Canadian Nuclear Society
Waste Management, Decommissioning and Environmental Restoration for
Canada's Nuclear Activities: Current Practices and Future Needs
Ottawa, Ontario Canada May 8-11 2005

Filter Drying Tools

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Abstract

Drying tools have been developed to speed up processing of spent purification filters from fuel handling and gland seal systems. Results to date have been mixed; in one case, the drying time was reduced significantly while in a second case, drying time does not appear to be any faster. Further measurements and testing are planned. If successful, the concept will be expanded to include other filters and flasks.

Introduction

Filters that are removed from heavy water systems have to be dried before being stored in the Solid Radioactive Waste Management Facility (SRWMF). Not only are they required to be physically dry, there is an administrative tritium restriction of < 10 uSv/h. The flask that is used at Point Lepreau to transfer fuel handling and gland seal filters does not let filters dry out very effectively and tritium levels drop very slowly (in the order of two months (or more) drying time is required to meet the limits). This long drying period causes availability problems with the flask. There have been occasions when filter changes were delayed because the flask already contained a filter that was not dry. During outages, we have been required to change fuelling machine filters several times within a matter of days. Having the flask tied up presented a significant challenge.

The problem thus required two separate solutions: a mechanism for speeding up drying in the flask and a method for handling multiple filters when required.

Problem Description

The typical set-up for drying a filter involved attaching ventilation trunking to the top of the flask. The top of the flask was also covered with a plastic bag and sealed around the trunking and flask body with duct tape. The other end of the trunking was attached to a ventilation inlet grille, providing suction to the flask. Hardwood blocks were placed between the bottom of the flask and the removable base. This set-up draws room air up through the flask and vents it to the active ventilation system.

Figure 1 - Original Drying Set-up

After reviewing the physical set-up, it was felt that the factor extending the drying time was the fact the air was merely pulled through the flask beside the wet filter media. This did not provide good air to water contact, resulting in a low driving force for the required evaporation of the contained water. It was felt that by drawing air through the filter, the resultant increased contact with the wet media by the air would increase the driving force for evaporation, yielding reduced drying times.

The idea of heating the incoming air to increase the drying efficiency was considered. Operating experience from other plants indicated that problems could develop with the various heaters, resulting in fires in the plant. Based on these reports, the concept of adding air heaters to the unit was rejected.

For outages, the problem was the requirement to store multiple filters under ventilation and shielding to free up the transfer flask so that it could be used to perform further filter changes.

Solution 1 – Modified Flask Base and Dolly

After several design evolutions, the concept of using a modified flask base and dolly was selected. A new flask base was designed to connect to a filter's discharge nozzle, much like the configuration that it would have while in service inside the filter housing. The flask transport dolly was also modified to provide the ventilation path through the filter, the base and the dolly to a ventilation connection. The sketches below show some of the details and are described in the following paragraphs. When everything is connected properly, the flow path is such that air moves into the flask at the top, passes through the filter media and discharges to the dolly via the filter nozzle. The ventilation connection draws the moist air through the dolly body and discharges it to the plant ventilation system.

Flask Base Design Modifications

A new base was built to fit the bottom of the flask. Instead of a central shielding pillar, a hole was drilled in the bottom plate to fit a piece of 2” nominal pipe. The pipe was welded in place and has been machined to match the internal dimensions of the filter housing discharge nozzle. This allows the filter being processed to be lowered onto the base and seated, much as it is inside the filter housing. Air flow through the filter media is thus induced by applying suction to the bottom of the flask base. This is achieved via the modifications to the flask transport dolly.

