2", 1500lb.) were repacked using a new graphite packing configuration to prevent a known side loading problem caused by the actuator spring. Engineering Services performed an actuator sizing review that allowed the use of a lighter actuator spring. This was subsequently installed and indications are that the previous side loading problem has been lessened to the point where it is no longer significant. Note: Refer to Figure #1 for valve data sheet on the fisher valve.

The Unit 6 spring outage in 1995 seen the introduction of a new graphite configuration for AOV's. This configuration was a sandwich style reduced height set installed in four Leslie AOV's (Leslie Model DDBOYSX, Size 3", 600lb.)

The configuration included the following components from top to bottom of the stuffing box (graphite washer, graphite bushing, composite end ring 0.250", solid graphite ring 0.125", composite ring 0.250", solid graphite ring 0.125",composite ring 0.250", graphite bushing, graphite washer, junk ring 0.1875"). The configuration was live loaded and operability was subsequently assured using Fisher flowscanning test equipment. To date this style has performed well with no leakage.

The unit 8 fall outage in 1995 has seen the further introduction of sandwich style configurations incorporating thin Teflon wafers between the rings of packing. This style is being used in six Copes Vulcan valves (Copes Vulcan model's CV600 3" 300lb and 3" 400lb) which have exhibited operability problems with traditional graphite packing configurations. Another example is a Fisher valve (Fisher model EWD 12" x 8 " 600lb) which traditionally leaked shortly after repacking with the OEM Teflon chevron type packing. Actuator sizing has been completed prior to installing any new packing configurations to ensure valve operability and satisfy original design requirements.

Note: Refer to Figures #2 and #3 for valve data sheets on the leslie and copes vulcan valves.

1995 has seen Bruce B begin retorquing valves in Units 6 and 8. These valves had been repacked with graphite materials and inservice for 5 years or more. The valve data base was used to identify these valves. The strategy used during this exercise was to document the as found torque value and then retorque to desired value.

The reason for retorquing as outage prerequisites was to identify possible additions to outage scope if problems were identified during the retorques. So far there have been no problems. There has been some resistance to the retorque program based on past station experience that the gland nuts would be corroded to the point that torquing would not produce any results. The returned data sheets and interaction that I have had with maintenance personnel performing the retorques indicated a large number of valves with low as found gland torque, which were then subsequently retorqued to a desired value without any problems relating to seized or corroded gland nuts.

BRUCE B VALVE PACKING PROGRAM STRATEGY

This packing program consists of a number of essential elements that include the following;

- Training/Procedures/Instructions
- Technical Support
- Packing Materials/Availability
- Valve Database/Configuration Management

Training/Procedures/Instructions

Training Mechanical Maintainers in correct installation methods and evaluating valve component condition is essential. It is also very important that all groups involved such as engineering support, planning, and outage management have a clear understanding of the goals of the packing program.

Having current procedures and instructions available for mechanical maintenance personnel to follow during inspection and installation will ensure that correct packing configuration is installed and a high quality job done.

Technical Support

Each facility that has a successful packing program has one common factor; a person dedicated to coordinate the program, provide direction and technical assistance. This technical support interfaces with the maintenance staff and assists in preparing for outage and operating work. To remain successful, facilities must invest resources so that technical support personnel stay current with respect to industry advancement and with issues surrounding packing technology.

Packing Materials

No program will function unless the correct packing materials are available in the required quantities when needed. Known packing sizes are typically stocked in small quantities in stores while the significantly larger outage related packing requirements are ordered just prior to shutdown. Individual valves or valve families are updated in the spare parts system with the appropriate packing materials. Purchase of graphite packing material must meet Ontario Hydro Specification M724 which has been developed exclusively to cover the procurement needs of graphite valve stem packing materials and associated components. This specification quantifies acceptance criteria with regards to chemical composition, dimensions and tolerances, documentation, packaging, quality assurance and qualification testing.

Database

A key component of the valve packing program has been the development and implementation of a computerized database to provide information such as packing material, configuration, required gland torque, dimensions etc. The valve packing database is also used to trend packing performance and identify materials required for like or similar valves.

Asbestos Replacement

Asbestos packing has been shown to have limited life and becomes very compacted with age, losing its ability to seal. Asbestos is also a hazardous material and is not recommended for continued and repeatable use in Ontario Hydro.

Asbestos packing will be replaced in the station under two initiatives:

I) CM - Corrective Maintenance
II) PM - Preventative Maintenance

The corrective approach will be to repack when the valves start to leak while the preventative strategy is to replace packing before they become leakers. Also, repacking will be governed to some extent by the knowledge that certain makes, models and types of valves have been identified as leakers due to their past operating and maintenance history.

