DEVELOPMENT OF AN IMPROVED LOW PROFILE HUB SEAL REFURBISHMENT TOOL

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ABSTRACT

The hub seal area of a fuel channel feeder coupling can be exposed to oxygen in the atmosphere if protective measures are not taken during maintenance outages. Exposure to oxygen can lead to pitting of the hub seal area. Although this is a rare occurrence, the resulting possibility of the feeder coupling leakage led to the development of a feeder hub refurbishment tool.

To reduce time and man-rem exposure during feeder hub seal refurbishment, an improved low profile hub seat refurbishing tool has been developed. The improved tool design will allow for quick and controlled removal of material, and the restoration of a roll-burnished finish equivalent to the original requirements.

The new tool can be used in maintenance operations, with the end fitting present, as well as under retube-type circumstances, with the end fitting removed.

1.0 BACKGROUND

Feeder hub refurbishing tools are used for the refurbishment of pitted or deeply scratched feeder hub seal areas. The leak tightness of the feeder hub to end-fitting joint depends on a seal surface having a high level of finish and tight tolerances on the mating parts. These joints cannot be tested until after the system is filled with heavy water, at which time any repairs or replacements are costly. Thus a high degree of dedication and attention to detail is required in the hub seal refurbishment process to ensure that an acceptable sealing surface is produced.

Feeder hubs exposed to air for extended periods of time can develop small pits. These pits and other installation problems, such as misalignment, can lead to leaks in the seal area of the feeder hubs. To return the surface of the seal area to its design finish, several types of hub seat refurbishment tools have been developed over the years. The most notable among these tools were the feeder hub seal "Borazon" (Wet) grinding tool and the low profile hub seat refurbishing tool.

2.0 "BORAZON" (WET) GRINDING TOOL

The "Borazon" Tool was designed by Strite Industries for use during the Pickering retube outage. This tool offered fast and uniform material removal and the ability to return the seal area to its design finish. The tool was designed for use during retube with the end fitting removed. It is therefore bulky and not suited for use during typical maintenance outages when the end fitting is in place.

The term "Wet" tool is used because the tool utilizes Sunnen MB-30 honing oil, a cutting fluid, pumped under pressure from a reservoir over the grinding wheel. The oil is fed back through a filter to remove the grinding particles from the oil. This cutting fluid also aids in cooling the surfaces.

A grinding cone, plated with boron nitride particles, is used as the cutting head. The cone has slots to allow for the flow of the cutting fluid. Plating of the cone was designed to a 220 grit finish.

The tool locates on, and clamps around, the outside diameter of the feeder hub. Attached is a locating plug with two "O" rings, that enters the hub ahead of

the grinding wheel to locate the tool and seal the oil in the feeder hub area.

Material removal is controlled by a dial micrometer similar to that of a lathe. The "Borazon" tool can remove about 0.005 of an inch in approximately 7 minutes and can be run continuously. Therefore, to remove 0.025 of an inch requires only 35 minutes operating time.

The "Borazon" tool has the capability, with a change of wheels, to roll-burnish the seal area. This restores the seal area to the design condition after refurbishment, thereby eliminating the need for Grafoil tape and reducing the possibility of further leakage.

3.0 THE LOW PROFILE HUB SEAT REFURBISHMENT TOOL

The low profile hub seat refurbishing tool was designed for use during maintenance outages when the end fitting is present. Consequently, the tool must operate in the very constrained space between the end fitting and the feeder hub, which is only 1.7 inches away.

This tool consists of a pneumatic nut runner with a "pancake" head having removable cones. The cones carry self-adhesive grit paper of various grades of coarseness, and are loaded against the feeder hub by a compression spring.

A single hub refurbishing operation requires many cone changes. The tool is operated dry, and material removed from the feeder coupling hub is taken away embedded on used up grit paper. There are three types of cones, for lapping, polishing and cleaning.

The material removal rate is determined by the coarseness of the grit paper, and with the most aggressive paper, the removal rate is only 0.0005" to 0.001" per minute. To remove 0.015" requires about 30 cone changes and approximately one hour.