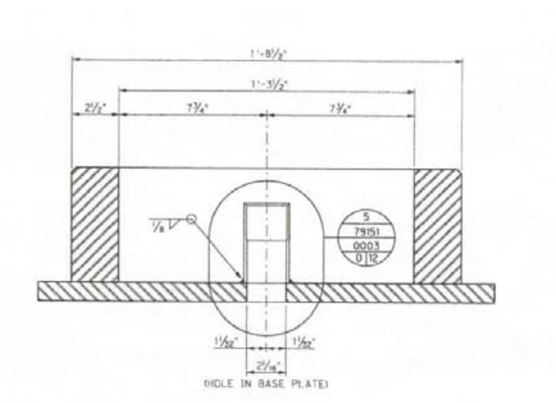

Figure 2 – New Flask Base

Transport Dolly Modifications

The dolly used to move the flask about the station has also been modified. The body weldment has been enclosed using 3/8” steel plate, and a 2” hole drilled into the top of the enclosure such that it aligns with the hole in the flask base when the flask is put in place on the dolly for transport. The enclosure is ported to a duct adapter, which is used to connect the assembly to the ventilation system via elephant trunking.

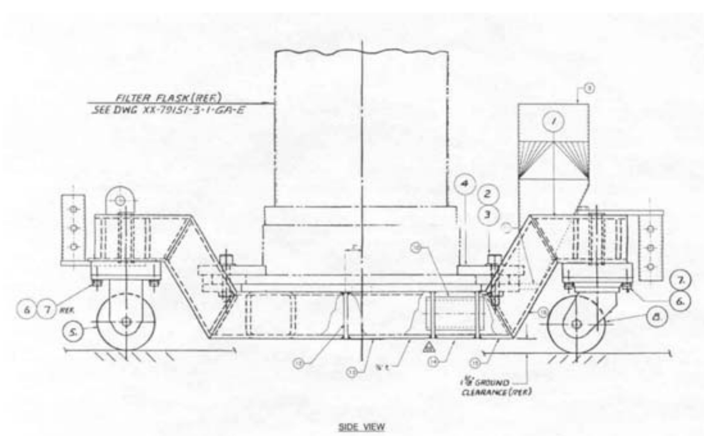

Figure 3 - Dolly Modifications

How It Works

The filter is drawn up into the flask as usual, using the flask's winch. Once the flask is positioned on the base, the filter is lowered inside the flask until the filter nozzle drops into the pipe on the base. The flask with its base is then positioned onto the transport dolly such that the hole in the top of the dolly aligns with the corresponding one in the flask base. The duct adapter is then connected to a ventilation intake using elephant trunking. Air flow is confirmed into the flask using a smoke bomb.

Figure 4 - Modified Drying Set-up

<u>Solution 2 – Filter Drying Insert</u>

The filter drying insert we've developed was a natural extension of earlier work done to provide shielded storage of filters awaiting transfer to the SRWMF. After our 1995 outage, we had two lead-filled shield flasks left over from our boiler primary side cleaning campaign. These were essentially hollow cylinders fabricated from steel and lead with an internal cavity about 20" in diameter. During the previously described outage in which we had to change several filters in quick succession, we solved the storage problem by placing four PVC pipes inside each flask to store the filters until they could be re-flasked. The pipes were capped at the bottom end to prevent spread of contamination and D_2O dripping onto the floor, since the flasks had no bottom. Filters changed out using the flask were then transferred to the PVC pipes for storage so that the transfer flask was available for further filter changes. Ventilation trunking was placed over the top of the storage flask; trunking and flask top were covered with plastic to contain the tritium and direct it to the ventilation.

The ventilation arrangement was satisfactory but cumbersome, and the drying insert was developed to simplify matters. The insert consists of an 18" Schedule 40 PVC pipe with four 6" PVC pipes embedded into it. Top and bottom of the 18" pipe are sealed using ¾" PVC plate. Three of the 6" pipes are configured to hold one filter, while the fourth pipe acts as the ventilation connection for the unit. The insert fits neatly inside the storage flask, allowing containment, shielding, and ventilation of filters stored in it.