Nuclear System Valves

The intent is to use the Liberty Technologies Packing 'Nforcer to perform diagnostics on safety related valves and so prioritize packing replacement. Graphite packing is the recommended replacement for asbestos in nuclear system valves.

Packing configurations and material recommendations will be supplied by Maintenance Support with approval from Engineering Services via the Responsible System Supervisor (RSS).

Equipment Spare Parts (ESP) and Material Management System (MMS) will be updated as required, the recommendation for packing spares being the responsibility of Maintenance Support. The RSS in turn will approve and pass this information on to the Spare Parts Task Force, (SPTF), for implementation.

Conventional System Valves

In most cases asbestos packing will be replaced with Graphite materials. In configurations that use Teflon packing, these materials will continue to be used in existing applications (mostly AOV s), but if this material is not performing satisfactorily a replacement graphite configuration will be proposed and an actuator sizing review undertaken to confirm the operability of the valve prior to the change being made.

The packing configuration and material recommendations will be made by Maintenance Support with approval from the RSS.

ESP and MMS to be updated with recommendations from Maintenance Support followed by approval from the RSS who will then pass on the information to the SPTF for implementation.

Configuration Management

The Bruce B Valve Packing Database will provide the configuration management tool for all valve packing changes.

IMPLEMENTATION ISSUES FOR THE PACKING PROGRAM

Training

A half day training class with actual valves for 'hands on' training will be scheduled on an as needed basis to keep Maintenance personnel updated with respect to packing changes and developments. An information class is proposed for engineering support staff, control technicians, spare parts task force, stores personnel or any other group potentially involved in valve packing.

Repack Scope

A strong effort will be made to identify leaking valves in both the nuclear and conventional systems prior to all planned outages. Valves that are 'leakers' or have had a poor history of packing leakage will be scheduled for repacking. A preventative repacking program will be implemented where groups of valves in high pressure and temperature systems will be identified for potential repacking.

Outage Preparation

In preparation for outages, planning, accurate data collection and regard to the required materials being available in the quantities needed is essential. Conventional system valves will be field surveyed months prior to shutdowns while the station is in operation. Most of the needed packing data can be collected during these walkdowns and a data sheet can be updated or created. Required packing materials will then be ordered at this time reducing the need for rush orders and potential delays. Because many nuclear valves cannot be accessed during station operation, it is necessary to use supplementary means to identify packing requirements prior to shutdown. Information on the drawings or the previous work history will identify many of the required dimensions needed to correctly order valve packing. Also, our current packing supplier has provided packing to other stations that have identical valves. Information from these other stations or from the valve manufacturer is often used to identify the needed packing materials.

Database

The data base is only as valuable as the information it contains. It must be constantly updated with information and verified, as the work is completed in the station.

EXPECTED BENEFITS OF THIS PACKING PROGRAM

It is not necessary to look far to get a view of the benefits from a quality graphite packing program. Since Bruce B implemented a graphite based packing program in 1988 there have been over 5,000 valves repacked. Leaks have essentially ceased and valves that were repacked every planned outage have not been re-worked in over six years. Similarly, stations such as Susquehanna and Quad Cities have repacked large numbers of valves using trained personnel, quality materials, and detailed data sheets with great success. These stations now treat packing leakage as the exception rather than the rule.

The benefits from these activities are:

- leakage reduced or eliminated
- packing life extended
- heat rate improved on conventional system valves
- slipping and burn hazards eliminated
- plant appearance improved
- leak sealing eliminated
- reduce/eliminate steam impingement damage to actuators

FUTURE STATION IMPROVEMENTS

Water Sealed Valves

It is our intention to replace all water sealed double packed valves with a single graphite packing arrangement. This is based on research work detailed in the report, COG-94-326 "Vacuum Leakage Studies".

Drain Valve Replacement

A proposal dating from 1989 requires that all drain and vent valves 2" and below on conventional steam and feedwater systems that have packing leaks be replaced with bellows sealed valves. In view of the significant improvements in packing and the extended life of currently available packing this is no longer a cost effective approach and so should be reviewed on a case by case basis. In 1989 this bellows sealed option may have been viable but that was before the use of the high quality graphite type packing that we have in use today.

A suitable alternative to this approach is to use a good quality bolted bonnet valve repacked with graphite packing. It has been demonstrated by AECL testing that a valve repacked with graphite should be leak free for the remaining life of the station.

Summary

The valve packing program is constantly evolving. It requires full time attention at Bruce 'B'. Valve packing is not low grade technology, the philosophy that we have done it this way for the last 20 years no longer applies in the 1990's and will only lead to many more problems in the near future.