The slow material removal rate and the lack of uniformity of removal (poor control of seal area geometry) restricts this tool to the repair of only lightly damaged hub seal areas, where the amount of material removed is less than 0.015" (axial measurement). If the seal area damage is deeper than this, the damaged hub has to be cut off and a new hub welded on. This is time consuming and man-rem expensive.

4.0 IMPROVED LOW PROFILE REFURBISHMENT DEVELOPMENT

A project sponsored by the CANDU Owners Group (COG) has produced a prototype "improved" low profile hub seal refurbishment tool. This new tool attempts to combine the best features of the previous tools, adapting a cutting head and roll-burnishing head, similar to the "Borazon" tool, to work in a low profile tool. These changes improve the quality of the sealing area and reduce operation time (and consequently radiation dose received by the operator).

4.1 *Current Requirements*

The new tool is the result of an investigation into adapting a cutting head and roll-burnishing head, similar to the "Borazon" Grinding Tool, to fit a low profile tool, similar to the hub-seat refurbishment tool. These changes are intended to increase the controlled removal rate, improve the quality of the sealing area and reduce operation time (and consequently the radiation dose received by the operator) required by the low profile hub seat refurbishing tool.

4.2 *Design Progress*

The design team was established with representatives from AECL (the designers of the original low profile tool) and Strite Industries (the designers of the "Borazon" tool). At various stages of development of the prototype design, review meetings were held with operations personnel from Bruce A. This

helped to ensure that the new tool was user friendly and met as many of the projected requirements as possible.

4.3 *Details of The Improved Low Profile Hub Seal Refurbishment Tool (Prototype)*

The improved low profile hub seal refurbishment tool is a "Wet" tool. Similar to the "Borazon" tool, this tool utilizes a cutting fluid, pumped under pressure from a reservoir tank over the grinding wheel. The oil is fed back through a filter to remove the grinding particles from the oil. The cutting fluid also aids in cooling the surfaces.

The basic design of the "Borazon" grinding cone has remained the same. The cutting head is slotted and plated with the same 220 grit boron nitride particles. To accommodate the size requirements, the height of the cone has been reduced.

This reduction in cone size is helped by the advent of new, modified seal rings. The seal rings were designed for use in refurbished hub seal areas. The lip of the hub side of the seal ring has a larger pitch diameter to match the material removed. This allows the seal area to remain lower, in its intended design location.

The tool locates on, and clamps around, the outside diameter of the feeder hub. The clamp has been modified to allow tool mobility, reducing problems of interference. Flex cables and an adjustable handle were introduced to reduce interference problems. Due to height restrictions, a separate plug and plug installation tool were developed to seal the oil in the feeder hub area.

Material removal is controlled by a feed-adjusting screw held in place by a lock screw in the center of the grinding wheel. A feed-adjustment wrench and gauge plate, marked for 0.002 of an inch travel (vertical shift), are used to control the depth of cut. One complete turn will allow 0.100 of an inch (vertical shift). The maximum vertical travel is 0.104 of an inch.

A Hooke's coupling method is used to drive the grinding cone. Times and rates of material removal have yet to be established, but are expected to be much faster than with the original low profile tool.

A design highlight of this tool, as it was with the "Borazon", is its capability, with a change of wheels, to roll-burnish the seal area. This allows the seal area surface finish to be restored to the design condition after refurbishment, thereby eliminating the need for the use of Grafoil tape and reducing the possibility of a leak.

Another design feature of the improved tool is a removable insert that allows the tool to be adapted to fit the feeder coupling of any current CANDU reactor.

4.4 *Anticipated Future Direction*

The anticipated future direction is to test and prove the prototype over the remainder of 1997 and the first quarter of 1998. These tests will be used to determine such things as the following:
A - To redefine the operating procedure.
B - To establish feed rates and material removal rates.
C - To verify geometry at various stages of material removal until 0.102 of an inch (vertical shift) has been removed.
D - To establish a spare parts list.

SUMMARY

The Improved Low Profile Feeder Hub-Seal Refurbishment Tool is still in the development stage, as a prototype. Its improved design features will allow for quick and controlled removal of material, and the restoration of a roll-burnished finish. Once testing and proving is completed, the new tool will be available to all CANDU operators should it become necessary to refurbish the feeder hub seal surfaces during maintenance outages.