Construction Details
A plate was installed about 4" from the bottom of the insert. The vent pipe penetrates the plate for its full diameter, providing a 6" ventilation channel from the bottom of the insert to its top. The three storage pipes rest in grooves cut into the top of the plate. Holes are drilled into the through the plate concentric to the pipes, sized to fit the nozzle of a fuelling machine or gland seal filter. All four pipes protrude through the top plate of the insert, with the vent pipe extending about 1" higher than the storage cavities. Reinforcement is added at various locations in the unit to ensure that it can support the weight of three filters. A lifting ring on the top plate of the unit allows it to be removed from the storage flask when necessary.

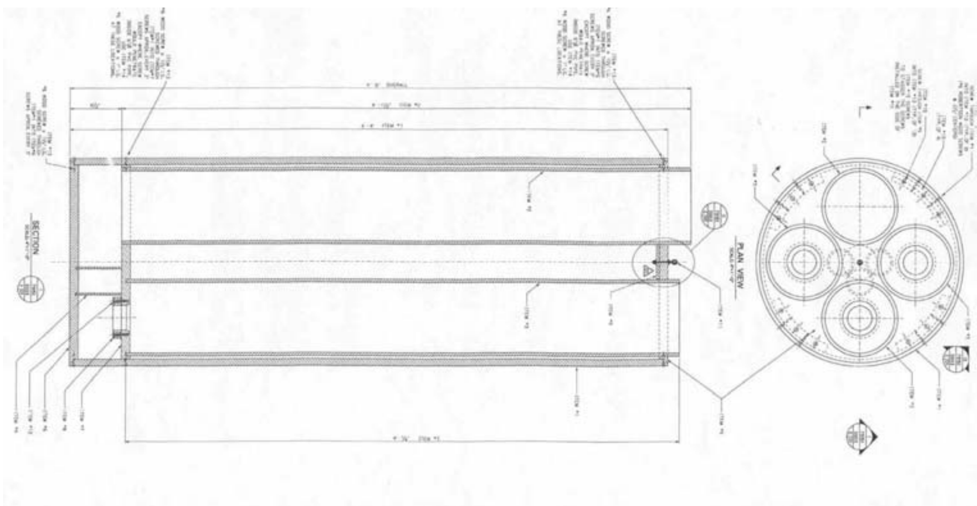

Figure 5 - Flask Insert

How It Works
The insert is placed into one of the two storage flasks. A filter is lowered into one of the cavities from the transfer flask using the flask's winch so that the filter nozzle inserts into the hole at the bottom of the cavity. The vent pipe is then connected to a ventilation intake using elephant trunking. Air flow is confirmed into the cavity using a smoke bomb. Unused cavities are capped off to enhance air flow through stored filters.

Trial Results

The drying insert has been put into service to store filters, but has not as yet been used to dry one. No account can thus be given of its efficacy.

The modified dolly and flask base have been used to dry two filters to date, with mixed results. The first filter was placed into the flask and put under ventilation, but no day to day record of its tritium readings were recorded. Drying time was about one week – a significant reduction in time.

At the time of issue of this report, the second filter has been on ventilation for over a month. No reason for this has been determined yet; monitoring is on-going.

Future Direction

The overall goal is to provide maintenance staff with a tool to dry filters and a set of specific guidelines for drying time. That way, the maintainers and work planners will know to allow “x” weeks of time after the filter is placed on ventilation before readying it for transfer to the SRWMF for storage. This will require monitoring several filters on a daily basis and tracking of the results before more definitive instructions can be made and this will be carried out as filters are changed out of the plant systems.

The problem of drying filters is not unique to the smaller filters of the plant. Similar difficulties are encountered with Primary Heat Transport (PHT), Moderator (MOD), and Spent Fuel Bay (SFB) filters as well. Once we confirm the efficacy of the drying method, similar modifications will be made to allow drying of these filters using the large filter transfer flask. Again, the target will be to provide the tool and definitive guidelines for its usage.

Conclusion

A pair of drying tools has been developed for use with fuelling machine and gland seal filters. Contradictory data have been generated as to their ability to reduce drying times. Further tests will be required to determine their true capacities.