The valve packing program has been in existence for 8 years at Bruce 'B' and it has taken 8 years to get to a leak free station. We currently have more than 5,000 valves repacked with at least 15,000 to go and probably more if we are to achieve an asbestos free station as well as remain leakfree.

It takes one person full time to drive the program with a lot of support from the other resource groups.

Report Date : 06-Oct-1995

Unit : 8 USI : 33320 Equip Code/No : CV5

USI Description : **PHT BLEED & RELIEF CCT**

Op. Temperature : **(B)** Op. Pressure : **(B)**

Room No :
Elevation : **630**
Column : **8H10**

Scaffold (Y/N) : **N**
Last Update : **Aug-08-1995**
Flowsheet/Grid : **NK29-FXX-33300-0001;B3**

VALVE INFORMATION

Material Code : **543N8954**

Manufacturer : **FISHER**

Model : **667 DBQ**

Size : **2 in.**

ANSI Rating : **1500**

Seat Held By : **CAGE**

Bellow Seal (Y/N) : **N**

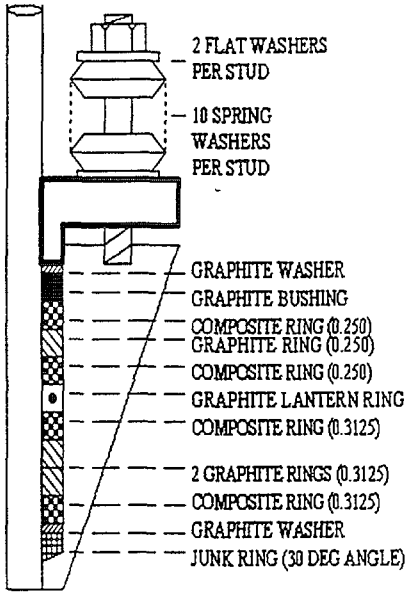
Valve Type :

Stroked 5 X (Y/N) :

Packed By :

Bonnet Bolt Torque : **ft-lbs**

Figure No.: **VALVE897.BMP**



NOTE : **IF THERE IS A "JUNK" RING PRESENT, REINSTALL RING WITH NEW PACKING.**

PACKING INFORMATION

Stem Diameter : **0.750 in.**

Gland Diameter : **1.375 in.**

Gland Depth : **4.188 in.**

Leakoff Port Depth : **2.688 in.**

Leakoff inside Dia. : **0.125 in.**

Stud Diameter : **0.563 in.**

Number of Studs : **2**

Nut Size : **0.938**

Gland Torque-Desired: **20 ft-lbs**

Gland Torque-As Left: **16 ft-lbs**

Pack. Friction-As Left : **578 lbs**

Upper Bushing Ht. : **1.250 in.**

Lower Bushing Ht. : **in.**

Lantern Ring Ht. : **0.500 in.**

Junk Ring Ht. : **0.250 in.**

Live Load : **Y**

Live Load Spring # : **9M98177**

Packing Type :

Packing Date :

Times Packed : **0**

Times Stem Repaired : **0**

Gasket Change Date :

Times Gasket Repaired : **0**

Comments / Hazards :

Figure #1

Return completed MECH MTCE UPDATE CHECK SHEET to MTCE SUPPORT.

Figure 1

Report Date : 05-Oct-1995

Unit : **8** USI : **41850** Equip Code/No : **LCV1**

USI Description : **REHEAT DRAINS**

Op. Temperature : **(B)** Op. Pressure : **(B)**

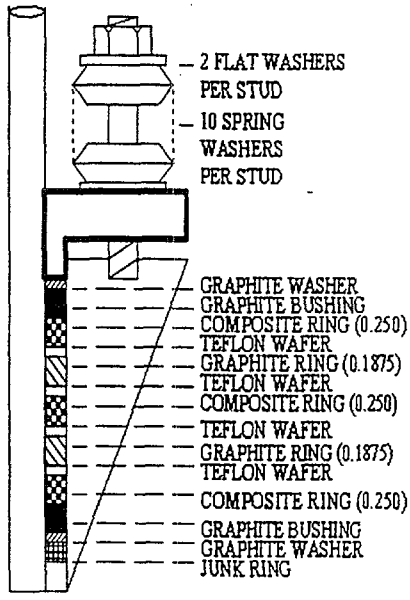
Room No :
Elevation : **591**
Column : **7P19**

Scaffold (Y/N) : **N**
Last Update : **Oct-03-1995**
Flowsheet/Grid : **NK29-FXX-41800-0002;D2**

VALVE INFORMATION

Material Code : **543D8093**
Manufacturer : **COPES VULCAN**
Model : **CV 600**
Size : **3 in.**
ANSI Rating : **300**
Seat Held By :
Bellow Seal (Y/N) : **N**
Valve Type : **GLOBE**
Stroked 5 X (Y/N) :
Packed By :
Bonnet Bolt Torque : **in-lbs**

Figure No.: **VALVE860.BMP**



NOTE : IF THERE IS A "JUNK" RING PRESENT, REINSTALL RING WITH NEW PACKING.

PACKING INFORMATION

Stem Diameter : **0.750 in.**
Gland Diameter : **1.250 in.**
Gland Depth : **2.675 in.**
Leakoff Port Depth : **in.**
Leakoff inside Dia. : **in.**
Stud Diameter : **0.375 in.**
Number of Studs : **2**
Nut Size : **0.688**
Gland Torque-Desired: **88 in-lbs**
Gland Torque-As Left: **112 in-lbs**
Pack. Friction-As Left : **363 lbs**
Upper Bushing Ht. : **0.438 in.**
Lower Bushing Ht. : **0.438 in.**
Lantern Ring Ht. : **in.**
Junk Ring Ht. : **0.250 in.**
Live Load : **Y**
Live Load Spring # : **6M70177**
Packing Type : **287-IB**
Packing Date : **May-01-1988**
Times Packed : **1**
Times Stem Repaired : **0**
Gasket Change Date :
Times Gasket Repaired : **0**

Comments / Hazards :

MACHINE GLAND FOLLOWER TO .875" IN LENGTH FROM BOTTOM OF FOLLOWER TO GROOVE.
REMOVE LOWER COPES GUIDE BUSHING, INSTALL NEW JUNK RING .250" WAUKESHAW

Figure # 2

Return completed MECH MTCE UPDATE CHECK SHEET to MTCE SUPPORT.

Figure 2

Report Date : 05-Oct-1995

Unit : **8** USI : **43230** Equip Code/No : **LCV5**

USI Description : **BOILER FEED SYSTEM**

Op. Temperature : **(B)** Op. Pressure : **(B)**

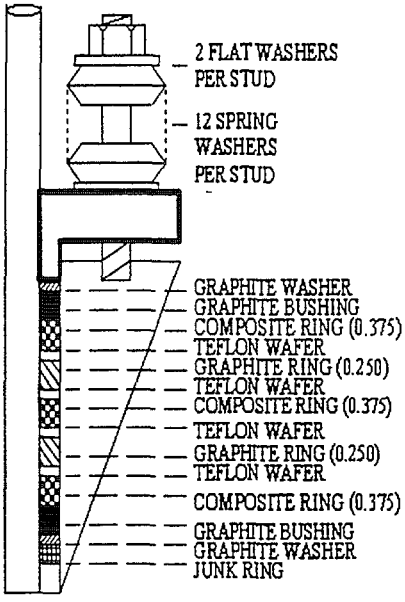
Room No :
Elevation : **663**
Column : **8P11**

Scaffold (Y/N) : **N**
Last Update : **Oct-03-1995**
Flowsheet/Grid : **NK29-FXX-43000-0005;**

VALVE INFORMATION

Material Code : **543D6196**
Manufacturer : **FISHER**
Model : **EWD**
Size : **12 in.**
ANSI Rating : **600**
Seat Held By :
Bellow Seal (Y/N) : **N**
Valve Type : **PLUG**
Stroked 5 X (Y/N) :
Packed By :
Bonnet Bolt Torque : **ft-lbs**

Figure No.: **VALVE861.BMP**



NOTE : IF THERE IS A "JUNK" RING PRESENT, REINSTALL RING WITH NEW PACKING.

PACKING INFORMATION

Stem Diameter : **1.000 in.**
Gland Diameter : **1.750 in.**
Gland Depth : **5.000 in.**
Leakoff Port Depth : **in.**
Leakoff inside Dia. : **in.**
Stud Diameter : **0.625 in.**
Number of Studs : **2**
Nut Size : **0.938**
Gland Torque-Desired: **25 ft-lbs**
Gland Torque-As Left: **ft-lbs**
Pack. Friction-Desired : **498 lbs**
Upper Bushing Ht. : **1.250 in.**
Lower Bushing Ht. : **1.250 in.**
Lantern Ring Ht. : **in.**
Junk Ring Ht. : **0.375 in.**
Live Load : **Y**
Live Load Spring # : **10L98177**
Packing Type :
Packing Date :
Times Packed : **0**
Times Stem Repaired : **0**
Gasket Change Date :
Times Gasket Repaired : **0**

Comments / Hazards :

COMPOSITE PACKING SET TO BE INSTALLED LCV5 OCT/95 OUTAGE, CONTACT DEAN CUMMING

Figure # 3

Return completed MECH MTCE UPDATE CHECK SHEET to MTCE SUPPORT.

Figure 3